



FINAL YEAR PROJECT COMPETITION & EXHIBITION (I-CPEX 2023)

INNOVATION UNLEASHED: EMPOWERING THE
FUTURE OF TECHNOLOGY

INTERNATIONAL FINAL YEAR PROJECT COMPETITION AND EXHIBITION (ICPEX) 2023

Editors

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INTERNATIONAL FINAL YEAR PROJECT COMPETITION AND EXHIBITION (ICPEX) 2023



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Preface

The International Final Year Project Competition & Exhibition 2023 (ICPEX 2023) e-book showcases the extended abstracts of participants who took part in this prestigious competition. Organized virtually by Universiti Kuala Lumpur (UniKL) Malaysian Institute of Information Technology, the event took place from 7th February 2024 to 7th March 2024.

ICPEX 2023, revolves around the theme "Innovation Unleashed: Empowering The Future of Technology." The competition features diverse categories including:

- i. Decision Support Systems/Embedded Systems/ Information Systems
- ii. Data Analytics/Artificial Intelligence Applications
- iii. Edutainment/ Games Application
- iv. Internet of Things/Smart Applications
- v. Cybersecurity/Telecommunications
- vi. Social Science
- vii. Industrial Technology

These categories highlight key areas where students demonstrated their creativity and problem-solving abilities, particularly in the fields of technology and innovation. The extended abstracts offer valuable insights into these categories, providing an in-depth look at how university students are addressing contemporary challenges through technological solutions and social science perspectives.

Editors

FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Aurora Drive: Aurora Driving License Management System

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Abstract— Driving school management system is a web-based solution developed to streamline the operations of a driving school and enhance the learning experience for students. This research paper presents the design, development, and implementation of the system, which allows the administrator, driving instructors, and students to effectively manage various aspects of the driving learning process. The research objectives of the study were to identify requirements, design, develop and evaluate the web-based management system for Aurora Driving School, namely 'Aurora Drive'. This website makes it simple for students to book for their driver's license and allows them to monitor their academic progress. The aim of this system is to develop a web-based management system which can be accessed easily by only having the internet connection that enables the driving instructor to manage all the tasks and update student learning progress on this website. The scope study of this research is divided into two parts: scope of user and scope of system. This system was developed using PHP language, CSS, JavaScript, and HTML. MySQL has been used to manage and save all the database and PhpMyAdmin is the administrator to handle the MySQL database. The methodology SDLC model that is applied throughout the research project is Rational Unified Process (RUP). This will also help the student to easily book for their driving class and check their learning update and information and help the administrator to manage all the business flow of this driving school through this website.

Keywords—Driving school, web-based management system, scope of user, scope of system, Rational Unified Process.

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1. Introduction

Aurora Driving School is a driving school that is located at Hulu Langat, Selangor and has been operating for almost 25 years since 1997. This driving school is very popular among the people around Selangor and Wilayah Persekutuan Kuala Lumpur since the location of this school is very strategic. There is no exact number of students per month because it is dependent on the situation such as school holiday, but it can reach thousands of students in a month in a range 1000 – 1500 students. Since the minimum age to get the driving license is between 16 to 21, which is teenagers or even students that are still in school, so mostly age of student there is in that range. They prefer to take the driving license during school holidays when they are not busy with another task or work. However, there are also students of all ages, including those who are already employed and the elderly, attending that school.

Currently, Aurora Driving School already has their own website. However, there are no functions that allow users or customers to automatically book for their lesson class there and for the driving teacher to submit all the student's progress. It is just a normal website for customers to find some information before they contact the school for their driving license process [1].

The two problem statements of the project are as follows:

- 1) Implement manual process for booking slot.
- 2) Hard to manage progress report for student performance.

The four objectives of the project are as follows:

- 1) To identify the requirements of Aurora Driving License system by conducting a case study.
- 2) To design the website that will replace the manual system of management for driving license process.
- 3) To develop a web management system that supports Aurora Drive License system.
- 4) To evaluate the acceptance of Aurora Driving License System by conducting the user acceptance.

The significance of the project are as follows:

- 1) To develop a driving school management system for Aurora Driving School to perform any operations more efficiently.
- 2) To help the driving instructor and administrator to save all the records efficiently and get all the data more quickly.
- 3) To help students make their driving class booking in a simpler and easiest way

2. Materials and Methods

Rational Unified Process Methodology (RUP) is an agile software development approach in which the four phases of the project life cycle inception, elaboration, building, and transition are separated into separate phases. All six of the fundamental development disciplines business modelling, requirements, analysis & design, implementation, testing, and deployment are used throughout each phase [2].

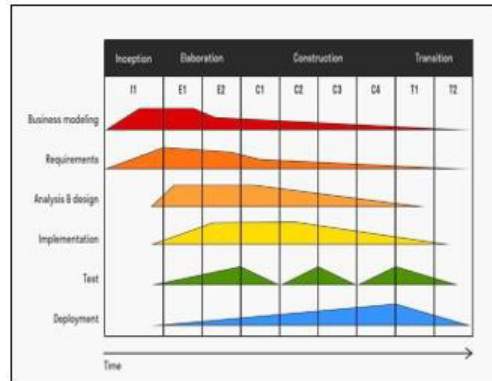


Fig 1: Rational Unified Process Methodology

A. Inception

During this phase the communication between client and planning is the main point of it. This phase will identify the scope of the project using a use-case model that will allow us to estimate the time required for the development. Meetings with clients have been conducted during this phase. The client requirements are identified in this phase and then it becomes easy to plan for the project. All the ideas pitching, gather the research resources has been done in this phase. Moreover, the project plan, project goal, risks, use-case model, and project description have also been created. A few proposed systems have been proposed to the supervisor to get the approval before this project can proceed. The project is checked against the milestones criteria and if it couldn't pass these criteria then the project can be either cancelled or redesigned [3].

B. Elaboration

During the elaboration phase, the system's requirements and its required architecture are assessed and analyzed. This is where the project begins to take shape. Interface and the database are designed in this phase. The objective of the elaboration phase is to analyze products and to lay a foundation for the future architecture. Planning and modelling are the main ones. The detailed evaluation and development plan is carried out and diminishes the risks. The use-case, business case and risks will be revised and redefined if needed [4].

C. Construction

In the construction phase of the Rational Unified Process (RUP), the software system is constructed in its entirety. The emphasis is on the development of components and other features of the system. Most of the coding also takes place in this phase. In this production process, the emphasis is on managing costs and means, as well as ensuring quality. In this phase the project is developed and completed [5]

D. Transition

The objective of the transition phase is to transfer the product to its new user. As soon as the user starts using the system, problems almost always arise that require changes to be made to the system. The goal, however, is to ensure a positive and smooth transition to the user. All the testing is conducted to get the user feedback to improve the system. The project will be transit from

development into production. The project documentation will be updated, and beta testing is conducted. All the defects are removed from the project based on the feedback from the client [6].

E. Production

This is the final phase of the model, and the project is maintained and updated accordingly. Finally, the project will be deployed to the server.
System Interface

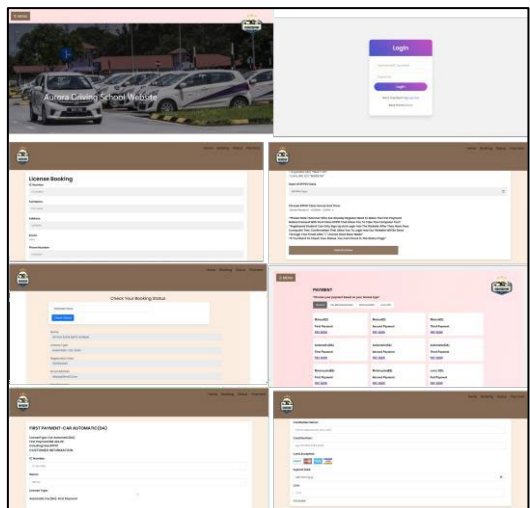


Fig 2: Booking, payment prototype

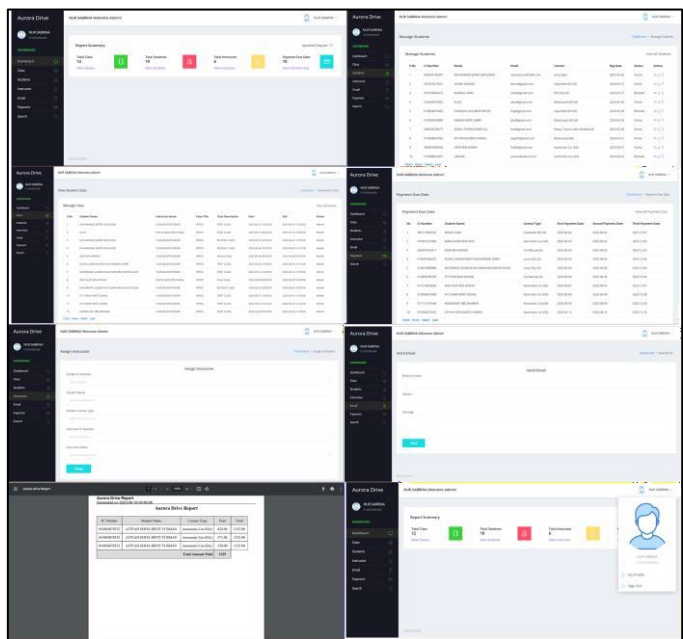


Fig 3: Admin prototype

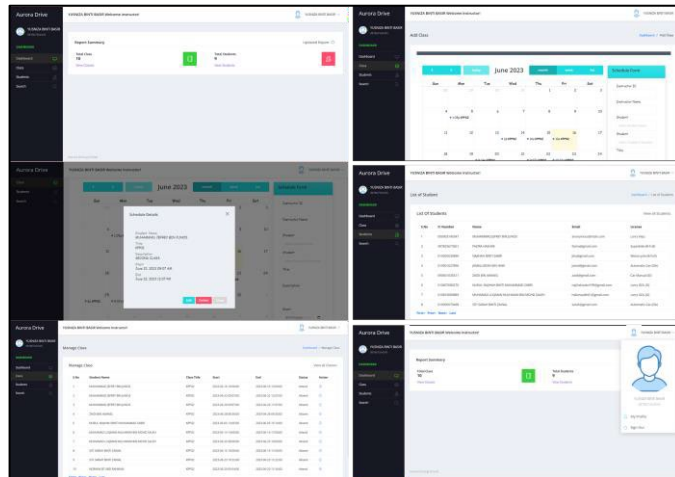


Fig 4: Driving Instructor prototype

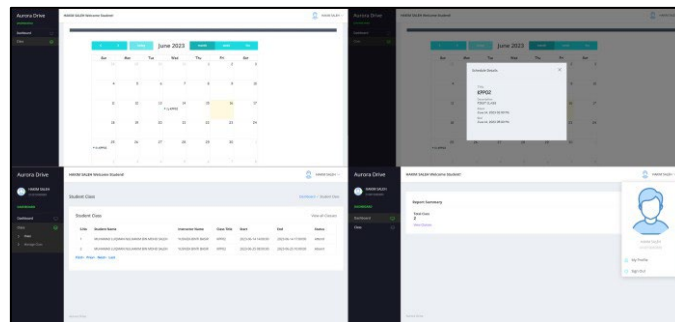


Fig 5: Student prototype

Fig 2 shows the prototype for the main function in this website which is the login, booking and payment prototype.

Fig 3 shows the prototype of administrator where it consists of the flow in the admin dashboard. Admin will login, then redirected into their personal dashboard and manage all the task in the dashboard such as manage student, view class schedule and learning progress, view the payment due date, assign instructor, and send email for notification purposes.

Fig 4 shows the prototype of driving instructor where it consists of the flow in the instructor dashboard. The driving instructor will login, then be redirected to their personal dashboard and manage all the class and student activities in the dashboard. Some of the functions are to create class schedules and submit student learning progress.

Fig 5 shows the prototype of student where it consists of the flow in the student dashboard. Students will login after passing the first class, then be redirected to their personal dashboard and view all their class schedules and learning progress there.

3. Results and Discussion

User acceptance testing has been conducted by the end users to ensure that all the system functionalities meet the requirements. UAT is crucial since it aids in demonstrating how the system functions in a way that is appropriate for real-world settings and usage. The goal of this UAT is to determine whether the system is acceptable or not by measuring user satisfaction with it in relation to the system's functionality and requirement definition [6]. Google Form is employed to carry out the testing. The project's testing phase included the distribution of the google form. All the users are from student UniKL MIIT and one user which is the driving instructor which is the client itself. The results have been recorded.

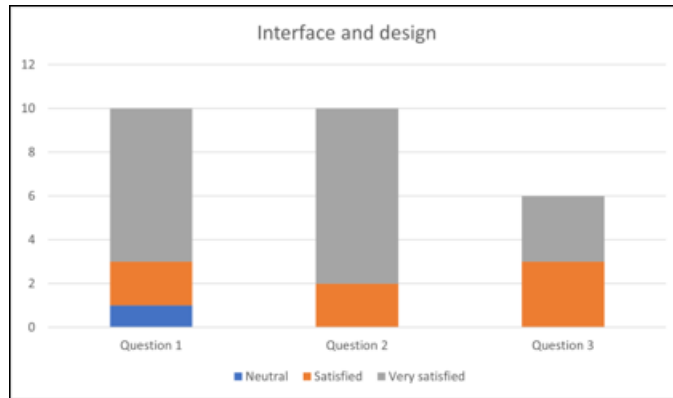


Fig 6: User acceptance testing - Interface and design

Based on fig 6, one user chose neutral, two users chose satisfied while the other seven users choose very satisfied for question 1. Therefore, this data shows that many users are very satisfied with the website visual. For question 2, two users chose satisfied while the other eight users chose very satisfied. Therefore, this data shows that most users are very satisfied with the website layout and navigation is easy to use. For question 3, three users chose satisfied while the other seven users chose very satisfied. Therefore, this data shows that most users are very satisfied with the website design is consistent and professional.

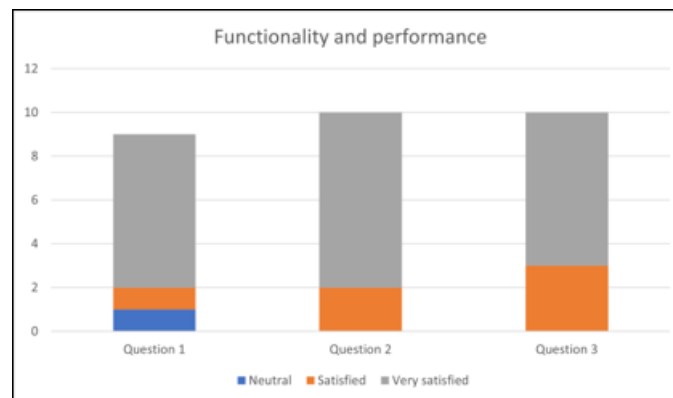


Fig 7: User acceptance testing - Functionality and performance

Based on fig 7, one user chose neutral and satisfied while the other eight user chose very satisfied for question 1. Therefore, this data shows that most users are very satisfied with the website's features and functionality. For question 2, two users chose satisfied while the other eight user chose very satisfied. Therefore, this data shows that most users are very satisfied that there are only minimal errors and issues have been encountered while using the website. For question 3 three users chose satisfied while the other seven users chose very satisfied. Therefore, this data shows that most users are very satisfied with the website loading speed.

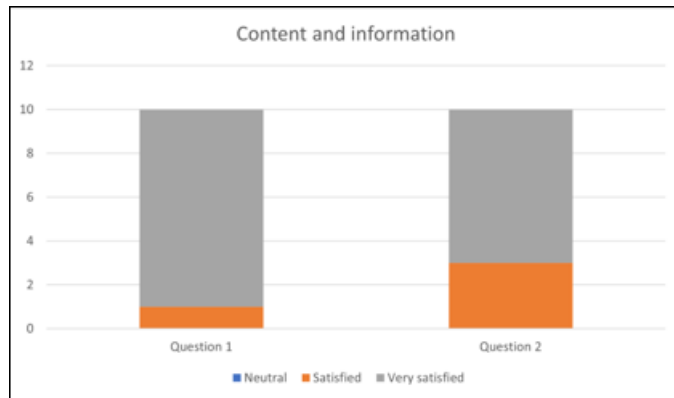


Fig 8: User acceptance testing - Content and information

Based on fig 8, one user chose satisfied while the other nine users chose very satisfied for question 1. Therefore, this data shows that majority of users are very satisfied with the website content that is very useful and relevant. For question 2, three users chose satisfied while the other seven users chose very satisfied. Therefore, this data shows that most users are very satisfied with the information on the website presented in a clear and understandable manner.

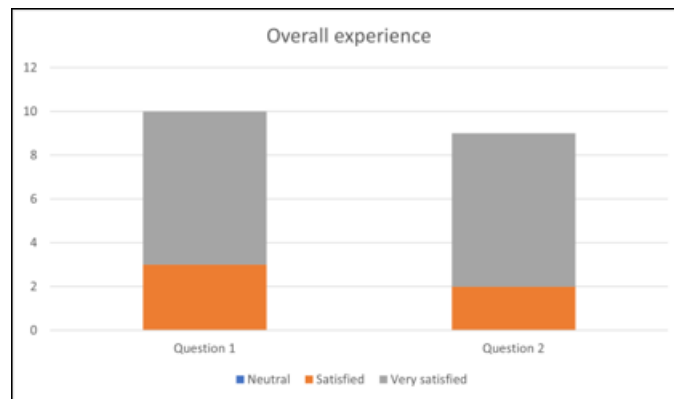


Fig 9: User acceptance testing - Overall experience

Based on fig 9, three users chose satisfied while the other seven users chose very satisfied for question 1. Therefore, this data shows that most users are very satisfied with this website. For question 2, two users chose satisfied while the other eight user chose very satisfied. Therefore, this data shows that most users are very satisfied with this website.

Based on the data that has been collected in the user acceptance testing from fig 6 to fig 9, 97% of respondents agree that this system has a meet all the requirements as expected and fulfill all the objectives of the testing. The high amount of percentage of respondent feedback indicates that this system is successfully developed where it solves all the problems that have been identified and achieves all the objectives.

4. Conclusion

This system has been developed due to a certain problem which is the manual process of driving school management. This system has been developed successfully and resolve that problem. All the objective that has been identified before also has been achieved. Based on the case study, all the comparison and requirements needed for this system has completely been build.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Braille KeyGlove: Assistive Sensor Glove for Visually Impaired using ESP32 Microcontroller.

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Abstract: Access to each individual's information and resources is essential to the smooth management of humanity. However, society has evolved that those with normal vision have the advantage of accessing the information they need. They can use this information to lead a better lifestyle and make the most of the tools and information at their disposal, but this tendency results in the social exclusion of the visually impaired community. A visually impaired person finds it difficult to use computers and other digital or educational software in the same way as normal people do. Due to their disability, there is a gap between the visually impaired and modern high technology advancements. Hence, Braille KeyGlove aims to develop a braille converter system using sensor glove that allows visually impaired people to perform typing tasks easily which enables them to use existing technological software facilities as well as allowing them to have equal access to online information and interactions. To achieve the aim, an Agile methodology has been rigorously employed throughout the research which encompasses key phases, including of requirements analysis, design, development, testing, deployment, and review phases. This project primarily uses ESP32 physical board with several capacitive touch sensors that can be connected to mobile devices. The overall development of the application is supported by using the Microsoft Visual Studio, enriched with Flutter extension to implement mobile and web-based applications across Android and Windows operating systems. With the advancement of this project, the aim of having visually impaired people interact and use today's technologies can be achieved.

Keywords: Visually Impaired, Mobile Application, Flutter, Web Application, Arduino, ESP32, Braille, Sensor Glove, C++, Braille KeyGlove

1. Introduction

For the seamless management of humankind, access to information and resources has become vital for each individual. Nevertheless, society has evolved in such a way that only those with the ability to see have access to the required information. They can employ this information to have a superior way of life and make the most of the tools and information available to them, yet this tendency is causing visually impaired people to be marginalized in society. Visual impairment, characterized as the inability to see with the naked eye. According to the National Eye Survey in 1996, approximately 1.2% of the

populace has some sort of visual impairment, and 1 out of 10 children have an undiagnosed vision problem that can prompt vision impairment whenever left untreated. Consequently, visual impairment hampers various aspects of life, including reading, mobility, and social interaction.

However, advancements in technology have significantly transformed possibilities for visually impaired individuals. The invention of Braille by Louis Braille in 1824 marked a revolutionary breakthrough in tactile communication for the blind [1], introducing a system of raised dots for reading through touch. Traditionally written on raised paper, advancements in technology have led to the use of electronic aids and the invention of braille typewriters. The same fundamental mechanism is adopted by computer printers to swiftly transform electronic text to paper. Nonetheless, the innovations still experience the effects of shortcomings; with the requirement for firm paper and reasonably large dots hindering the steadiness of Braille [2]. Electronic Braille solutions have struggled to keep pace with contemporary technological advancements, leaving visually impaired individuals grappling with barriers in navigating computers, digital software, and educational resources. This technological gap contributes to social exclusion, limited information access, and restricted employment opportunities, perpetuating discrimination against the visually impaired. Despite the availability of conventional Braille-based systems, Malaysia lacks intelligent solutions tailored to the daily communication and educational needs of the visually impaired.

Thus, to overcome these limitations, assistive technology has emerged as a powerful solution, enhancing functionality through the integration of hardware and software. Consequently, this research aims to develop an embedded system to convert Braille symbols into standard characters with the following primary objectives: To design a sensor glove that can connect to an Android device allowing visually impaired people to have equal access to online information and interactions, to develop a braille converter system using sensor gloves that allows visually impaired people to perform typing tasks easily and to implement a sensor glove that enable visually impaired people to use existing technological software facilities such as online Notepad.

2. Methodology and Requirements Engineering

The research project employed the Agile Model, encompassing phases such as requirements analysis, design, development, testing, deployment, and review. This model is chosen for its ability to articulate tasks, timelines, and achievements early in the planning stages, thereby offering a clear overview of the project's progression and anticipated outcomes.

2.1 Architecture Design

The architectural design of the Braille KeyGlove application encompasses four interconnected components: the microcontroller, mobile application, web application, and database. The capacitive touch sensor attached to the glove detects touch values, which are processed by the microcontroller and stored in the real-time database using the built-in Wi-Fi module. The mobile application retrieves the converted data from the database and displays Braille symbols accordingly. The web application is responsible for configuring and synchronizing delay settings between the mobile and web applications. Therefore, a system architecture diagram of the Braille KeyGlove is shown in Figure 1.

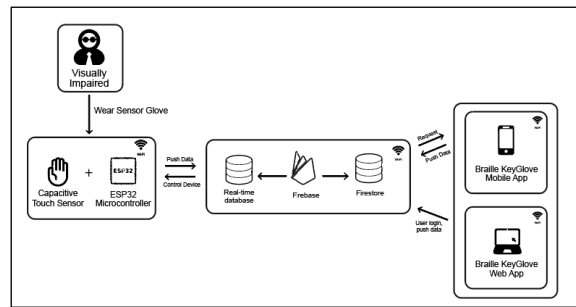


Figure 1: System Architecture of Braille KeyGlove.

2.2 System Design

The hardware interface design for the Braille KeyGlove system is divided into two parts: the microcontroller interface and the sensor interface on the glove. The capacitive touch sensors on the glove are strategically placed following the location of the Braille cell, which consists of six dots arranged in a 3x2 matrix. A total of 12 capacitive touch sensors will be attached to the glove, each serving a specific functionality such as selector, character zone, confirmation of uppercase and symbols, confirmation of lowercase, confirmation of numbers, and backspace, enter, and clear text. Figure 2 shows a sensor glove structure.

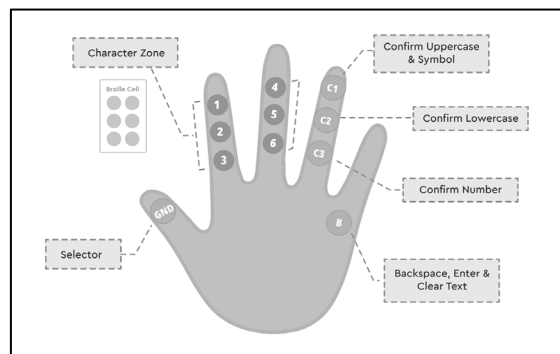


Figure 2: Sensor Glove Structure

2.2 Implementation

The development of the Braille KeyGlove encompasses the structured creation of both mobile and web application modules, in addition to the construction of a physical prototype. Regarding mobile application development, the Braille KeyGlove app is meticulously organized into four modules; Info, Braille Converter, Note Module, and Translation Module — seamlessly integrated with Firebase services through the utilization of Flutter's Firebase plugins. This integration involves leveraging real-time database and Firestore functionalities to facilitate live data communication with the ESP32 microcontroller. Simultaneously, the web application introduces a sophisticated delay configuration feature, affording users the capability to customize character control durations through an interactive slider, as visually illustrated in Figure 3.

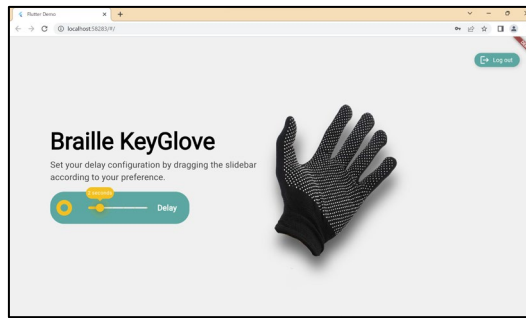


Figure 3: Delay Configuration page.

Transitioning to the prototype development phase, GPIO pins were methodically assigned for Braille characters, components such as the vibration motor were intricately connected, and WiFi capabilities were seamlessly integrated using the ESP32 microcontroller, as elucidated in the circuit diagram featured in Figure 4.

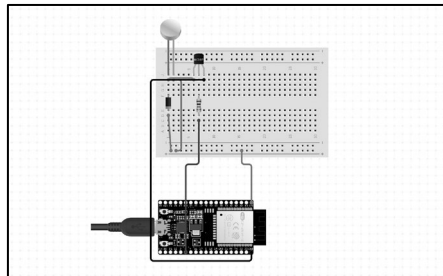


Figure 4: Braille KeyGlove's circuit diagram.

WiFi connectivity and Braille conversion were meticulously achieved through precise code management, culminating in the systematic upload of the final code to the prototype, as demonstrated in Figure 5.

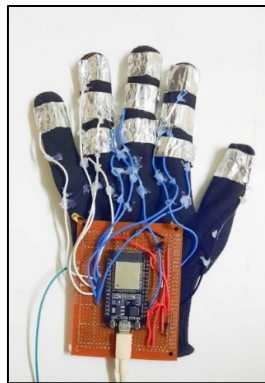


Figure 5: Final Prototype.

3. Results and Discussion

This chapter focuses on two pivotal tests conducted for the Braille KeyGlove: System Testing, aimed at verifying functionality through systematic steps, including the identification of test coverage areas, writing test cases, and analyzing test results; and User Acceptance Testing (UAT), which assessed the usability and effectiveness of the Braille KeyGlove by engaging 15 able-bodied individuals and one visually impaired participant.

The User Acceptance Testing involved tasks like typing and navigation, along with a Likert scale questionnaire to gather feedback on ease of use, effectiveness, satisfaction, and overall user experience.

This comprehensive approach ensures thorough testing and validation of the Braille KeyGlove's performance and suitability.

Table 1: Result of the evaluation of Braille KeyGlove

Statement	Scale				
	1	2	3	4	5
Question 1	0%	0%	0%	49%	51%
Question 2	0%	2%	2%	41%	55%
Question 3	0%	0%	8%	55%	37%
Question 4	0%	2%	6%	35%	57%
Question 5	0%	0%	8%	39%	53%
Question 6	0%	2%	8%	39%	51%
Question 7	2%	0%	4%	43%	51%
Question 8	0%	2%	10%	37%	51%
Question 9	0%	0%	8%	39%	53%
Total	0.2%	0.8%	5.2%	41.8%	46.4%

The Braille KeyGlove implementation significantly enhances typing efficiency and effectiveness. User evaluation demonstrates high agreement on objectives: improving typing (94%), ensuring online access (86%), and enabling independent software use (92%). Positive feedback reinforces its impact on empowerment and digital experiences. High agreement reflects user acceptance and feature alignment with needs. Acknowledging sample size limits, further research with diverse users is recommended. Continuous user-driven improvements will enhance overall experience.

4. Conclusion

In a nutshell, the Braille KeyGlove project has successfully achieved its objective of bridging the gap between visually impaired and the era of advancements in telecommunications technology. Through meticulous development and implementation, this innovative solution has significantly enhanced the quality of life for the visually impaired by replacing the conventional Braille typewriter. Based on the comprehensive testing and evaluation, the Braille KeyGlove has proven to be highly effective in enabling visually impaired individuals to perform typing tasks with ease and accuracy, empowered and fostered them the greater independence, productivity, and overall well-being. As technology continues to evolve and new possibilities emerge, the Braille KeyGlove project stands as a testament to the positive outcomes that can be achieved through the merging of technology and human-centered design. The project's success serves as an inspiration and a call to further explore and develop innovative solutions to empower and improve the lives of visually impaired individuals.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

EASCON: Smart Attendance Application Using Near-Field Communication (NFC) Technology

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Abstract: The traditional manual method of recording student attendance in academic institutions might be inefficient and error-prone, thus necessitating the development of an automated attendance management system that is accurate and efficient. As the uses of smartphones are very common nowadays, it is possible to integrate several technologies to assist both students and institution personnel for attendance tracking. Near-Field Communication (NFC) technology offers a potential solution by enabling automatic attendance data captured through NFC-enabled identification (ID) cards. Hence, this study introduces EASCON, a smart NFC attendance application with the aim of improving and enhancing the functionality and usability of attendance records tracking. EASCON is expected to be utilised by students, instructors and administrators through the uses of smartphone and NFC-enabled ID cards. By implementing System Development Life Cycle (SDLC) through Adapted Waterfall Model approach, EASCON is successfully developed and tested. Phases such as requirements gathering, design, implementation and testing have been methodically commenced before configuration and installation of EASCON. The final score of System Usability Score (SUS) obtained was 71.8, thus acknowledging the usability of EASCON to successfully capture and track the students' attendance. The NFC-based system holds promise for many authorities and industrial practitioners, offers precise attendance records for individuals, and benefits the community. Future enhancements of EASCON will include mobile app integration and data analytics, together with other enhanced data security mechanisms for an efficient and secure attendance tracking management.

Keywords: mobile attendance app, Near-Field Communication (NFC), attendance tracker

1. Introduction

Attendance tracking and monitoring is one of the daunting tasks identified in education sector. Issues such as inaccurate data, cumbersome paperworks and error-prone processes could have resulted from the traditional manual attendance tracking routines where pens and papers are still utilized by both

students and instructors [1]. With the existence of various tools such as biometric authentication devices, the routines could be improved, thus further assist the administrators of the institution in monitoring the attendance subsequently. However, the use and maintenance of biometric authentication devices are costly [2]. At the same time, it is also possible nowadays to track the attendance via a much cheaper option like using mobile devices and wireless communication protocol such as Near Field Communication (NFC). Nonetheless, the uses of NFC for attendance tracking in Malaysian education sector are not thoroughly explored.

NFC enables short distance communication between devices, thus allowing data exchange to happen seamlessly. This is ideal for tracking the students attendance where the students could just use their student identification (ID) cards (embedded with NFC chip) or NFC-enabled smartphones. The data captured via NFC cards or smartphones could then be automatically stored in the database. NFC is said to be reliable and secure due to its practicality and existing encryption mechanism [3]. Implementing an NFC-based attendance system in a school resulted in improved accuracy and efficiency compared to traditional methods [4].

This study aims to investigate the applicability of NFC in producing a mobile app named EASCON that could track and store the attendance data captured through NFC cards. The specific objectives would be to identify the current issues of conventional attendance tracking method, to identify the requirements for EASCON development, to design and develop EASCON and lastly to evaluate the functionality and usability of EASCON. EASCON is expected to be used by student, instructor, admin and parent.

2. Materials and Methods

In general, four phases of System Development Life Cycle (SDLC) via Adapted Waterfall Model approach have been gone through for completing this study, specifically requirements gathering, design, implementation and testing phases. Further explanation is divided into materials and methods.

2.1 Materials

In understanding how EASCON works, **Figure 1** illustrates the context diagram of EASCON where the users would include student, lecturer, admin and parent.

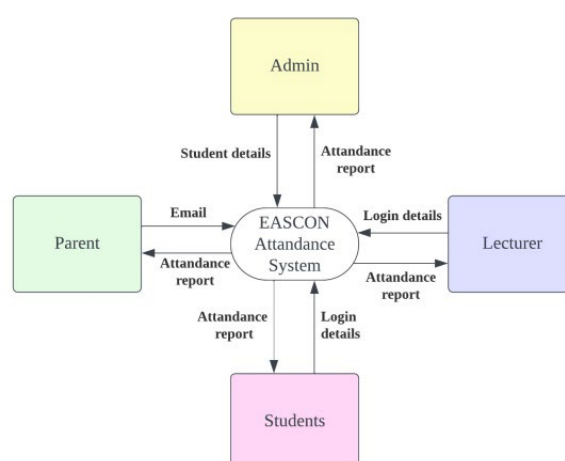


Figure 1: Context Diagram of EASCON

For developing EASCON, the system requirements that include the equipments needed to design and develop EASCON are explained in **Table 1**.

Table 1: System Requirements of EASCON

Requirements	Description
Hardware	<u>Laptop Specification</u> Model : Asus Processor: Nvidia RTX 1650 Operating system: Windows 11 Pro Memory: 12 GB RAM Storage: 1 TB System Type: 64 – bit
	<u>Card</u> Near-Field Communication (NFC) Card
Software	<u>Android Studio</u> Version: Latest Version Programming Language: Java
	<u>Visual Studio Code</u> Version: Latest Version Programming Language: HTML, CSS, PHP, and JAVASCRIPT
	<u>Firebase</u> Version: Latest Version Description: For the database of the application

2.2 Methods

The study has utilized Adapted Waterfall Model as the major reference for the project methodology. The maintenance phase was omitted as it was beyond the scope of this study.

The details of each phase are as the following:

- Requirement Gathering – Functional, Non-Functional, User, System & Data Requirements
- System Design – Context Diagram, Data Flow Diagram, ER Diagram, System Architecture
- Implementation – Installation and Configuration of EASCON
- Testing – Test the functionality and usability of EASCON via test plans and System Usability Scale (SUS) respectively

3. Results and Discussion

EASCON has been successfully tested and evaluated for its functionality and usability. The app is able to record the students attendance via NFC cards, thus allowing both lecturer and admin to perform attendance monitoring in the app. In a situation where the student is absent from the class, the absentism report would be automatically generated and e-mailed to the parent for their acknowledgement.

For the app evaluation, 30 respondents that consists of potential students, lecturers and admins have provided feedbacks in measuring the usability of EASCON. **Table 2** shows the summary of respondents' demographic profile.

Table 2: Summary of Demographic Profiles of Respondents

Demographic	Items	Total Respondent	Percentage
Gender	Male	17	56.67
	Female	13	43.33

Age	Below 21	3	10
	21 - 25	14	46.67
	26 - 35	6	20
	Above 35	7	23.33
Position	Student	21	70
	Lecturer	6	20
	Admin	3	10

The usability evaluation of EASCON was performed via series of questions which the results were later analyzed and measured through System Usability Scale (SUS). 10 questions [5] to measure EASCON usability were asked to the respondents accordingly. The final SUS score obtained was 71.8 that could indicate the good results as the score falls above the suggested average marks - 68 [5-6]. Hence, EASCON could be deemed as functional and usable. For this reason, the objectives of this study have been successfully acquired.

4. Conclusion

EASCON could provide accurate attendance tracking and monitoring where it would be beneficial for all related parties in the education industry. It also offers parents the convenience of receiving real-time information on their children's attendance, thus encouraging them to take a more active role in their children's education. Additionally, the app encourages accessibility by letting students use their student ID cards or smartphones, the devices that are already widely used throughout their everyday life, to record their attendance. Future improvements to EASCON will include interaction with mobile apps and data analytics, along with further advanced data security features to increase the efficiency and security of attendance monitoring administration.

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E-Counselling POLISAS

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Abstract: Highlights the pressing issue of stress, depression, and anxiety among students at Politeknik Sultan Haji Ahmad Shah (POLISAS). The current challenges faced by students in accessing counselling services, including delays in securing appointments and lengthy processes for obtaining post-session feedback, are acknowledged. The following are some issues that students who attend appointments encounter; students find it harder to attend in-person counselling session, longer waiting time for the counselling session and longer waiting process of receiving after session report. With the e-Counselling POLISAS application, the main objective is to attend online counselling session, to receive online slots on availability date and to generate report after the online session ends. The main scopes for this application that makes it easy for administrators to use or carry out tasks through this application while also offering convenience to students and counsellor to handle online sessions. The admin can accept the upcoming online appointment sessions according to the appropriate counsellor by sending both the students and counsellor an approval notification as a reminder. Students need to complete the Depression Anxiety Stress Scale (DASS) assessment to determine the severity of their mental health condition. Students will receive the results, and they may then make an appointment with the counsellor based on the availability slots. Counsellor must send meeting links to students for online appointments. After every online session, counsellor can upload reports for students to review. Complementing the quantitative analysis, the discussion segment endeavors to provide a qualitative understanding of the application's reception. Insights gleaned from user feedback, surveys, and interviews contribute to a holistic examination of user experiences. The discussion delves into the identified strengths of the e-Counselling POLISAS application, acknowledging successful features, user satisfaction, and positive outcomes.

Keywords: Counseling, Application, Online

1. Introduction

Counseling is referred as "talk therapy." In this process, an individual, a couple, or a family meets with a licenced professional counselor to talk about issues and difficulties they are facing on a daily

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basis. Professional counseling is discreet and nonjudgmental. People may communicate their thoughts, get attentive listening, and gain new perspectives on their situations and experiences through counseling. It could be simpler for those who are receiving counseling to comprehend their issues. People discuss with their counselors the intended results and goals for counseling and try to achieve them.

Counseling may help with various concerns and challenges you could be having. It can assist in managing stress, offer treatment for anxiety, and ease the symptoms of depression. Counseling can provide the chance to review or create new life objectives while also assisting people in finding clarity and a sense of purpose. People can utilize counseling to resolve concerns and problems in their relationship or to mediate conflicts with their partner. Counseling may be beneficial since it gives a very secure and private setting to discuss the difficulties and challenges. Discussing these issues with others might be challenging since they feel so personal. It may feel dangerous or awkward to talk to the usual support network, friends, or loved ones.

A qualified and licensed professional counselor will respond to the difficulties in a sincere, compassionate, and sympathetic manner. An experienced therapist will use approaches and tools that are supported by research.

1.1 Problem Statement

Due to this issue, one application must be developed to assist in resolving issues that both students and the psychology unit are experiencing. The following are some issues that students who attend appointments encounter:

- 1.1.1 students find it harder to attend in-person counseling session.
For a variety of reasons, most students find it difficult to express their feelings and thoughts to a counselor in person. This is due to the lack of exposure to family or peer discussion of personal issues. The distance between the hostels and the conflicting class schedule makes it difficult for the students to walk and burdensome to attend the counselling session.
- 1.1.2 longer waiting time for the counseling session.
Students wait a long time to get an appointment with a counselor.
- 1.1.3 longer waiting process of receiving after session report.
Students must submit an earlier application for an appointment report with references for themselves or for any other parties, such as a clinical therapist.

1.4 Project Objectives

With the e-Counseling POLISAS application there are 3 objectives, namely:

- 1.4.1 to attend online counseling session.
- 1.4.2 to receive online slots on available dates.
- 1.4.3 to generate report after the online session ends.

2. Materials and Methods

Psychological development and change involve five main things such as moral, social, physical, cognitive, and emotional matters. In the practice of counseling, a counselor should know the background of adolescents and be prepared to conduct all counseling honestly and responsibly. A counselor should understand about the character of adolescents in giving opinions [1].

Mental health is one of the main causes that affect the physical and social well-being of an individual. Not only that, the issue of mental health and emotional stress among the people needs to be

taken seriously as it has various adverse effects on the country. Mental health issues that now involve various layers of society include all domains, namely biological, psychological, social and spiritual [2].

Psychology does not study the soul or mental directly because psychology is abstract, but the limits of psychology to the manifestation and expression of the soul or mental which is in the form of behavior and process or activity, so that psychology can be defined as a science that studies behavior and mental processes [3].

Most universities provide counseling centers for students vulnerable to stress, but similar support for academics is limited and invisible. As if academics are immune from mental stress and feelings, mental health management is not highlighted in most university administrations. Although some universities have research centers involved in mental health management, the mechanisms of assistance that can be provided are not explained in detail or open for academics to seek assistance [4].

2.1 Prototype Model

The prototype model is a software development approach that involves creating a simplified model of the future product to test its concept and functionality with minimal resource costs. The process of creating a prototype involves a few steps based on testing results and feedback: development, testing, and continuous improvement.

The prototype may include only the essential design elements and features that are necessary for visualizing and demonstrating the fundamental capabilities of the product. Prototypes are used by the development team in collaboration with customers and stakeholders to test the product's design, architecture, and functionality [5].

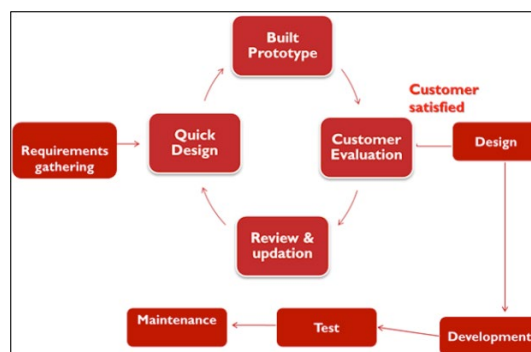


Diagram 1: The Prototype Development Life Cycle

3. Results and Discussion

The results and discussions section of the e-Counseling POLISAS application unfolds as a comprehensive exploration of the project's outcomes, shedding light on the effectiveness, challenges, and potential areas for refinement. This critical phase represents the culmination of extensive development, implementation, and feedback collection, offering a nuanced perspective on how the application has impacted the Psychology Unit at POLISAS. Within this section, we delve into quantitative and qualitative analyses, examining key performance metrics, user engagement patterns, and the overall reception of the application by both students and counselors.

The results presented herein are rooted in a meticulous examination of data collected throughout the application's implementation phase. We scrutinize user interactions, assessing the frequency and depth of engagement with various features, from mental health assessments to personalized counseling

sessions. Quantitative metrics, such as the number of users, session durations, and frequency of logins, offer a numerical lens through which the impact of the application is evaluated.

Complementing the quantitative analysis, the discussion segment endeavors to provide a qualitative understanding of the application's reception. Insights gleaned from user feedback, surveys, and interviews contribute to a holistic examination of user experiences. The discussion delves into the identified strengths of the e-Counseling POLISAS application, acknowledging successful features, user satisfaction, and positive outcomes..

4. Conclusion

As the e-Counseling POLISAS application prototype concludes its development and implementation, a significant milestone is reached in redefining the landscape of mental health support within the Psychology Unit at POLISAS. From its inception, the overarching goal of creating a transformative tool that surpasses conventional counseling methods, with a focus on the proactive identification and assistance of students in navigating their mental health journeys, has been pursued. Throughout the extensive initiative, advanced technologies, particularly artificial intelligence, have been meticulously integrated to enhance the efficiency and efficacy of the counseling process. This prototype stands as a testament to the commitment to leveraging innovation for the benefit of students, facilitating the early detection of potential mental health issues and enabling timely, personalized interventions.

Furthermore, the future plan encompasses an ambitious roadmap for enhancing user engagement. Initiatives may include the development of targeted awareness campaigns, incentives for participation, and integration with broader campus initiatives promoting mental health awareness.

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e-Publication Management System (ePMS)

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Abstract: The advancement of scientific research has led to a significant increase in the number of publications across various domains. In Universiti Kuala Lumpur (UniKL), UniKL Research and Innovation Department (RNI) is one of the UniKL sections that are responsible for collecting information for all the publications that were published by UniKL lecturers. However, the traditional process of managing publications faces numerous challenges, including manual data extraction, outdated metadata and difficulty in generating audit reports. To address these issues, this project proposes the development of e-Publication Management System (ePMS) that aims to streamline and enhance the entire research publication management process for both R&I members and lecturers. ePMS is designed as a comprehensive platform that integrates various functionalities, including collecting, managing, maintaining, preserving and disseminating the publications of the entire university.

Keywords: Publication Management System, Publication, Web Scraping

1. Introduction

e-Publication Management System (ePMS) is a comprehensive and user-friendly platform designed to streamline the entire academic publication management process for UniKL Research and Innovation Department (RNI) and UniKL lecturers. Thus, managing publications within university settings presents a myriad of challenges.

1.1 Manual Authors and Publications Data Collection

One of the primary challenges RNI department encounter is the manual collection of authors' data and publications from sources like Google Scholar. This process, though widely practiced, is inherently flawed due to its susceptibility to errors, inconsistencies, and time-consuming nature. Manual data collection not only introduces inaccuracies but also demands substantial human resources to maintain and update the database regularly. As universities continue to produce a vast amount of scholarly output, manual collection methods become increasingly unsustainable and hinder the institution's ability to accurately represent its research landscape.

1.2 Outdated Metadata

The integrity of metadata associated with academic publications is crucial for ensuring the accuracy and reliability of research information. However, RNI Department struggle with outdated metadata that rely on manual updates for maintenance. This manual intervention often leads to a lack of real-time updates, resulting in outdated information, and potential data integrity issues.

1.3 Difficulty in Generating Reports

The sheer volume of academic publications within university settings presents a significant obstacle for RNI department when generating audit reports. Extracting relevant metadata from vast datasets is labor-intensive and time-consuming, making it challenging to monitor and evaluate scholarly output effectively which can affect the time and quality of the audit reports.

2. Methodology

2.1 System Architecture

The following figure shows the system architecture for ePMS.

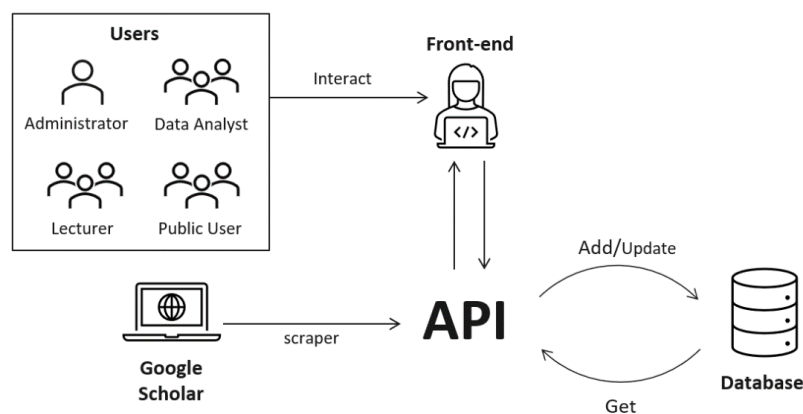


Figure 1: System Architecture

- Users

There are four types of users for this system which are administrator, data analyst, lecturer and public user. The administrator assumes responsibility for overseeing the system's comprehensive functionality, including data extraction, management of authors and publications, and user accounts administration. The data analyst is tasked with conducting report audits and updating the MIRA status for each publication, ensuring data integrity and accuracy. Lecturers are entrusted with verifying their owned publications within the system, contributing to the assurance of data authenticity. Public users are granted access solely to the system's repository of publications, fostering widespread access to scholarly materials.

- Front-end

Front end systems are responsible for displaying and rendering content, receiving user inputs, and providing an interactive interface for users to interact with the underlying functionality of the application. It encompasses the user interface (UI) and user experience (UX) components of a system, focusing on the presentation layer. Front-end systems will interact with back-end systems through APIs to retrieve and update data, perform business logic, and process user requests.

- API

An API (Application Programming Interface) defines the methods, data formats, and endpoints that front-end use to access the functionalities such as retrieve and update data, perform business logic, and process user requests. In the API, besides other basic CRUD functions, there's also a function called data extraction function that was used to extract data from Google Scholar using a technique called web

scraper. This function is developed using Puppeteer, a Node.js library that provides a high-level API for automating and controlling web browsers. It allows developers to programmatically interact with web pages, perform data extraction of web pages.

- Database

As for the database, MySQL is used for storing and managing structured data. It provides a robust and scalable platform for storing, retrieving, and manipulating data in a relational format. MySQL is widely used for web applications and content management systems where efficient and reliable data management is required hence suitable for our system where efficiency is one of our main objectives

2.2 System Features

The overall system features for each role are presented in the use case diagram as shown in Figure 2 below.

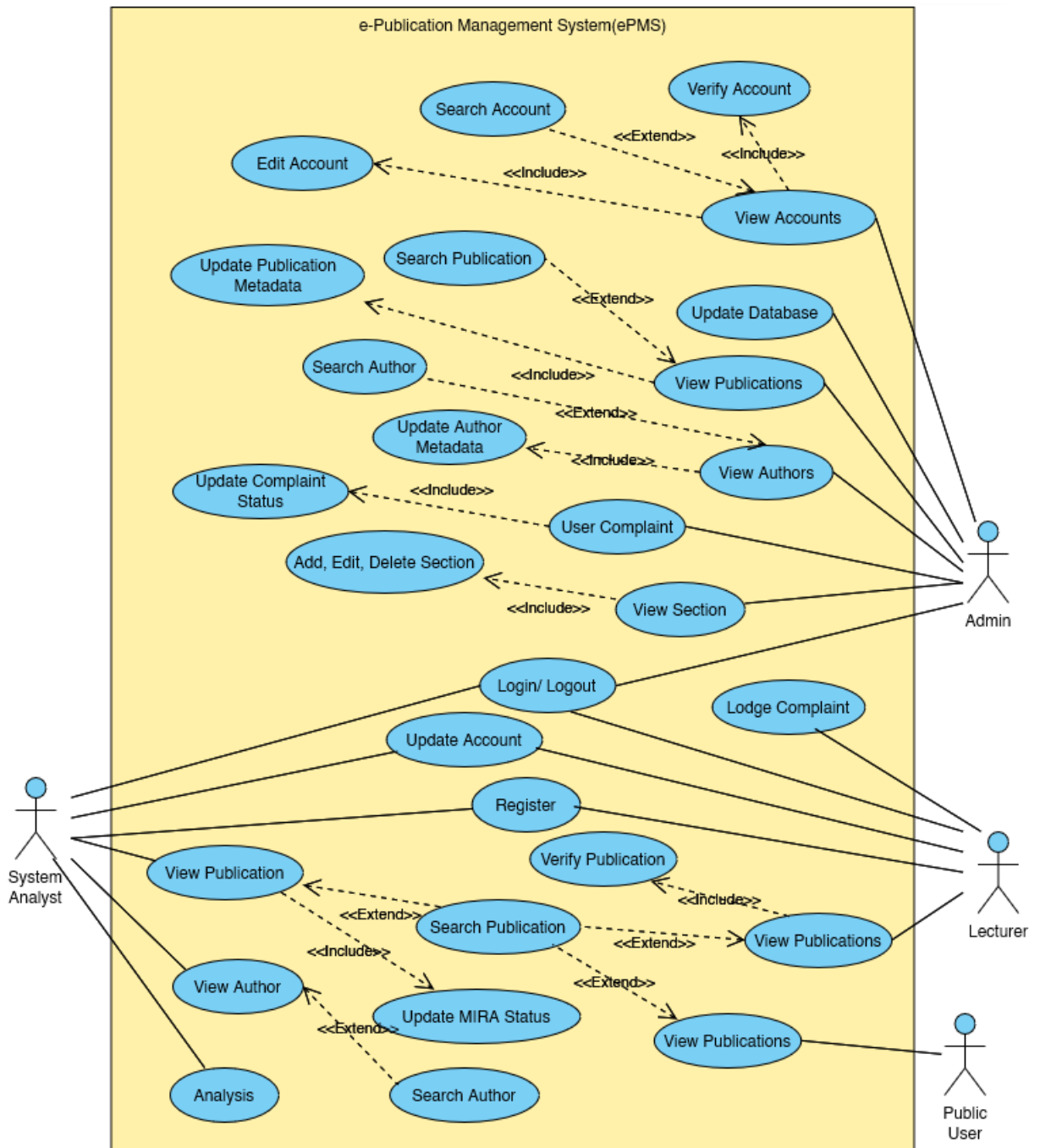


Figure 2: Use Case Diagram

2.3 Logical Design

The following figure shows the relationship of entity and their attributes stored in the database.



Figure 2: Entity Relationship Diagram

1. Entities

- Data Analyst: Represents the data analyst.
- Section: Represents the lecturer’s section.
- Author: Represents the authors of the publications available in the system.
- Publication: Represents the publications available in the system.
- Lecturer: Represents the lecturers of the system
- Complaint: Represents the complaint submitted by lecturers.

2. Relationship

- Relationship between Author and Publication: One author can have multiple publications, but each publication is owned by only one author. This is a one-to-many relationship.
- Relationship between Author and Lecturer: One author can be linked with only one lecturer, and each lecturer can only be linked to one author. This is a one-to-one relationship.
- Relationship between Lecturer and Complaint: One Lecturer can lodge many complaints, but each complaint can be lodged by only one Lecturer. This is a one-to-many relationship.
- Relationship between Lecturer and Section: One Section can have many Lecturer, but each Lecturer can associate with only one Section. This is a one-to-many relationship.

3. Results and Discussion

This section consisting of some comparison about relevant existing system and application that is crucial as a reference compared to ePMS.

3.1 Results

Features	Google Scholar	Scopus	ScimagoJR	ePMS
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Include all type of documents	YES	YES	YES	YES
Frequent Update	YES	YES	NO	YES
Easy Export	NO	YES	YES	YES
Detailed Citation	NO	YES	YES	YES
Easy to Use	YES	NO	YES	YES
Journals ranking system	NO	YES	YES	YES
Filtering options	NO	YES	YES	YES
Author profile auto generated	YES	NO	NO	YES
No subscription Required	YES	NO	NO	YES
Owned by UniKL	NO	NO	NO	YES

Table 1: Comparison between Google Scholar, Scopus, ScimangoJR and ePMS

3.2 Discussions

Based on previous comparison table between Google Scholar, Scopus, ScimangoJR and ePMS, ePMS emerges as a strong system for a academic publications platform, particularly for RNI department and university members. ePMS likely offers tailored features and seamless integration with institutional resources and focus on accessibility and alignment with institutional requirements positions it as a compelling system that aligned with RNI's needs.

4. Conclusion

The e-Publication Management System is a comprehensive software solution designed to automate various processes related to managing publications. It offers a comprehensive set of features to streamline publication processes, enhance collaboration, and improve overall efficiency. By automating manual tasks, facilitating communication, and providing valuable insights, the system empowers staffs, lecturers, authors, and students to effectively manage the publication lifecycle and contribute to the advancement of knowledge in their respective fields.

In conclusion, e-Publication Management System revolutionizes the traditional publishing management, offering a more efficient, collaborative, and quality-driven approach. By integrating advanced technological solutions, it empowers authors, staff, and lecturers to work together seamlessly, resulting in faster manuscript handling, improved communication, and enhanced publication outcomes.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Fit Allergy Check: Food Allergy Prevention and Fitness Enhancement System

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Abstract: In the contemporary landscape of health-conscious living, the convergence of food allergies, dietary preferences, and fitness aspirations takes center stage, prompting the need for comprehensive solutions. "Fit Allergy Check" emerges as a versatile mobile application meticulously crafted to meet the multifaceted needs of individuals navigating these challenges. Its cornerstone feature, "Allergen Checking," empowers users to efficiently and accurately identify allergenic ingredients within an extensive array of food and beverage products. Through the seamless capture of product ingredient lists via quick snapshots, users gain the ability to make informed decisions, significantly reducing the risk of allergic reactions and contributing to public health and safety. For those dedicated to muscle gain or weight management, "Ingredient Reference for Underweight" and "Ingredient Reference for Overweight" step in with tailored recommendations, aligning with specific fitness objectives and encouraging the consumption of nutrient-rich foods for muscle growth or healthier weight maintenance. Adding to its arsenal, "Fit Allergy Check" introduces the "Calories, Phosphate, and Sodium Reference" function, allowing users to effortlessly assess the nutritional content of foods by simply taking a picture. This feature facilitates the meticulous monitoring of daily calorie, phosphate, and sodium intake, providing invaluable support for users striving to maintain balanced and health-conscious diets. Consolidating these functionalities on a singular platform, "Fit Allergy Check" not only simplifies but transforms the health and wellness journey, empowering users to prioritize their well-being, make informed dietary decisions, and confidently pursue their fitness goals. In conclusion, "Fit Allergy Check" emerges as an indispensable ally, navigating the complexities of modern health and fitness, and ushering users into a realm of healthier, safer, and more informed living.

Keywords: Allergen, Underweight, Overweight, Calories, Phosphate, Sodium

1. Introduction

The Fit Allergy Check system is designed to offer a holistic solution for individuals managing dietary restrictions, fitness goals, and allergenic concerns. This innovative platform enables users to easily check for allergens in food products and make informed decisions about their consumption. The system goes beyond allergen checking by incorporating features such as personalized nutrition recommendations for underweight and overweight individuals, calorie monitoring for those with high cholesterol, sodium tracking for individuals with high blood pressure, and phosphate monitoring for kidney patients. Fit Allergy Check not only simplifies allergen detection but also provides a multifaceted approach to support users in achieving their health and fitness objectives.

1.1 System Objective

- Help users identify and avoid allergens that may trigger allergic reactions or adverse health effects.
- Assist underweight users in identifying ingredients that may need to be consumed in moderation.
- Assist overweight users in recognizing ingredients that should be consumed in moderation.
- Determine BMI to assess whether one falls within the normal, underweight, or overweight range.
- Help users check their daily intake of calories, phosphate, and sodium.

1.2 Background Research

The “Fit Allergy Check” system was created in response to the rising awareness of the need to manage dietary restrictions, encourage activity, and handle allergenic concerns.

A sizeable section of the population suffers from allergies, which are frequently brought on by foods including peanuts, tree nuts, milk, eggs, wheat, soy, fish, and shellfish. For those who have allergies, controlling allergic reactions and eliminating trigger components are essential. To discover allergenic ingredients in various foods and develop trustworthy allergy databases, extensive research has been done. These databases include precise details on allergen content, potential for cross-contamination, and labelling needs.

The value of eating and exercise in preserving a healthy lifestyle has become widely acknowledged. Regular exercise, gaining muscle, and weight control have been shown to lower the risk of chronic diseases, enhance overall wellbeing, and improve body composition. Numerous exercise routines, dietary strategies, and the effects of macronutrients and micronutrients on muscle growth, fat reduction, and general fitness performance have been examined in scientific studies.

Technology development has completely changed how people monitor and administer their health. Information, monitoring tools, and interactive elements are now easily accessible thanks to wearable technology, mobile applications, and web platforms. To enable people to make educated decisions about their food intake and allergen avoidance, research has concentrated on the development of user-friendly interfaces, precise ingredient recognition algorithms, and dependable allergen detection technologies.

“Fit Allergy Check” has been created to meet the demand for an effective and user-friendly system that combines allergen screening with suggested nutrition by incorporating these study findings. The system helps users efficiently manage their nutritional needs and avoid allergic substances by utilising the knowledge and breakthroughs in allergy.

2. Materials and Methods

This section encompasses the scope of the project, technology used, and the methodology applied for system development.

2.1 Scope

Users will feel convenient while using this system. “Fit Allergy Check” is a mobile app that consist of 5 main features:

- Allergen Checking
 - Users can accurately detect allergenic ingredients by checking the ingredient lists of various food and beverage by using the method.
- Ingredient reference for underweight
 - Assisting users in choosing foods that are nutrient-rich and encourage weight growth.
- Ingredient reference for overweight
 - Enables users to choose their food with knowledge by helping them to grasp the nutritional value of various foods.
- Check BMI
 - Assist users in determining if they fall within the normal, underweight, or overweight range.
- Display the calories, phosphate, and sodium content
 - Users can effortlessly determine their daily intake of calories, phosphate, and sodium by capturing an image of their food.

Besides the main features, here is another feature:

- Add for allergen
 - Users can add which allergen to avoid on the first time using the allergen checking features.
 - After the first time of adding, the data will keep in database and no need to re-enter every time.
- Add extra ingredient for underweight
 - Users can add extra ingredient to avoid, other than ingredient that already set in the default system.
- Add extra ingredient for overweight
 - Users can add extra ingredient to avoid, other than ingredient that already set in the default system.
- Recognize food
 - Take a photo of the food or choose from the gallery to enable food recognition.
- Add calories, phosphate and sodium to daily consumption
 - System will display the daily total consumption for user to review

2.2 Technology Used

- Android Studio

The official Integrated Development Environment (IDE) for developing Android applications is called Android Studio. More capabilities offered by Android Studio increase our ability to produce high-quality Android apps. At the Google I/O conference on May 16, 2013, Android Studio was introduced as the official IDE for creating Android applications. In May 2013, it began offering an early access preview of version 0.1. Beginning with version 1.0, the first stable constructed version was released in December 2014. Kotlin has been Google's preferred language for creating Android applications since May 7th. Besides this, Android Studio also

supports other programming languages. (Android Studio, 2021)

- Flutter

With only one programming language and one codebase, programmer can create quick, gorgeous, natively built applications for mobile, web, and desktop using the Flutter UI toolkit. It is open-source and free. It was first created by Google and is now controlled by an ECMA standard. Dart is a programming language used to create Flutter apps. Dart can be trans-compiled into JavaScript code and has many similarities to other programming languages like Kotlin and Swift. Flutter is primarily designed for 2D mobile apps that work on both iOS and Android operating systems. It may be used to create fully functional apps that have access to a camera, storage, network, third-party SDKs, and more. (Flutter Tutorial, 2021)

- Dart

Dart is a high-level, general-purpose programming language that was created by Google. The new programming language debuted in 2011, but its stable version wasn't made public until June 2017. When the Flutter uses dart, it becomes more popular than it was at the time. Closure and lexical scope are features of the dynamic, class-based, object-oriented programming language Dart. It is very similar to Java, C, and JavaScript in terms of syntax. One can learn Dart with ease if familiar with any of these programming languages. Dart is an open-source programming language that is frequently used to create Internet of Things (IoT) apps, modern web applications, desktop applications, and mobile applications. (Dart Programming Language, 2021)

- Firebase

Google's Firebase is a tool that makes it simple for developers to create, maintain, and expand their apps. It makes it easier for developers to create apps more quickly and securely. Because there is no programming required on the firebase side, it is simple to use the features more effectively. It offers services to web, unity, android, and iOS. It offers online storage. The database used for data storage is a NoSQL one. (Firebase – Introduction, 2021)

2.3 Methodology

I decided to use agile model in this project. The Agile model is an iterative and adaptable method for creating software that emphasizes providing value in small doses and adapting to changing requirements. Sprints are used to divide the development process into smaller iterations where functional software is supplied gradually. Agile approaches also encourage tight cooperation between team members and stakeholders. Feedback is regularly gathered to improve requirements, realign priorities, and guarantee that the finished product satisfies user expectations. (Agile Model, 2021)

3. Results and Discussion

This section delves into the evaluation of the system, involving a thorough comparison between the completed system and its initial performance objectives. Ongoing testing ensures that the system remains in harmony with these predefined goals. An online evaluation form has been employed to collect feedback from 20 users, concentrating on key aspects of the system prototype, including heuristic, content, navigation, and comment. The following section will detail the results derived from this evaluation process.

3.1 User Interface Satisfaction Result

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Satisfy Point
	1	2	3	4	5	
Heuristics						
Primary goal of the system/purpose is clear.	0	1	2	5	12	4.4
Clean, simple design.	0	0	1	5	14	4.65
Pleasing colour scheme.	0	0	1	7	12	4.55
Appropriate use of space.	0	1	1	10	8	4.25
Consistent design.	0	1	2	4	13	4.45
Text and colour are consistent.	0	0	1	5	14	4.65
Icons are universally understood.	0	0	1	4	13	4.6
Images are meaningful and serve a purpose.	0	1	1	6	12	4.45
Content						
Major headings are easy to understand.	0	1	0	7	12	4.5
Minimal text/information presented.	0	1	1	6	12	4.45
Clear terminology, no jargon.	0	0	1	6	13	4.6
Links are clear and follow conventions.	0	0	1	7	12	4.55
Help is available on every page.	0	1	1	8	10	4.35
Important content is above the fold.	0	0	1	7	12	4.55
Search box is easy to identify and easy to use.	0	0	0	6	14	4.7
Navigation						
Consistent navigation	0	0	2	7	11	4.45
Easy to identify your location on the site.	0	0	1	4	15	4.7
Consistent way to return to 'main page/system'.	0	0	1	4	15	4.7
Organisation of information makes sense.	0	0	1	7	12	4.55
Comment						
Comment:	<ol style="list-style-type: none"> 1. Simple and easy to use! 2. Helpful app 					

	<ol style="list-style-type: none"> 3. User friendly 4. Convenience, like it! 5. Good system 6. Useful to me 7. Easy to scan ingredient list 8. Wonderful experience!
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Table 1 User Interface Satisfaction Result

The overall results show that the system has achieved a satisfactory level. However, upon careful evaluation, it became apparent that there were specific areas for improvement. It is worth noting that attention should be paid to the effective use of space within the interface. Additionally, ensuring the availability of help functionality on every page will help enhance the overall user experience. These identified areas will be refined in a targeted manner to further improve system usability and user satisfaction.

4. Conclusion

In the contemporary landscape of health-conscious living, the Fit Allergy Check system plays a pivotal role in seamlessly integrating into individuals' daily routines. Similar to scenarios where individuals seek guidance for various pursuits, Fit Allergy Check serves as a dedicated platform for users to effectively manage their nutritional needs and allergens.

Throughout the development process, the significance of effective time management became apparent, given the diverse functionalities that needed meticulous coding. Prioritizing tasks ensured that essential components were addressed promptly, with certain features, like the e-wallet withdrawal, slated for future development phases.

The developing process unfolded in stages, with an initial focus on project introduction, scope definition, and thorough background research. Subsequent stages involved the preparation of essential system diagrams, including ERD, DFD, and class diagrams. The final stage was dedicated to the intricate task of coding the system.

This project has not only provided valuable insights into effective project management but has also honed my programming skills. I am grateful for the opportunity to undertake this project, as it has significantly contributed to my personal and professional development.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

ICE: An Integrated Social Media Management Application

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Abstract: Due to the proliferation of social media platforms and the ongoing challenges faced by individuals and businesses in maintaining relevance and connectivity in the digital era, it is crucial to establish an online presence across many social media platforms. Nevertheless, the task of content management and engagement analysis across these platforms has been a challenge. To address this issue, an integrated social media management system is proposed. This project is guided by three main objectives: firstly, to identify and analyze the process flow of a comprehensive and integrated social media management application; secondly, to design; and thirdly, to develop the social media management application. This project employed the agile development methodology to allow for iterative enhancements and rapid response to user feedback. A distinctive feature of the proposed system is its integration of both Facebook and Instagram accounts, offering users a unified interface for the two most prominent social media platforms. With this system, users can efficiently streamline content creation, scheduling, and posting across multiple platforms. Furthermore, the system provides robust analytics to track post engagement, empowering users to make informed decisions regarding content formats, posting schedules, and overall content strategy—particularly advantageous for businesses and content creators. Additionally, the proposed system includes a unique capability that allows businesses to gather user feedback, enabling customers to express their opinions. This feedback can be gathered, curated, and optionally published seamlessly across social media accounts either immediately or at scheduled intervals, thereby facilitating interactive customer interactions and the re-use of content as testimonials. In a world where online presence is fundamental for personal connections and business success, the proposed system offers a comprehensive solution that contributes to the ongoing evolution of digital communication and marketing strategies.

Keywords: Social Media, Content Management, Digital Communication

1. Introduction

Starting from 2020, social media platforms have become essential for people worldwide, due to the Covid-19 pandemic. This was because every student and worker were forced to stay at home during the Movement Control Order (MCO). As a result, the individuals that were isolated at home had no choice but to turn to social media to interact with their friends and families or use it as a form of entertainment to pass time. Besides, many individuals also started posting or sharing their social media content frequently during the pandemic to keep their friends or family updated with their daily activities, causing the social media platforms to become extremely popular and making everyone realize how convenient it is to use social media platform.

As a result, it is not unusual to see a user posting the same content to multiple social media platforms like Twitter, Instagram or Facebook. This is due to the increase of new social media platforms being introduced to the public and people having different friends or followers on different platforms and having to keep them all updated. As a result, the task of content management and engagement analysis across these platforms has been a challenge due to having to switch to other platforms just to keep track of each platform and wasting a lot of time in the process. To address this issue, an integrated social media management system was proposed.

To attain the goal of this project, the following objectives have been set:

- I. To identify and analyze the process flow of the Social Media Management Web Application from the admin and user perspective.
- II. To design a social media management web-application that allows users to manage social media posts on more than one platform simultaneously.
- III. To develop a social media management web application that simplifies the process of scheduling contents across multiple social media platforms.

The expected outcome is that the proposed system will have the feature to allow users to control which social media platform they would like to publish their content on or to publish them across multiple platforms simultaneously. Besides that, users can also schedule their posts across social media platforms to help maintain a consistent presence online by clicking on the calendar icon in the form and selecting a date for the post to be scheduled to. The scheduled posts can be viewed in the form of a calendar to help plan their posts and keep track of what days they have no posts scheduled for more conveniently. Users can also view and analyse their social media performance such as post engagement to help determine what kind of content will attract more attention. Other than that, users can view their published content history which is sorted from the latest published content to the oldest published content. The proposed system will also have a feature that allows users to contact the admin easily by filling up the form in the contact us page and clicking submit, then the message will be sent to the admin's inbox. Lastly, the proposed project is limited to social media platforms such as Facebook and Instagram only.

2. Materials and Methods

The methodology chosen to develop the proposed system the Agile software development life cycle which refers to an iterative and incremental approach to software development. The Agile method breaks the tasks into small iterations in which each iteration typically lasts from one to four weeks with each iteration usually having a team working through a full software development life cycle such as planning, analysis, design, implementation, maintenance and launch. The project is divided into smaller parts to help minimize the project risk and reduce the project delivery time.

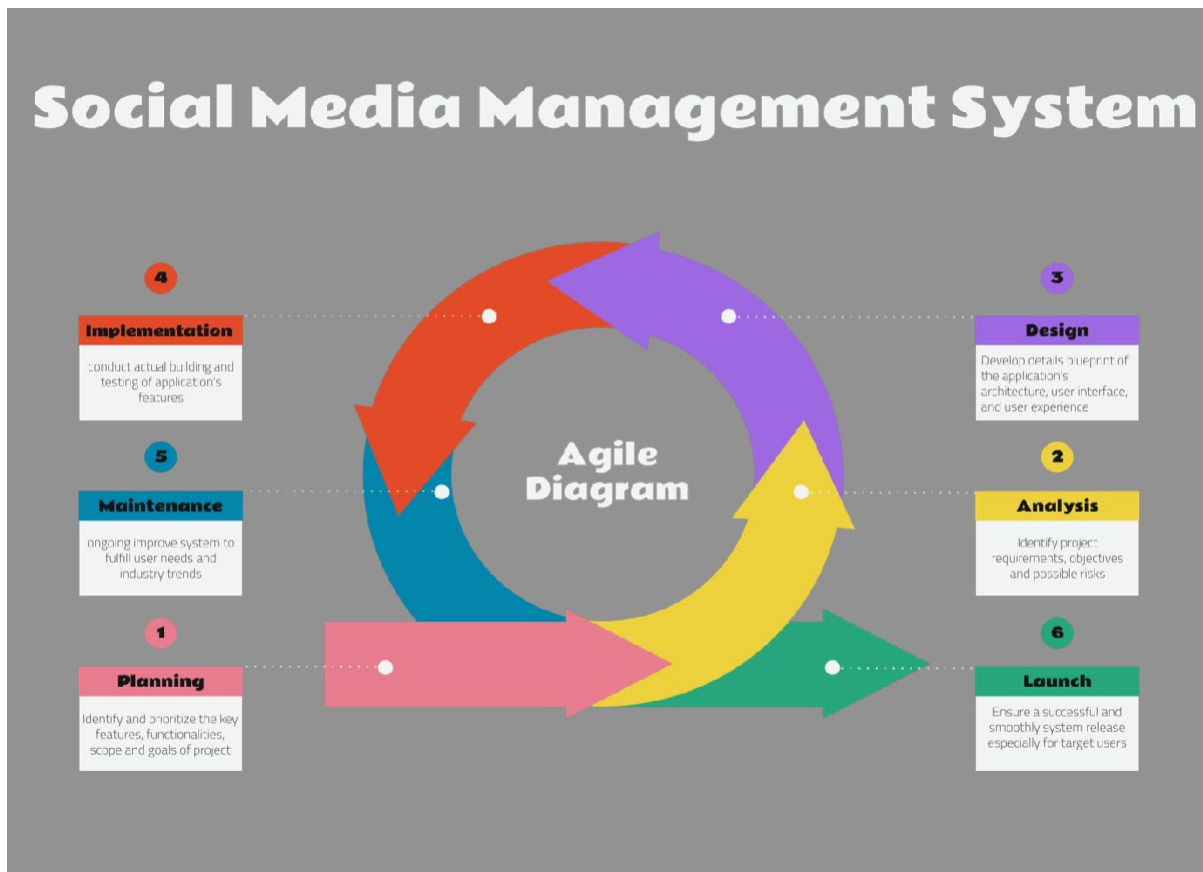


Figure 1: Example of the agile diagram

2.1 Phases within the Agile SDLC Model

The Agile SDLC Model is divided into 5 iterations with each iterations having to go through a full software development life cycle such as planning, analysis, design, implementation, maintenance and launch. The task within the iterations will be explained below.

2.1.1 Iteration 1

In iteration 1, the planning and user interface for the login feature was completed. Users are required to have a social media account already registered to login to the system. Owner needs to connect one of their social media account for manage and the others normal users can manage the connected social media account.

2.1.2 Iteration 2

In iteration 2, the user interface of contents history and contents schedule was designed. Users can schedule their posts by clicking on the calendar icon in the form and select a date for when the post should be published.

2.1.3 Iteration 3

In iteration 3, the calendar for scheduling and viewing scheduled posts as well as the customization for the calendar view to increase users applicability and visual experience was built. The Calendar was built with HTML, CSS, JavaScript for functionality and animation.

2.1.4 Iteration 4

In iteration 4, the user interface of the roles permission of the social media page was designed. The connected social media account can view the roles of the users that are connected to their social media page and see when they were last active on the website. The owner of the social media pages as well as the admins connected to that page can also published their content to the same page for everyone to see if they enabled the permissions on the Facebook application.

2.1.5 Iteration 5

In iteration 5, the user interface of the daily social score visual graph was completed. Our system used JavaScript Graphics to build the data visualization graph. The data will be obtained from the social media platform of the user's account and directly displayed to the user.

3. Results and Discussion

3.1 User Interface Design

The user interface design of the system was developed using HTML, CSS, JavaScript. PHP coding and MySQL database was also used in the proposed system for creating, reading, updating, storing and deleting data in databases.

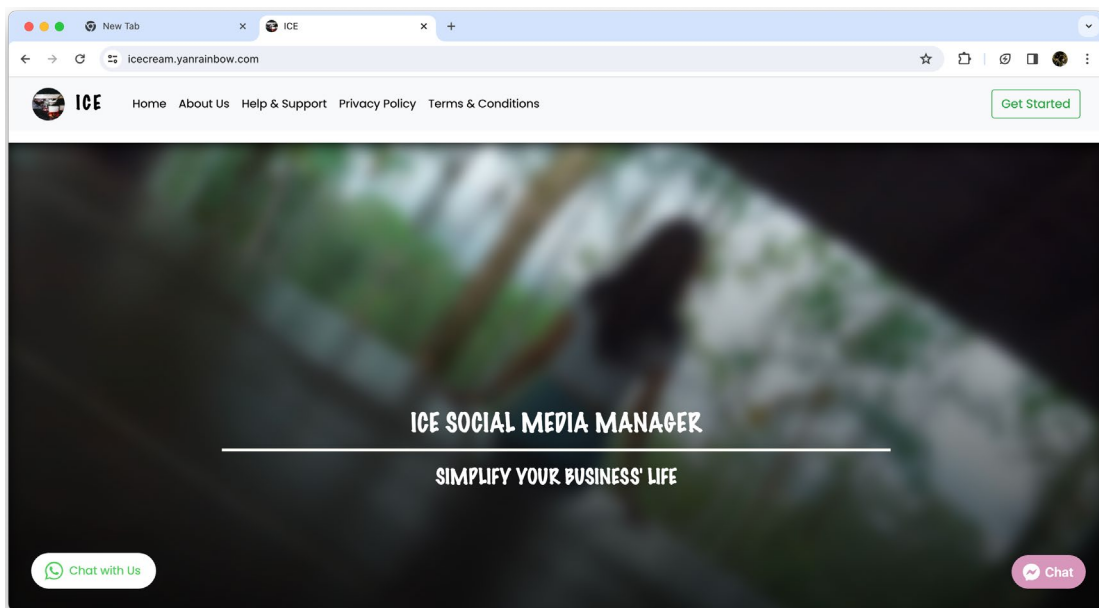


Figure 2: Home page of the social media management web application

Figure 2 is the interface design of our home page that is shown when a user visits our website.

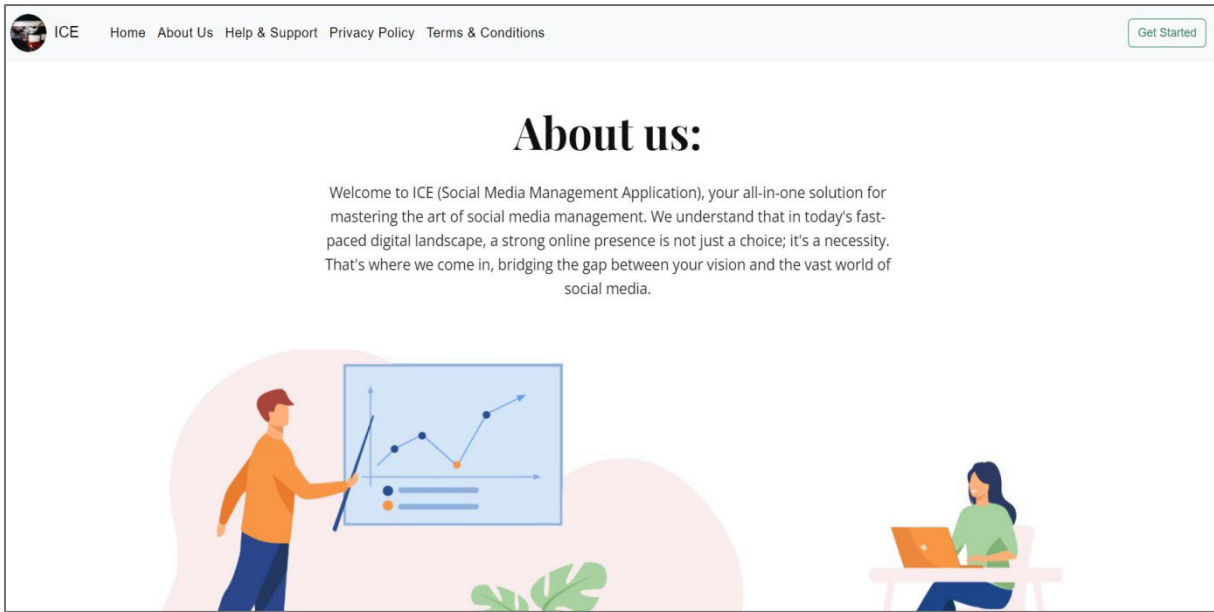


Figure 3: About us page of the social media management web application

Figure 3 is the about us page that includes information related to our application

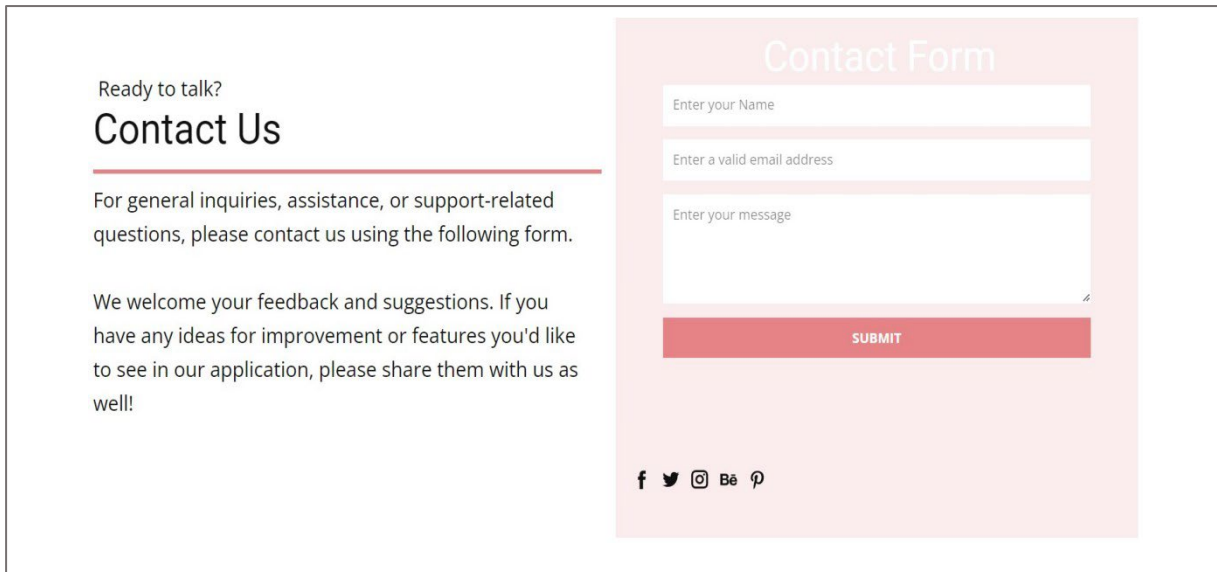


Figure 4: The contact form in the contact us page

Figure 4 is the interface design of the contact us form whereby user can send an email to the admin by filling up the form and clicking submit.

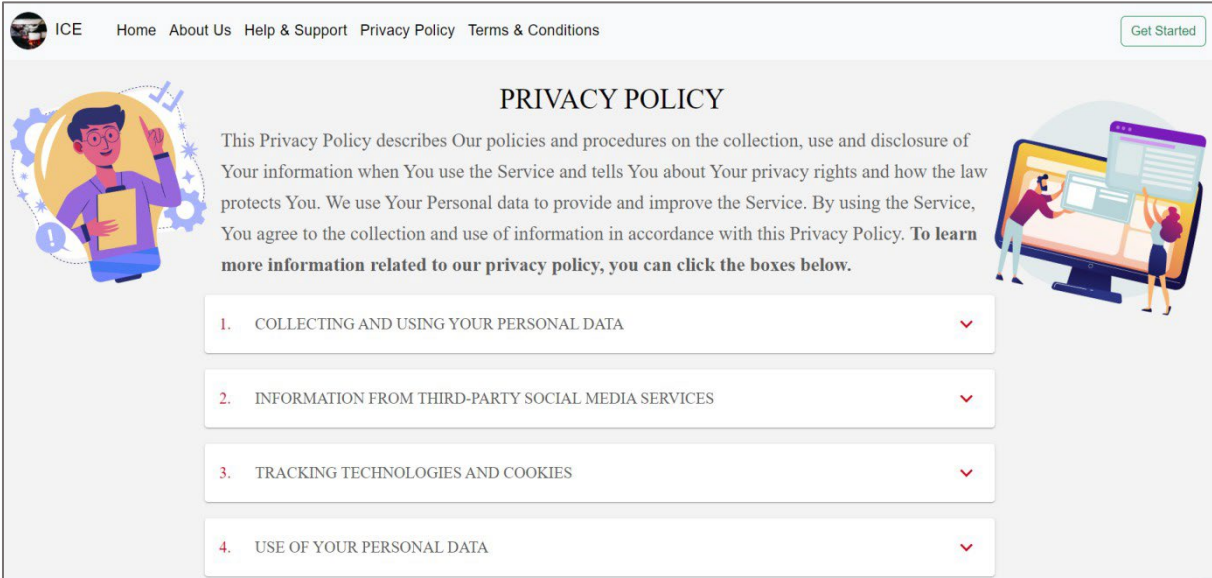


Figure 5: The interface design of the privacy policy page

Figure 5 is the interface design of the privacy policy page which contains all the information related to our system's privacy policy.

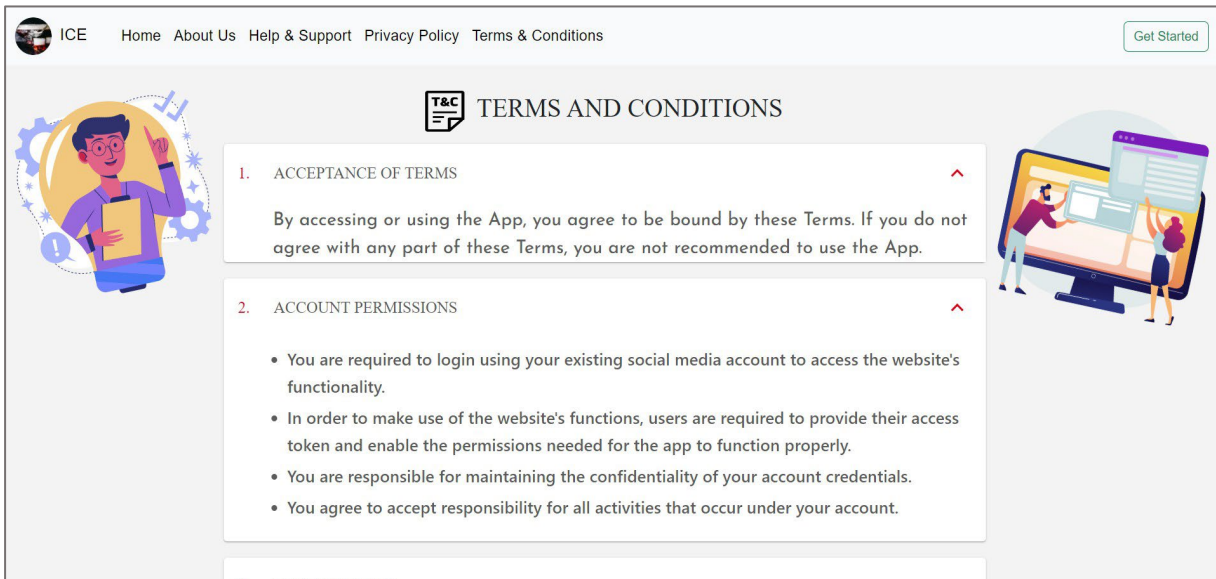


Figure 6: The interface of the terms and conditions page

Figure 6 is the interface design of the terms and condition page which contains all the information related to our system's terms and conditions.

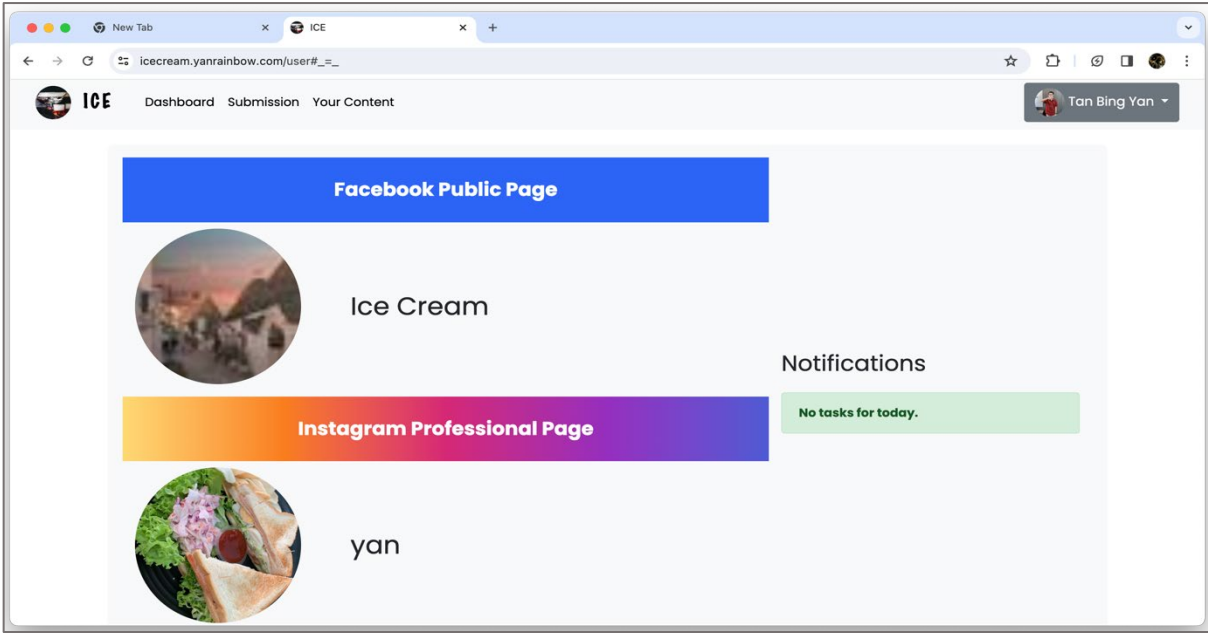


Figure 7: The interface design of the dashboard page

Figure 7 is the main page that the users see when logging into our website. It is also the place where the user's social media analytic data is displayed

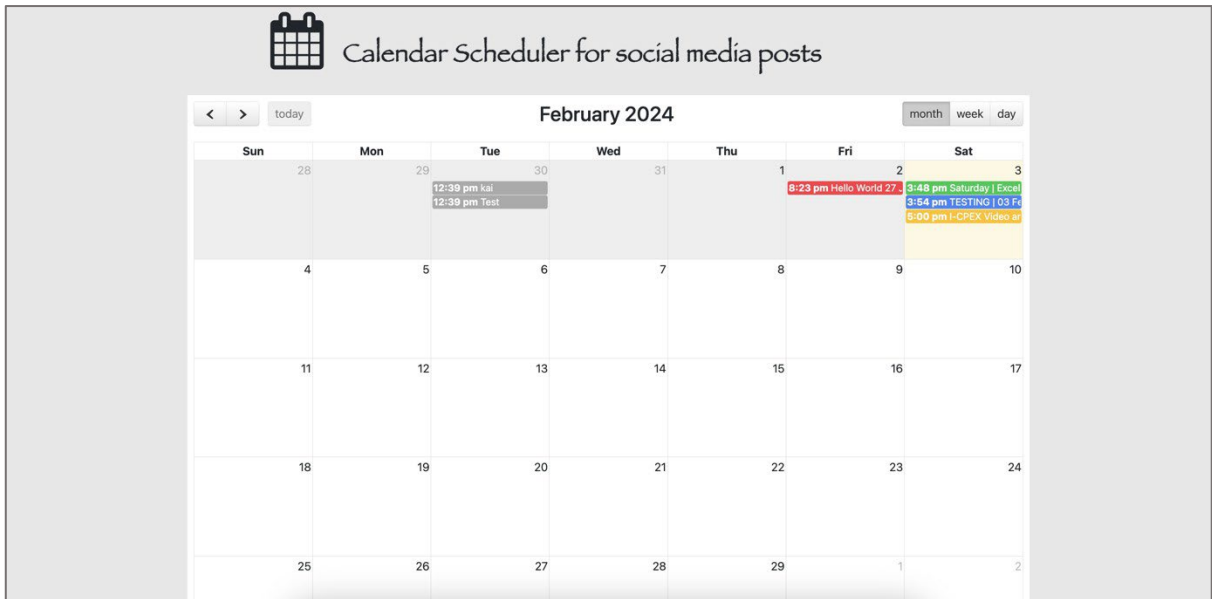


Figure 8: The interface design of the calendar

Figure 8 shows the interface design of the calendar whereby all the user's scheduled post is displayed here for easier managing of content posting.

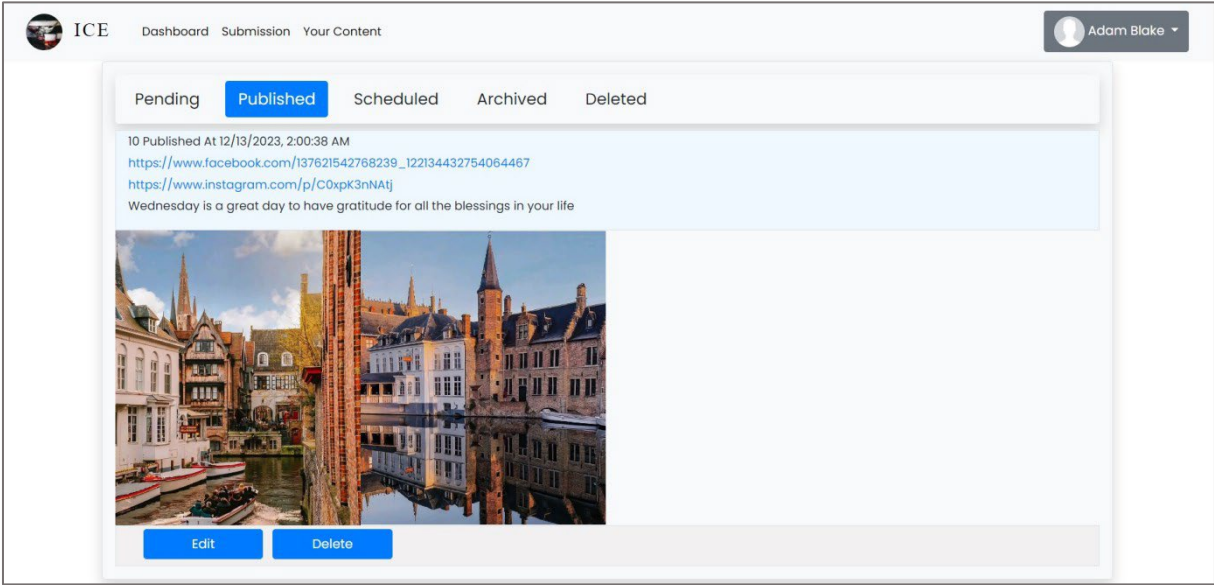


Figure 9: The interface design of the published section in the submission page

Figure 9 shows the interface design of the published section in the submission page where the user can view all their published post.

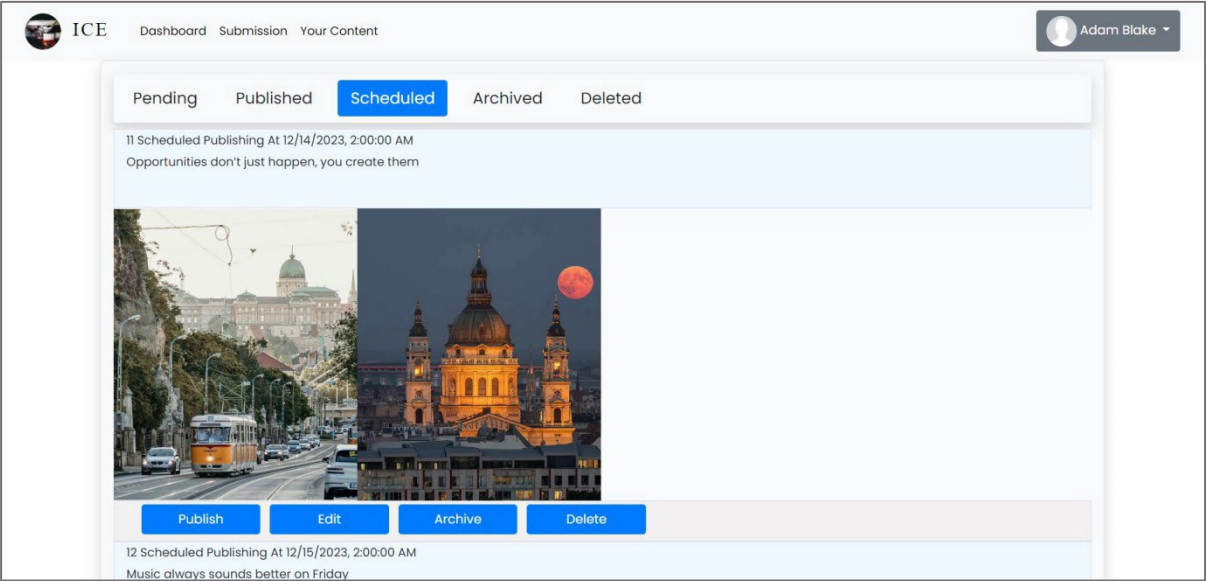


Figure 10: The interface design of the scheduled section in the submission page

Figure 10 shows the interface design of the published section in the submission page where the user can view all their scheduled post.

Figure 11 shows a popup form titled "Edit & Update Content Data". The form includes a close button (X) in the top right corner. It contains two text input fields: "Content" with the value "test" and "Email" with the value "destroyer2345678910@gmail.com". Below these fields is a light gray area with a teal "Upload Image" button. Further down are two time selection fields: "Select MYT Time" (21/12/2023 11:50 PM) and "Schedule Post Time" (21/12/2023 03:50 PM). A checkbox labeled "Term & Condition" is checked. At the bottom right are "Close" and "Update" buttons.

Figure 11: The interface design of the popup form for editing the content data

Figure 11 shows the interface design of the popup form where the user can edit/update their created post.

3.2 User interface satisfaction result

To verify whether the system's performance and functionality is working as intended and see if the users are satisfied with the interface design of the system, a survey was handed out using google forms which allow us to collect the user's opinion and analyse them more conveniently. Besides that, users were also allowed to suggest any new improvements they would like to be added to the system as well.

Were you satisfied with the overall user interface design of our platform?

10 responses

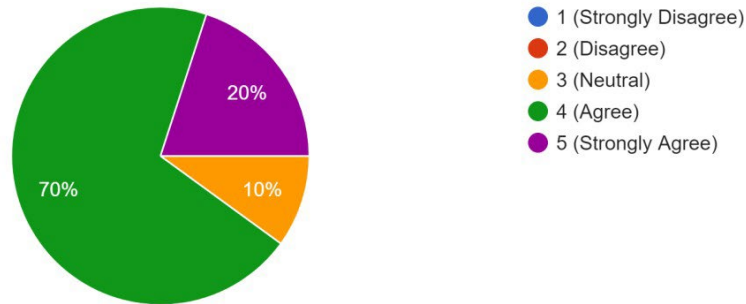


Figure 12 above shows that 90% of the users are satisfied with the overall user interface design of the system.

The results for the rest of the question in the survey will be displayed in the tables below and it is based on the percentage of answers collected from 10 users.

Table 1: The User Interface Satisfaction Result for the questions with the options of (1- 5) as the answer

Items	1	2	3	4	5
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Were you satisfied with the overall user interface design of our platform?	0%	0%	10%	70%	20%
How would you rate the ease of use of the interface in performing common tasks (Ex. creating/publishing post)?	0%	0%	10%	50%	40%
Was it easy to navigate through different sections and features of the interface?	0%	0%	10%	60%	30%
Were you able to find the information you were looking for easily?	0%	0%	10%	80%	10%
What are your thoughts on the visual design of the interface? Does it appeal to you?	0%	0%	10%	40%	50%
Were you satisfied with the speed and responsiveness of the interface?	0%	0%	10%	60%	30%
Did you find the available help and guidance feature helpful? (Ex. sending email to admin for help)	0%	0%	20%	60%	20%
On a scale of 1 to 5, how useful did you find the analytics features in	0%	10%	10%	60%	20%

understanding your social media performance?					
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The overall result of the table above shows that majority of the users were satisfied with the interface design and performance of the proposed system.

Table 2: The User Interface Satisfaction Result for the questions with the options of (Yes or No) as the answer

Items	Result	
	Yes	No
Were you able to publish your created post to the social media platform successfully?	100%	0%
Was the details of the published post same as the one that the user has inputted?	100%	0%
Did you encounter any issues when selecting the date and time for your scheduled posts?	100%	0%
Was the scheduled posts published at the correct time?	100%	0%
Was the media files that you attached to the posts the same as the one you inserted?	100%	0%
Were you able to successfully delete the created post by clicking on the delete button?	100%	0%

The overall result of the table above shows that all the functions of the proposed system is working as intended and that there is no issue with the system.

4. Conclusion

In conclusion, the proposed system was developed using the Agile software development life cycle model where the task was divided into four iterations with each iterations having a team working through a full software development life cycle such as planning, analysis, design, implementation, maintenance and launch. Besides that, testing was carried out to check whether the system's performance and functionality is working as intended and see if the users are satisfied with the interface design of the system.

Based on our own analysis and the opinions gathered from the users through the survey, there is still a lot of improvements that can be added to our social media management application. Some of the ideas that we have come up with for the future improvements are enhancing the content scheduling feature by enabling the ability to schedule posts across multiple platforms simultaneously as well as implementing a "smart" scheduler that suggests the best times to post based on the user's social media analytic data and user engagement patterns. Besides that, we would like to also integrate other social media platforms such as Twitter, Snapchat, Tiktok, Pinterest, LinkedIn, Shopify to our system in the future to allow users to publish/schedule content to other platforms as well simultaneously.

In addition, we would like to also develop a mobile application for our social media management system, making it more convenient for users to manage their social media accounts and schedule their posts more conveniently using the mobile app. Other than that, implementing automation and AI features is another feature that we would like to add in the future. For example, adding AI-driven features for content creation, including image and video editing tools as well as developing sophisticated chat bots for automated customer interaction and support. Lastly, we would also like to add the Personalization and customization feature to provide users with the options for personalized content recommendations and allow users to customize their dashboard and social media analytic based on their specific needs.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Nursery Garden: Gardening E-Commerce Management System

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Abstract: In recent times, a growing trend has emerged where people prefer to shop online rather than visit physical stores, driven particularly by the impact of Covid-19. With the necessity of staying indoors to ensure safety and prevent the spread of the virus, individuals have found themselves seeking ways to engage and interact while being confined to limited activities. This has led many Malaysians to explore gardening and plant nurturing as a fulfilling pastime. Addressing this trend, the Nursery Garden E-Commerce Management System has been developed to cater to customers who wish to purchase plants and gardening supplies without the need to physically visit a store. The proposed system features a diverse array of modules designed to enhance the user experience. These encompass customer management, plant management, product management, category management, shopping cart management, order management, payment integration, and bidding management. By encompassing these modules, the system aims to provide a comprehensive and seamless online shopping experience tailored to the unique preferences of gardening enthusiasts and customers seeking to beautify their surroundings. Furthermore, the system provides features like customizing the plant, soil, and pot, which appeal to younger customers. Additionally, for customers who are unable or inconvenienced to pick up the plant, the system offers a feature to allow them to make payments and provides assistance in taking care for a period of time. Lastly, the system includes a bidding feature for customers to participate in. As modern lifestyles continue to evolve and adapt to changing circumstances, the Nursery Garden E-Commerce Management System stands as a relevant and timely solution that caters to the shifting dynamics of shopping preferences and the growing passion for gardening within the Malaysian community.

Keywords: "E-Commerce", "Customization", "Bidding System".

1. Introduction

The proposed system, Gardening E-Commerce Management System, is aimed to provide a comprehensive platform to buy plants and gardening products online. It provides a convenient way for customers to purchase plant and gardening products online without going to the physical onsite garden. Besides, this proposed system has bidding features. It allowed the customer to bid on the plant they wished. Additionally, it provides a function that enables the customer to customize the planter, plant, and soil by themselves and visualise their choice.

1.1 System Objectives

1. To provide a comprehensive platform for customers to buy plant and gardening products more effectively and efficiently.
2. To provide an opening platform for the customer to tailor the plant, pot and soil according to their preference.
3. To provide a bidding platform for the plant enthusiasts to buy the limited or rare plant according to their capability.

1.2 Background Research

Nowadays, people usually like to buy items online without going to a physical shop, especially those who have experienced Covid-19. Due to the necessity of staying home for safety and to prevent the spread of the virus, Malaysians needed more human interaction and a restricted range of activities. Many Malaysians have developed a keen interest in nurturing plants and gardening to fill this. Thus, purchasing the item online has become a trend for Malaysian in recent years (Houseplant Trend Grows In Malaysia, 2021).

After a series of interviews with customers in the garden located in Pontian Besar, Pontian, Johor, I have gathered information about the problems customers encounter when purchasing plants and gardening products at the physical garden. First, customers may not find the specific plants they want in the garden due to the wide variety of assortments, making it impossible for a single garden to stock them all. Additionally, customers may face time constraints that prevent them from visiting the garden to make their purchases. Furthermore, some customers might encounter issues related to the capacity of their vehicles, fearing that plants may soil their cars.

In addition to the customers' perspective, I have also conducted interviews with garden owners in Pontian, Johor. They have observed that young people seldom purchase these plants and gardening products, likely because of their limited interest in plants. These garden owners hope that this app can help expand the market for young customers. Moreover, one garden owner mentioned, "The garden's turnover has significantly declined compared to the period before Covid-19. This is due to the Movement Control Order (MCO), which restricts people's travel and prevents Singaporean tourists from visiting and spending money in Johor Bahru, Malaysia."

Finally, as per the customer's viewpoint, certain limited edition or rare plants may not be easily found through conventional retail outlets. Consequently, they express a desire for the market to offer a platform catering to plant enthusiasts in search of distinctive additions to their collections. From my perspective, the bidding feature can seek a balance of affordability for customers and revenue generation for garden owners. Within this bidding system, plant enthusiasts seeking unique additions to their collections are inclined to bid higher amounts to acquire such plants, thereby increasing the garden owner's revenue. Besides, this revenue can assist the garden owner in covering the costs associated with acquiring these rare or limited plants.

2. Material and Methods

This section has included the project scope, technology used, and the methodology to develop the system.

2.1 Project Scope

The Garden E-Commerce management system is developed as an Android application for customers and a web application for administrators. The scope of this proposed system should include the following:

1. Account Module

For this proposed system, it is imperative that customers can register their accounts, effortlessly log in using their registered credentials, and conveniently update their personal information. Simultaneously, administrators should have the ability to access and view the customer list to manage accounts effectively.

2. Plant Module

In the plant module, customers should have the capability to review and search for plants. Furthermore, customers can match and customize the planter, plant, and soil, visualizing their customizations. They should be able to easily modify the style and pattern of the planter, plant, and soil at any time and view their customizations.

3. Product Module

In the product module, customers should be able to review and search for gardening products. Simultaneously, administrators must have the capability to create new gardening products, update their information, and delete gardening products as needed.

4. Category Module

In the category module, administrators should be able to add, view, edit, and delete categories as necessary.

5. Cart Module

Within the cart module, customers will find a user-friendly experience. They can effortlessly add plants and gardening products to their cart, make necessary edits to quantities, review their selections, and remove items as needed.

6. Order Module

In the order module, customers should have the ability to create new orders and review their existing ones. When a customer places an order, the system should automatically update the plant and gardening product inventory to reflect the changes.

7. Payment Module

In the payment module, customers should have the capability to proceed with payments when they place an order. The system will then automatically detect the payment status from the API and transmit this information back to the backend for processing. This ensures a seamless and efficient payment process for customers.

8. Bidding Module

In the bidding module, customers should be able to place bids on specific plants within the designated bidding period. Administrators have the authority to initiate a bidding process for the plants, allowing customers to participate. When the bidding period concludes, the system will ascertain the winning bidder for each plant.

9. Delivery Module

In the delivery module, customers should have the capability to track their delivery status when the courier is in the process of shipping their order. Additionally, administrators are responsible for updating the delivery status of orders. This ensures that customers can stay informed about the progress of their orders and that administrators can manage and update delivery information effectively.

2.2 Methodology Choice

The methodology chosen for this proposed system is an iterative model. The iterative process commences with a basic implementation of a portion of the software requirements and progressively improves subsequent versions until the complete system is achieved. Design adjustments are made with each iteration, and new functional capabilities are incorporated. The fundamental concept underlying this approach is to develop a system through repeated cycles and in smaller increments at a time. Iterative model development is a development approach that combines both iterative design or method and incremental build models. It involves carrying out multiple iterations of the software development cycle simultaneously. This process can be characterized as an "incremental build" approach in software development. (Tutorialspoint, 2023).

3. Conclusion

In conclusion, the Garden E-Commerce management system presents a comprehensive and user-centric approach through its various modules, addressing the needs of both customers and administrators. The system establishes a robust and user-friendly online platform, eliminating the necessity for physical visits to gardens. Notably, the customization feature allows customers to tailor plants, pots, and soils to their preferences, fostering creativity and curiosity, particularly among the younger demographic. This personalized approach enhances the overall appeal of the system, making it an attractive option for customers seeking a unique gardening experience. The seamless integration of customization features streamlines the process, ensuring that customers receive plants, pots, and soils tailored to their selected styles. This feature is especially noteworthy as it caters to the preferences of a younger audience, tapping into their enthusiasm for personalized and creative choices.

Furthermore, the inclusion of a bidding platform adds a dynamic element to the system, providing customers with the opportunity to bid on limited or rare plants based on their budget. This not only enriches the purchasing experience but also creates a balanced marketplace by addressing the demand for unique plants while considering the pricing expectations of garden owners.

Lastly, the Garden E-Commerce management system includes an admin site designed for efficient platform management. Garden owners or administrators undergo various processes to ensure the system's effective operation. They have the flexibility to create or update plants and products at any given time, initiate bids and styles, showcasing them to customers as needed, and keeping order and delivery statuses up to date. This administrative functionality empowers the admin to monitor the system's condition seamlessly, facilitating a smooth and always streamlined management process.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

LifeSpring: Nursing Home Management System

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Abstract:

Malaysia's evolving demographics and societal dynamics have underscored the urgent need for efficient nursing home management. These facilities grapple with issues such as deficient communication, limited access to vital medical information, and laborious visitor registration procedures. To tackle these challenges, I introduce LifeSpring, a comprehensive Nursing Home Management System, including a mobile app for on-the-ground operations and a web-based backend management system for streamlined oversight and reporting. The system's main objectives are to drive efficiency, foster seamless communication and data sharing, and fortify security and visitor management. It accomplishes these goals through a suite of features, combining resident and staff management, centralized medical records, an adaptable communication portal, appointment scheduling, and a unique Biometric Authentication-based Appointment Verification system. This study spotlights the myriad benefits of LifeSpring, promising improved day-to-day operations and diminished administrative burdens. LifeSpring's mobile app empowers on-site personnel with real-time data access, appointment scheduling, and a convenient communication portal. The web-based backend system provides managers with comprehensive oversight and report-generation capabilities, simplifying administrative tasks. A distinctive feature of this system is the Biometric Authentication-based Appointment Verification system, which enhances security and simplifies visitor check-ins. Real-time communication tools enable seamless updates and information sharing among doctors and guardians. LifeSpring's multifaceted solution is designed to promote efficiency, transparency, and security within nursing homes, ensuring that elderly residents receive the best care possible. In a society marked by an aging population and changing family dynamics, LifeSpring aims to significantly contribute to the well-being of elderly residents and enhance the overall standard of care, addressing an essential need in the realm of nursing home management.

Keywords: Nursing Home, Biometric Authentication-based Appointment Verification, Real-time Communication

Introduction

Nursing Home Management System - LifeSpring, is designed to offer a holistic solution for managing nursing home operations efficiently. It serves as a centralized platform facilitating streamlined processes, such as record-keeping, appointment scheduling, and data management, resulting in enhanced day-to-day operations and reduced administrative burdens. Moreover, the system prioritizes improved communication and information sharing by incorporating features like a dedicated community space for healthcare professionals and caregivers to share vital updates in real-time. Additionally, the implementation of a Biometric Authentication-based Appointment Verification System ensures heightened security standards, contributing to an overall safer and well-managed environment within nursing homes. LifeSpring aspires to bring transformative efficiency, communication, and security to nursing home management.

1.1 System Objectives

1. To improve Nursing Home Management Efficiency
2. To Enhance Communication and Information Sharing
3. To Enhance Security and Visitor Management

1.2 Background Research

The management of Nursing homes plays a crucial role in ensuring the well-being and care of elderly residents. With an aging population and changing societal dynamics, the need for efficient and comprehensive management systems for Nursing homes has become increasingly important.

Below are the current demands and challenges in Malaysia:

1. Enhanced Communication and Information Sharing

Effective communication between the management, caregivers, and guardians of elderly residents is vital. Currently, there is a lack of real-time and efficient communication channels to update guardians about the well-being and status of their elderly relatives. This leads to concerns, uncertainties, and the need for constant follow-ups.

2. Access to Medical Information

Guardians often face challenges in obtaining up-to-date medical information and reports regarding the health conditions of their elderly relatives. This lack of accessibility hampers informed decision-making and impedes the provision of necessary medical care.

3. Streamlined Visitor Registration Process

The current visitor registration process in Nursing homes is often time-consuming and requires manual paperwork. This process can be inconvenient for both visitors and the management, leading to delays and potential security concerns.

The development of a Nursing Home Management System with unique features, such as real-time communication, access to medical information, and biometric authentication-based visitor pass management, addresses the current demands and challenges faced by Nursing homes in Malaysia. With an aging population and changing family dynamics, the prevalence of such systems is expected to increase. This project aims to contribute to the welfare of elderly residents, empower guardians, and enhance the overall management and care provided in Nursing homes.

1. Material and Methods

This section focuses on the project scope, the technology used, and the methodology to develop the system.

1.1 Project Scope

The Nursing Home Management System will include the following core features:

- Resident Management System
- Staff Management System
- Medical Records Management System
- Communication Portal
- Appointment Scheduling System
- Biometric Authentication-based Appointment Verification System

2.2 Technology Used

- Firebase
- Flutter

2.3 Methodology Choice

In this proposed system, I choose to use a prototype model based on its suitability for the project's incomplete and evolving requirements. The prototype model is an iterative and trial-and-error approach where a prototype is developed, tested, and refined until it meets the user's acceptance criteria. It also serves as a foundation for the final system or program. Besides, interacting with the prototype gives the proponents a realistic experience and helps in comprehending the intended system's requirements. Prototyping is particularly beneficial for complex systems without existing processes or systems to determine requirements. (Long, 2013)

2. Results and Discussion

This section specifically focuses on the outcomes of the evaluation. It involved the use of an online questionnaire designed to explore user satisfaction with the system's user interface. The following will present the results and findings of the evaluation.

3.1 User Interface Satisfaction Result

Items	1	2	3	4	5	Average
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Heuristics						
Primary goal of the system/purpose is clear.	0	0	0	7	13	4.5
Clean, simple design.	0	0	0	3	17	4.7
Pleasing colour scheme.	0	0	1	5	14	4.4
Appropriate use of space.	0	0	0	4	16	4.6
Consistent design.	0	0	0	4	16	4.6

Text and colour are consistent.	0	0	0	6	14	4.6
Icons are universally understood.	0	0	0	5	15	4.6
Images are meaningful and serve a purpose.	0	0	0	4	16	4.6
Content						
Major headings are easy to understand.	0	0	0	7	13	4.6
Minimal text/information presented.	0	0	0	5	15	4.6
Clear terminology, no jargon.	0	0	0	6	14	4.6
Links are clear and follow conventions.	0	0	0	5	15	4.6
Help is available on every page.	0	0	0	5	15	4.7
Important content is above the fold.	0	0	0	5	15	4.6
Search box is easy to identify and easy to use.	0	0	0	6	14	4.7
Navigation						
Consistent navigation	0	0	0	6	14	4.6
Easy to identify your location on the site.	0	0	0	7	13	4.6
Consistent way to return to 'main page/system'.	0	0	0	5	15	4.6
Organisation of information makes sense.	0	0	0	5	15	4.6
Comment or suggestion:	<ol style="list-style-type: none"> 1. Nice UI 2. User friendly interface, easy to understand the function 3. Icon is clear and can directly know its function 					

From the overall results, the system meets the approval and satisfaction of the majority of users. Based on the feedback, I will consider applying more pleasing color scheme to make my system more attractive.

4. Conclusion

This Nursing Home Management System is a comprehensive and innovative solution designed to address the pressing challenges faced by nursing homes in Malaysia. With a focus on key objectives such as improving efficiency, enhancing communication and information sharing, and fortifying security and visitor management, the system aims to bring about transformative changes in the management of elderly care facilities.

The inclusion of core features like the Resident Management System, Staff Management System, Medical Records Management System, Communication Portal, Appointment Scheduling System, and Biometric Authentication-based Appointment Verification System collectively ensures a holistic approach to nursing home administration.

This integrated platform not only streamlines day-to-day operations, reduces administrative burdens, and promotes transparency but also prioritizes the well-being of residents by providing a secure, well-managed environment.

As the system is poised to bridge communication gaps, facilitate real-time collaboration, and elevate security standards, its successful implementation holds the promise of setting new standards in the field of eldercare management, contributing to improved efficiency, communication, and overall resident satisfaction.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Responsive Website: Online Restaurant Take-Away System

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Abstract: Amidst the COVID-19 pandemic, Kuala Lumpur restaurants swiftly adopted online take-away services. This study enhances Lan Zhou Mee Tarik's online system through a flexible website, employing the Modified Waterfalls Model for requirement analysis, design, implementation, testing, and maintenance. Tools like XAMPP, Figma, Visual Studio Code, HTML, CSS, MySQL, PHP, and JavaScript ensure smooth operation and user-friendly design. Testing involving 45 respondents showed a 95% agreement in reduced order processing time and errors. Consideration of a customer rating system is suggested for continual improvements and customer engagement, emphasizing the role of online take-away systems in restaurant success and customer satisfaction.

Keywords: Online take-away system, Website, Restaurant, Food, Order

1. Introduction

1.1. Research Background and Problem Statement

Technology integration is essential for food and beverage companies in the digital age. As information technology advances, e-commerce platforms are essential for quick sales growth [1]. Following the COVID-19 outbreak, Malaysia's food and beverage business has moved online for convenience.

Adopting e-commerce technologies has enhanced efficiency and sales, potentially yielding 30% revenue [2]. Given the 300% rise in online food ordering speed compared to dine-in traffic, especially among younger generations, customer expectations for superior service have spurred demand for online take-away systems [3]. Multimedia technology can improve ordering times and dine-in experiences, demonstrating its importance for service quality.

1.2. Research Objectives and Expected Outcomes

This study aims to address the challenges Lan Zhou Mee Tarik faces by implementing an online take-away system will enhance revenue streams, customer satisfaction, and operational efficiency for the restaurant.

The objectives are as follows:

- a. To identify how developing a responsive website will benefit customers.
- b. To develop an online take-away system by using a responsive website for the restaurant to help customers quickly order food online.
- c. To determine the effectiveness of an online take-away system using a responsive website for the restaurant.

1.3. Research Questions

To achieve the objectives and desired outcomes, this study will investigate the following questions:

- a. Why develop a website for an online take-away system?
- b. What are the advantages of using a responsive website for an online take-away system?
- c. How does an online take-away system improve the restaurant's effectiveness?
- d. What are the challenges of an online take-away system?

This section concludes the introduction by summarizing the background information, problem statement, research objectives, and questions. The following section will delve into the materials and techniques used in the study.

2. Materials and Methods

This section will comprehensively explain the materials and methods utilized in developing the online take-away system, applying the Modified Waterfalls Model as the methodology for this research.

2.1. Materials

Materials were crucial to the online take-away system's design, development, and testing. Thus, the research's development tools, programming languages, and other resources will be described:

- a. Software Tools:
 - Adobe Photoshop: To modify the website's visual content.
 - Adobe Premiere Pro: For editing the website's video content.
 - Figma: Create information architecture, wireframes, and prototypes.
 - XAMPP Control Panel: Provides database server connectivity.
 - Visual Studio Code: Website development tools for editing and developing code.
- b. Programming Languages:
 - HTML: A markup language for web content structure.
 - CSS: Web page layout and appearance customization language.
 - PHP: Server-side programming for dynamic web page creation.
 - MySQL: For storing and managing data.
 - JavaScript: For adding interactivity to web pages.
- c. Other Resources:
 - phpMyAdmin: Web-based MySQL database management utility.
 - Lan Zhou Mee Tarik Restaurant: Provided website material and images.

2.2. Methods

a. Requirement Analysis

A preliminary survey via Google Forms assessed website content and structure among thirty individuals in Kuala Lumpur to evaluate the website's content and structure. Data quality was prioritized [4], and client meetings refined content requirements and project timelines. Due to budget limitations, some visual assets were sourced online, with 90% of data coming from client input.

b. Design

The design process starts with crafting information architecture, informed by pre-survey data, to efficiently organize content. This enhances user efficiency and encourages revisits [5]. Using Figma, UI/UX wireframes and design templates are created to visualize website flow and ensure user-friendliness. Refer to Appendix A for the information architecture and the website interface design.

c. Implementation

According to the information, requirements, interactions, and features, source code was utilized to develop the website. Integration with the XAMPP control interface facilitated database linkage, while Visual Studio Code was used for coding in HTML, PHP, MySQL, JavaScript, and CSS. During website development, performance and user experience on all devices were considered. Due to XAMPP control panel difficulties, development took longer than expected.

d. Testing

The testing step is crucial for ensuring the functioning and quality of the website. This stage thoroughly assesses every form, script, and link to ensure compliance with current web standards and optimal performance. Additionally, the website is tested with the target audience, as explained in the next section.

e. Maintenance

Website maintenance is essential for ensuring effectiveness and user satisfaction. This phase involves enhancing, modifying, and maintaining website functionality based on user feedback to ensure ongoing user contentment.

3. Results and Discussion

An evaluation survey assessed Lan Zhou Mee Tarik's online takeout system. The Google Form survey reached 45 UniKL BIMD students and restaurant employees. Separate questionnaires were provided to 38 customers and seven administrators, evaluating usability, effectiveness, operations, and back-end features. The survey aims to gauge the system's performance.



Figure 1: Difficulties During Placing Order

Figure 1 shows that all 38 participants successfully placed orders without difficulties, highlighting the efficiency of the online take-away system. The system's simplified ordering process notably reduces order time. The lack of reported issues underscores its effectiveness and user-friendliness, fulfilling customer needs and improving operational efficiency, ultimately enhancing the dining experience.

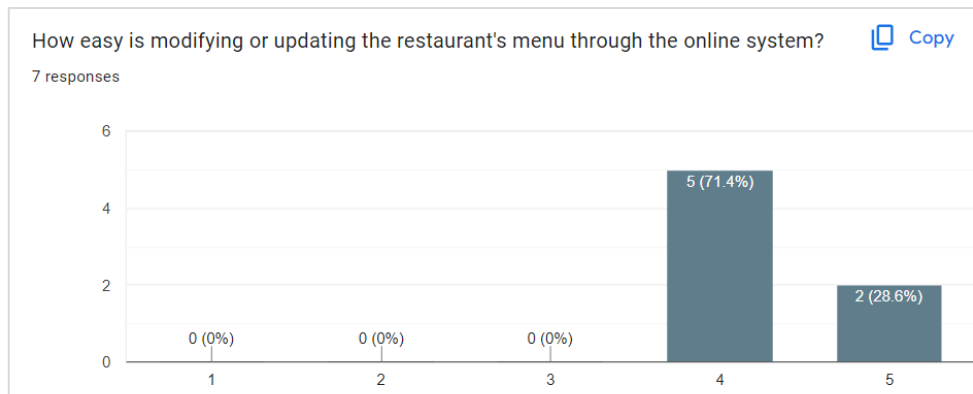


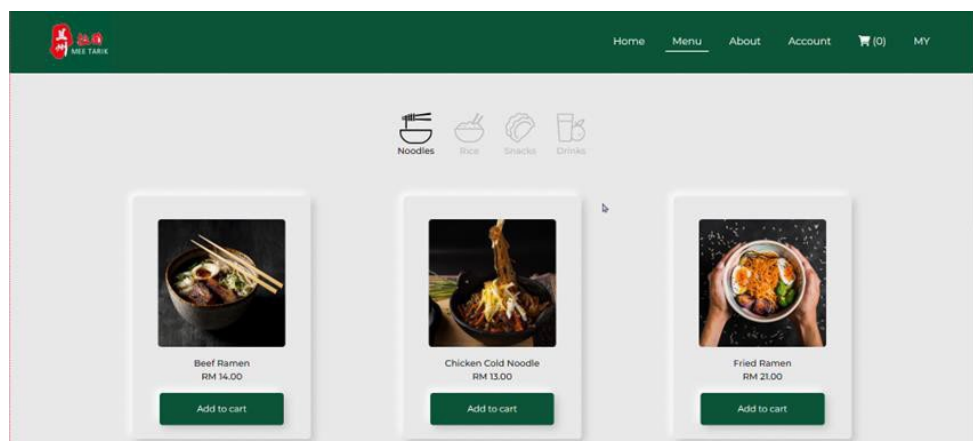
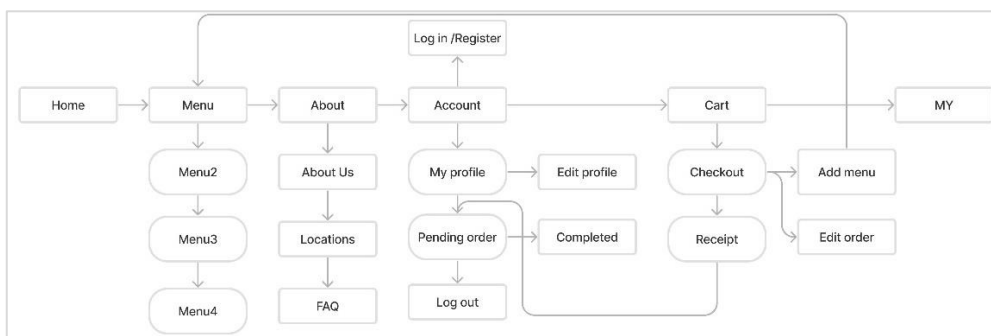
Figure 2: Ease of Modifying/Updating Restaurant Menu Using the System

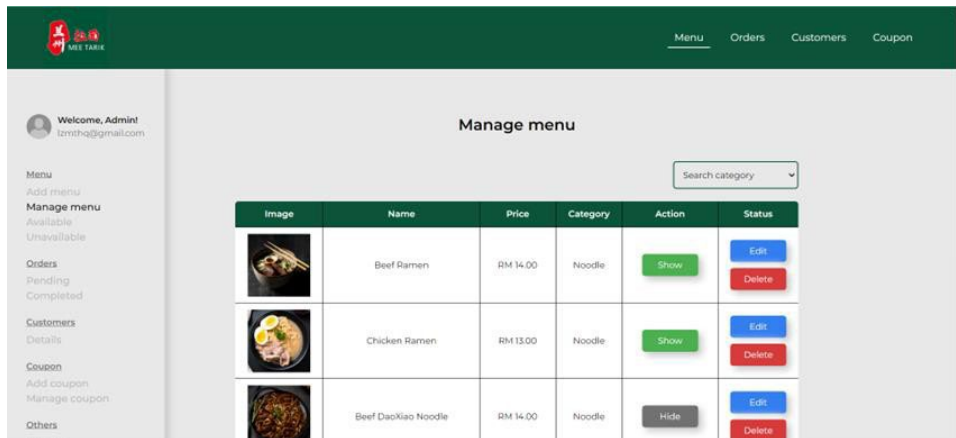
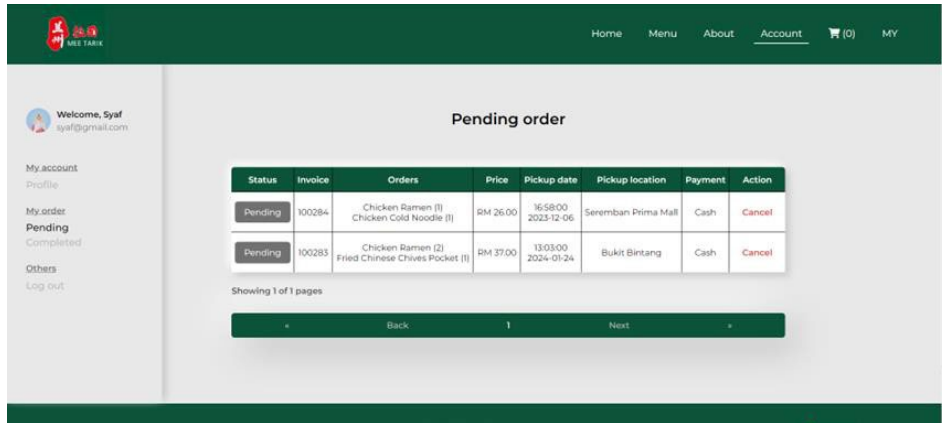
Figure 2 shows that 71.4% of administrators found the online take-away system easy to use, with 28.6% strongly agreeing. This indicates high satisfaction with the system's usability and effectiveness. Administrators' positive feedback underscores a significant level of contentment and trust in the system's functionalities, suggesting its potential to streamline processes and enhance restaurant operations.

4. Conclusion

Creating and testing the online take-away system following the Modified Waterfalls Model has yielded successful outcomes, meeting objectives with a user-friendly website across devices. Integrating a customer rating system is recommended for future enhancements. Feedback highlights the system's effectiveness in reducing order time and errors, emphasizing customer satisfaction. Despite challenges, the project succeeded in achieving its goals.

Appendix A





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A Decision Support System for Personalized Laptop Recommendations

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Abstract: A Decision Support System for Personalized Laptop Recommendations is designed to help people make informed decisions by providing detailed information and highlighting differences among different options. With the increasing educational level and demand for laptops, this system aims to address the issue of students who may not know how to choose the best laptop. The system's structure, useful functions, and construction are detailed. As an online system, the system provides benefits and convenience to users, with the administrator updating the information and content. This system is particularly useful for students who may be completely unaware of laptops.

Keywords: Student Tech Guidance, Online Decision Support System, Personalized Laptop Recommendations

1. Introduction

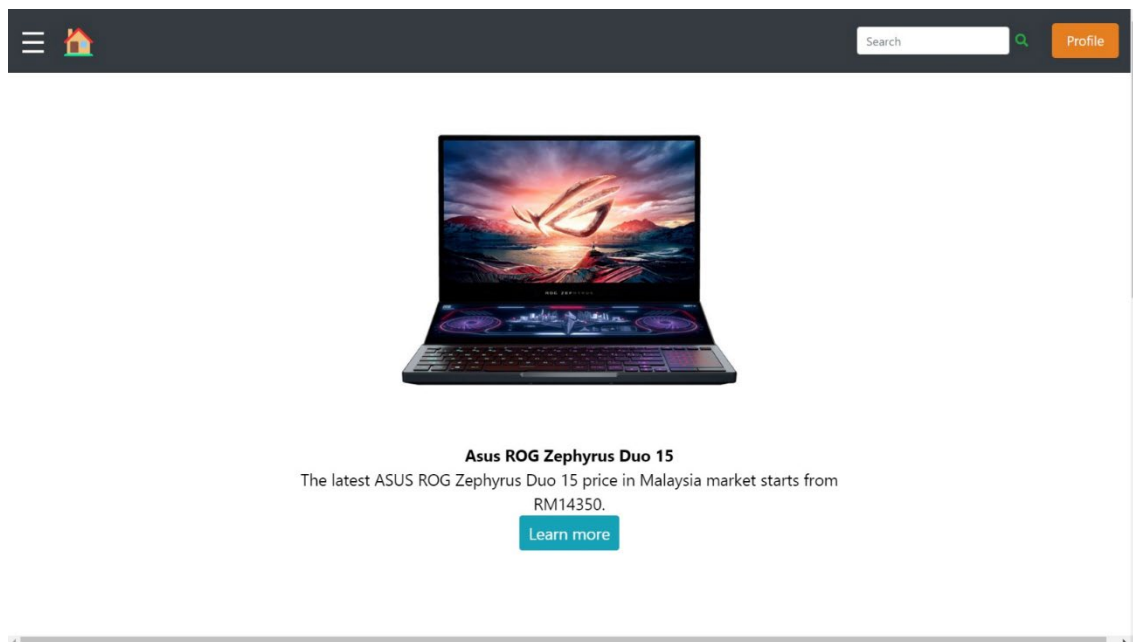
1.1 Objectives

A Decision Support System for Personalized Laptop Recommendations is designed to help people make informed decisions by providing detailed information and highlighting differences among different options. With the increasing educational level and demand for laptops, this system aims to address the issue of students who may not know how to choose the best laptop. The system's structure, useful functions, and construction are detailed. As an online system, the system provides benefits and convenience to users, with the administrator updating the information and content. This system is particularly useful for students who may be completely unaware of laptops.

The objectives are summarized as below:

- i. To help students find a laptop that matches their budget
- ii. To help students better understand the specifications of their computers and what they need
- iii. To enable students to use a user-friendly interface for beginners

Prototype / Research Screen Capture:



1.2 Scope

The Decision Support System (DSS) is a tool designed to help college students make informed decisions about their laptop needs, especially in today's competitive market. It offers a wide range of laptop models at different price points, allowing users to find options that meet their needs while staying within their financial constraints. This system is crucial for students seeking quality laptops without compromising functionality.

The DSS system aims to help students navigate the technical complexity of laptop specifications by analyzing their specific needs and performance expectations. It provides personalized recommendations based on objective criteria, ensuring laptops are optimized for their academic pursuits. This personalized approach simplifies the decision-making process, enhancing productivity and satisfaction for students.

Our DSS's user interface is crucial for a seamless experience, focusing on intuitive navigation and user input. It simplifies exploring laptop features, encourages deeper exploration, and encourages comparisons. Our system aims to enhance user convenience, fostering satisfaction and confidence in students using the right technological tools for academic endeavours.

In conclusion, the project aims to assist college students in selecting the perfect laptop for their academic journey, using a multifaceted approach including budget considerations, personalized specification analysis, and a user-friendly interface.

2. Material and Method

2.1 Material

The project materials included a strategic selection of resources critical to the development of the project. It discusses the SDLC methodology for system development and project management, focusing on the creation of a decision support system for recommended laptops. It uses models such as Waterfall, Spiral, Agile and RAD and emphasises the importance of documentation in the SDLC process.

2.2 Method

The project utilized the Rapid Application Development (RAD) methodology for its development process. This method offers faster delivery times, enhanced flexibility, and adaptability, making it suitable for stringent deadlines. Its iterative approach allows for frequent input, prompt modifications, and ongoing progress. RAD also promotes stakeholder involvement, ensuring their needs are taken into account throughout the development process. Four vital phases were fulfilled to apply the RAD methodology, ensuring a comprehensive and inclusive system.

3. Result and Discussion

This section of the report shows the outcomes of the project. This primary purpose is to test the Decision Support System for the Recommended Laptop to make sure that its features can be utilized as intended to fulfil the project's objectives and specifications.

3.1 Result

The project's results have considerably enhanced users' comprehension of laptop configurations, enabling them to select laptops that meet their requirements more effectively. Moreover, our designed web pages facilitated their ability to compare prices from various reputable sources.

Furthermore, we have designed our website to be user-friendly so that our users can easily understand how to use the web pages we have designed to find information about laptops. In addition to this, we have also designed a page for users to learn how to use our website, we have provided all the demonstrations or presentations, with photos and comments to make the user achieve a comfortable experience. This makes it easy for users to operate the site.

3.2 Discussion

The project has significantly improved users' understanding of laptop configurations, addressing technical ambiguity and enhancing confidence in choosing laptops. It has also streamlined the process of comparing prices across reputable sources, providing a comprehensive tool for informed decision-making. The user-centric design philosophy in the website has facilitated a seamless and intuitive experience, with detailed demonstrations, presentations, visuals, and explanatory comments. This holistic approach fosters long-term engagement and trust in the platform, making it a reliable and indispensable resource in laptop selection.

4. Conclusion

The results of the study show that the system we designed is very good at helping users find laptops that fit their budget, helping students better understand the specifications of computers and their needs and providing a user-friendly interface for beginners. The survey indicates room for improvement in the Decision Support System for Recommended Laptop, including providing more features commentary, creating a chat forum, and adding alternative online shopping websites. The system will add other online shopping websites such as Amazon, Harvey Norman, et cetera to advance the comparability among diverse choices.

Appendix A

Github link: <https://github.com/XiangYi23/smartlaptop>

Appendix B

Survey Google form: <https://forms.gle/zSsdHfXukshjFq6dA>

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Student Project Repository (SPR)

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Abstract: The project name Student Project Repository (SPR) is a website that used to let student to upload their FYP project, select FYP topic, history project upload, feedback system, and QR code system. This SPR is use to let student understand where student should upload project without waiting lecture to create and wait to submit. Also, easily to let student manage their time to read feedback from teacher, without download or share link just using QR code to open the project. The tools that used for this is CMS Wordpress, Jetengine and php code for modified plugin. WordPress use for frontend design, database, and edit user. Jetengine is a plugin that use to create a upload form and receive and send data to wordpress backend and database. PHP code is use to modified the existing plugin for extension. On data, can be view user personal data, project details, feedback and QR code link. This data can be view on WordPress database. In addition, for future word.

Keywords: Student Project Repository, SPR, upload project, project FYP Topic, upload project to get feedback and QR code system.

1. Introduction

The Final Year Project Topic Repository is an innovative online platform designed to assist students in their final year of undergraduate or postgraduate studies in finding suitable project topics. The repository serves as a comprehensive resource where students can explore a wide range of project ideas across various disciplines and gain inspiration for their own research endeavours.

1.1 Introduction subheadings optional

The system provides students with the capability to upload files or projects seamlessly. Students can log in using their student ID, and upon uploading a project, the system automatically generates a QR code for easy scanning without the need for a direct link. Students have the flexibility to delete or submit their projects based on minimum requirements set by the teacher.

1.2 Additional introduction subheadings

The repository aims to simplify the topic selection process by organizing topics, providing descriptions, and offering personalized recommendations based on students' field of study, interests, and preferences. The repository fosters collaboration and knowledge-sharing among students through features like discussion forums, enabling them to engage in conversations, seek advice, and share insights related to specific project topics. It also provides additional project resources such as research papers, articles, and relevant literature to support students in their project development process.

2. Materials and Methods

I will choose WordPress as my frontend and PHP as my backend. For WordPress as frontend because WordPress is a popular content management system (CMS) that offers a wide range of themes, templates, and plugins.

2.1 Materials

WordPress is based on PHP thus has an easy ability to integrate with any PHP backend system. Such an affinity allows the developers a chance to utilize the potency of PHP if they wish to make changes in certain plugins or reconfigure their functions to match with system characteristics. So on, plugin can be modified by using PHP code to make it further extension.

1. Jetengine as main feature of the function
2. Jetform Builder for create form to submit data
3. Jetengine custom post type for show data on backend
4. Smart filter for filter topic category
5. Jet Review for review the student feedback and receive reply form student
6. Jetengine Listing and dynamic field for post Progress history from data

2.2 Methods

Custom Post Types (CPT), Custom Fields, Dynamic Content, Front-end Submission Forms, Listing Grid, Relation Fields. This method is mainly using on this project to receive data and send data. Also, using code snippet to modified the plugin user email as PHP.

3. Results and Discussion

Student Project Repository offers a unified space where students can upload, describe, and present their final year projects. This has facilitated the sharing of ideas and insights among peers from various disciplines. Knowledge sharing. By enabling students to document their projects comprehensively, the repository promotes knowledge sharing. It allows future students to access previous projects, learn from their approaches, and build upon existing work. Visibility and recognition. Students' projects are now easily accessible, enhancing their visibility to professors, potential employers, and other interested parties. This exposure can lead to recognition for innovative and impactful projects. Technological proficiency. The project has enhanced students' proficiency in WordPress, web development, and content management systems, skills that are valuable in the modern digital landscape. Feedback and improvement. The repository allows for feedback from peers and professors, enabling students to improve their projects based on constructive criticism and suggestions.

3.1 Results

The result 1 of the function show the form and with simple detail insert, select file, and other.

Result 1: Project Upload

F|Y
STUDENT PROJECT REPOSITORY

HOME PROJECT UPLOAD PROGRESS HISTORY SUBJECT TOPIC ACCOUNT

PROJECT UPLOAD

STUDENT NAME*
Please Fill in

STUDENT ID*
Please Fill in

STUDENT BATCH*
Please Fill in

STUDENT EMAIL*
Please Fill in

PROJECT CATEGORY*
Please Fill in

PRIVATE OR PUBLIC*
Please Fill in

PROJECT SUBMIT*

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Swakarya-Digital: Wedding Photography Booking System

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Abstract: Swakarya is a web-based wedding photography booking system designed to streamline the booking process. The objective of this system is to create an efficient system with some crucial functionalities like booking, payment and uploading features. It allows users to make bookings anytime and anywhere, with the provided functionalities. The system includes essential functionalities like a home page, list of packages provided, user profile, booking, payment, gallery, feedback, and about us page. Users must log in before making bookings. The system displays wedding packages and services offered, along with date and time availability. Different interfaces cater to wedding couples, Swakarya staff, and the system administrator. In addition, the current booking system relies on social media platforms and manual tracking processes through Google Excel spreadsheets. This setup presents challenges for both the admin and the client. Therefore, the system addresses problems including ineffective manual booking, inefficient social media bookings, and poor date availability recognition. The problems are effectively resolved by automating the booking process for the user and offering improved management tools for the admin to manage the booking and album. The system is being developed using the waterfall model, which comprises six distinct phases, including requirements, design, implementation, testing, and maintenance. PHP, HTML, JavaScript, CSS, Bootstrap, and a MySQL database were used to develop the system. The development tools used for this project include XAMPP, Visual Studio Code, and MySQL. Thus, having a web-based system can promote a better enhancement of the business and increase the user's positive interaction with the company.

Keywords: web-based system, booking, wedding photography, photography

1. Introduction

Photography is the art of capturing and processing light using a camera to create meaningful images [1]. A picture can convey a profound meaning and tell a thousand different narratives. In fact,

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photography tends to offer itself to various interpretations, particularly in contemporary art and photography [2]. It requires considerable effort from photographers who handle both physical and digital development and editing of photos. Wedding photography is a popular service in the industry, as it captures the most important day in a couple's life and holds significant responsibility. Professional wedding photographers are tasked with capturing artistic, spontaneous, and beautiful moments during the ceremony, reception, and outdoor photoshoots. Effective communication with clients is crucial, and prior arrangements or bookings are highly beneficial to ensure a smooth and enjoyable wedding day for the couple [3].

1.1 Problem Statement

The problem statement identified in this project includes are incapability of social media platforms to assure a successful booking, inefficient manual booking and ineffective identification of date availability.

1.2 Project Objectives

Specifically, the objectives of this research study are to analyze the existing web-based systems for wedding photography as well as other similar systems on the market that include a booking feature. The second objective is to design the Swakarya booking system by implementing both booking and uploading features. Lastly, to develop a Swakarya booking system for the use of the user and company and validate the fully functional system by performing system and user acceptance tests.

1.3 Significance of Project

The significance of this project is its potential to revolutionize Swakarya Studio's operations. Implementing a web-based booking system can greatly benefit Swakarya Studio. It offers increased convenience for clients, streamlines the booking process, enhances data management, and fosters customer satisfaction. Furthermore, the inclusion of secure online payment options would expedite transactions and instil trust and confidence in clients, fostering positive experiences and long-term relationships. Overall, the significance of this project lies in its potential to transform Swakarya Studio's operations, drive growth, and elevate the overall customer experience.

2. Materials and Methods

The waterfall model, introduced by Winston Royce in 1970, is a project management methodology consisting of six phases: requirements, design, implementation, testing, and maintenance. It provides a sequential and structured approach, making it easy to track project progress and manage timelines and costs [4].

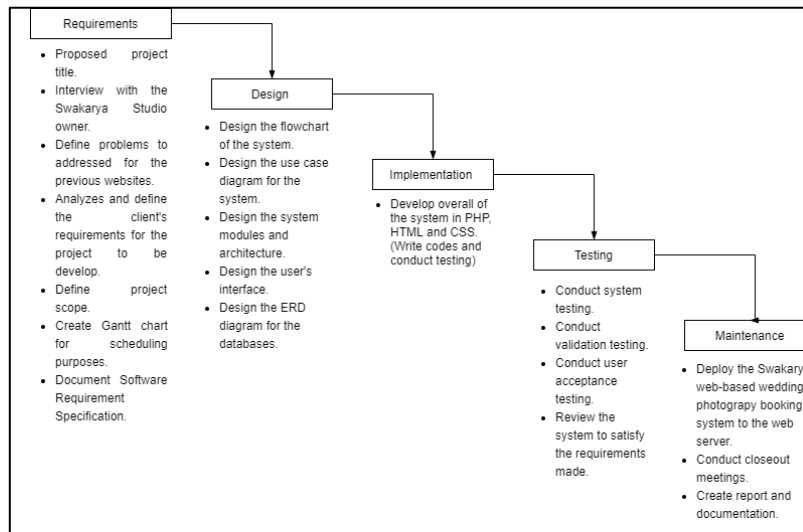


Figure 1: Waterfall Model

In this project, the waterfall model has been chosen to apply as it is easy to be well-informed of the project development progress. Furthermore, the waterfall model enforces discipline and ensures that each phase is completed before moving on to the next. It is well-suited for projects of varying complexity and aligns with the fixed timelines and structured nature of final-year projects.

2.1 Requirement Phase

During the requirement phase, the project defines and analyzes project requirements. This involves evaluating the project title, interviewing domain experts, and meeting with stakeholders. Similar systems are also analyzed to determine software requirements. Documentation includes project scope, description, functional/non-functional requirements, planning, hardware/software requirements, and budget. The final output is the Software Requirement Specification (SRS) document, which undergoes review for subsequent phases.

2.2 Design Phase

In the design phase, the objective is to convert SRS requirements for implementation. It involves defining the software architecture, both high-level and detailed, to ensure proper system development. This phase includes a flowchart use case diagram, system architecture, user interface, and database design (ER diagram and data model). Designing the use case diagram is crucial as it provides clarity on project goals, predicts system rules, and errors, and maintains a list of goals to achieve.

2.3 Implementation Phase

The implementation phase uses logical design to build the software product. It involves developing, coding, and testing. Front-end development utilizes HTML and CSS, while back-end development utilizes PHP and JavaScript. The system is divided into small modules, which are then integrated to create the complete system. Proper integration ensures the correct flow of the system.

2.4 Testing Phase

In the testing phase, various types of testing are performed: unit, integration, system, user acceptance, and validation testing. Unit testing assesses individual module efficiency and verifies code correctness. Integration testing identifies defects in module interactions, ensures proper system flow, and verifies system behaviour. System testing reduces risk by ensuring compliance with functional and non-functional requirements. It is crucial to eliminate bugs during system testing before proceeding to

user acceptance and validation testing. User acceptance and validation testing validate the system against user requirements and client satisfaction.

2.5 Deployment Phase

Once testing phases are completed, the system is deployed to a web server suitable for potential users. The maintenance phase follows deployment, where any changes and enhancements are determined. This phase aims to improve the system over time, ensuring its user-friendliness.

3. System Interface

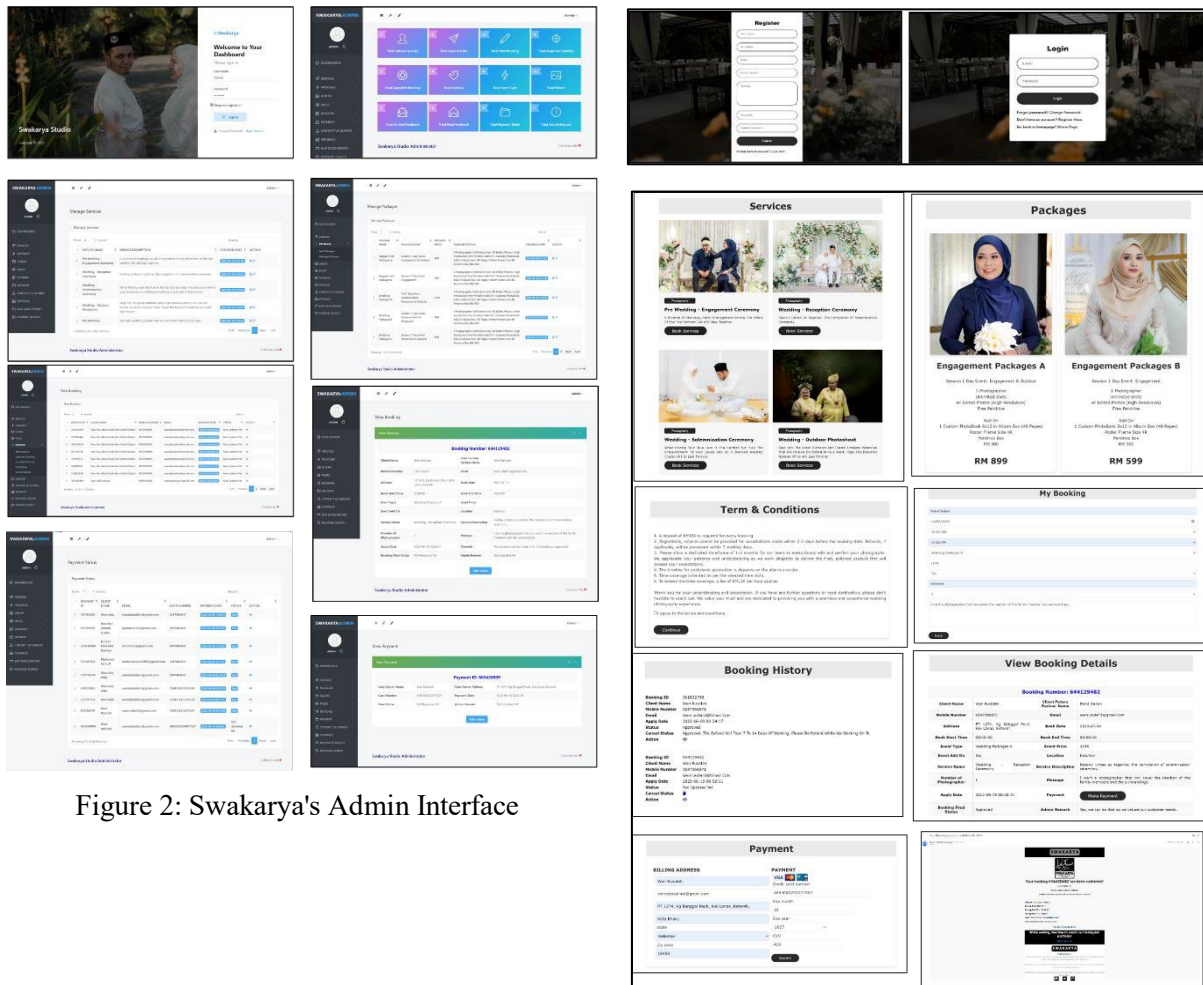


Figure 2: Swakarya's Admin Interface

Figure 3: Swakarya's Client Interface

Based on Figures 2 and 3, the system interface for both admins and users exhibits an efficient and clean design, facilitating an effective booking process. The user interface is designed to provide a seamless experience, allowing users to easily navigate through the system and make bookings effortlessly. Similarly, the admin interface offers a user-friendly platform for managing bookings and ensuring smooth operations. Both interfaces prioritize efficiency and a streamlined user experience to enhance the booking process for both users and admins.

4. Results and Discussion

User Acceptance Testing (UAT) ensures the alignment between system functionalities and user requirements. It gathers input from actual users and tests software capabilities before deployment,

enhancing robustness and usability. UAT assesses functionality, usability, and performance, collecting valuable user feedback to resolve flaws [5]. In this project, UAT involved 17 respondents and analyzed affirmative responses across areas like usability, efficiency, and accuracy. This approach identifies strengths and areas for improvement, creating a user-centric product.

4.1 Questionnaire

A UAT questionnaire was created using Google Forms and shared on social media. Users gave feedback in three sections: Swakarya admins, clients, and overall. A Likert scale of 1-5 was used to measure agreement/disagreement. This approach provided a thorough analysis of user opinions on system performance and satisfaction.

4.2 Respondents' Results and Summary

The results by the respondents have been collected and calculated to get the percentage for each of the quality attributes which includes usability, efficiency, and accuracy.

The calculation is calculated by dividing the question on each section for each quality attribute. To calculate the quality attribute:

$$\frac{\sum QA}{\sum E}$$

where QA = Total Percentage of Quality Attributes, E = Total Element

Table 1: Respondent Results

Quality Attribute	Total Results(%)
Usability	97.1
Efficiency	97.1
Accuracy	100

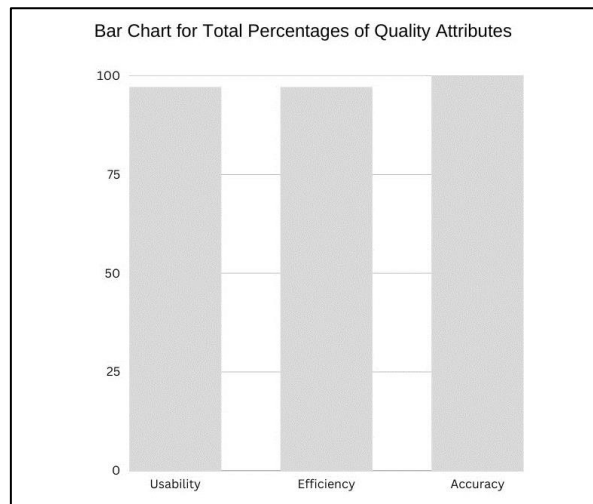


Figure 4: Bar Chart of Total Percentage

The analysis of the questionnaire and corresponding bar chart confirms the system's high user acceptance. Accuracy achieved a perfect score of 100%, highlighting its reliability. Usability and efficiency both scored an impressive 97.1%, indicating easy navigation and streamlined operations. These results demonstrate the system's strength in delivering precise outcomes, providing a positive user experience, and enabling efficient task execution.

5. Conclusion

The chapter evaluates the Swakarya system, proposes future enhancements and addresses limitations. Recommendations are provided for improving system capabilities.

5.1 System Limitations

The system limitations for Swakarya-Digital are the system requires a stable internet dependency whereas the web-based system needs stable and good internet connectivity to be used without any interruption. In addition, the system lacks online banking options for payment integration. Thus, the system is not fully functional to process a real-time online banking transaction.

5.2 Future Recommendations

Future recommendations for Swakarya-Digital: Wedding Photography Booking System includes are to improve the system's scalability, the system can develop a mobile application version of the Swakarya booking system. This allows the user to access and utilize the system conveniently on their smartphones. Furthermore, the system can also be further enhanced by incorporating automated scheduling for the photographers. This would streamline the process of matching the photographer's availability with the client's requested date and reduce the manual effort for the photographer.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

U-Marked : Student Attendance Application

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Abstract: Attendance tracking is an important aspect of monitoring student overall performance and accountability at academic institutions. The traditional paper-based method for recording student attendance is time-consuming and lacks real-time data analysis capabilities, which will significantly hinder the efficiency of educational institutions and limit their ability to make precision data-driven decisions. The objective is to provide a mobile application that utilizes geolocation services to enhance attendance accuracy. This application will allow lecturers to efficiently record attendance, generate hard copies of attendance records, and permit students to mark their own attendance or request a leave for the day. In the literature review, there are multiple types of student attendance software on the market, such as a fingerprint scanner to capture attendance, a wireless walk-in RFID reader, and a facial recognition system. This hardware might improve the accuracy of capturing attendance, but the cost will increase significantly. In comparison to existing systems, many attendance solutions require additional hardware and biometric data for improved security and accuracy. However, this is not mandatory for all institutions, as the application can also function using just a smartphone. Despite the different approaches, the common objective is to automate attendance recording and provide accurate, real-time data for analysis and decision-making. In summary, the transition from traditional paper-based attendance tracking to a mobile application utilizing biometric and geolocation technologies represents a significant advancement in educational efficiency and accountability. While various hardware options exist to enhance accuracy, they may come with a substantial cost. The system offers flexibility by allowing institutions to operate solely with smartphones if desired. Ultimately, the overarching goal remains consistent: the automation of attendance recording to provide precise, real-time data for informed decision-making.

Keywords: U-Marked, student attendance, geolocation, biometric, mobile application

1. Introduction

Attendance tracking is an important aspect of monitoring student overall performance and accountability at academic institutions. The traditional paper-based method for recording student attendance is time-consuming and lacks real-time data analysis capabilities, which will significantly hinder the efficiency of educational institutions and limit their ability to make precision data-driven decisions.

Jonathan Sandling, head of academic studies at a leading university in the United Kingdom, states, “There is a positive correlation between student attendance and performance. Higher levels of attendance are directly linked to a higher likelihood of a student successfully completing their program of study and achieving higher grades.” (The importance of student attendance tracking software, 2023).

Furthermore, newly advanced technologies such as biometric authentication and GPS (Global Positioning System) have expanded the capabilities of student attendance apps. Fingerprint and facial recognition offer a high level of security and accuracy for taking attendance. A GPS-based system allows for geolocation-based attendance verification on and off campus.

1.1 Objectives

The objectives of this project are as follows:

- Provide a mobile application that assists admins in managing different modules of the mobile application.
- Provide a mobile application that can let the lecturer collect attendance from the student.
- Provide a mobile application that can let the student take attendance for the class session.

1.2 Scope

The system is an attendance mobile application for admin, lecturer and student and consist of the following features:

- Admin panel
 - An admin panel to assist the admin in managing different types of modules, for example, class management, subject management, location management, and user management.
- Class module
 - Allow the lecturers and students to join the class to view their attendance records.
- Attendance module
 - Allow the lecturers to collect attendance from student.
 - When capturing attendance, the student needs to use biometric authentication, such as a fingerprint or facial recognition, to record their own attendance.
 - The attendance module will use geolocation to track the student's location to identify whether the student is on campus or not.
- Side module
 - Post & Comment: It allows the lecturers and students to post and comment inside the class module.
 - Chatroom: It allows the user to communicate with the lecturer or classmate.

2. Materials and Methods

This section will explain the methodology that employ in this project to help streamline the software development process and the software and hardware for this project to be developed.

2.1 Materials

- Software:
 - Integrated Development Environment (IDE):
 - Android Studio
 - Visual Studio Code
- Programming Languages:
 - Flutter
- Version Control:
 - Git (for source code management and collaboration)
- Backend Development:
 - Databases (MySQL, Firebase)
 - APIs and Web Services:
 - Firebase, Google Cloud Platform (for cloud-based services)
- Design Tools:
 - Adobe XD, Sketch, Figma, Canva (for UI/UX design and prototyping)
- Testing and Debugging:
 - Emulators/Simulators
- Analytics and Crash Reporting:
 - Firebase Analytics, Google Analytics
- Project Management and Collaboration:
 - Microsoft Teams

2.2 Methods

The methodology that is employed in this project is an iterative development process. The iterative process was chosen because it starts with the simple implementation of a small set of requirements and evolves into a complete system. It allows the system to be developed with basic functionality first, then slowly implement more functionality until it is complete. (SDLC - Iterative Model, n.d.)

3. Results and Discussion

3.1 Results

Based on the methodology that this project employ, the following table below represent the timeline of the project development process.

Table 1: Chronological project development timeline

No	Task Name	Start	Finish	Duration	Year 2023														
					October		November				December				January				
						W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	Correcting FPY 1 report	12/10/2023	19/10/2023	1 week															
2	User Auth module development	20/10/2023	26/10/2023	1 week															
3	Class module development	27/10/2023	2/11/2023	1 week															
4	Attendance module development	3/11/2023	16/11/2023	2 weeks															
5	Chatroom module development	17/11/2023	23/11/2023	1 week															
6	Quick-Attendance development	24/11/2023	30/11/2023	1 week															
7	Q&A module development	1/12/2023	7/12/2023	1 week															
8	Testing activities and video recoding	8/12/2023	10/12/2023	2 days															
9	Completing report chapter 6,7,8	11/12/2023	22/12/2023	1 day															
10	Correction and improvement	23/12/2023	29/12/2023	1 day															

3.2 Discussions

Each development week has a discussion session with the supervisor to review progress, address any challenges encountered, and collaboratively strategize on solutions. These sessions serve as a valuable opportunity for the student to seek guidance, clarify doubts, and receive constructive feedback, fostering a dynamic and supportive learning environment.

4. Conclusion

With the help of this mobile application for student attendance, lecturers and students may take attendance in a much more convenient manner. The application streamlines administrative tasks for lecturers and provides students with a seamless experience, encouraging a more efficient and contemporary approach to attendance management. Admin panels are all-inclusive tools that let administrators effectively manage different modules. These modules' incorporation into the admin panels gives administrators strengthened control and simplified management, which enhances the overall efficacy and simplicity of administration in the learning environment.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

AI-Powered UNIKL Information Directory Chatbot Using Azure Cognitive Service

Amir Aiman Muhammad Sukri¹, Roziyani Rawi², Sri Banu Munisamy³, Shahidatul Arfah Baharudin⁴, Nur Farahwahida Ab Aziz^{5*}

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Abstract: This project focuses on creating and deploying an innovative Information Chat Bot utilizing Microsoft Azure Cognitive Services. This project is aimed to develop a mobile application that has a chatbot which provides information about the lecturers and facilities of UniKL MIIT and to monitor the performance of the chatbot using cloud monitoring tools. By leveraging Natural Language Processing (NLP) and Cloud Computing, particularly within the Microsoft Azure framework, the study explores the potential of chatbots to enhance user experiences and streamline information access. Through an exhaustive literature review and practical application, the study highlights the significance of chatbot technology while offering valuable insights and recommendations for future research and implementation across various fields. The results of this project are chatbot will provide information to the user by mobile application that created with FlutterFlow and Microsoft Azure framework. This project develops as a foundational contribution to the advancement of chatbot technology and its influence on user engagement and information dissemination.

Keywords: chatbot, Microsoft Azure Cognitive Service, UniKL MIIT, Natural Language Processing, Cloud Computing, Microsoft Azure Framework, FlutterFlow.

1. Introduction

In an era when information is of utmost importance, seamless acquisition, and effective distribution of it are essential foundations for academic institutions globally. The diverse characteristics of data, including various forms such as text and audio-visual formats, need a systematic strategy to guarantee lucidity and comprehension for the end-user. However, the present abundance of information brings a major problem - the propagation of disinformation, a process accentuated by the prominence of social media over conventional news channels [1]. Artificial intelligence has become a crucial instrument for delivering information in response to the ever-changing communication environment. The use of chatbots in customer service, as shown by Gartner's forecast that more than 37.5% of customer service and support industries would employ chatbots by 2023 [2], highlights a significant change in how information requirements are addressed. This publication examines the convergence of information, technology, and academic assistance via a

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comprehensive initiative designed to tackle the difficulties encountered by UniKL MIIT students.

The main problems of delayed answers, inadequate information, and system unreliability are analysed, resulting in the establishment of goals to create a chatbot application using Microsoft Azure Cognitive Services. By narrowing its testing ground to the Computer Engineering Technology sector, the initiative aims to give thorough information regarding professors and facilities. The anticipated outcomes include developing a mobile application that is easy to use and utilises Azure services to effortlessly get information. Nevertheless, the drawbacks, such as possible expenses linked to higher user sessions and the labour-intensive process of data gathering, highlight the intricacies involved in constructing and maintaining such groundbreaking systems. This publication aims to contribute to the ongoing development of information accessibility and technology integration in educational institutions as we begin this academic journey.

2. Literature Review

2.1 Mental Healthcare Chatbot

This author created a chatbot system tailored to offer support for mental health, aiming to provide users with a confidential and accessible avenue for guidance and assistance with their mental well-being. Employing techniques in natural language processing and machine learning, the chatbot engages with users in a compassionate manner, evaluating their mental health condition and delivering suitable responses. It offers strategies for coping, exercises for mindfulness, and connections to professional aid when necessary, fostering an environment that is nonjudgmental and discreet [3]. Although the specifics of the platform are not explicitly mentioned, it is likely accessible through web and mobile applications, thereby enhancing its accessibility. The software requirements of the system are anticipated to involve languages such as Python or JavaScript, coupled with frameworks for natural language processing and machine learning like TensorFlow or NLTK, potentially integrating with databases for the retrieval of resources.

2.2 Chatbot for College Website Using Python

This author presented a Python-based chatbot system specifically tailored for a college website, offering information on various aspects like activities, courses, faculty details, and admission procedures. The chatbot aims to enhance user engagement by providing timely and accurate responses to inquiries, including commonly asked questions and personalized solutions. Employing natural language processing methods and machine learning algorithms, the system understands user queries, assesses context and intent, and delivers relevant information using rule-based techniques and machine learning models. The chatbot, designed as a web-based platform, can seamlessly integrate with the college website, accessible via a web interface across multiple devices and platforms. It utilizes Python tools like NLTK for natural language processing tasks and Flask for web interface development, ensuring proper response to user inquiries and an engaging experience on the college website [4].

2.3 Development of a Chatbot for Informing Student of the Schedule.

This author discusses the development of a chatbot system aimed at informing students about their timetables, including class schedules, test dates, and other important events. Utilizing natural language processing and machine learning techniques, the chatbot

interprets student inquiries, retrieves relevant scheduling information from a database, and provides rapid and accurate responses, thereby streamlining the process of accessing schedule details for both students and administrative staff. Accessible via a web-based platform, the chatbot features a user-friendly interface for students to easily interact with and obtain timetable information. The system may utilize technologies like web APIs and webhooks to interface with existing platforms or databases for data retrieval [5]. While specific software requirements are not detailed, it is anticipated that the implementation involves programming languages such as Python or JavaScript, alongside related libraries and frameworks for natural language processing and web development.

2.4 AI and Web-Based Human-Like Interactive University Chatbot (UNIBOT)

UNIBOT, an AI-powered chatbot tailored for university-related inquiries which offers a broad array of functions, catering to admissions queries, course details, event information, and personalized responses based on individual user preferences. Leveraging natural language processing, machine learning, and sentiment analysis techniques, UNIBOT effectively addresses user inquiries by analyzing input to discern context and intent, employing rule-based methods and machine learning algorithms to generate relevant responses [6]. Moreover, UNIBOT's incorporation of sentiment analysis enables it to recognize and respond to user emotions, enhancing the conversational experience. Functioning as a web-based platform seamlessly integrated into the university's website, UNIBOT ensures accessibility across various devices and operating systems, providing a user-friendly interface for students, prospective candidates, and other website visitors to engage with. Python and JavaScript are key programming languages utilized for UNIBOT's development, with Python facilitating the implementation of NLP and ML techniques, and JavaScript enabling the creation of the web-based interface. Additionally, UNIBOT relies on libraries such as TensorFlow, Keras, and Flask to enhance its AI capabilities and ensure smooth web functionality, resulting in an efficient user experience.

2.5 Automating Student Management System Using Chatbot and RPA Technology

The authors introduce a system integrating chatbot and Robotic Process Automation (RPA) technologies to automate student management tasks, including enrolment, attendance monitoring, fee collection, and academic result generation. By combining these technologies, the system aims to enhance efficiency in administrative procedures related to student management. The chatbot serves as the interface for users, facilitating communication and performing various student management functions such as responding to inquiries, providing information, and guiding users through procedures. RPA technology automates repetitive backend operations like data input, form submission, and report preparation, reducing errors and saving time [7]. While the platform specifics are unspecified, it is likely a web-based system with the chatbot accessible via a website or separate application. Programming languages such as Python or JavaScript are necessary for system implementation, along with natural language processing and RPA tools like UiPath or Automation Anywhere. Integration with existing databases or student management systems may also be required for efficient access and updating of student information.

2.6 Artificial Intelligence Chatbot System for Student Inquiries in the LKC_FES Website

The author builds this project to aims a chatbot powered by AI to assist students with their queries on the LKC_FES website. By employing natural language processing and

machine learning algorithms, the chatbot system is designed to understand and respond to student inquiries in a conversational manner, providing timely and accurate information to enhance the user experience and reduce the workload of human staff members. The study focuses on the design and implementation of the chatbot system, which includes integrating a knowledge base, user interface, and conversational logic, showing promising results in appropriately addressing student queries and serving as an effective tool for managing a high volume of inquiries on the website [8]. Overall, the report underscores the potential benefits of AI chatbot systems in educational settings, particularly for student support services, by improving information dissemination efficiency and enhancing user experience through real-time responses to student requests. As AI technology continues to advance, such chatbot systems have the potential to become indispensable resources in educational institutions, offering improved interaction and assistance for students.

3. Methodology

This project adopted the Agile methodology for its one-year development, equivalent to two semesters within the study timeframe. Agile facilitates rapid and flexible development through iterative cycles known as sprints, enabling continuous incorporation of user feedback, enhancement of application features, and improvement of user experience. The Agile process implemented in this project includes phases such as Planning, Design, Development, Testing, Deployment, and Review, as illustrated in Fig 1, ensuring efficient project management and iterative progress towards project goals.



Fig 1. An overview of Agile Methodology that implemented in this project.

3.1 Planning Phase

During this phase, the research team conducts a thorough examination of related projects to establish project objectives, scope, and the problem statement. They critically analyze various software and frameworks by reviewing publications such as books, journal articles, reports, and research papers for comparison. Additionally, the team creates and implements a Work Breakdown Structure (WBS) along with a Gantt Chart to streamline the project timeline and facilitate smooth monitoring of project progress. This helps in effectively controlling project costs, whether in terms of time, hardware, or software

resources.

3.2 Design Phase

3.2.1 Network Diagram

The project anticipates operating in three distinct environments: the Cloud Environment, UniKL MIIT Environment, and Outdoor/Home Environment. In the Cloud Environment, Microsoft Azure Framework components, including Azure Cognitive Services, Azure Search, Azure Bot Service, and Azure Storage, will be utilized to enable the integration of mobile applications developed in Dart Language through WebView Function. These services will operate in the cloud to facilitate the functionality of the chatbot application.

In the UniKL MIIT Environment, users will access the chatbot via the internet using the campus network structure. Access to the chatbot will be enabled within the campus network, with traffic passing through access points, switches, routers, and servers present within the campus network infrastructure.

In the Outdoor/Home Environment, users will access the chatbot through their mobile applications connecting to either home Wi-Fi or cellular networks. This environment allows users the flexibility to interact with the chatbot from various locations outside the campus network, ensuring accessibility and convenience for users regardless of their location. Fig 2 shows the network diagram overview of this project.

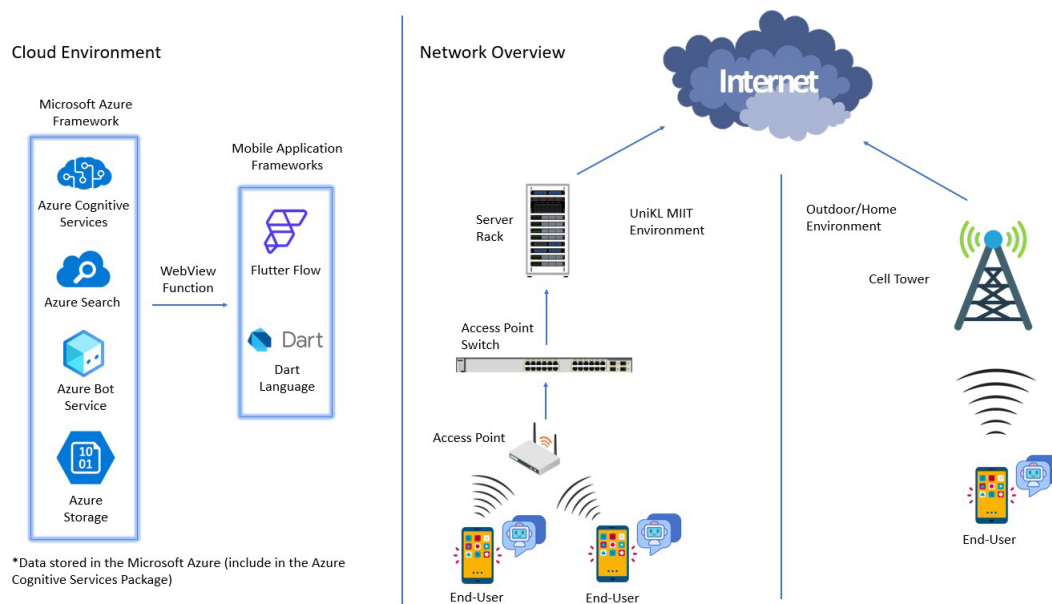


Fig 2. An Overview on Network Diagram of the Project. System Integration

Fig 3 illustrates the process of system integration within the application, enabling the chatbot to retrieve information from the Microsoft Azure Framework and transmit it to the application. It outlines the movement of data between the cloud environment and the application, along with potential scenarios if the data transfer fails to progress to the next steps.

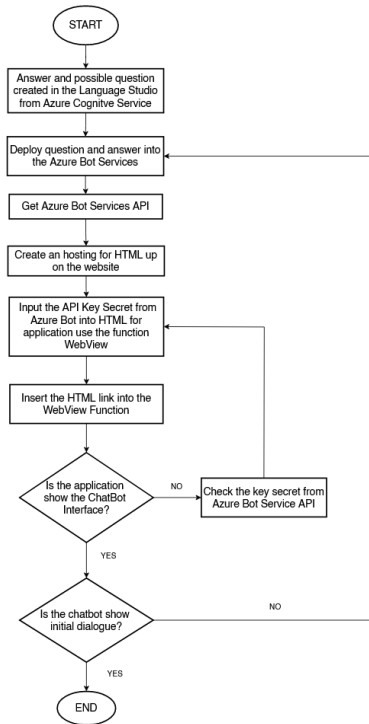


Fig 3. System Integration Flowchart

3.3 Development Phase

In this phase, the selected design and model are prepared for insertion into the chatbot application, which involves creating a secret key for integration and embedding it into HTML and CSS code for designing the chatbot interface. Once the interface design is finalized, it is stored in Azure Storage for hosting a static website, and the domain name of the static website is linked with the application using the WebView Function. Additionally, the cloud services within the Azure Framework, such as Azure Cognitive Service, Azure Search, Azure Bot Service, and Azure Storage, are integrated with the chatbot application, allowing the Azure Bot Service to track bot deployment and user interaction statistics. Upon completion of integration, the mobile interface design progresses, with UI development utilizing a drag- and-drop method alongside framework development.

As in Fig 4, the figure shows an overview of this project system works and in Figure 3.6 are what are the component that inside of Microsoft Azure which under in one resource group that include the Microsoft Azure Language Studio, Microsoft Azure Search, Microsoft Azure Bot Service and Microsoft Azure Storage.

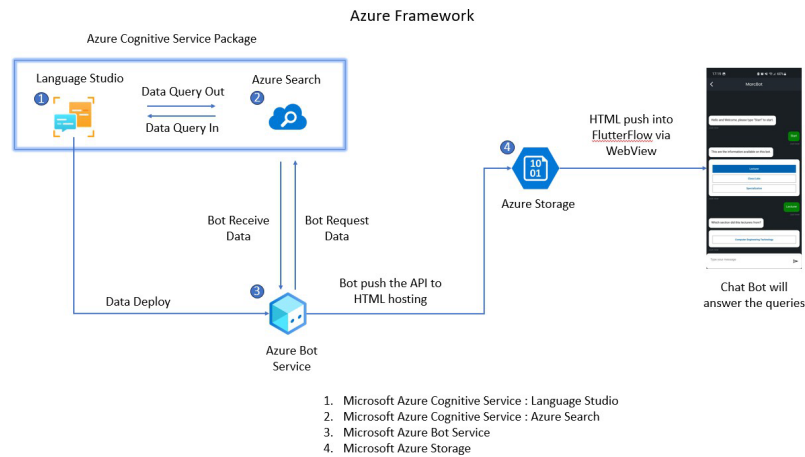


Fig 4. Azure Framework that linked with Azure Resource Group.

3.4 Test Phase

During the testing phase, the application undergoes a pilot test to assess its readiness before deployment. This phase involves evaluating the chatbot's accuracy in providing answers, testing response times, and analyzing the application's ability to handle traffic stress. All test results are compiled into a report to ensure compliance with Azure Bot Service standards. Additionally, integration testing between applications and the chatbot is conducted during this phase. Any identified problems or bugs are addressed through adjustments and troubleshooting of the framework. For instance, Fig 5 illustrates a bug where the keyboard fails to automatically disappear when navigating to another page.

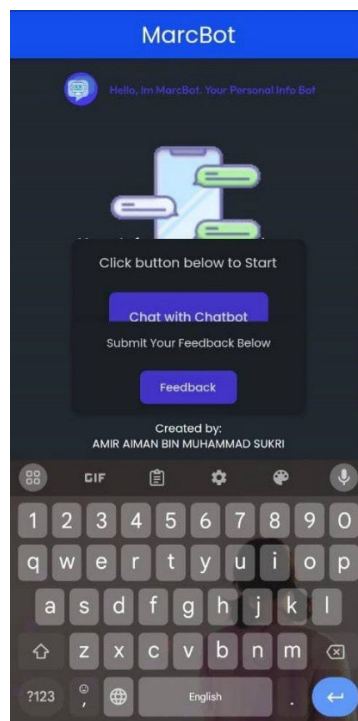


Fig 5. One of the bugs when creating the mobile application.

3.5 Deploy Phase

During this phase, the application is deployed via an APK, allowing users to install it on their Android devices by scanning a QR code. Once installed, users are directed to the Welcoming Page, followed by the Home Page where they can choose to start a conversation with the chatbot or provide feedback. The application primarily functions to provide information about lecturers and facilities at UniKL MIIT. Additionally, this phase assesses the network and integration performance of the chatbot application, particularly under high inquiry volumes, to identify any potential performance issues. Fig 6 displays the QR code linking to the APK installation for user convenience.



Fig 6. The QR Code is used to download the APK of the application.

3.6 Review Phase

In the final phase, documentation is conducted to evaluate the performance of both the cloud framework and chatbot applications. The performance of the cloud framework is monitored using Microsoft Azure Monitor, while end-user experience feedback is gathered through review forms created with Microsoft Form using a UAT Model. This phase is crucial as it ensures that all project objectives are achieved and addresses any remaining issues related to information retrieval. Recommendations and improvements are then proposed for enhancing either the application or the framework to ensure continued user satisfaction and usage.

4. Results And Discussion

4.1 Mobile Applications Pages

Fig 7 depicts the onboarding page, serving as the welcoming interface when users open the app, enhancing user experience. Fig 8 displays the main page of the mobile application, functioning as the primary menu for the chatbot application. It includes buttons for accessing the chatbot conversation page and providing feedback. Fig 9 illustrates the chat page where conversations between the chatbot and users occur. The chatbot initiates messages and directs users to the information it can provide, allowing users to type their queries or select from provided prompts.

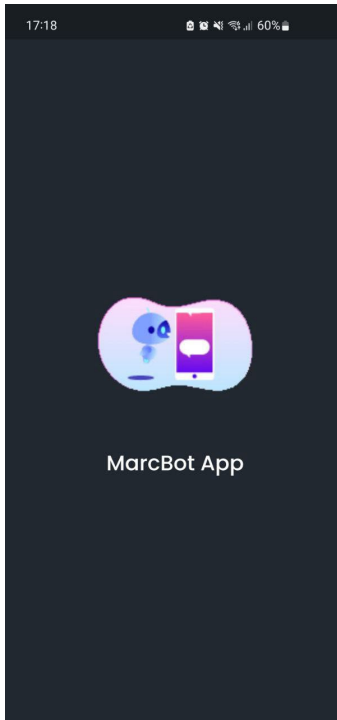


Fig 7. Results of Welcoming Page.

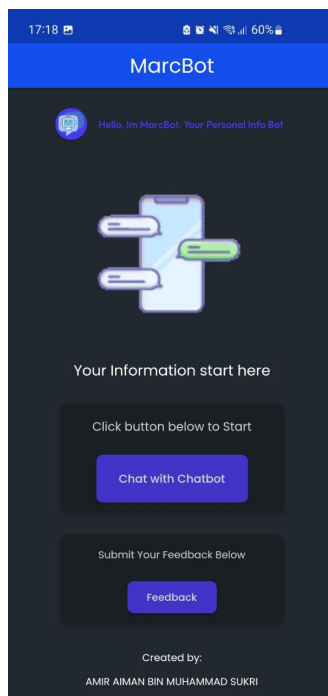


Fig 8. Results of Home Page

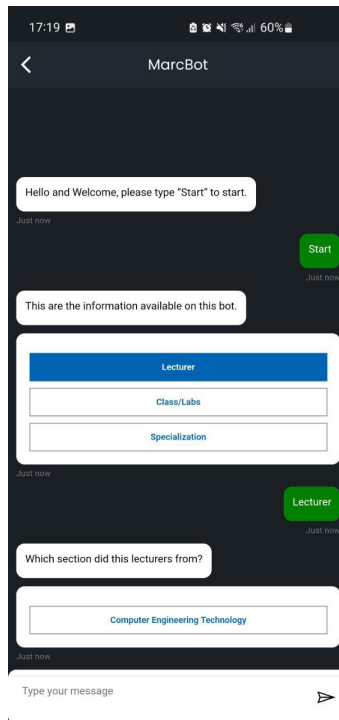


Fig 9. Result of Chat Page

4.2 Microsoft Azure Monitor Results

Table 4.2 provides an overview of data collected from various Azure Platform services employed in operating the application, sourced from graphs generated by the Azure Monitoring System. This data was collected over five working days, during which 30 users interacted with the application. The subsequent sections delve into specific metrics related to Azure Bot Service, Azure Cognitive Service (Language Studio), Azure Cognitive Service (Azure Search), and Azure Storage. These metrics include request traffic, request latency, HTTP request availability rate, client errors, server errors, search queries per second, end-to-end latency, and transaction counts, offering insights into the performance and operation of the application across different Azure services.

Table 1 Table of all results in Microsoft Framework.

DATE	Azure Bot Service		Azure Cognitive Services (Language Studio)				Azure Cognitive Service (Azure Search)	Azure Storage	
	Request Traffic (Count)	Request Latency (Average/millisecond)	HTTP Request : Availability Rate (Average/Percentage)	HTTP Request : Client Errors (Count)	HTTP Request : Server Error (Count)	HTTP Request : Latency (Average/millisecond)	Search Queries per Second (Average/Second)	Success E2E Latency (Average/milliseconds)	Transactions (Count)
5/1/2024 (FRIDAY)	305	712.67 ms	100.00%	4	0	581.53 ms	1.27 sec	25.29 ms	155
8/1/2024 (MONDAY)	390	692.25 ms	100.00%	6	0	698.44 ms	1.44 sec	22.98 ms	191
9/1/2024 (TUESDAY)	209	651.79 ms	100.00%	0	0	997.95 ms	1.68 sec	20.04 ms	163
10/1/2024 (WEDNESDAY)	365	682.41 ms	100.00%	0	0	891.49 ms	1.58 sec	25.47 ms	191
11/1/2024 (THURSDAY)	372	633.53 ms	100.00%	4	0	501.18 ms	1.28 sec	32 ms	168

5. Conclusion and Recommendation

5.1 Conclusion

In conclusion, the development of an information chatbot for UniKL MIIT successfully achieved the goal of providing students with accessible lecturer information and facility details. By offering timely and accurate responses, the chatbot demonstrated the potential of technology to enhance the overall learning experience. Additionally, the application's network performance was evaluated using cloud management tools, ensuring its reliability and scalability. This initiative underscores the value of leveraging technology to streamline information retrieval processes within educational institutions. Furthermore, the project highlights the importance of digital companions like chatbots in facilitating

seamless access to information anytime, anywhere, as evidenced by positive user feedback. It's crucial to prioritize public disclosure guidelines and avoid compromising confidential information.

5.2 Recommendation

Many users have recommended expanding the application's information coverage to include additional sections and classes at various levels within UniKL MIIT. This enhancement would ensure that users have access to comprehensive information without concerns about accessibility limitations.

Additionally, users have suggested incorporating an offline mode feature, allowing users to access the chatbot's information without an internet connection. This feature would be particularly useful in scenarios where users find themselves in locations with poor or no internet connectivity, enabling uninterrupted access to the application's resources.

Furthermore, users have proposed improving the graphical user interface (GUI) of the mobile application to enhance its user-friendliness. By enhancing the GUI, the application would become more intuitive and inviting, encouraging users to utilize it more frequently for retrieving information.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Automated Vehicle Classification (AVC) Using Machine Learning Implementation in Malaysia's Toll System

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Abstract: Congestion at Malaysian toll plazas persists due to manual toll rate settings at multiclass lanes, leading to errors and inefficient traffic flow, causing significant economic losses during peak hours. Thus, this project aims to develop the best model detector for an automated vehicle classification system using computer vision and machine learning algorithms to enhance toll collection efficiency. The methodology involves understanding the business context, acquiring 1,735 images spanning seven vehicle classes, modeling, user evaluation, and deployment using Streamlit and MySQL. Model training utilizes YOLOv8, YOLO-NAS, and Faster R-CNN, with evaluation metrics such as Mean Average Precision (MAP), precision, and others. Key materials include OpenCV, Ultralytics, TensorFlow 2.0, and others. YOLOv8 exhibits superior performance with the highest MAP of 0.995 after fine-tuning compared to other models, demonstrating effectiveness in real-time object detection. The system employs a single detection process, ensuring only one vehicle is detected at a time, enhancing accuracy. The project contributes to the accomplishment of Sustainable Development Goals (SDG), including SDG 11, SDG 9, and SDG 15, supporting sustainable mobility practices. Future enhancements may involve multi-sensor fusion and axle detectors for improved accuracy.

Keywords: Automated Vehicle Classification, Toll, MLFF, RFID, Faster R-CNN, YOLO-NAS, YOLOv8, Machine Learning, Object Detection, Computer Vision, SDG, Deep Learning, TensorFlow, OpenCV, Ultralytics.

1. Introduction

Congestion in Malaysia's toll plazas has spurred the exploration of solutions, including infrastructure enhancements like additional tollbooths, widened lanes, and the adoption of electronic toll collection systems and Radio Frequency Identification (RFID) technology. However, these measures have shown limitations in addressing congestion effectively. Therefore, this project proposes a solution using computer vision and machine learning algorithms to develop an Automated Vehicles Classification (AVC) system, minimizing human errors in toll rate settings, and reducing congestion at toll plazas. Experimented models include YOLOv8, YOLO-NAS, and Faster R-CNN. Additionally, this initiative aims to provide a practical contribution to Malaysia's tolling technology advancement,

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particularly in reaching Multi Lane Free Flow (MLFF). This project also introduces an alert system for motorcycles passing through the toll and proposes a new vehicle classification system: Class 0 for government emergency vehicles, Class 1 for vehicles with two axles and 3- or 4-wheels excluding taxis, Class 2 for vehicles with two axles and 5 or 6 wheels excluding buses, Class 3 for vehicles with 3 or more axles, Class 4 for taxis, Class 5 for buses, and Alert for motorcycles. Furthermore, this initiative aims to foster innovation in toll collection systems by embracing continuous learning and contributing to the evolution of intelligent transportation technologies.

1.1 Problem Statements

The current manual toll rate setting by human operators at the multiclass lane is identified as prone to errors and congestion, resulting in inefficient highway traffic flow. Additionally, traffic congestion during peak hours has been a persistent problem, causing substantial economic losses [4].

1.2 Literature Review

Research highlights the effectiveness of object detection algorithms, particularly YOLOv8, YOLO-NAS, and Faster R-CNN, in various applications. YOLOv8 excels in real-time object detection [1], YOLO-NAS automates architecture optimization [5], and Faster R-CNN demonstrates high accuracy [3], especially in complex scenarios. These algorithms offer significant advancements in computer vision, ensuring precise and efficient vehicle classification for toll collection systems [2].

2. Materials, Methods, and Implementation

This section includes the materials used in this project, the overall project methodology, and a flow of vehicle classification system implementation in Malaysia’s toll system.

2.1 Materials

- OpenCV, Ultralytics, TensorFlow 2.0
- Streamlit, XAMPP, MySQL
- Labellmg, Roboflow
- NVIDIA
- Google Colaboratory, Pycharm
- Microsoft Power BI

2.2 Methods

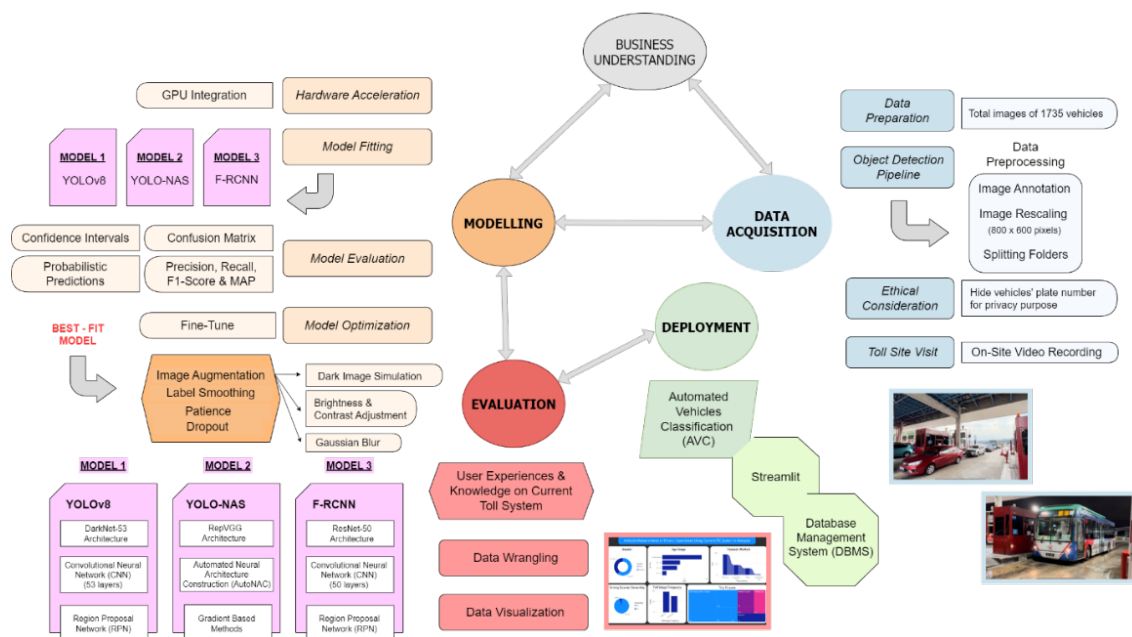


Figure 1: Overall project methodology

2.3 Implementation

Real-time video stream captures vehicles passing through the toll. Image processing extracts frames from the video, ensuring a rapid frame-per-second rate. Object detection occurs using the vehicle classification model. The system performs ROI pooling to focus on specific areas within the detected frames. Output filtration employs non-maximum suppression to remove overlapping bounding boxes, retaining only accurate detections. Finally, vehicle class is identified, and toll collection is executed accordingly. However, if the alert class is identified, an alarm system will be activated.

3. Results and Discussion

This section presents and analyzes the results of three object detection models: YOLOv8, YOLO-NAS and Faster R-CNN with ResNet50 as the backbone. These models were evaluated on a dataset of vehicle images, aiming to detect various classes of vehicles accurately. The primary focus of this section is to examine and compare the performance of these models based on their evaluation metrics and provide insights into their strengths and limitations.

3.1 Results of Overall Models' Performance

Table 1: Summary of performance evaluation for all models.

Performance Evaluation	Precision	Recall	F1-Score	MAP-50
YOLO-v8	1.00	0.97	0.90	0.95
YOLO-NAS	0.55	0.73	0.63	0.55
Faster R-CNN	0.04	1.00	0.08	0.87

Table 1, The evaluation of YOLOv8 DarkNet-53, YOLO-NAS, and Faster R-CNN ResNet-50 highlights key differences among these object detection models. Choosing the most suitable model among these options depends on the specific needs of the application. Faster R-CNN and YOLO-NAS remain viable choices in situations where trade-offs between precision and recall are acceptable or when computational efficiency is a crucial factor. The comparative analysis involved utilizing pre-trained weights for the selected test and validation images. This evaluation aimed to assess the overall detection capabilities, particularly in accurately identifying a higher number of vehicle instances with higher confidence value records.

These observations prove that YOLOv8 produced correct classifications for the vehicles present in the images, and detected and classified more instances of vehicles compared to the Faster R-CNN and YOLO-NAS. The YOLOv8 model also tended to assign higher confidence levels to its classifications, indicating a higher degree of certainty in its predictions.

3.2 Fine Tuning Model: YOLOv8 Darknet53

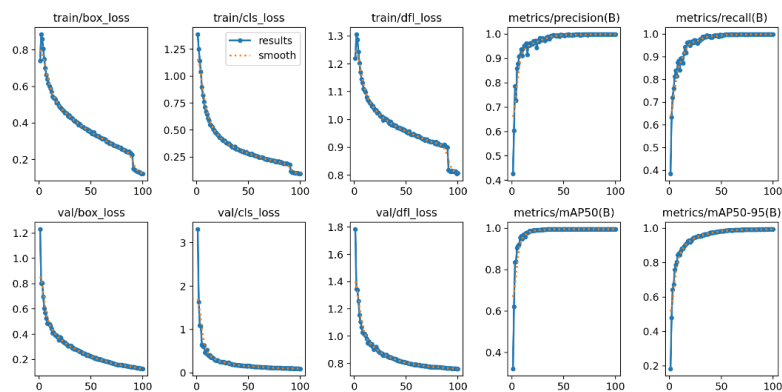


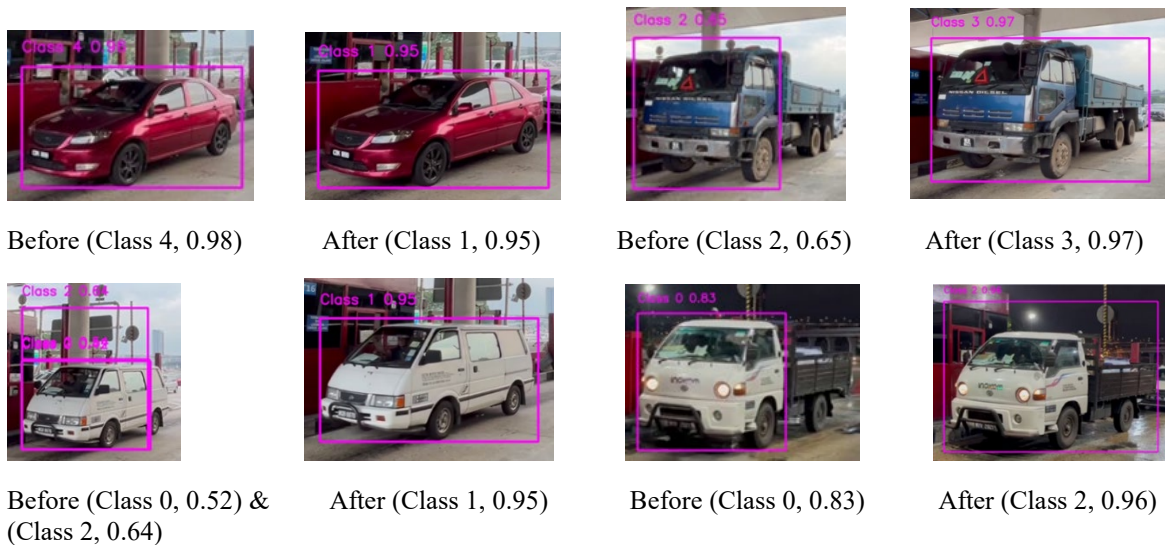
Figure 2: Results of fine-tuning YOLO-v8 model

Figure 2, visual validation of the fine-tuned YOLO-v8 model’s performance, showcasing its ability to precisely locate and classify objects across 650 images and 800 instances and at the same time, minimizing false positives and false negatives across. It achieves exceptional precision and recall scores of 0.999, resulting in a mean Average Precision (mAP) of 0.995 at an IoU threshold of 0.50 and 0.993 at 0.50-0.95. This indicates a substantial improvement in accuracy compared to the original model. Importantly, it's pivotal to emphasize that the model did not experience overfitting. This highlights the successful integration of techniques such as label smoothing, dropout, and patience, which effectively mitigate overfitting in the model architecture.

4. Conclusion

In conclusion, our Automated Vehicle Classification (AVC) system represents a paradigm shift in Malaysia's toll collection. Our meticulous evaluation of three object detection models has uncovered nuanced distinctions in their performance. The selection of YOLOv8 DarkNet-53, coupled with meticulous fine-tuning, establishes a robust and versatile model that excels across diverse vehicle classes and real-world scenarios. Multi-sensor fusion, including LiDAR technology, provides high-resolution data even in varied lighting conditions. Integrating with the Vehicle Registration Database gives us comprehensive vehicle information, aiding accurate identification. Furthermore, adding axle detectors in toll systems can help classify vehicles more accurately according to Malaysian standards. This combination of features enriches our understanding of vehicle characteristics and enhances system performance for various applications.

Appendix A: Final Output Comparison of YOLOv8 Model Before and After Fine Tuning.



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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Cardiovascular Disease Spatial Analysis and Machine Learning (CVD SAML)

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Abstract: Although Cardiovascular Disease (CVD) are among the leading causes of death globally, their association with underlying factors and geographic variation have not been adequately examined. In this study, CVD mortality hotspots are identified using spatial statistical methods. Machine Learning (ML) algorithms – random forest (RF), decision trees (DT), naïve bayes (NB), k-nearest neighbours (KNN) were applied to predict the presence of hotspots in a geographical information system framework. The contribution of the project lies in the development of a versatile web application. This generic application allows for easy decoupling and application in various countries, to analyze the development of CVD in different geographical settings. This study aligns with the achievement of the third Sustainable Development Goal (SDG), specifically focusing on Good Health and Well-Being.

Keywords: Machine Learning, CVD, Spatial Analytics

1. Introduction

Cardiovascular Disease (CVD), or commonly known as heart attack, stroke, and coronary heart disease, remains the leading cause of death globally. According to the World Health Organization (WHO), CVD is accountable for 17.9 million deaths each year, which comprises 31% of deaths worldwide. 85% of these deaths were due to heart attack and stroke [1]. Despite the deadliness of CVD, it has been discovered that over 70% of the CVD cases originate from modifiable risk factors, implying that early diagnosis and treatment can potentially prevent the development of CVD [2]. In Malaysia, CVD was the leading cause of mortality in 2019, and ranked fourth for hospitalizations in Ministry of Health (MOH) hospitals [3]. It is estimated that CVD results in annual productivity losses of approximately MYR 4 billion in 2017 for Malaysia [4]. By reducing the number of CVD cases, the heavy impact brought upon by CVD to the economic, medical, and social factors on Malaysia will be reduced significantly.

While there are many existing investigations of applying machine learning (ML) and spatial analysis on CVD, there is not much research which involves simultaneous use of ML

and spatial analysis to predict the likelihood of CVD morbidity and mortality. Many of the risk factors chosen in existing studies are limited and skewed towards medical factors instead of incorporating a broader category of risk factors. A study in 2023 discovered that the risk of CVD may be strongly affected by factors which are not commonly gathered during clinical interactions such as health status and value of life which encourages using a broader category of risk factors [5]. Studies are also limited to the prediction of CVD in individuals and do not apply machine learning methods to the analysis of CVD risk factors.

To fill these research gaps, this study conducted a comprehensive analysis and learning of the distribution of risk factors and hotspots by building an application to simplify the process of conducting data processing and then spatial analysis followed up by machine learning. While there are many existing applications with spatial analysis and machine learning with data processing, these applications are not able to perform spatial analysis and machine learning simultaneously. The user has to move between applications to conduct the analysis, which can be complicated and time consuming. The application from this study is designed to perform data processing, spatial analysis, and machine learning in a single platform.

2. Materials and Methods

Figure 1 summarizes the methods used over the course of this study.

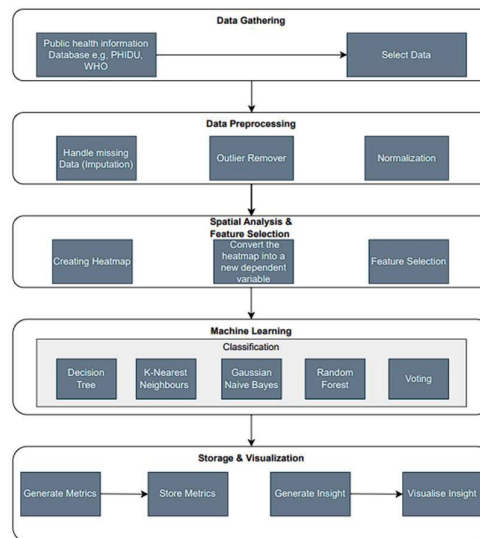


Figure 1 Diagram of research methods and workflow

2.1 Materials

The data used is sourced from the Public Health Information Databases such as Development Unit (PHIDU) and World Health Organization (WHO) websites. The programming language used in the frontend and backend are typescript and python respectively. Typescript is selected due to its scalability and static typing, which helps to manage code maintenance, refactoring, debugging and readability. To support various paradigms and easy integration purposes, Python represents one of the best languages. For storing and managing of the data, MongoDB is chosen due to its ability to handle highly diverse data types compared to traditional relational databases. The link for the project's source code can be found on GitHub using this link <https://github.com/orgs/FIT4701/repositories>

2.2 Methods

2.2.1 Spatial Analysis

Local clustering technique Getis-Ord G_i^* is applied to locate the hotspots and coldspots, creating a heatmap to identify the spatial correlation of CVD mortality rates. A high positive G_i^* value indicates hotspots, whereas a high negative G_i^* value indicates coldspots. The formula of Getis-Ord G_i^* is as below:

$$G_i^* = \frac{\sum_{j=1}^n w_{i,j}x_j - \bar{X} \sum_{j=1}^n w_{i,j}}{[n \sum_{j=1}^n w_{i,j}^2 - (\sum_{j=1}^n w_{i,j})^2]} \quad Eq1$$

$$S = \frac{i-1 + i + i+1}{n-1}$$

2.2.2 Machine Learning (Classification)

The dataset first undergoes train-test split where 80 percent of the dataset is used in model training while 20 percent of the dataset is withheld and used to evaluate model performance during training. Different classification ML algorithms are used, and the best performing model is evaluated for further analysis of results. To address the imbalanced dataset, the classification threshold is optimally set at 0.40. This adjustment accounts for any model bias that may lead to the model to predict most of the test data as non-hotspots. This strategic thresholding ensures a more accurate and positive classification outcome.

3. Case Study – Australia

In this case study of Australia, the data used in this study is sourced from Public Health Information Development Unit (PHIDU) website. The data selected is represented at a Population Health Area (PHA) level, where each PHA consists of one or more Statistical Areas Level 2 (SA2)24. Government agencies in Australia typically selects SA2 as the area level of choice for data analysis, but PHA is preferred for representing health data. To ensure the relevancy of the collected data, data published in the recent years of 2016 and 2023 were selected, where data published in each year represent data collected up to around 5 years prior to publication. The data used in this study are selected from a data archive published by PHIDU in 2016 and 2023 (<https://phidu.torrens.edu.au/social-health-atlases/data>)

3.1 Spatial Analysis

It can be observed that the CVD hotspots have increased from 2016 to 2023, spreading to the south and east directions. In 2023, the hotspots have expanded from the Northern Territory to South Australia, Queensland, and the south part of Western Australia.

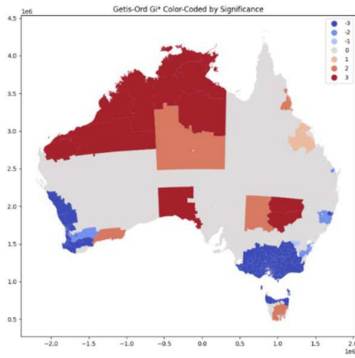


Figure 2 2016 Heatmap

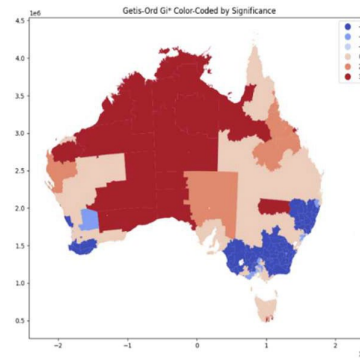


Figure 3 2023 Heatmap

3.2 ML Model Performance

The metrics used to compare the performance of various ML models in hotspot prediction are presented in Table 1. It can be observed that Random Forest is the best performing model in this case. It also achieved the highest AUC-ROC score, which indicates that it has a higher true positive rate over false positive rate [6][7]. The second-best performing model is Naïve Bayes but there is a significant drop in precision as it tends to falsely predict non-hotspot areas as hotspot areas. Decision Trees performs better in terms of F1-score and Recall compared to KNN. KNN performs worse than other algorithms especially in terms of F1-score and Recall. After training several models and obtaining the model with the best performance, the key risk factors identified by the models are extracted from the ML model. This is accomplished by calculating the feature importance scores of each risk factor used by the ML model. Feature importance measures the importance of the feature (risk factor) for the entire model [8].

Table 1 Performing result

Model	Accuracy	AUC-ROC	F1-score	Precision	Recall	Specificity
Decision Trees	0.957	0.868	0.444	0.364	0.571	0.969
KNN	0.97	0.696	0.364	0.5	0.286	0.991
Naïve Bayes	0.957	0.869	0.5	0.385	0.714	0.964
Bayes						
Random Forest	0.978	0.892	0.545	0.75	0.429	0.996

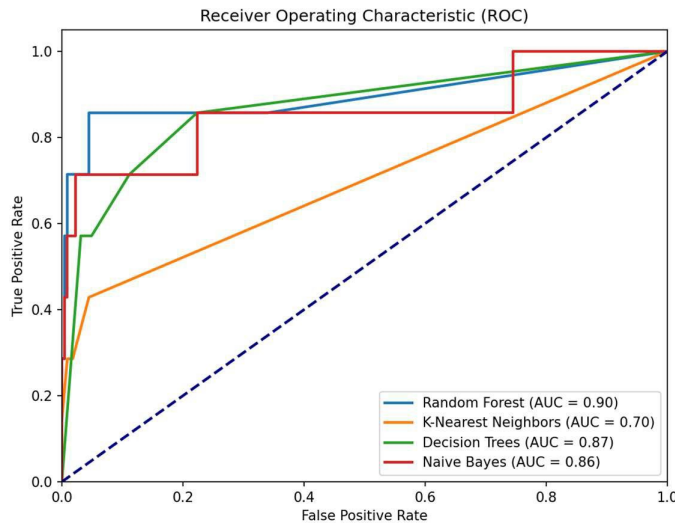


Figure 4 Receiver Operating Characteristic chart of trained ML models

4. Conclusion

In this project, we built a web application where data processing, spatial analysis and machine learning can be conducted in a single platform which provides convenience for the user. This spatial analysis section identifies the hotspots of CVD mortality rate, and analyses the spatial patterns of the CVD clusters, creating a new feature for ML model training. ML section trains the model, identifying risk factors which have the most influence on the presence of CVD hotspots.

From the local spatial patterns analysis results (Getis-Ord G_i^*), it can be observed that the spatial patterns consist of high cluster values, with neighbours having similar values. This indicates that counties with high CVD mortality rates are located close to each other rather than by random chance. Slight shifting of the hotspots is observed as well, which shows that the locations of the hotspots might

change over time, this could be due to health improvement programs, or improved health care quality of certain counties.

To summarize the project, there are a few criteria to highlight. The idea of combining spatial analysis and machine learning contributes towards the uniqueness of this project. Each component (spatial analysis, machine learning and data processing) is designed to be decoupled, therefore the user could selectively choose which component to conduct the analysis and do not need to follow any order of using the components, which makes it a creative project. Also, the innovation to consider non-medical risk factors enables non-medical organizations or even individuals to contribute towards reducing the CVD mortality rate. For example, if lack of exercise is a risk factor which heavily impacts the CVD mortality rate, fitness events could be organized by different parties to encourage individuals to participate, and this would potentially reduce the CVD mortality rate. Rather than being limited to the location featured in the case study which is Australia, this application has the capability to conduct analyses in diverse locations, including Asia, Malaysia and even on a global scale. This is contingent upon the availability of data that can be matched with the selected locations, categorized by area levels such as PHA, state, country and beyond. This makes the application generic and applicable to multiple scenarios. This application will also aid policy makers to implement appropriate strategies and formulate suitable health policies to encourage people living in areas with higher cardiovascular diseases rate to act, thus making a positive impact on reducing CVD mortality rates. This aligns with the United Nations' third sustainability goal of ensuring healthy lives and promoting well-being.

As a case study, geographical distribution of CVD deaths in Australia and its influential factors of stroke prevalence were analyzed. The inclusion of risk factors from the relative balance of their feature importance scores proves that the causes of CVD comprise of a wide range of risk factors, and they should all be part of any public health formulation tackling CVD.

For future research, other locations such as Asia, Malaysia or United States can be considered, as the application built is generic and decoupled which allows different locations to be added and analyzed. Enhancement on the spatial analysis could also be made by introducing global spatial analysis techniques such as Global Moran's I and Getis Ord General G to determine the overall distribution of the cluster more accurately.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Deep Learning Approach for Basal Stem Rot Disease Detection of Oil Palm Tree using RGB Image Analysis

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Abstract: The economic significance of oil palm trees in Southeast Asian countries relies on their oil, making their health crucial for yield and income. However Basal stem rot (BSR) disease poses a threat to production. While current studies accurately detect oil palm trees but lack automated assessment of individual tree health, especially for early BSR symptom identification in densely populated regions. This study introduces an improved approach for early BSR symptom detection, using the Multi-Convolution Residual (M-CR) U-Net and Overlapped Contour Separation (OVCS) algorithm. The M-CR U-Net outperforms alternatives with a dice coefficient of 0.978, intersection over union of 0.871, precision of 0.989, and recall of 0.982, demonstrating enhanced training efficiency. The OVCS algorithm improves segmentation outcomes, showing an average performance improvement of 2.716%. This methodology presents significant potential for effective BSR disease detection in crowded oil palm tree areas, contributing to better plantation management.

Keywords: Deep learning, Computer Vision, UAV, Oil Palm Tree, Basal Stem Rot

1. Introduction

The oil palm tree (*Elaeis guineensis* Jacq.) is a vital commercial plant cultivated extensively in various regions, driven by the high demand for its oil in the food processing and manufacturing sectors [1]. The palm oil industry, valued at USD 65.73 billion in 2015 and expected to reach USD 92.84 billion by 2025[2]. However, the industry's sustainability is threatened by Basal Stem Rot (BSR) disease caused by *Ganoderma boninense*, resulting in significant economic losses [2]. It is a major concern, spreads easily, yields reduction up to 80% and leading to annual economic losses of up to USD 365 million in Malaysia[1]. However, detecting early-stage BSR disease in oil palm trees through UAV images is a formidable challenge due to two main factors [3, 4]. Firstly, the visual similarities between healthy and early-stage BSR-infected trees result in poor classification performance. Secondly, crowded regions in oil palm plantations with overlapping tree boundaries further complicate early-stage BSR detection as demonstrated in a previous study [5].

Hence, this study introduces an algorithm for early BSR disease detection in oil palm trees, emphasizing crowded plantations. It combines a Multi-Convolution Residual (M-CR) U-Net with an Overlapped Contour Separation (OVCS) algorithm. The M-CR U-Net, with multiple kernel sizes and skip connections, improves training efficiency and segmentation accuracy. The OVCS algorithm precisely identifies individual trees in crowded areas by detecting and eliminating overlapping boundaries. The study contributes to effective disease management and precise yield modelling.

2. Materials and Methods

2.1 Oil Palm Tree BSR Disease Detection Algorithm

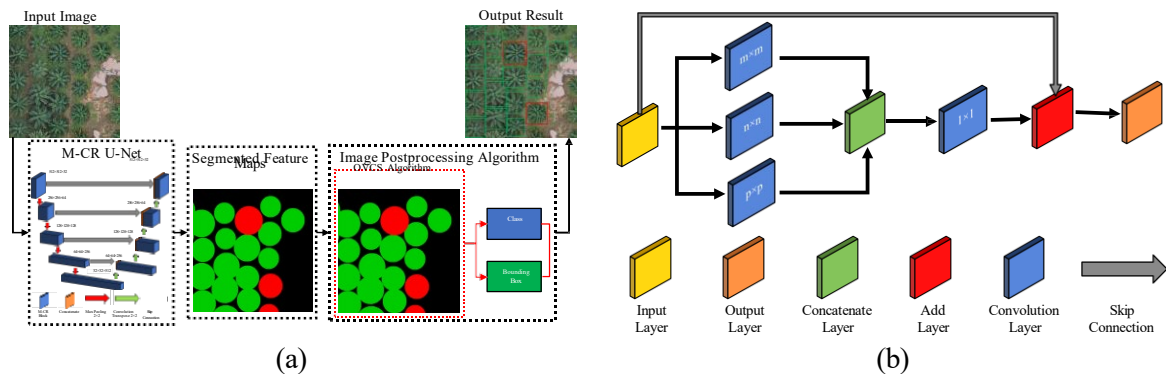


Figure 1: (a) General workflow of the proposed oil palm tree BSR disease detection algorithm; (b) Detailed architecture illustration of M-CR block embedded in M-CR U-Net

The oil palm tree BSR disease detection algorithm, depicted in **Figure 1(a)**, utilizes the M-CR U-Net to segment individual trees from a UAV image. The resulting probability map undergoes postprocessing with the OVCS algorithm to improve segmentation accuracy by resolving overlapping trees. Final detection involves defining a bounding area within the original image based on the segmented results, enhancing visualization of the output.

2.2 Overlapped Contour Separation (OVCS) Algorithm

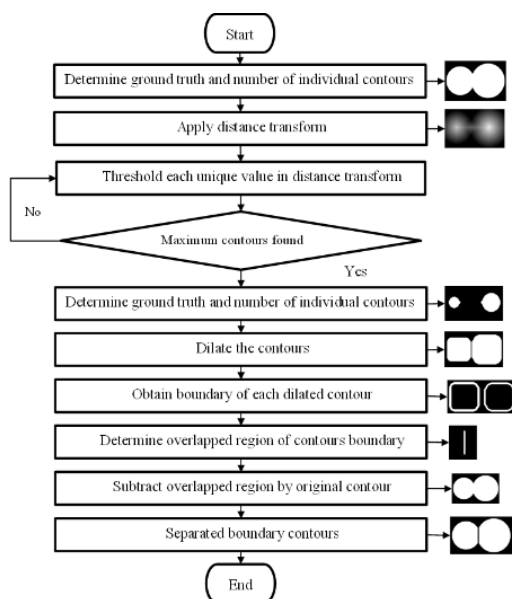


Figure 2: Flowchart of the proposed OVCS algorithm

The proposed OVCS algorithm addresses challenges in oil palm tree detection arising from overlapping boundaries of segmented regions as illustrated in **Figure 2**.

$$D_{\min}(x,y) = \text{Min} [\sqrt{(x_{=0} - x_{\neq 0})^2 + (y_{=0} - y_{\neq 0})^2}] \quad \text{Eq. 1}$$

The distance-transformed image is thresholded to identify unique values, leading to the separation of individual ground truth contours. The resulting contours undergo dilation without overlapping, and from each dilated contour, the boundary is extracted. The algorithm determines overlapping regions by assessing the overlap between boundaries of each contour as mathematically represented in **Eq. 1**.

$$\text{Contour}_{\text{separated}} = \text{Contour}_{\text{original}} - \text{Region}_{\text{overlapped}} \quad \text{Eq. 2}$$

Finally, the separated contours are obtained by subtracting the overlapped region from the original contour as mathematically represented in **Eq. 2**.

2.3 Multi-Convolution Residual (M-CR) U-Net

This study introduces the M-CR block (Figure 1 (b)), to address vanishing gradient and fixed kernel size issues during training. Using multiple convolution kernels (m, n, p) enhances segmentation performance. Optimal kernel size combinations were determined through a comprehensive experiment [6]. The bottleneck layer and skip connection simplify training, leading to the M-CR U-Net's superior ability to extract diverse details and improve segmentation outcomes.

3. Results and Discussion

3.1 Training Performance Analysis

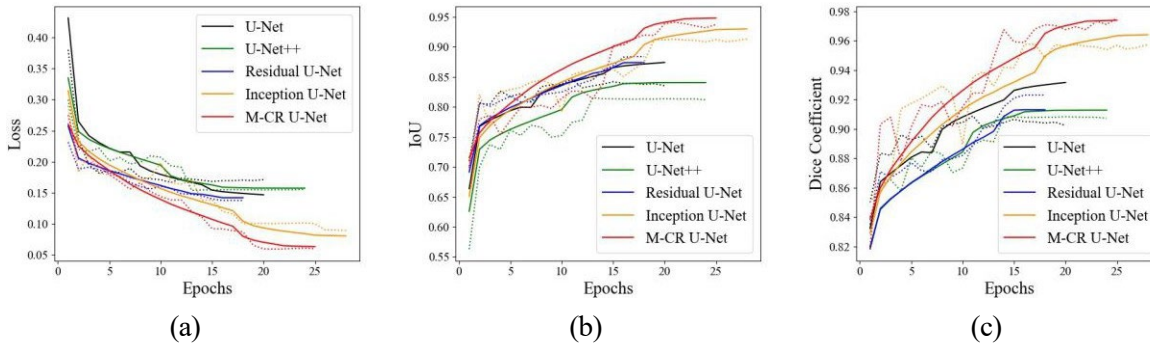


Figure 3: Training(solid) and validation(dotted) performance for (a)Dice Loss; (b)IoU;(c)Dice Coefficient

The proposed M-CR U-Net outperforms other U-Net architectures in training, with the lowest loss and highest IoU and dice coefficient (**Figure 3**). It achieves this by employing skip connections to enhance feature transfer and utilizing diverse convolution kernel sizes for increased feature diversity.

3.2 Inference Performance Analysis

Table 1: Inference performance results of the independent sample Z-test.

	IoU		Dice Coefficient		Precision		Recall	
	M±SD	p-val	M±SD	p-val	M±SD	p-val	M±SD	p-val
U-Net	0.776±0.094	5.753×10^{-7}	0.888±0.071	2.314×10^{-7}	0.923±0.061	1.561×10^{-6}	0.879±0.083	1.117×10^{-11}
U-Net+	0.768±0.088	1.576×10^{-8}	0.876±0.078	2.209×10^{-9}	0.916±0.069	1.576×10^{-7}	0.875±0.079	3.059×10^{-13}
Residual	0.796±0.115	6.176×10^{-4}	0.896±0.092	1.791×10^{-6}	0.929±0.088	4.156×10^{-4}	0.892±0.091	4.928×10^{-8}
Inception	0.819±0.098	2.467×10^{-3}	0.913±0.077	3.103×10^{-3}	0.944±0.061	7.398×10^{-3}	0.924±0.082	1.886×10^{-3}
M-CR	0.849±0.117	-	0.945±0.088	-	0.967±0.072	-	0.958±0.084	-

The Z-test compares the inference performance mean of M-CR U-Net with another U-Net family architecture. The null hypothesis assumes equality, but the consistently low p-values for other U-Net architectures (**Table 1**) lead to accepting the alternative hypothesis. This supports that M-CR U-Net outperforms the other architecture

3.3 Precision-Recall (PR) and Receiver Operating Characteristic (ROC) Curve Analysis

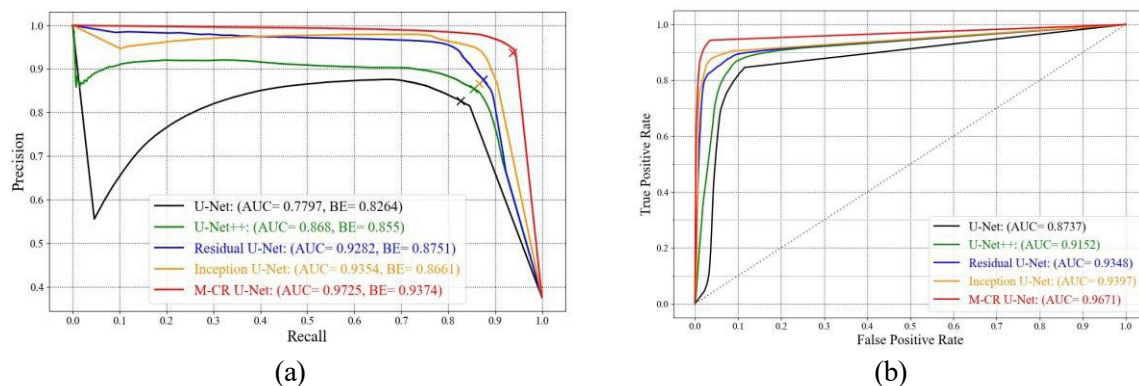


Figure 4: Inference performance results of the (a) PR-Curve;(b) ROC-Curve.

Figure 4(a) shows M-CR U-Net excelling among tested architectures, with the highest AUC (0.9725) and BE point (0.9325) in the PR curve. It accurately predicts outcomes while minimizing false positives. In **Figure 4(b)**, M-CR U-Net outperforms other U-Net architectures with an AUC of 0.9671, demonstrating superior balance between false positives and negatives in the ROC curve. Both PR and ROC curves confirm M-CR U-Net's segmentation performance surpasses existing U-Net architectures.

3.4 OVCS Algorithm Comparative Analysis

Table 2: Inference performance results by M-CR U-Net after applying the OVCS algorithm.

	IoU(%)	Dice Coefficient(%)	Precision(%)	Recall(%)
M-CR U-Net	84.900	94.500	96.700	95.800
M-CR + OVCS	87.100	97.800	98.900	98.200
Improvement	2.591	3.492	2.275	2.505

The OVCS algorithm significantly improved BSR disease detection in oil palm trees, yielding an average enhancement of 2.716% across evaluation metrics. Compared to results without the algorithm, its effectiveness in refining segmented region boundaries is evident, as indicated in **Table 2**.

4. Conclusion

In summary, this study introduced an oil palm tree BSR disease detection algorithm using a semantic segmentation model and an image postprocessing algorithm with RGB UAV images as input. The proposed M-CR U-Net outperformed four other U-Net family architectures in terms of training and testing performance, exhibiting faster convergence and better segmentation results. Evaluation metrics, including IoU(0.871), Dice Coefficient(0.978), precision(0.989), and recall(0.982), demonstrated the M-CR U-Net's excellence in segmenting intricate details and its potential for early BSR disease detection. The image postprocessing algorithm (OVCS) effectively separated overlapped boundaries, further improving segmentation results. The proposed method holds strong potential for oil palm tree health monitoring, promising increased efficiency and effectiveness in plantation management.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Investigation of Artificial Neural Network Performance as the Classifier of the Muscle Contraction Pattern on Surface Electromyography

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Abstract: Muscle fatigue is a frustrating problem that happens after exercise. Electromyography (EMG) is an essential technique used to measure muscle activity during various tasks. Despite its popularity, previous studies have yet to determine which EMG features are critical in classifying muscle contraction patterns across different physical activities and obtaining optimal performance. Therefore, this study aims to classify muscle contraction patterns during stepping exercises from sEMG and investigate the performance of Artificial Neural Networks as a classifier of this contraction pattern. 60 participants voluntarily participated in this exercise and their EMG signal was recorded. The raw EMG signal undergoes filtering, rectification, and linear enveloping. Then, each signal from each participant was segmented into a relax signal and a contract signal. Time domain and frequency domain features were then retrieved from every relax and contract signal and fed into the ANN model. For validation purposes, ANN model performance has been compared with other machine learning models which are support vector machines and Decision Tree. The results indicate that ANN outperformed the other machine learning models with 94.4% accuracy performance in classifying the muscle contraction patterns from the sEMG signal. The findings from this research could contribute valuable insights to inform more effective and personalized rehabilitation services in identifying muscle contractions autonomously, thereby improving the overall mobility and quality of life for individuals facing muscle fatigue and financial problems.

Keywords: EMG, Artificial Neural Networks, Muscle Fatigue, Muscle Contraction

1. Introduction

Steppers are widely used for knee rehabilitation, particularly focusing on muscles like Vastus Lateralis (VL) and Vastus Medialis (VM). This study uses surface Electromyography (sEMG) to classify muscle

contraction patterns during stepping exercises, employing Artificial Neural Networks as classifiers. EMG signals, used in interfaces and rehabilitative devices, capture muscle-generated electrical impulses influenced by factors like age and muscle strength. EMG signals can be utilized in general man-machine interfaces for Human Computer Interface (HCI) and in rehabilitative equipment such as robotic prostheses to create device control commands. Compared to other bio-electric signals, EMG signals vary widely subject to age, gesture style, muscle strength, motor unit paths and skin-fat layer [1].

2. Methodology

The EMG data used in this study were acquired from 60 participants from the past research year 2017 [2]. Participants aged 22 to 24, with BMI ranging from 17 to 37, used a stepper for lower limb movement data collection, including EMG. Raw EMG signals from the Vastus Lateralis (VL) muscle were loaded into MATLAB for processing, which included filtering, rectification, linear enveloping, and Fast Fourier Transform. However, noise is often present in collected data. To address this, both low-pass and high-pass filters are employed to remove high-frequency and baseline noise, respectively.

Time domain features are commonly used by researchers in pattern recognition and classification studies. These features are analyzed using MATLAB, specifically MATLAB 2023a, in this study. The features in the time domain are quick and easy to implement [3]. The seven-time domain features used in these studies were the normalized mean, standard deviation, root mean square, maximum amplitude, variance, skewness and kurtosis. Furthermore, motor unit recruitment and muscle fatigue assessment use frequency-domain properties. Mean frequency (MNF) and median frequency (MDF) are widely used for evaluating muscle fatigue in surface EMG data.

Next, the study analyses muscular contractions using MATLAB and an artificial neural network (ANN) classifier using 86 characteristics. The data is separated into three sets: test, validation, and training, with accuracy as the major metric. The technique combines performance evaluation, feature extraction, and data segmentation to provide a thorough insight. For comparison, the study employed the Waikato Environment for Knowledge Analysis (WEKA) as an alternative learning method. Classifiers were assessed for classification accuracy of muscle contractions after features were fed into WEKA. The comparative performance of various machine learning algorithms was then determined by comparing the WEKA findings with the ANN outcomes.

3. Results and Discussion

3.1 Classification Results of ANN

Following the procedure of the proposed classification using the prepared datasets, set of experiments were performed. It gave the highest accuracy of EMG classifying such as the result shows that ANN has classified the EMG signals by 96.5% of accuracy. Figure 1 shows that 41 of the guesses for class 0 were right and 42 of the predictions for class 1 were wrong. There was only one mistake in each class. The model does well on all datasets, but it does especially well on the test set in terms of accuracy.

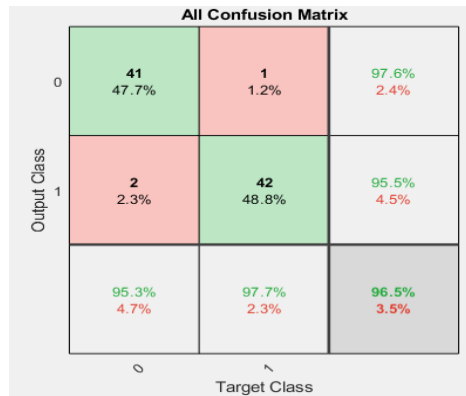


Figure 1: Result of All Confusion Matrix

3.2 Model Performance Comparison

The Waikato Environment for Knowledge Analysis, commonly known as Weka, stands as a significant machine learning method within our toolkit. A classifier based on Sequential Minimal Optimization (SMO), typically associated with support vector machines (SVM), was utilized. Diverse algorithmic families offer diverse approaches for SVM, k-NN, and ANN. Comparing these algorithms can help determine which model is best for the situation. SVM and k-NN handle non-linear data well. Table 1 shows the comparison of artificial neural network and other learning machine method of the 60-feature. The result is an average correct rate of all the combination's outcomes of the selected feature is denoted.

Table 1: ANN performance comparison

Method	Results (%)
Artificial Neural Network	96.5
Support Vector Machine	95.833
k-Nearest Neighbours	95.833

4. Conclusion

The study investigates the effectiveness of artificial neural networks (ANNs) in categorizing muscle contraction patterns during stepping workouts through electromyography (EMG) signal analysis. ANNs outperform SVM and k-NN in handling complex EMG data. Future work aims to optimize data preparation, apply findings to rehabilitation, and extend analysis to other muscle groups for broader applications.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

KidFits: Children's Clothing Size Matching Recommender System

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Abstract: No matter how attractive the clothes, a well-fitted clothing is essential for compliance and safety, requiring functionality to accommodate growth and incorporating self-help features. However, the lack of a standardized sizing system across brands complicates this purposes, often resulting in increased costs due to returns and exchanges in online shopping. In response, this project presents the Clothing Size Matching Recommender System, or Kidfits, designed for children aged 5 to 17 years, leveraging Triangular Fuzzy Logic and open-source Python libraries within the Rapid Application Development framework to provide accurate size recommendations. By using web scraping techniques and triangular fuzzy numbers, validated by expert tailors, Kidfits achieves a 95% success rate in offering satisfactory fits, testing extensively on a diverse sample of children. The results shows great potential in revolutionizing online retail by improving parents and guardians satisfaction. Kidfits is anticipated to have a positive impact on the children's clothing industry, reducing return rates, attracting more consumers (particularly parents and guardians), and increasing confidence in online shopping experiences.

Keywords: Triangular Fuzzy Logic, Web Application, Recommendation System

1. Introduction

The prevalence of internet shopping saw a significant rise, increasing from 48.8% in 2016 to 53.3% in 2018, according to the Malaysian Communications and Multimedia Commission [1]. This surge in online shoppers coincided with a notable increase in Malaysia's manufacturing sales, which grew by 5.2 percent in December 2019, reaching RM76.1 billion up from RM72.3 billion the previous year. This growth was predominantly fuelled by the textile, clothing, and footwear sectors, as reported by the Department of Statistics Malaysia (2019) [3]. Motivated by these developments, this project aims to explore the creation and implications of a clothes size matching recommender system tailored for the children's clothing industry, particularly within the online retail sector. Such a system seeks to address the prevalent issue of sizing "misfit" in children's clothing by providing accurate size recommendations.

The challenge of determining the correct sizing for children's clothing is significant, given the rapid and varied growth patterns among this demographic. Unlike adults, whose clothing sizes can often be predicted based on sales and fit history, children frequently outgrow their clothes at a much faster rate [4]. The lack of a standardized sizing system across different clothing brands further exacerbates this problem, leading to confusion and frustration for parents and guardians trying to purchase clothing for their children, especially online [5].

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Leveraging advanced web development techniques, the Kidfits platform introduces a Children’s Clothing Size Matching Recommender System that utilizes Triangular Fuzzy Logic. The Kidfits stands to be a transformative development in the e-commerce landscape, potentially boosting the prevalence of online shopping in Malaysia by addressing one of the primary concerns of consumers: finding correctly sized clothing for their children.

2. Materials and Methods

This section delves into the detailed methodology employed to develop the Kidfits system, structured into four distinct subsections to provide comprehensive insights into the processes and principles that underpin the construction and functionality of Kidfits.

2.1 Materials

In the development of the Kidfits system, several open-source Python libraries were utilized, showcasing the project's reliance on robust, well-established resources within the Python ecosystem. The resources employed in this study are detailed below in Table 1, alongside a brief explanation of their roles in the Kidfits system.

Table 1: List of Python Libraries Used in Kidfits

Library	Explanation
SKFuzzy	Package that interfaces with numpy arrays to implement fuzzy logic
Numpy	Library for scientific computing in Python, used for performing mathematical operations
BeautifulSoup	Library for parsing HTML and XML documents, facilitating the scraping of web data
Django	Building the web application component of Kidfits.
SQLite	Local data storage without the need for a separate server process

2.2 Methods

In order to develop the Kidfits system, the Rapid Application Development Model (RAD) was selected as the guiding framework. This choice was informed by the specific characteristics and advantages of RAD, particularly its suitability for managing small to medium-sized projects where components or functions need to be developed concurrently. The RAD model is renowned for its flexibility, allowing for iterative changes and adaptations throughout the development. The RAD model is structured around four distinct phases as shown in Figure 1.

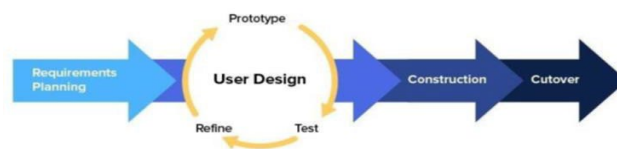


Figure 1: Rapid Application Development (RAD)

2.3 Equations

In this subsection, the focus will be on the mathematical underpinning of the Kidfits system, particularly the Triangular Fuzzy Logic used to calculate size recommendations. Triangular Fuzzy Logic employs 'fuzzy sets' for decision making, with each set defined by a membership function that determines the degree of truth of an element belonging to that set. In the context of triangular fuzzy sets, the membership functions are shaped like triangles. The Kidfits system use Triangular Fuzzy Numbers (TFNs) to represent size categories, namely small, medium, and large. This allows for more nuanced recommendations that can account for the unique growth patterns and body shapes of children.

A Triangular Fuzzy Numbers (TFNs) is defined by a triplet $T(a, b, c)$, $a \leq b \leq c$,

Where; a =lower limit point b =optimum point c =upper limit point

The membership function of a TFN is defined as follows:

$$Tr(x: [a, b, c]) = \begin{cases} 0, & x \leq a \\ \frac{x-a}{b-a}, & a < x \leq b \\ \frac{c-x}{c-b}, & b < x \leq c \\ 0, & x > c \end{cases}$$

This function determines the degree of membership of each point x , which is the body measurements (e.g., height, weight, chest, waist, hip and inseam), to the fuzzy set, varying linearly between the points a, b, c .

After utilizes web scraping techniques to gather size chart data directly from various brand websites, the system employs triangular membership functions to calculate the degree of membership for the given measurements within each size category defined by the charts. This sophisticated approach allows Kidfits to offer nuanced size recommendations which not only providing a single size option, but the system is capable of suggesting multiple sizes. The membership values are then converted into percentages, indicating the degree to which the clothing fits, based on the sizes offered by various brands. The higher the percentage, indicates that the size is recommended to be selected, as stated by Voskoglou [6].

2.4 Samples and System Validation

The Kidfits platform was tested with a group of 20 children, consisting of 10 boys and 10 girls, ages ranging from 5 to 17 years. Comprehensive measurements such as height, weight, chest, waist, hip, and inseam were collected from these participants. To facilitate the testing process, size charts from four prominent children's clothing brands, identified as Brand A, Brand B, Brand C, and Brand D, were extracted using web scraping techniques. An expert in tailoring was engaged to validate the fit accuracy of the size recommendations provided by Kidfits. Furthermore, a Likert-scale questionnaire, ranging from 1 (strongly disagree) to 5 (strongly agree), was distributed to parents and guardians to evaluate their experience using the Kidfits platform. This survey gathered feedback from 40 respondents selected from the staff of UniKL and the surrounding community. The feedback focused on various criteria to measure the system's usability, effectiveness, and overall satisfaction levels.

3. Results and Discussion

Table 2 displays the experts' evaluation of the Kidfits platform. Given that the sample size was 20, only a subset of the data is presented. The findings indicate that subject matter experts in tailoring have validated a notable 95% success rate in size matching, with 19 out of 20 samples categorized as satisfied or above.

Table 2: The Validation Result by Expert on the Satisfaction of Clothing Fit Recommended by Kidfits

Sample	Gender	Age	Membership value (%)	Recommended		Validation by expert		
				Brand	Size	Satisfied	Partly Satisfied	Dissatisfied
Sample 1	F	5	97	Brand C	5	√		
Sample 2	M	5	99	Brand C	5	√		
Sample 3	F	6	90	Brand B	3-4y	√		
Sample 4	M	6	100	Brand B	7-8y		√	
Sample 5	M	7	94	Brand D	5	√		
Sample 6	F	8	93	Brand C	7	√		

Figure 2 details the experiences of parents and guardians with the Kidfits platform, simplifying the rating scale to three categories: satisfied, neutral, and not satisfied, for easier interpretation. The results

reflect the successful implementation of Kidfits, with the majority of parents and guardians reporting satisfaction across evaluated features.

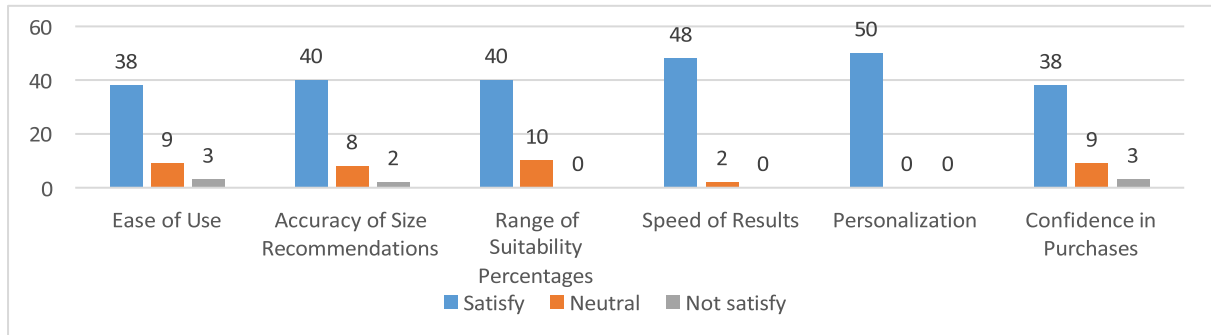


Figure 2: Parental Satisfaction with Kidfits Platform Function and Features

4. Conclusion

The Kidfits system, utilizing Triangular Fuzzy Logic, has significantly improved online shopping for children's clothing by offering precise size recommendations, thereby enhancing parents and guardians satisfaction and reducing return rates due to sizing errors. However, its reliance on accurate input data and the current focus on size rather than fit preference and design suggests areas for future enhancement. Despite these limitations, Kidfits presents a promising approach to addressing the challenges of online clothing retail, with potential for further advancements in accommodating a wider range of clothing items, integrating machine learning for personalized recommendations, and promoting environmental sustainability in consumer choices. This innovative system not only streamlines the shopping experience but also opens avenues for research into more sophisticated, user-centric, and sustainable online retail solutions.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Kinetic Analysis for Catalytic Co-Pyrolysis of Aseptic Carton Waste and Water Hyacinth Mixtures using Thermogravimetric Analysis with Validation of Artificial Neural Network (ANN) Model

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Abstract: Pyrolysis is a popularized thermochemical process in recent years in converting biomass into a variety of useful materials such as liquid products, gaseous compounds and solid charcoals. The pyrolysis of pure aseptic carton waste, water hyacinth, and their binary mixtures were analyzed by introducing water hyacinth hydrochar as the catalyst to enhance bioenergy production. The pyrolysis processes were conducted at different heating rates from 10 °C/min to 100 °C/min within a temperature range of 50 °C to 900 °C to observe their thermal degradation behaviour. Furthermore, Artificial Neural Network (ANN) was utilized for validation by inputting the heating rates and temperatures to simulate the prediction of weight loss of samples. From the kinetic results, Kissinger-Akahira-Sunose (KAS) model achieved the highest accuracy due to the highest coefficient determination obtained, along with the use of the transfer function of Logsig-Logsig (LL) in ANN being able to produce the lowest deviation between the activation energy (E_a) from the experimental results. The E_a values obtained through KAS model experimentally were 79.47 kJ/mol, 90.17 kJ/mol and 100.86 kJ/mol for binary mixtures of aseptic carton waste and water hyacinth in mass ratios of 20:80, 50:50 and 80:20, respectively. The use of water hyacinth hydrochar catalyst had successfully further reduced the E_a values to 49.55 kJ/mol and 28.19 kJ/mol for the binary mixtures of mass ratios 20:80 and 80:20 respectively, however, a slight increment to 102.37 kJ/mol occurred for the binary mixtures of mass ratio 50:50 due to possibility of inhabitation effects. The generated outcomes would greatly aid the optimization design and scaling up of the pyrolysis reactor using the stated feedstocks in the future.

Keywords: Catalytic pyrolysis, Kinetic analysis, Aseptic Carton Waste, Water hyacinth, Artificial neural network

1. Introduction

Pyrolysis in recent years has emerged as one of the most promising sustainable approaches in energy generation and resource usage. Among various potential feedstocks available for pyrolysis, aseptic carton waste, and water hyacinth are foreseen to be prominent selections due to their abundance in quantity and the environmental impacts brought about by their conventional disposal methods. Aseptic carton waste, dominantly made of layers comprising of plastic, aluminum, and paper implies consequential challenges for a proper disposal approach due to complications in separating its different components. Analogously, water hyacinth in water sources such as lakes rivers, and ponds causes ecological imbalance due to its uncontrolled rapid growth rate. However, despite the adverse effects brought about by the stated materials, they offer possible routes of energy recovery and resource recovery via the thermochemical route of pyrolysis.

Kinetic studies are crucial in contributing to process design to unravel the underlying mechanisms of pyrolysis. Through the investigation of the thermal degradation behaviour and kinetic parameters, the complex interaction among the components of the feedstocks during co-pyrolysis can be elucidated for optimizing the pyrolysis process parameters, scaling up of design and decision making in pyrolysis reactor modeling. However, the execution of experiments can be costly, labour intensive and time-consuming due to the necessity of repetitions to affirm accuracy. Therefore, the introduction of the artificial intelligence computational model, known as Artificial Neural Networks (ANN) is deemed to be able to convey predictions of the kinetic parameters, in which validations on the prediction accuracy were examined in this study.

2. Materials and Methods

2.1 Materials

2.1.1 Sample Preparation of Feedstock and Catalyst

For the feedstock, water hyacinth and aseptic carton waste were collected, cleaned, dried under the sun for 35 to 48 hours and ground into a particle size of $710 \mu\text{m}$ respectively. As for the catalyst in the form of hydrochar, water hyacinth was subjected to hydrothermal carbonization at 180°C for 30 minutes. The samples were blended in different ratio with and without the catalyst as shown in **Table 1**.

Table 1: Samples of Different Weight Ratio With and Without Water Hyacinth Hydrochar Catalyst

Samples	Weight ratio
1	0:100
2	100:0
3	20:80 + C
4	50:50 + C
5	80:20 + C

2.2 Methods

2.2.1 Experimental Setup

10 mg of well-mixed sample was loaded onto a ceramic crucible and thermally analysed by the thermogravimetric analyser. High-purity nitrogen gas of 99% was used as protective gas at a flow rate of 100mL/min at 50°C for 20 minutes. The temperature range (T_α) was set from 50 °C to 900°C, with heating range (β) of 10, 20, 30, 50 and 100 °C/min. The experimental data was collected in the form of thermogravimetric curve and derivative thermogravimetric curve.

2.2.2 Kinetic Analysis

The kinetic parameters, in the form of activation energy (E_a) and pre-exponential factor (A), were determined using three different iso-conversional approaches namely Kissinger-Akahira-Sunose (KAS), Flynn-Wall-Ozawa (FWO) and Friedman (FR) to compare their accuracies in terms of regression (R^2). The formulas for each iso-conversional approach was listed as below:

Flynn-Wall-Ozawa (FWO):

$$\ln \beta = \ln \left(A \frac{E_a}{Rg(\alpha)} \right) - 5.331 - 1.052 \frac{E_a}{RT_\alpha} \quad \text{Eq. 1}$$

Kissinger-Akahira-Sunose (KAS):

$$\ln \left(\frac{\beta}{T_\alpha^2} \right) = \ln \frac{AR}{E_a g(\alpha)} - \frac{E_a}{RT_\alpha} \quad \text{Eq. 2}$$

Friedman (FR):

$$\ln \left(\frac{d\alpha}{dt} \right) = \ln [A \cdot g(\alpha)] - \frac{E_a}{RT_\alpha} \quad \text{Eq. 3}$$

2.2.3 Topology of ANN model

MATLAB 2022b was used to develop the computational model of ANN analysis. The Levenberg-Marquardt training algorithm was adopted to enhance a minimal mean square error in the prediction analysis. With the incorporation of *dividerand* function, the data division was segregated into 70% training, 15% validation and 15% testing. Tan-sigmoidal (tansig) and log-sigmoidal (logsig) were the two transfer functions employed for comparisons due to reported provision of the best mean square error and coefficient of determination upon reaching as high as 0.99 due to capability in adjusting the weight factor accordingly to minimize error. Mean square error was used to examine the performance as shown below:

$$MSE = \frac{1}{n[\sum_{i=1}^n (\lambda_i - \beta_i)^2]} \quad \text{Eq. 4}$$

The number of neuron for the model was determined through trial and error until the the coefficient of determination (R^2) was close to 1. R^2 which was the expression on the optimization between the actual output (t) and predicted output (o) values was demonstrated as:

$$R^2 = 1 - \left[\frac{\sum_i (t_i - t_o)^2}{\sum_i (o_i)^2} \right] \quad \text{Eq. 5}$$

The optimum set of values obtained from the optimal number of neurons, which was the first number of neurons to be constant with low MSE and highest R^2 were used to examine the data precision in terms of its proximity compared to the experimental data.

3. Results and Discussion

3.1 Accuracies of Different Iso-Conversional Method

Table 2: Regression Value of Different Iso-Conversional Method

Kinetic Model	FWO	KAS	FR
Samples	R²	R²	R²
TP	0.9840	0.9858	0.9444
WH	0.9811	0.9822	0.9242
TP:WH (20:80 + C)	0.9307	0.9380	0.7859
TP:WH (50:50 + C)	0.9818	0.9831	0.9731
TP:WH (80:20 + C)	0.9206	0.9311	0.8963
Overall Average	0.9672	0.9681	0.9158

From **Table 2**, in comparison among the three different iso-conversional methods, KAS was considered of having the highest accuracy due to its ability to achieve the highest R² value, hence the experimental E_a obtained through KAS method was further used for comparison with the simulated E_a in the latter section of 3.3.

3.2 Evaluation of Compability of ANN Model

Table 3: Optimal Number of Neurons and Minimum Average Mean Square Error Obtained

Samples	Number of Neurons		Average Mean Square Error	
	LL	TT	TT	LL
TP	7	7	4.805 x 10 ⁻⁴	4.441 x 10 ⁻⁴
WH	7	7	2.868 x 10 ⁻⁴	5.076 x 10 ⁻⁴
TP:WH (20:80 + C)	7	7	4.104 x 10 ⁻⁴	5.209 x 10 ⁻⁴
TP:WH (50:50 + C)	7	7	4.455 x 10 ⁻⁴	4.819 x 10 ⁻⁴
TP:WH (80:20 + C)	7	7	3.568 x 10 ⁻⁴	5.383 x 10 ⁻⁴

The number of neurons were varied from 2 to 8 for both the logsig-logsig (LL) and tansig-tansig (TT) transfer functions. From **Table 3**, it was observed that all the samples coincidentally achieved the optimal number of neuron at the 7th neuron. Another notable observation was that the average MSE obtained for both the transfer functions of LL and TT were comparably low and similar. Hence, to

discern which transfer function yields a greater accuracy, comparisons of the experimental E_a and simulated E_a for both transfer functions were executed in section 3.3.

3.3 Evaluation of Accuracy of Different Transfer Function

Table 4: Comparison of TT and LL Data

Transfer function	TT			LL		
	<i>EXP E_a</i> (kJ/mol)	<i>ANN E_a</i> (kJ/mol)	Percentage error (%)	<i>EXP E_a</i> (kJ/mol)	<i>ANN E_a</i> (kJ/mol)	Percentage error (%)
TP	108.00	108.47	0.71	108.00	108.01	0.38
WH	72.34	72.21	1.67	72.34	72.29	0.77
TP:WH (20:80 + C)	49.55	49.09	3.97	49.55	50.03	2.38
TP:WH (50:50 + C)	102.37	104.47	2.27	102.37	102.46	1.20
TP:WH (80:20 + C)	33.25	30.82	3.18	33.25	33.84	0.72
Overall Average			2.36			1.09

From **Table 4**, the overall average percentage difference of experimental E_a and the simulated E_a via LL transfer function is slightly lower than that of TT transfer function, therefore this has illustrated that the thermogravimetric curve simulated through LL transfer function is more closely fitted with the experimental thermogravimetric curve in contrast to TT transfer function. Hence, ANN model has been proven to be reliable and accurate through the demonstration of LL transfer function.

4. Conclusion

From the studies conducted, ANN has proven to be a highly suitable and accurate tools for predicting parameters of pyrolysis process. Such innovation enable engineer to gain deeper understanding of the underlying mechanisms governing pyrolysis accurately characterizing the kinetics, allowing the optimization of process conditions, yield improvements and development of a higher efficient pyrolysis system. Therefore, ANN can be confidently affirmed in offering a reliable framework for modelling kinetics of pyrolysis reactions.

FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Non-Invasive Diabetes Detection Using Gait Acceleration

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Abstract: Diabetes is a disease affecting various organs and systems as a result of increased blood sugar levels which can cause diabetic neuropathy and diabetic foot ulcers. Traditionally, invasive methods such as pricking the finger and measuring blood glucose are used to detect diabetes. However, invasive methods are inconvenient and can cause discomfort to patients. A different approach for identifying diabetes is through gait analysis where abnormalities in walking patterns can be analysed for diabetes early detection. Gait analysis is the study of human walking or running mechanics. Since diabetes does not show external or internal symptoms, gait data collected from gait sensors can provide useful information for detecting the presence of diabetes. Therefore, this project investigates diabetes detection with the acceleration of the hip, knees and ankles collected from wearable sensors using a lightweight feed-forward neural network (FFNN) model. To our best knowledge, no studies have investigated the use of gait acceleration for diabetes detection using hybrid models. Current research utilises hybrid models with non-gait data such as electrocardiography data and the Pima Indians Diabetes Database. The optimal accuracy of the proposed FFNN model is 89.91%. It was found that accelerations of knees and ankles reported the highest contribution to the model accuracy. This project delivers a non-invasive method for diabetes detection which can potentially replace conventional invasive methods, improving the convenience and quality of patient care. In addition, the outcomes proves that machine learning can be applied in real-time detection of diabetes, allowing for continuous diabetes monitoring through wearable sensors.

Keywords: diabetes, gait, machine learning, accelerometer

1. Introduction

Diabetes mellitus (DM) [1] is caused by the impairment of insulin or assimilation. It leads to the rise of blood sugar levels causing various diseases towards multiple organs and systems. One of the common neuropathies found in diabetic patients due to DM is diabetic neuropathy (DN) [2]. DN is a kind of nerve injury that typically affects the legs and causes tingling, numbness, burning, or pain feelings. These outcomes result in modifications to the patient's stride biomechanics, such as changes to ground reaction force (GRF), plantar pressure, muscle activity and kinematic patterns [3]. Besides that, diabetic foot ulcer (DFU) can develop as a result of long-term biomechanical alterations. Additionally, foot amputation might be required if DFUs are not taken care of [4].

Traditionally, invasive methods such as pricking the finger and measuring blood glucose are used to detect diabetes [5]. It might be difficult to diagnose and manage diabetes in older people since the patients may not show any obvious symptoms. Patients also prefer to stay away from invasive blood testing [6] since these procedures might be costly and uncomfortable [1]. Therefore, it is essential to replace invasive methods with non-invasive methods such as gait analysis for diabetes detection.

Gait analysis is the study of human walking or running mechanics. Since diabetes has no internal or external symptoms, the characteristics acquired through gait analysis might offer useful information for identifying the presence of diabetes [7]. Gait sensors can be used to obtain these gait features. The information gathered by the sensors may be utilised to assess irregular gait patterns and identify diabetes. The detection of diabetes uses a variety of gait sensors, including accelerometers, pressure sensors, and electromyography (EMG) sensors [8]. In this paper, diabetes detection with gait data is investigated using accelerometers.

Machine learning (ML) and deep learning (DL) techniques offer a cost-effective and efficient way to detect the risk of diabetes in patients as manual analysis of bio-signals and gait data might be difficult. The data collected during test trials might not always have a consistent pattern. In these circumstances, the analysis of raw signals does not yield much information from the data. Thus, many significant features can be obtained using feature extraction methods with the help of ML [9].

2. Materials and Methods

2.1 Data Description

The dataset in this paper was obtained from Sánchez-DelaCruz et al. [2]. The authors collected data from 10 subjects with abnormality in gait due to DN (30% female, 56.4 ± 4.17 years, 88.34 ± 12.18 kg, 1.62 ± 0.04 m, 7 ± 3.5 diabetic suffering years), and 5 healthy subjects (40% female, 37.4 ± 5.31 years, 76.6 ± 11.84 kg, 1.61 ± 0.04 m). The eligibility criteria included individuals of any gender, aged 15 years or older and capable of independent mobility. Before the actual experiment, the subjects had to perform two familiarisation attempts while wearing the sensors [2].

This dataset was collected using a sensor network that consists of five 3-axis ADXL-335 accelerometers linked to an Arduino MEGA-2560 card. The accelerometers were placed on the hip, on each ankle and on each knee [2]. The data were obtained from the accelerometers directly without any filtering. The measurements obtained from the accelerometers were unprocessed readings of the x, y and z axes. Thus, the dataset consisted of 6,000 samples from 15 subjects (4,000 samples for diabetic patients and 2,000 samples for healthy subjects) with fifteen input parameters (x, y and z data from five sensors) and one output (diabetic or healthy).

2.2 Sampling Criteria

The modelling and coding for this study are implemented using Python programming language and the Google Colab platform. Tensorflow and Keras libraries are used for developing ML models. A common method of splitting the dataset into training and testing data is the holdout method. The accelerometer dataset is shuffled randomly to avoid any order bias. Then, the dataset is divided with 80% allocated for training and 20% for testing, where the training and testing datasets have 4,800 and 1,200 samples respectively.

2.3 Data Preprocessing

The data are preprocessed before fitting the input parameters into the deep learning model. Normalisation is used in this dataset to improve the quality of data. Data normalisation is a crucial preprocessing step in machine learning and deep learning. Data normalisation can improve convergence, prevent overfitting and improve model performance. The approach used in data normalisation is to scale the data to a range from 0 to 1. This converts the values of all features to a

similar scale. Data normalisation is usually performed after dividing the data into training and testing data. This is to ensure the scaling factors are learned from the training data only and are not affected by the testing data.

2.4 Network Architecture

Figure 2.1 shows the structure of the proposed FFNN model. The input layer is connected to the FFNN structure. The FFNN structure consists of layers that are fully connected. After that, the FFNN structure is connected to the output layer for classification.

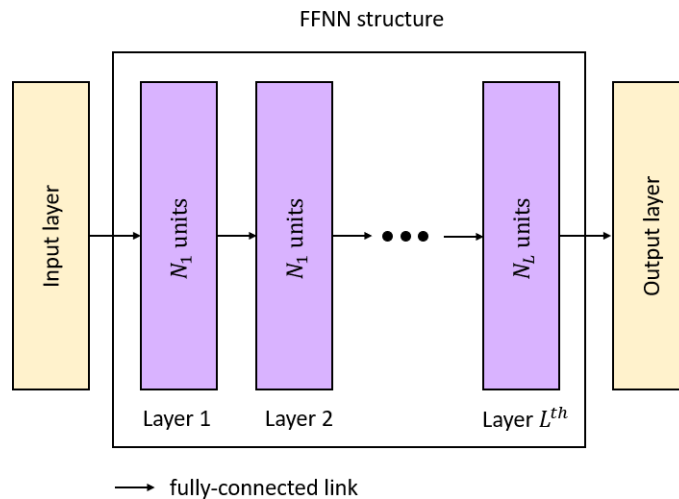


Figure 2.1: Proposed FFNN model.

2.5 Hyperparameter Tuning

Table 2.1 shows the parameters and hyperparameters of the proposed FFNN model. The optimiser used is Adam and the learning rate of 0.01 has been optimised to give the best performance for the model. In addition, the early-stopping callback function is used to terminate the training process if there is no improvement to the validation loss after 20 epochs. The best accuracy of the model is achieved using a batch size of 64 and 70 epochs determined by the callback function.

Table 2.1: Model parameters and hyperparameters.

Model	Parameters	Epochs	Optimiser	Learning rate	Batch size
FFNN	17,581	70	Adam	0.01	64

2.6 Model Performance Evaluation

The performance of the model is assessed using different evaluation parameters, such as accuracy, recall, precision, F1 score, Receiver Operating Characteristic (ROC) and Area Under the Curve (AUC). These features can be computed using a confusion matrix as shown in **Table 2.2**.

Table 2.2: Confusion matrix for two-class classification problem.

		Actual labelling	
		Non-diabetic	Diabetic
Predicted output	Non-diabetic	True negative (TN)	False negative (FN)
	Diabetic	False positive (FP)	True positive (TP)

Accuracy is the number of accurate predictions to all of the model's predictions [3], which can be computed using the confusion matrix in **Table 2.2**.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \quad \text{Eq. 1}$$

Recall or sensitivity describes the number of subjects accurately identified as positive-diabetic to the total number of subjects identified as positive, including the false predictions. The recall can be obtained using **Eq. 2** by referring to the confusion matrix.

$$\text{Recall} = \frac{TP}{TP + FN} \quad \text{Eq. 2}$$

Precision is the number of subjects accurately classified as positive to the total number of subjects classified as positive. **Eq. 3** shows the calculation of precision.

$$\text{Precision} = \frac{TP}{TP + FP} \quad \text{Eq. 3}$$

F1 score is a metric where recall and precision are combined. A compromise typically occurs between recall and precision. Hence, the F1 score shows how balanced these two metrics are in the model. F1 score can be calculated using **Eq. 4**.

$$\text{F1 score} = \frac{2TP}{2TP + FP + FN} \quad \text{Eq. 4}$$

Furthermore, the ROC and AUC are also used to assess a model's performance. The ROC curve is a visual illustration of the true positive rate (TPR) versus the false positive rate (FPR). The ROC curve of a perfect model would reach the top left corner of the plot. AUC is the area under the ROC curve which represents the overall model performance across all possible classification thresholds.

$$\text{TPR} = \frac{TP}{TP + FN} \quad \text{Eq. 5}$$

$$\text{FPR} = \frac{FP}{FP + TN} \quad \text{Eq. 6}$$

3. Results and Discussion

Table 3.1 shows the performance of the FFNN model. The FFNN model achieved 89.91% for accuracy, 90.76% for precision, 95.13% for recall and 92.21% for F1 score after being trained for 70 epochs. **Figure 3.1** shows the ROC curve and the AUC of the FFNN model. The ROC curve of a good model is close to the top left corner of the plot, indicating high true positive rates. AUC values range from 0 to 1, where an AUC above 0.9 is considered excellent. In **Figure 3.1**, the proposed FFNN model achieved a high AUC of 0.957 which indicates the model has good performance in distinguishing between diabetic and healthy classes.

Table 3.1: Performance of FFNN model.

Model	Accuracy (%)	Precision (%)	Recall (%)	F1 score (%)
FFNN	89.91	90.76	95.13	92.21

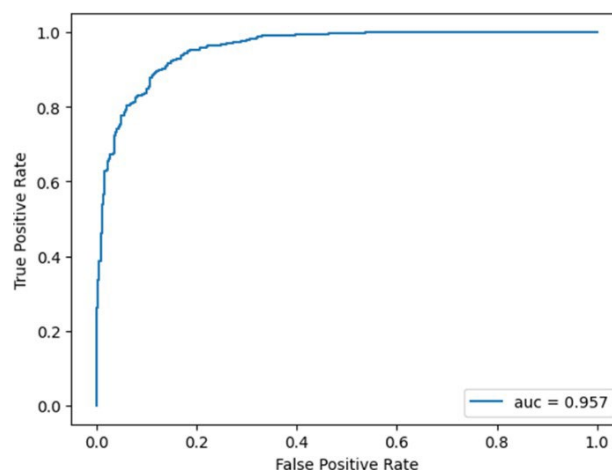


Figure 3.1: ROC curve and AUC of FFNN model.

4. Conclusion

Diabetes can cause health implications such as DN and DFUs. Gait analysis has recently been applied in diabetes diagnosis and early detection. The conventional invasive techniques of diabetes detection can potentially be replaced by gait analysis. Furthermore, machine learning can be used with gait data to learn complex patterns in the input data. Thus, this paper proposed a method to identify diabetes using a lightweight deep FFNN model with accelerometer data. The proposed FFNN model achieved 89.91% for accuracy, 90.76% for precision, 95.13% for recall and 92.21% for F1 score. Although the model achieved a high accuracy using gait acceleration, there is potential for greater improvements by utilising input data with muscle activation and muscle forces. By using gait data with muscle activation and muscle forces, the model can learn more about the relationship between diabetes and the engagement of muscles during walking. Thus, it is worth exploring diabetes detection with deep learning using dataset with different gait data types such as acceleration, muscle activation and forces.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Prediction of Potato Slice Moisture Content using Convolutional Neural Network (CNN)

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Abstract:

Traditional proximity analysis for assessing potato moisture content in the food industry is known for its time-consuming and destructive nature, where quality assessment demands meticulous testing, significantly slows production lines. This study explores the application of a Convolutional Neural Network (CNN) model as a non-destructive and efficient approach to address the limitations posed by slow production due to scrupulous testing and strict protocols. Its aim is to determine moisture content in potato slices, offering high-throughput screening capabilities. Methodologically, the study entails data collection through potato drying, meticulous dataset construction, and CNN model training. There are 462 number of datasets prepared which involve precise measurement of moisture content, rigorous image processing, and data augmentation to be classified into three moisture content ranges – targeted (<19%), medium (20%-49%) and high (50%-100%). The trained CNN model showcases exceptional outcomes by leveraging the Adam optimizer over 50 epochs, resulting in an impressive 96% accuracy in predicting the moisture content of potato slices. It exhibits minimal error compared to established approaches, highlighting the substantial potential of CNN in ascertaining potato moisture content, signifying a significant advancement in food quality analysis methodologies. Furthermore, by automating sorting systems to identify and reject substandard products, CNN significantly contributes to waste reduction and improved efficiency through the development of smart automation systems, contributes to diverse food processing contexts, serving as a roadmap for future research.

Keywords: Potato Moisture Content, Convolutional Neural Network, Food Science, Machine Learning

Introduction

Solanum Tuberosum, also referred to as the russet potato or russet Burbank, is widely acknowledged as a prominent agricultural crop, comparable to other key staples such as corn, rice, wheat, and sorghum [1]. It has been widely accepted and included as a fundamental component in numerous traditional culinary practices. Processing is necessary to prolong the shelf life of potato products. An essential method employed in potato processing is moisture removal or drying. Several methods for drying food include solar drying, osmotic drying, microwave drying, and convectional hot-air drying. A processed potato must undergo an examination to determine the moisture content percentage. This procedure primarily involves proximate analysis, which can be highly time-consuming, taking up to 70 minutes for a single test. Additionally, it is important to note that this method is destructive, meaning that the sample will be irreversibly altered or destroyed during testing [2]. The objective of this study is to build a prediction method of measuring moisture content of potato using Convolutional Neural Network (CNN). CNN presents a viable solution for achieving this objective. This method offers a non-intrusive and effective approach for measuring the moisture content of potato slices, allowing for the analysis of a large quantity of samples with a rapid rate of processing. Scientific research has shown that CNNs are useful in assessing the moisture level of potatoes [3].

1. Materials and Methods

The potato drying process started with the procurement of russet potatoes from a local market, aiming to gather a dataset comprising a minimum of 300 photographs. Five potatoes weighing between 450g and 500g each were deemed sufficient to generate the desired images. Precision slicers were utilized to create potato slices with a thickness ranging from 0.8mm to 1mm, ensuring uniformity across the dataset. Pre-treatment of the potato slices involved blanching in a water bath at 105°C for a maximum of 20 seconds, as suggested by [4] to prevent undesired curling during drying. Following pre-treatment, individual potato slices underwent moisture content analysis using a tray dryer set at 60°C for 7 hours. Slices were dried in a tray dryer set at 55°C with an airflow of 1.8m/s, following recommendations from [5]. Periodic weight measurements, taken every 10 minutes, tracked moisture content loss over time. The moisture content (MC) is calculated by deducting the wet weight with the weight after drying. The 462 sorted dataset is divided into three moisture content categories, High (100-50% MC), Medium (49-18% MC) and Targeted (<17% MC), feed as an input into the CNN. The dataset is then partitioned into training data and a validation set using a 60:20:20 split, with 60% for training, 20% for validation, and 20% for testing.

The classified data underwent a rigorous screening process aimed at identifying and eliminating photos with significant noise, such as blurriness or high contrast which involved adjustments to hue, brightness, and shadow correction to enhance image quality. **Figure 1** shows the different between two dried potato images, before and after the image processing.

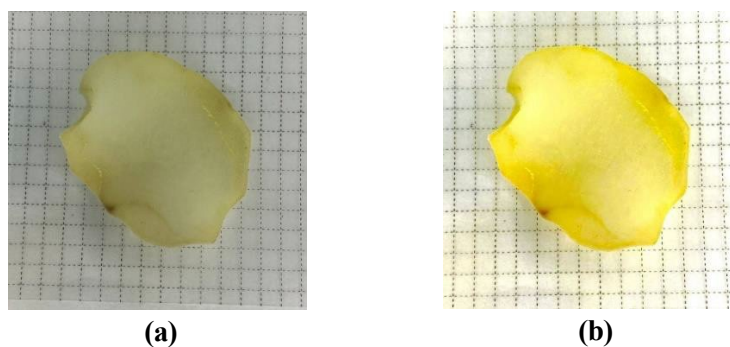


Figure 1: Dried potato image taken (a) before and (b) after the image processing

The first neural network method involves setting up a Convolutional Neural Network (CNN) using Keras, a high-level Python deep learning library that runs on top of TensorFlow (TF) for image classification within a Jupyter Notebook environment [6]. There are seven steps involves in CNN using Keras in this work; import the libraries, import the dataset, data augmentation, labelling and data mapping validation, building CNN model, CNN model compilation and data training and validation. Two optimizers, Adam and RMSprop, are chosen during CNN training for their effectiveness in updating neural network attributes. Adam optimizer or Adaptive Moment Estimation optimizer is an extension of stochastic gradient descent algorithm that is designed to update the weights of a neural network during training. RMSprop or Root Mean Squared Propagation in the other hand restricts the oscillations in the vertical direction of learning in the model. The learning rate is 0.001 and 0.0001 for Adam optimizer while 0.001 and 0.1 for RMSprop. Both are trained with 25 and 50 epochs.

The CNN structure as shown in **Figure 2** consists of several layers of feature extraction such as convolution and max pooling. The first convolutional layer consists of 16 filters and a kernel size of (3, 3). The purpose of this layer is to detect and analyse patterns within the incoming images. A max pooling layer with a pool size of (2, 2) is added after the convolutional layer. This layer performs dimensionality reduction on the data, preserving important characteristics and facilitating effective feature extraction. Another convolution layer with 32 filters and max pooling layer with identical setting with the first is repeated to enhance the feature extraction process. The classification layer consisted of flattening layer and dense layer; to facilitate the transition from the convolutional layers to the fully linked layers and to capture captures intricate patterns acquired from the convolutional layers, respectively. The dense layer, serving as the output layer, comprises 3 neurons that correspond to the number of classes in the classification test, namely 0, 1, and 2, representing the categories of targeted, medium, and high.

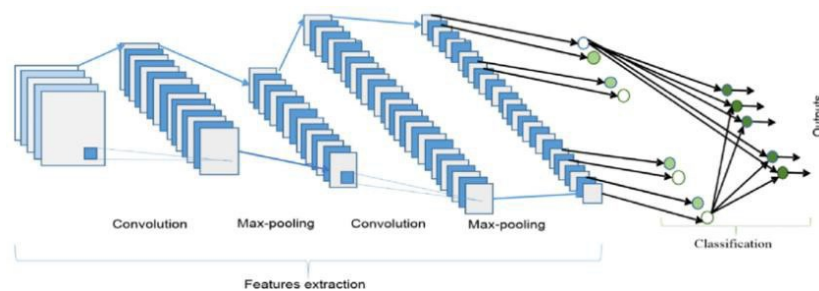


Figure 2: CNN Structure

2. Result and Discussion

Evaluation of model performance in machine learning involves monitoring metrics like accuracy and loss on both training and validation sets. Minimizing the loss function is a primary goal, representing how well the model performs the task. Validation loss assesses the model's generalization to unseen data. **Figure 3** illustrates the model's effort to minimize both training and validation losses. Overfitting, where the model excels on training data but poorly on new data, is indicated by low training loss and high validation loss, highlighting the importance of generalization. Therefore, a good model is associated with a lower validation loss. It is essential to monitor both training and validation loss to strike a balance and ensure that the model is learning the underlying patterns in the data without memorizing noise or overfitting.

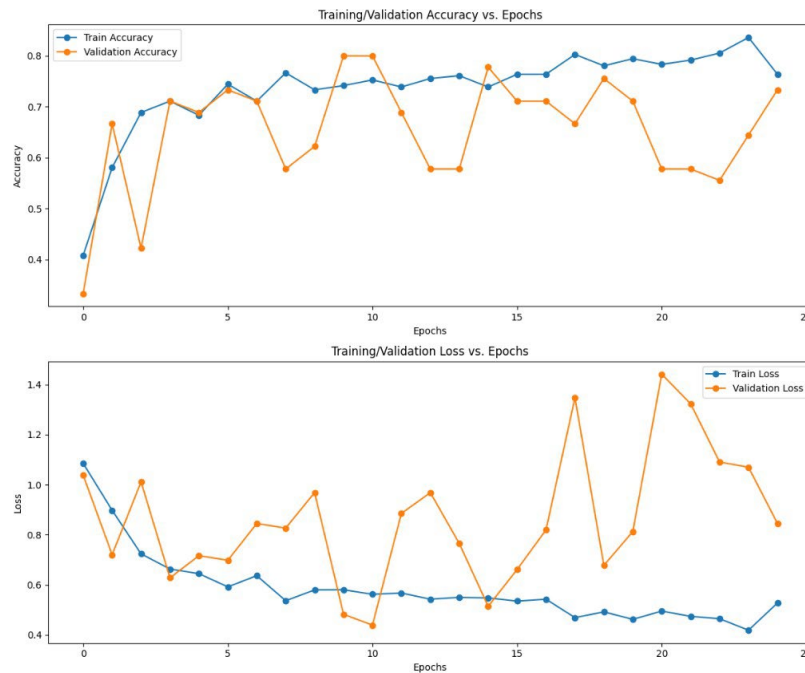


Figure 3: Training/Validation of accuracy and loss against epochs

The comparison between two optimisers, Adam optimiser and RMSProp optimiser are shown in **Table 2**. The Adam optimizer, configured with a learning rate of 0.001 and trained for 50 epochs, yielded competitive results. The model achieved a high test accuracy of 0.9556, indicating its effectiveness in predicting outcomes. Additionally, the low test loss of 0.1362 suggests accurate predictions aligning closely with actual outcomes.

Table 2. Optimisers performance

Optimizer	Epoch	Learning Rate	Test Accuracy	Test Loss	Validation Accuracy	Validation Loss
Adam	25	0.001	0.7778	0.3240	0.8000	0.4997
Adam	50	0.001	0.9556	0.1362	0.6667	0.9405
Adam	50	0.0001	0.9556	0.1528	0.6889	1.1438
Adam	25	0.0001	0.8889	0.3360	0.7111	0.8844
RMSprop	25	0.001	0.9111	0.2978	0.7333	0.8453
RMSprop	50	0.001	0.8889	0.3000	0.6222	1.0695
RMSprop	50	0.1	0.8222	0.2577	0.6444	1.0073
RMSprop	25	0.1	0.3333	1.0986	0.3333	1.0986

3. Conclusion

The study to built the CNN model in predicting the The study investigated the performance of machine learning models, particularly focusing on the optimization algorithms Adam and RMSprop, in predicting outcomes based on varying hyperparameters. The findings revealed significant differences in model performance, with the Adam optimizer demonstrating superior accuracy and convergence speed compared to RMSprop. To enhance the relevance and impact of this study, several practical suggestions are proposed. Firstly, augmenting the dataset by integrating various potato varieties and processing techniques can improve prediction accuracy. Additionally, conducting thorough evaluations of hyperparameters and regularly assessing model performance can enhance precision in moisture content forecasting. Diversifying research beyond potato slices and creating physical prototypes to

demonstrate model effectiveness offer promising directions for future investigation. Lastly, staying updated with evolving technologies ensures research remains at the forefront of technical developments in the field. These strategies aim to bridge the gap between theoretical findings and practical applications, ultimately improving the study's accessibility and effectiveness.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Properties prediction of green seawater concrete with machine learning algorithm

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Abstract: The extensive use of freshwater in the manufacturing of concrete building material, places a major stress on current clean water applications and poses an environmental risk. Because Malaysia is surrounded by seawater, it has the potential to be used in the building construction without the need for desalination. Artificial neural networks (ANN) are utilised in this study to build prediction models for the fresh and hardened properties of seawater concrete. The data bank is created from collecting previous published experimental data with curing variation, cement types, and concrete mix proportions, as their inputs; and the outputs are slump (Model SCS), 28-day compressive strength (Model SCCS), and 28-day rapid chloride permeability (Model SCCP). Multilayer feedforward neural networks with one input layer, one hidden layer, and one output layer comprise the ANN models. With coefficients of determination larger than 0.9, root mean square error less than the maximum value, and mean absolute percentage error less than 10%, all of the ANN models are valid and adequate, with Model SCS performing least well and Model SCCP performing the best. Fly ash (FA) content, w/b ratio, and cement content impact slump; compressive strength, blast furnace slag (BFS) content, and seawater content influence compressive strength; and w/b ratio, silica fume (SF) content, and fine aggregate content effect Model SCCP. This study shows that ANN models are appropriate for future concrete research and should be used to increase industry confidence in using seawater concrete.

Keywords: Seawater concrete, machine learning algorithm, artificial neural network, properties prediction

1. Introduction

Along with steel and wood, concrete is one of the primary building materials used in the construction industry. When it comes to construction, concrete is frequently the material of choice since it is less expensive, takes less upkeep, and is more adaptable and durable than other options. Because of these benefits, concrete has become more and more popular in the construction sector, and

considerable resources and work have gone into making the best use of it. Concrete construction has become more common as a result of urbanization and population growth, as buildings are required to house a growing population and meet the demands of a greater standard of living. However, the conventional method of creating concrete has long been considered unsustainable due to the rapid depletion of natural resources induced by the usage of those materials in the production process. In order to address this problem, a lot of effort has been focused on creating "green" or sustainable concrete over the past few decades. This has involved conducting extensive research on alternative raw materials to determine whether they can be used to produce concrete that is suitable for its intended use. The use of seawater, which is more plentiful than freshwater, for mixing concrete has been the subject of more research in recent years due to its potential benefits. In addition to lowering the cost of concrete structures, the promotion and usage of seawater-mixed concrete can help to alleviate the environmental problems related to concrete production. Conclusively, the idea of using seawater in concrete mixing appears to hold considerable potential for both economic and environmental benefits. Projects near coasts and other maritime regions may find this method particularly alluring.

The majority of the concrete data generated by research trials are not employed for optimization because they have already served the objectives of the study. On the other hand, by optimizing the concrete with the data, users may forecast and optimize the concrete by establishing the relationship between different elements and the qualities of the concrete. It is not practical to examine every mix proportion modification through tests to determine the qualities of the concrete due to time and financial constraints. To get the intended outcomes in this situation, the prediction model can be utilized to design the concrete using fewer relevant and readily available data. Furthermore, without computer assistance, processing all the data would be too laborious and challenging for human brains to handle; so, statistical modeling is utilized to help humans optimize the concrete. Artificial neural networks (ANN), k-nearest neighbors (KNN), and response surface methodology (RSM) are widely used techniques for creating concrete prediction models due to their high accuracy and practicality.

Because casting and curing the concrete don't require additional expenses or time, prediction models are more economical and time-efficient for doing concrete research. Fewer studies, nevertheless, concentrate on creating prediction models to forecast the characteristics of concrete combined with seawater. The prediction model created by [1] to enhance the characteristics of silicomanganese slag concrete by the application of fly ash and silica fume is one of the most current research endeavors. Hwang and Yeon [2] additionally improved the mix proportion of fly ash-incorporated seawater-mixed concrete to increase its permeability and compressive strength. In order to maximize the impact of seawater compositions on the characteristics of seawater-mixed concrete, additional research is required due to the paucity of existing studies, as well as the development of more prediction models. Therefore, additional study is required to develop prediction models that forecast the fresh and hardened characteristics of seawater-mixed concrete. By doing so, more insights into seawater concrete can be gained, which in turn will promote the use of seawater-mixed concrete in the more environmentally friendly concrete sector. In order to gain a deeper understanding of how important parameters affect the properties of seawater-mixed concrete, the primary goal of this research is to create prediction models by gathering data that can be used to forecast the fresh and hardened properties of the material using non destructive method of ANN.

2. Model Development with ANN

In order to create the prediction models, information must be gathered from reliable sources on the following parameters: slump, 28-day compressive strength, 28-day fast chloride permeability, curing

type, cement type, concrete mix proportions, and so on. Seawater utilized for data collection must have chemical compositions that closely resemble ASTM D1141-98 [3]. Before the data are used to create the ANN models, they must first undergo pre-processing, which includes partitioning, normalizing, fine-tuning, and filtering outliers or incomplete data. An input layer, a hidden layer, and an output layer make up the multilayer feedforward neural network (ANN) utilized in this investigation. The output layer of the ANN uses a linear transfer function, while the hidden layer uses a hyperbolic tangent sigmoid transfer function. The Levenberg-Marquardt algorithm is used to train the ANN models, and the coefficient of determination, root mean square error, and mean absolute percentage error are used to assess the models' performance. Following the development of the models, the Connection Weight Approach is used to assess the relative importance of the parameters. The top three parameters are then chosen for further parametric analysis. Model SCS, Model SCCS, and Model SCCP are the names of the ANN models created to forecast the slump, compressive strength, and fast chloride permeability of seawater concrete, respectively. A total of 173 data points have been gathered, of which 115 are pertinent to the Model SCS, 142 to the Model SCCS, and 50 to the Model SCCP.

3. Results and Discussion

It is clear from Table 1's observations and performance metrics that Model SCCP performs and is accurate the best, followed by Model SCCS and Model SCS. Additionally, it has been demonstrated that R, R², RMSE, and regression plots are adequate and suited for assessing the effectiveness of artificial neural networks (ANNs) and facilitating model comparisons. In terms of MAPE, the Model SCS, Model SCCS, and Model SCCP have respective values of 6.67%, 5.85%, and 6.75%. Given that the MAPE for each model is significantly lower than 10%, this further demonstrates the applicability of the ANN models. It has been noted, meanwhile, that Model SCCS has the lowest MAPE, but Model SCCP has the greatest MAPE, followed by Model SCS by a narrow margin. This suggests that although MAPE can effectively assess the ANN models' validity, it is unsuitable for evaluating the accuracy of several ANN models in this particular research. Additionally, there is little variation in MAPE across the generated ANN models.

Of the three ANN models that were created using R, R², and RMSE, Model SCS performs the worst. This could be because the slump of seawater concrete is extremely sensitive to environmental conditions. For instance, the slump of the concrete will be impacted by the temperature and humidity of the mixing area. The results will also be influenced by technical factors, such as the length of time spent mixing the concrete, the reference standards for the slump test, and the timing of the test. This is because evaporation will cause a higher temperature and longer time to reduce the fresh concrete's moisture content. The results of the slump test might also be influenced by the kind and moisture content of the material utilized. Water absorption varies among materials; the droop will lessen as a result of the lower moisture content in materials with higher water absorption.

Table 1: Performance of ANN Models

Model	R	R ²	RMSE	MAPE (%)
SCS	0.9571	0.9160	10.2 mm	6.67
SCCS	0.9733	0.9472	3.68 MPa	5.85
SCCP	0.9932	0.9865	122 C	6.75

The top three crucial parameters of the Model SCS, Model SCCS, and Model SCCP have all undergone parametric analysis to examine the connections between the parameters and the corresponding outputs. The results have all been confirmed and backed up by earlier research. In

conclusion, adding fly ash to concrete improves its workability; however, this benefit diminishes as the percentage of fly ash replacement rises. This is because FA contains small, smooth particles that displace water from the cement by reducing friction between the particles. Additionally, it is discovered that the slump of seawater concrete rises with a greater w/b ratio, falls with a larger cement concentration, and diminishes at a lower w/b ratio and higher cement content. This is mostly because there is less friction between the particles when the cement percentage is low and the w/b ratio is high, which results in an increased free water content. Additionally, a lower w/b ratio accelerates the hydration process, which decreases workability.

When the cement content rises or the seawater content falls, seawater concrete's compressive strength increases. This is mostly caused by the faster rate of hydration that occurs when the w/b ratio drops. This leads to an increase in the creation of hydration products, such as ettringite, which fill the gaps in the concrete and give cementation force to bind the particles together (C-S-H gel). Additionally, when blast furnace slag replaces cement in seawater concrete, the lowest compressive strength is obtained at 50% replacement percentage. This is because the compressive strength of the concrete diminishes as the slag replaces the cement. Because of its finer particles, BFS can aid in filling up voids in the concrete; but, because of its slower pozzolanic reaction, which leads to less hydration product development, the BFS's compressive strength is still lessened. Furthermore, because of the slower rate of hydration, the permeability of the seawater concrete increases with a larger w/b ratio. Less gaps are filled as a result of the decreased hydration products, which results in less compact and dense seawater concrete. Because it contains larger pores, the seawater concrete is therefore more permeable. The permeability of the seawater concrete is effectively reduced by silica fume and fine aggregate, which are components with small particle sizes that can become trapped in the voids of the concrete and seal the pores. Additionally, the silica fume's huge surface area accelerates the process of hydration, raising the density of the concrete. In summary, the permeability of seawater concrete is reduced by an increase in the fine aggregate content and replacement percentage of silica fume.

4. Conclusion

The research's objectives and aims have been successfully attained, and the results have been demonstrated to be logical, reasonable, and satisfactory. Through the use of prediction models created with ANN, this research can help further our understanding of the behaviors of seawater concrete. This project should demonstrate how technological advancements have made it possible to study the complicated features of seawater concrete and how ANN models, with their capacity for prediction, are a suitable tool for concrete research. The present study demonstrates that the qualities of seawater concrete may be enhanced through the use of artificial neural networks (ANNs). This finding could stimulate further research on seawater concrete and serve as a foundation for the industry's adoption of seawater concrete.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Quanto: Algorithmic Trading with Deep Learning

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Abstract: Algorithmic trading has been a rising trend in recent years following the rise of technology. Data scientists from all around the world have been trying their best to prove that market trend and price is indeed predictable via big data analysis, machine learning and deep learning technology. While it was an extremely complicated task to tackle due to the limitation in technology in the past, this task has become more feasible than ever following the exponential growth in machine learning and deep learning technology. All these had led to the increasing popularity of algorithmic trading. In fact, most of the volume of stock traded daily in the market is contributed by algorithms instead of manual traders who execute the trades. However, though the volume is tremendous, a big portion of these trading volumes are coming from big corporates, especially hedge funds, insurance firms and investment banks. This monopolisation has led to a lack of resources and innovation in the field of algorithmic trading. In this report, you will see how Quanto, an intelligent algorithmic trading application, makes state-of-the-art trading algorithms more accessible than ever to the community. We will be highlighting the current issues faced by algorithmic trading and discussing how Quanto can step in and expose algorithmic trading to more people, leading to a larger community and hence escalating the potential of innovation in this field. This report will also include all the system details like system architecture, requirements and use case diagrams for a comprehensive understanding of how the overall system works. In short, Quanto wants to revolutionize the field of algorithmic trading by incorporating machine learning and deep learning technology into commercial trading algorithms. In the end, the users should have a clear understanding of the direction where Quanto is heading and hopefully be intrigued by the unlimited potential of algorithmic trading.

Keywords: Algorithmic Trading, Trading Bot, Automated Trading, Stock Prediction, Market Prediction, Trend Prediction, Sentiment Analysis

1. Introduction

Algorithmic trading has been gaining a lot of traction in today's fast-paced stock market trading environment. However, due to its complexity in execution, algorithms, especially great algorithms that leverage machine learning and deep learning technology, are more often than not, exclusive to institutional traders like hedge funds, insurance firms and investment banks [1]. While being exclusively used by institutional traders, algorithmic trading has witnessed an exponential growth in

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demand from the retail end [2]. Quanto is here to bridge the gap by bringing this exclusive service to the public, aiming to increase the awareness of and exposure to algorithmic trading among the public.

By increasing the exposure of the community to algorithmic trading, Quanto intends to solve one of the main problems in trading – human emotion. According to an article published by The Edge Markets, due to the increasing popularity of investing and trading during the COVID-19 pandemic, there is an exponential growth in the number of retail traders and investors [3]. However, due to the lack of experience in this field, a lot of them tend to suffer losses due to emotions, especially when the market is volatile. Algorithmic trading could minimize the influence of human emotion in trading and vastly reduce the need for constant monitoring of the market conditions by traders [4].

Another problem that algorithmic trading faces currently is the lack of resources and innovation in this field. There are not many players in the field of algorithmic trading, hence the lack of innovation. Quanto can solve this problem by incorporating advanced deep learning technology into trading algorithms and providing access to the public via a user-friendly and intuitive user interface. In the coming sections, we will delve deeper into how Quanto can revolutionize algorithmic trading and what exactly will be done in order to achieve its ambition.

2. Materials and Methods

2.1 System Architecture

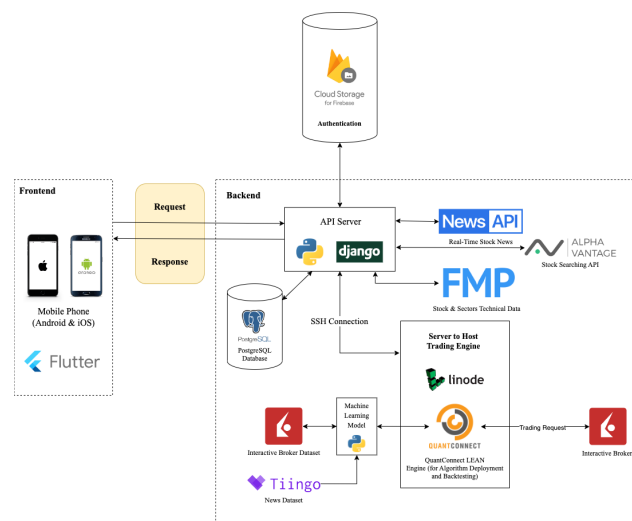


Figure 1: Quanto's System Architecture

Flutter is used as the front-end framework due to its cross-platform capability. The backend server is built with the Django framework primarily using Python as the programming language. Firebase Cloud Storage is used to store and encrypt users' data for authentication purposes. Then, PostgreSQL is the database of choice to due its excellent integration with the Django framework. There are 3 third-party APIs used in Django for different functions, News API is used to fetch daily financial news, Alpha Vantage is used for searching up-to-date stocks' ticker symbol, and FMP is used to fetch real-time stock and sector technical information.

Then, the Django server is connected to another Linode server via SSH connection, to gain access to the powerful algorithmic trading engine built upon the open-source QuantConnect's LEAN Engine. This trading engine hosted powerful trading algorithms that leverage deep learning technologies and is capable of making real-time trades by sending requests to the Interactive Broker via its API. The deep learning model is trained with the Interactive Broker real-time dataset and Tiingo News dataset.

2.2 System Modules

There are altogether 3 main modules that build up Quanto, they are Algorithms Discovery Module, Algorithms Deployment Module and Stock Technical Dashboard. Algorithms Discovery Module allows users to browse through different trading algorithms, view the technical details of each algorithm and use one of the flagship features of Quanto, which is to perform backtesting with the selected trading algorithms. With backtesting, the user is able to see how well the trading algorithms perform in the past based on the time period chosen by the user, it could be 1 year, 5 years or even 10 years and more.

After discovering the right algorithms, the Algorithms Deployment Module essentially allows user to perform live and paper trading deployment (live trading is simulated with virtual cash) and check real-time deployment status and its performance via a performance dashboard. Lastly, the stocks technical dashboard will show the stocks technical summaries page, real-time stocks chart and stocks news page to the users.

2.3 Trading Algorithms

Quanto is an intelligent algorithmic trading application that aims to commercialize trading algorithms that are integrated with deep learning technology. While having a few selected prebuilt trading algorithms built into Quanto for public access, Quanto is also equipped with three proprietary trading algorithms, including a TensorFlow Neural Network Model for stock price prediction, a Multilayer Perceptron Model for trend prediction and a Sentiment Analysis Model to predict the stock movement based on the market sentiments. The TensorFlow Neural Network model is chosen to predict the stock prices based on the input of previous stock prices. According to previous research, it is proven that the TensorFlow Neural Network model is great at processing sequential inputs like stock prices, which are time-series data. With proper optimization through the built-in optimizer like the Adam optimizer, we can build a model that can predict stock prices with high accuracy.

On the other hand, the Multilayer Perceptron Model is flexible in terms of its ability to include various stock technical indicators as the input parameters, adjust itself accordingly and generate a decent outcome. The Sentiment Analysis Model has been proved in various studies to be effective due to the high correlation between stock trend movement and market sentiments. With high-quality sentiment analysis, we can better predict the trend of the stock market with higher accuracy.

The output of these deep learning trading algorithms will help us to make decisions on which stocks to trade, at what criteria, and when to sell the current holdings. This proprietary algorithm together with the ML model will then be hosted on a server to connect and trade with Interactive Broker via its API.

3. Results and Discussion

3.1 Results

Backtesting was conducted on three trading algorithms, this allow us to properly access the performance of the algorithms with historical data and compare them to the performance of SPY Exchange-Traded Funds (ETF). The TensorFlow Neural Network Model showed a robust total return of 21.78% from January 1, 2020, to January 1, 2023, outperforming the average SPY returns of 9.65% for the same period. On the other hand, the Multilayer Perceptron Model yielded a more modest total return of 5.43%, falling below the SPY average. The Sentiment Analysis Model, tested with various equities (including Tesla, Microsoft, Goldman Sachs and more) from January 1, 2017, to January 1, 2023, achieved an impressive 71.50% return, significantly exceeding the SPY's average return of 12.89%. Overall, these algorithms exhibited varying degrees of success, with the Sentiment Analysis Model showing particular promise in predicting stock news sentiments and price movements.

3.2 Discussions

For the Tensorflow Neural Network model, the profit generated throughout the backtesting period is robust and consistent, displaying great potential for a profitable trading algorithms. However, the Multilayer Perceptron Model produces subpar results, speculating on the reasons for this outcome, the suboptimal performance may be attributed to the number of indicators in use. In this algorithm, the technical indicators used here are close prices, volume, RSI, trend, accumulation/distribution, stochastic oscillators, and KAMA, which may confuse the model and hence impact the outcome of the model. Fine-tuning parameters, selecting optimal features, and filtering high-quality indicators could potentially enhance the effectiveness of this model. Meanwhile, the Sentiment Analysis Model shows an outstanding 71.50% return, despite its successes, it is advisable to conduct extensive testing in a paper trading environment before deploying the algorithm live and trading with real money. This precautionary step ensures the robustness of the models in real-world scenarios and reinforces the need for careful evaluation before implementing them in actual trading environments.

3.3 Tables

Table 1: Trading Algorithms and Their Return

Item	Algorithms	Backtesting Period	Return (in %)
1	Tensorflow Neural Network	Jan 01, 2020 – Jan 01, 2023	21.78
2	Multilayer Perceptron	Jan 01, 2020 – Jan 01, 2023	5.43
3	Sentiment Analysis	Jan 01, 2017 – Jan 01, 2023	71.50

4. Conclusion

We envisioned to revolutionize the field of algorithmic trading via Quanto by commercializing trading algorithms with advanced machine learning and deep learning technology incorporated into it. We reviewed state-of-the-art algorithms in stock market prediction and sentiment analysis to understand the current trend so that we can select the right algorithms to use for developing Quanto’s proprietary trading algorithms. Quanto had achieved all the objectives set in the beginning and fulfilling all the requirements gracefully, demonstrating its strength and effectiveness as a user-friendly algorithmic trading platform.

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Rabbit Breeds Classification using CNN

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Abstract: This article presents a focused study on Rabbit Breed Classification using a Convolutional Neural Network (CNN). The central problem addressed is the need for a precise system to categorize rabbit breeds based on photos. The primary objectives involve developing a CNN algorithm for accurate classification and evaluating its performance. The study encompasses collecting a dataset of rabbit images and follows standard procedures including data collection, preprocessing, model training, and evaluation. The key findings indicate the CNN algorithm's effectiveness, achieving a high accuracy level of 98.13% in classifying rabbit breeds. The study also identifies trends in the algorithm's performance, particularly noting the influence of the number of training epochs on accuracy. The discussion suggests potential improvements, proposing the exploration of advanced techniques like transfer learning and data augmentation to enhance the CNN algorithm. In conclusion, this study successfully demonstrates the application of a CNN algorithm for rabbit breed classification, showcasing its potential with a remarkable accuracy of 98.13%. The study concludes by recommending further research to explore the algorithm's application in other animal classification problems, highlighting the broader implications of the proposed approach.

Keywords: Classification, Convolutional Neural Networks, Rabbit Breed

1. Introduction

Rabbits have been raised for diverse purposes, such as companionship, meat and fur production, research, and exhibition. The identification and categorization of rabbit breeds are crucial due to the diverse benefits these animals provide. With rabbits being a viable option for sustainable production, understanding various rabbit breeds and breeding methods is essential for the continued expansion and development of the rabbit business. Different rabbit breeds have been developed over time for specific purposes, each possessing unique characteristics that make them well-suited for particular roles [1]. Accurately identifying and categorizing rabbit breeds is crucial, given their potential for sustainable production, research, and exhibition.

1.1 Problem statement

Understanding the classification of rabbit breeds poses a considerable challenge due to the extensive variety of breed variations and color patterns [2]. This complexity can lead to difficulties in accurate identification, potentially impacting critical decisions in the breeding market, such as mating and genetic selection [3]. Due to these challenges, it becomes evident that a robust rabbit breed classification system is essential. This necessity is further underscored by the proven superiority of Convolutional Neural Networks (CNN) over other methods. For instance, CNN achieves an impressive accuracy of 93.57%, surpassing the 82% accuracy obtained with Support Vector Machines (SVM) on the same dataset [4]. Consequently, the adoption of CNN for rabbit breed classification promises higher accuracy results, addressing the challenges faced in the industry.

1.2 Objectives

To develop a prototype of Rabbit Breed Classification using Convolutional Neural Network (CNN)

2. Methodology

2.1 Research Methodology Framework

The research methodology framework in **Figure 1** consists of three phases aimed at developing a Convolutional Neural Network (CNN)-based classification system for rabbit breeds. In the preliminary phase, a foundational study is conducted to comprehend the problem statement, acquire the necessary knowledge, and collect rabbit breed datasets. Shifting to the development phase, strategic planning guides the design of an efficient CNN prototype, implemented to effectively classify diverse rabbit breeds. The final evaluation phase scrutinizes the CNN algorithm's accuracy, utilizing data training and testing to refine the model. Performance evaluation yields crucial insights into the prototype's efficiency, identifying areas for improvement or optimization.

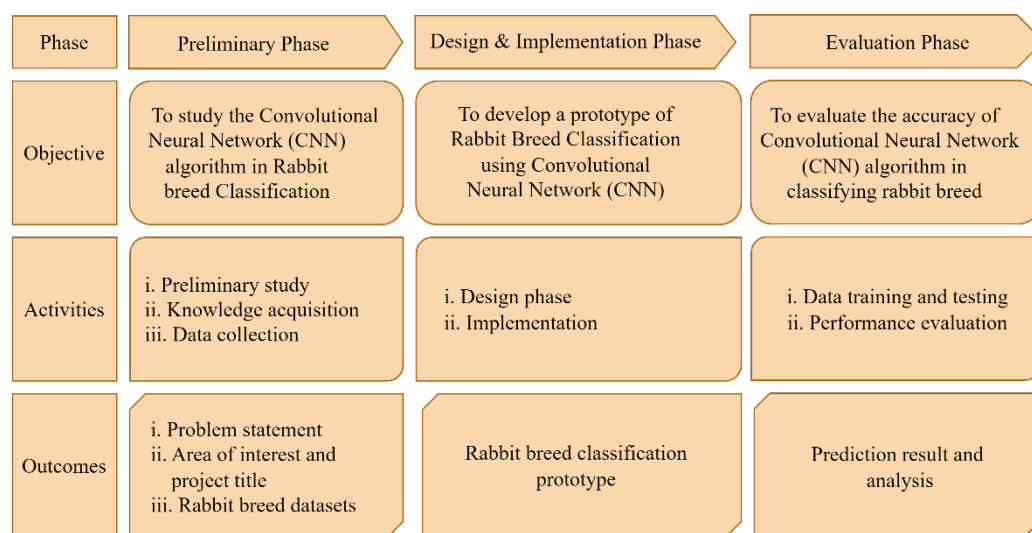


Figure 1: The Research Methodology Framework of The Project

2.2 Methods

The system architecture of a model designed for rabbit breed classification starts with a database that undergoes image pre-processing, which includes normalization, resizing, and data augmentation. The pre-processed images are then split into training, testing, and validation datasets. These datasets feed into the Convolutional Neural Network (CNN) model development phase, which consists of a

training phase using the training and validation datasets, and a testing phase using the testing dataset. **Figure 2** shows the system architecture of rabbit breed classification using CNN.

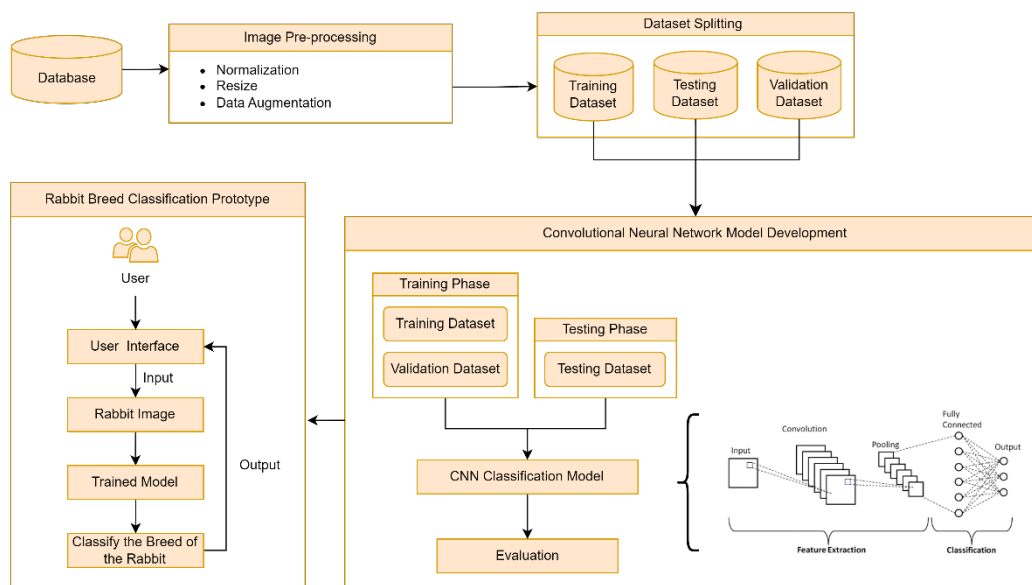


Figure 2: System Architecture of Rabbit Breed Classification Using CNN

3. Experiment and Result

3.1 Experiment settings

In the conducted experiments, two distinct sets of parameters were evaluated to assess their impact on the performance of a machine learning model. Both experiments utilized a dataset with a fixed size of 4500 instances and belonged to a classification problem with five classes. The data was partitioned into training, validation, and testing sets using different splitting percentages. In Experiment 1, an 80:5:15 ratio was employed for training, validation, and testing, respectively. On the other hand, Experiment 2 adopted a 70:15:15 ratio for the same purpose. Additionally, the experiments varied in the number of epochs, a hyperparameter that determines the number of times the entire dataset is processed by the model. Experiment 1 was conducted for 10, 30, and 50 epochs, while Experiment 2 replicated these epoch values to observe their impact on model performance. The goal of these experiments was to analyze how changes in the splitting percentage and the number of training epochs influence the model's ability to generalize and perform well on unseen data. This systematic exploration of parameters helps in understanding the trade-offs and finding an optimal configuration for the specific classification task at hand. **Table 1** overview the settings of the experiments.

Table 1: Experiment Settings

Parameter	Experiment 1	Experiment 2
Dataset size	4500	4500
Splitting percentage (Training: Validation: Testing)	(80:5:15)	(70:15:15)
Epoch	10, 30, 50	10, 30, 50
Number of classes	5	5

3.2 Results

Table 2 presents test accuracy and test loss values for two experiments: Experiment 1 (80:5:15 split) and Experiment 2 (70:15:15 split) across different epochs. In Experiment 1, test accuracy consistently improved, reaching 98.13% at 50 epochs, accompanied by a decrease in test loss. This indicates the model's strong generalization to unseen data. Conversely, Experiment 2 displayed fluctuations in test loss despite increasing accuracy (96.80% at 50 epochs), suggesting potential overfitting or underfitting during training. These results concluded that Experiment 1 exhibited the best performance accuracy, with the test accuracy consistently improving and reaching an impressive 98.13% at 50 epochs. This finding underscores the model's robust generalization to unseen data, highlighting the significance of careful parameter tuning for achieving optimal machine learning results. The outcomes underscore the critical need to evaluate model generalization on an independent test set, with the observed variations between Experiment 1 and Experiment 2 underscoring the profound impact of training-validation-testing splits. This comparative analysis offers valuable insights into the model's robustness and real-world applicability. It further emphasizes the pivotal role of meticulous parameter tuning, showcasing its significance in achieving optimal machine-learning results.

Table 2: Table of Models Accuracy and Loss

Epochs	Experiment 1 (80: 5: 15)		Experiment 2 (70: 15: 15)	
	Accuracy	Loss	Accuracy	Loss
10	0.9519	0.1831	0.9533	0.2345
30	0.9733	0.2424	0.9440	0.2480
50	0.9813	0.2021	0.9680	0.2780

4. Conclusion

In conclusion, our study on Rabbit Breed Classification using Convolutional Neural Networks (CNN) showcases the effectiveness of the algorithm, achieving a remarkable 98.13% accuracy in categorizing rabbit breeds based on photos. The comparative analysis of Experiment 1 and Experiment 2 reveals crucial insights into the performance and generalization capabilities of the model. Experiment 1, with its 80:5:15 split, demonstrated superior results, consistently improving test accuracy, and achieving an impressive 98.13% at 50 epochs. This research has significant implications for the rabbit industry, offering superior performance compared to alternative methods like Support Vector Machines. The study highlights the importance of meticulous parameter tuning, including the number of training epochs, for optimizing model performance and generalization to unseen data. Furthermore, we suggest exploring advanced techniques such as transfer learning and data augmentation to enhance the CNN algorithm's capabilities. Overall, our findings underscore the promising application of CNN in addressing breed classification challenges, paving the way for future research in animal classification problems.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Respiratory Signal Analysis: E-Nose Measurements for COPD Detection among Smokers and Healthy Individuals Using Machine Learning

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Abstract: Chronic Obstructive Pulmonary Disease (COPD) is a serious global health issue, particularly among smokers. Early detection of COPD can improve prognosis and reduce its impact. Previous studies have indicated that respiratory signal analysis could be an early indicator of COPD. Nevertheless, the intricate and diverse nature of respiratory patterns poses a significant challenge to the generalization capabilities of detection models, as the variability in breathing behaviors within individuals and across populations can lead to difficulties in accurately capturing and classifying abnormal patterns. Therefore, this research analyzes respiratory signal patterns through an electronic nose (e-nose) prototype to detect COPD in both smokers and healthy individuals using Artificial Intelligence (AI). The study utilizes a dataset from a prototype developed using the ESP32 microprocessor and an e-nose sensor array. Subsequently, statistical analysis is employed to identify distinct patterns from the sensor outputs and participants' medical records. A total of 50 subjects participated in data collection, consisting of 40% active smokers, 30% passive smokers, and 30% non-smokers. Finally, a proposed AI model is used to generalize inference engines for COPD detection based on respiratory system signal patterns. The machine learning model utilizes Deep Convolutional Long Short-Term Memory (ConvNet-LSTM), proving reliable in handling spatiotemporal data such as respiratory system signal patterns, achieving an accuracy of 100%. Based on the training data results of the proposed ML model, early detection and interpretation of COPD findings and implications can be achieved. This study serves as an important initial step in enhancing the early detection and management of COPD, contributing to the relationship between breath patterns and lung health conditions.

Keywords: Chronic Obstructive Pulmonary Disease, E-Nose, Machine Learning.

1. Introduction

The lungs are an essential organ in the human body that has a significant role in organizing the respiratory system and blood circulation. If the lungs are impaired in their function, the impact can be felt on the overall health of the human body. One example is chronic obstructive pulmonary disease (COPD), which is a chronic lung condition characterized by airflow restriction. According to the Global Initiatives for Chronic Obstructive Lung Disease (GOLD) 2023 report, COPD is the third leading cause of death in the world, with 3.23 million cases in 2019 [1]. GOLD then explained that the most common risk factors for COPD are cigarette smoke and air pollution from chemical particles, industrial gasses, and households. Unfortunately, COPD is a silent killer that is often diagnosed late and is a significant health problem today.

A study suggests using exhaled breath analysis with an e-nose sensor to predict early COPD symptoms. However, the complex and diverse nature of respiratory patterns presents a significant challenge to the generalization capabilities of detection models. This non-invasive approach analyzes volatile organic compounds (VOCs) in breath, providing insight into inflammatory endotypes and airway microbiology. The integration of IoT-based e-nose analysis has the potential to revolutionize respiratory diagnostics, enabling real-time, remote monitoring. An AI model using ConvNet-LSTM architecture classifies exhaled breath patterns into 'normal' and 'high risk' labels.

2. Materials and Methods

2.1 Materials

The following are some of the materials used in this research project. The project employs ESP32 as the main processor with IoT capability [2], sensory systems based on MQ sensors [3], [4], a data acquisition system using the ADC module [5], and a power delivery and backup system.

- a. ESP32 REV1 TYPE-C - Esp32 Rev1 is a powerful microcontroller with built-in WiFi and Bluetooth capabilities.
- b. MQ-7 (CO) - This sensor detects carbon monoxide gas. It's commonly used for monitoring indoor air quality or safety purposes.
- c. MQ-135 (VOC) - The MQ-135 sensor can detect volatile organic compounds such as alcohol, benzene, smoke, and other gases.
- d. MQ-9 (CH₄) - Similar to the MQ-7, but specifically designed to detect methane gas. It finds use cases in natural gas leakage detection or landfill gas monitoring.
- e. Analog-to-Digital Converter (ADS1115) - An ADC converts the analog output of the gas sensors into digital values that the ESP32 can process.
- f. Battery LiPo 3,7V 200mAh - Lithium Polymer batteries provide power to your system. With a capacity of 200 milliamperes per hour, this battery should have enough energy to run the device for an extended period without frequent recharging.
- g. Boost Converter 3.3V-to-5V - Since most components require either 3.3 volts or 5 volts. A boost converter ensures that the voltage level provided by the battery is suitable for all devices connected to the circuit.

2.2 Methods

This study introduces a new portable prototype to detect COPD early using an e-nose. The e-nose utilizes MQ gas sensor modules, which are tin dioxide (SnO₂) n-type semiconductors sensitive to gases in human breath. The system includes three MQ series gas sensors (MQ-7, MQ-9, MQ-135) and an ESP32 microprocessor for data processing. Attached to a mask, the e-nose collects exhale data for non-invasive COPD prediction. Users can monitor this data on a computer or smartphone connected to the ESP32. An AI prediction system, specifically a deep neural network model based on ConvNet-LSTM model [6], analyzes the exhale data from the e-nose to predict early COPD signs.

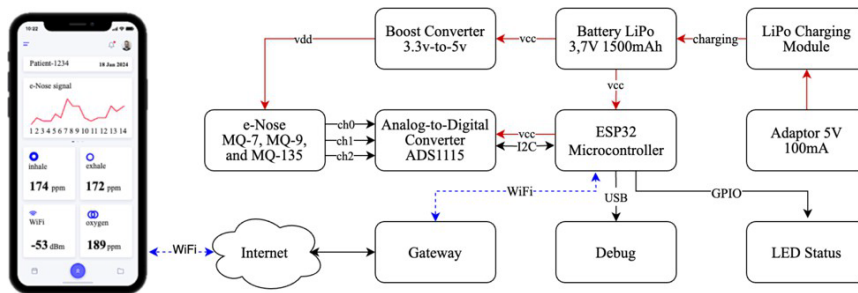


Figure 1: The system architecture E-Nose utilizes an ESP32 microprocessor

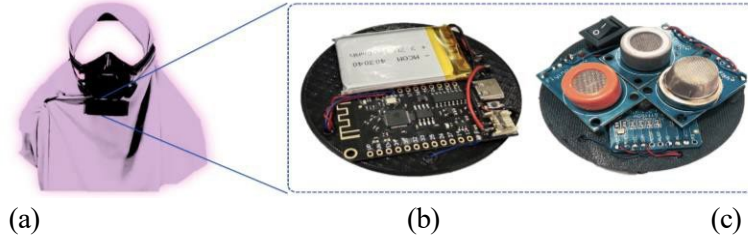


Figure 2: (a) The proposed IoT-enabled mask consists of: (b) ESP32 microprocessor, battery, and (c) e-nose sensors, MQ-7, MQ-9, and MQ135.

As illustrated in Figure 1, a microprocessor based on ESP32 designed for data processing with IoT support through internal wireless module, requires activation through a 3.7 Volt LiPo battery or USB type C connection to a power supply. Equipped with three MQ sensors linked to an ADS115 analog-to-digital converter, ESP32 reads digital signals from the sensors. Sensor readings can be accessed through a web interface from a PC or mobile phone and the prototype can be seen in Figure 2.

2.3 Equations

This section discusses the construction of a detrending moving average (DMA) by computing simple moving average (SMA) filter. The SMA_i statistic of window n at time index i for a sequence of subgroup averages is computed using Eq. 1.

$$SMA_i = \frac{1}{n} \sum_{k=i-n}^i x_k \quad Eq. 1$$

where y_i is defined as a time-dependent average function of y_i . In the simplest case, called backward DMA, y_i can be estimated as the ordinary moving average:

$$y_i = x_i - SMA_i \quad Eq. 2$$

3. Results and Discussion

The presence of various endogenous and exogenous factors may lead to changes in the composition of exhaled VOCs. This chapter provides experimental findings from case-control studies focused on COPD detection by analyzing e-nose patterns.

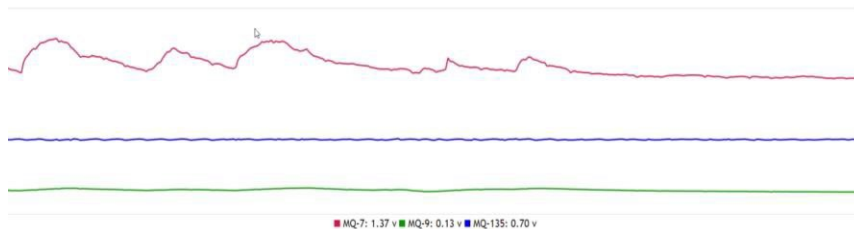


Figure 3: Real-time graphical display of data from MQ-7, MQ-9, and MQ-135 sensors

3.1 Results

This study presents the results of integrating MQ sensors with a mask to read breath exhalation data, which is displayed as analog signals as illustrated in Figure 3. These analog signals are initially converted to digital signals through the ADS1115 analog-to-digital converter and received by the ESP32 microprocessor. The ESP32 processes the digital signal data, presenting reading data through a web interface. Access to the web interface requires connection to an access point linked to the ESP32, obtaining an IP address for web server access. Involving 50 participants, including 40% active smokers, 30% passive smokers, and 30% non-smokers, the study explores the correlation between smoking and COPD. An AI model utilizing ConvNet-LSTM architecture achieves 100% accuracy in COPD diagnosis based on respiratory signals. However, further research with a larger and more diverse sample is essential for broader validation. This breakthrough marks a significant advancement in respiratory medicine, offering promise for improved COPD treatment and quality of life.

3.2 Discussions

This study employs an AI model, specifically the ConvNet-LSTM architecture, to analyze respiratory signals from 50 participants with varied smoking histories for COPD correlation. ConvNet-LSTM effectively handles spatiotemporal data, yielding a robust model with over 100% accuracy in COPD diagnosis. This breakthrough emphasizes the potential of advanced AI and highlights the importance of early COPD detection. Future studies will expand participant diversity for broader applicability, fostering interdisciplinary collaboration for efficient healthcare solutions.

4. Conclusion

The composition of volatile organic compounds in exhaled breath can vary due to factors like airway inflammation, smoking, and medications, as seen in case-control studies comparing COPD to control conditions. Using the ESP32 microprocessor, the prototype enables real-time data access wirelessly for direct health monitoring, complemented by the ConvNet-LSTM AI model for early COPD detection. These results highlight the potential of IoT-enabled masks for innovative and comfortable health monitoring, emphasizing the need for further validation of the AI model with larger datasets and integration into healthcare systems. This study marks a significant step in advancing early COPD detection, linking breath patterns to lung health.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

SIOCA: Streamlined Internet of Things for Oral Cavity Assessment with an AI Inference Engine

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Abstract:

Accurately diagnosing oral cavity diseases using intraoral imaging plays a pivotal role in treatment planning. However, this classification task poses inherent challenges due to the oral cavity's varied appearances and the existing knowledge gap among medical practitioners. The integration of intraoral cameras in dentistry introduces complexity, potentially leading to variations in diagnoses and increased diagnostic diversity. Addressing these challenges, this study proposes an innovative prototype to record oral cavity images, leveraging the capabilities of an Internet of Medical Things (IoMT)-enabled intraoral camera. The intraoral cameras are developed using a microcamera module, ESP32 microprocessor, and wireless connectivity. The integration of IoMT holds the promise of significantly increasing data availability and capturing diverse labels from medical practitioners. Additionally, an Artificial Intelligence (AI) model was developed for automated tooth labeling of the imaging data. A dataset of 750 images across 7 classes is collected using the intraoral camera, operated by medical practitioners in real-world cases. The increase in the variety and quantity of medical data could enhance the performance of the AI model in classifying oral cavity diseases. For the classification task, the proposed AI model integrates a modified Convolutional Neural Network (CNN) as a feature extraction module and a Fully Connected Network (FCN) as the classifier. Experimental results, obtained through 10-fold cross-validation, demonstrate the feasibility of the proposed IoMT system with AI capabilities in producing accurate diagnoses. This integration holds immense promise in improving the quality of dental and oral cavity treatments, showcasing the potential of combining IoMT and AI for enhanced healthcare outcomes.

Keywords: Oral Cavity Disease, Intraoral Camera, Internet of Medical Things, Artificial Intelligence.

1. Introduction

The development of technology in the world has created rapid changes that affect all aspects of human life, including the digital revolution, the integration of artificial intelligence, and global connectivity. One form of technological development is artificial intelligence (AI), which has impacted dental clinical practice in diagnosing oral diseases. AI has helped diagnose and analyze health data quickly and accurately. In dental clinical practice, AI is used to diagnose oral diseases, such as the oral cavity, with proper labeling of oral diseases using intraoral images being essential for analysis and prediagnosis in treatment planning.

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There are challenges in developing automated methods for this purpose, as there are different appearances of oral diseases and disease stages usually show abnormal appearances affected by misalignment and crowding. In addition, different dentists' understanding and interpretation may result in different medical treatment plans related to the patient's diagnosis. A global model capable of summarizing knowledge and generalizing imaging techniques in dentistry needs to be developed.

Existing intraoral cameras on the market are not yet capable of using artificial intelligence (AI) directly. AI technology for image inference is used for the prediagnosis of oral diseases, so many recent examples of image data with excellent quality are required. Thus, accurate and consistent predictions will be made. The use of intraoral cameras in dentistry further improves accuracy and reduces the possibility of mixed diagnoses. The more data recorded using intraoral cameras, the more varied the diagnoses found by medical institutions. In recent years, several advanced techniques in artificial intelligence have been proposed to classify image data with high accuracy. Although these techniques can be applied in classification tasks, most of them depend on the amount and quality of data.

This technological innovation aims to address issues in the recording system of the oral cavity using intraoral cameras. SIOCA consists of several components, namely the ICU (Intraoral Camera Unit) for capturing oral conditions, the data processing unit (DPU) for processing data recorded from the ICU, and a web server for collecting data and generating predictive/generalization models of cases related to oral diseases. Another goal of this invention is to integrate the intraoral camera device, data display device, and web server into a prediction system that can be used to strengthen the interpretation process of oral diseases using object detection and prediction models. This integration can collect valuable medical data in one secure centralized database and can be used to improve system performance.

This research uses a prototype to automatically label teeth on image data using an intraoral camera supported by the Internet of Medical Things (IoMT). The use of IoMT can increase the amount of data which leads to the improvement of artificial intelligence models in classifying oral diseases. Using 750 images as input corresponding to 7 classes, resnet50 is used as a feature extraction module, and artificial neural networks are used as classifiers. Experimental results conducted with 10 fold cross-validation, showed that the proposed IoMT with artificial intelligence capabilities, is feasible to provide diagnosis with accuracy to improve the quality of dental and oral care.

2. Materials and Methods

2.1 Materials

This prototype consists of several components including an ICU equipped with a microcamera to capture oral conditions, a DPU utilising ESP32 to handle the recorded data from the ICU, and a website for data collection. Develop prediction models and generalisations regarding oral disorders based on a dataset that has been previously collected and used for training. Another goal of this prototype is to combine intraoral camera devices, data display devices, and web servers into a prediction system that can be used to strengthen the interpretation process of oral diseases using object detection and prediction models. This system integration is designed based on the Internet of Things (IoT) which allows sensor nodes (ICU and DPU) to connect with a centralized web server system via wireless communication.

2.2 Methods

- Internet of Medical Things

Internet of Medical Things (IoMT) refers to applying Internet of Things (IoT) into the medical field. The IoMT enables a medical system to connect various smart devices, such as wearable

sensors, medical examination instruments, and hospital assets, for establishing an information platform [1].

- Resnet-50
ResNet-50 architecture is expressly designed to address challenges associated with deep Convolutional Neural Networks (CNNs), particularly the phenomenon wherein increasing convolution network depth results in accuracy degradation. The attribute of network depth is deemed indispensable for achieving heightened model accuracy [2]. This model, developed in 2016, secured a position among the top 5 in a competitive scenario, boasting an average error rate of a mere 3.57% [3].
- Fully Connected Network
Fully Convolutional Network (FCN) is a further development of CNN, where all layers used are convolutional layers. Instead of using fully connected layers like CNN in prediction, FCN still employs convolutional layers to classify data into classes. The main goal of FCN is to produce semantic segmentation similar to the original image, with the output size being the same as the input image. The FCN output itself makes predictions for pixels in the image [4].
- Tensorflow.js
TensorFlow.js is a high-performance deep learning framework written in JavaScript that is compatible with both client-side and server-side environments. It provides an easy entry point for in deep learning for a community that often prioritizes the end user. TensorFlow.js has the ability to expand the reach of advanced machine learning techniques to a wider audience. We have observed a diverse range of applications utilizing TensorFlow.js [5].

3. Results and Discussion



Figure 1: Prototype Design

Figure 1 displays the comprehensive full illustration of the medical picture recording device at the network edge, featuring the sensor nodes. The ICU comprises a camera, sensor, lighting module, operating button, and USB communication and charging connectors. The operation button includes a power button, an image recording button, and a video recording button. The device can be linked to the DPU either by a USB cable or wirelessly using a WiFi network (IEEE 802.11b Direct Sequence). Furthermore, the DPU is a portable display device equipped with various characteristics such as data processing buttons, file display window, object detecting area, and oral disease prediction results.

The block diagram in Figure 2 illustrates the data communication flow in the system, starting at the network edge, specifically from the ICU to the DPU and then to the central server. The sensor module captures images which are then analysed by the ICU's internal microprocessor and transmitted to the DPU using the wireless connection module. The DPU may internally analyse data by synchronising prediction models online and displays oral disease prediction findings offline. Data from the DPU can be forwarded to the webserver for collecting the dataset into the database.

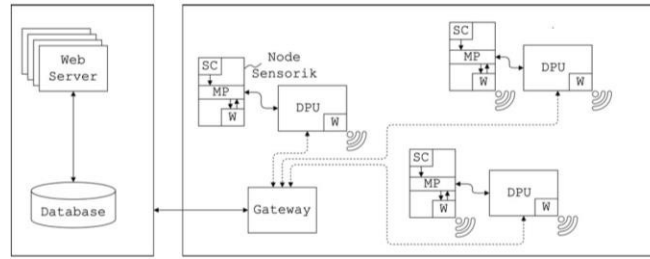


Figure 2: Block Diagram

Using 10-fold cross-validation, the classification results. generated by the proposed model are reasonable with an f1 score of 90%. It can be seen that the IoMT device significantly increases the amount of image data and variations thereby improving the AI training performance. This is mainly because the intraoral camera supported by the proposed IoMT can record and transmit data from various medical institutions, overcoming institutional boundaries with a centralized web cloud computing approach.





	precision	recall	f1-score	support	
0	0.77	0.95	0.85	21	
1	0.95	0.87	0.91	23	
2	0.93	0.93	0.93	14	
3	1.00	0.94	0.97	18	
4	0.96	1.00	0.98	23	
5	0.76	0.87	0.81	15	
6	1.00	0.64	0.78	14	
accuracy			0.90	128	
macro avg	0.91	0.89	0.89	128	
weighted avg	0.91	0.90	0.90	128	

Figure 3: F1 Score

4. Conclusion

This study presents a prototype for automatic identification of oral disorders using intraoral images captured by an IoMT-driven camera. An advanced neural network extracts contextual elements from raw image data, with a JavaScript-based conversion enabling web-based deployment. The AI model achieves a 90% F1 score on real patient datasets, indicating its potential to enhance dental and oral care quality.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Powering Up Learning: Exploring Electric in Fifth-Grade Science Through 2D Games

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Abstract: This project focuses on teaching basic electrical skills to people of all ages, emphasizing the importance of starting this education early in childhood to build confidence and competence in handling everyday tasks. Recognizing the difficulty students face in grasping electricity-related concepts, the project aims to address these challenges through the use of educational games. By targeting elementary school children, the research seeks to understand and overcome the hurdles in learning science. The chosen approach involves developing a mobile game using the Unity game engine, employing 2D platform game concepts to make information browsing enjoyable and accessible. The Agile Methodology is adopted for development, ensuring a systematic process of planning, designing, developing, testing, deploying, reviewing, and launching the educational game. The goal is to enhance the learning process by making it engaging and effective, with an anticipated 68% improvement in student engagement and understanding.

Keywords: — Electricity, Educational Games, 2D Platform Games, Games Application

1. Introduction

Teachers face challenges in helping primary students comprehend physics concepts, particularly those that are not visually apparent. Science education involves multimodal communication, with learners creating meaning through shared representations. To enhance the teaching of electric circuits in year 6, the study employs multimodality and variation theory as theoretical frameworks. Despite the simplicity of building electric circuits, students require guidance to articulate explanations of observable and functional processes involving abstract concepts like energy and electric current.

1.1 Problem Statement

Students struggle to keep up with learning sessions, especially in theoretical courses, which leads to a phobia of the subject. The apparent dullness and lack of interest originate from a poor learning strategy that relies primarily on textbooks (1). Science education has obstacles such as limited resources and obsolete textbooks,

which impede effective instruction (2). The use of ineffective and potentially damaged learning materials in schools exacerbates the situation, as do insufficient classroom space, inadequate scientific laboratories, and obsolete, error-ridden textbooks (3).

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1.2 . Research Objectives

- To identify how effective learning is in schools now
- To develop an interactive science game for students play
- To evaluate the effectiveness of learning Science in games

2. Materials and Methods

2.1 Materials

Prior to setting out on project creation, the improvement of a storyboard, flowchart, and model is vital for map out the client's excursion, enumerating viewpoints like style, visual plan, UI, and content. Adobe Illustrator and Adobe Photoshop are used to design an app that looks good, create vector layouts, and choose the colors for the 2D educational game. The undertaking design has been settled after intensive examination.

2.2 Methods

According to Unhelkar (4), the Agile methodology is a more adaptable and iterative approach to software development than the conventional Waterfall life cycle. The choice among Agile and Waterfall techniques is investigated, with Lithe tasks considered generally useful for "greenfield" improvements and for the most part ideal for little ventures, as indicated by Van Casteren (2017). However, medium-sized projects are constrained by both Agile and Waterfall methodologies. Unhelkar recommends that Coordinated might be excessively shortsighted, while Waterfall can present extreme above. In enormous, complex ventures, the organized methodology is frequently utilized. The Agile method was chosen for the current project because it works well for small projects that start from scratch. In the improvement of a 2D intuitive game, the efficient instructive Deft Model is applied, underlining consistent criticism all through the plan cycle. The concentrate additionally recognizes the value of nimble techniques in instructive settings, as verified by Duvall, Hutchings, and Kleckner (2017).

3. Results and Discussion

The research used the Microsoft Forms platform to evaluate the functionality and efficacy of a project, sending the project's.apk file to participants for testing. Participants, ages 11 to 12, played 2D games and submitted comments using Microsoft Forms. The survey, which covered topics such as economics, learnability, user experience, and appropriateness, was delivered to 32 people, resulting in useful research data. The Microsoft Forms platform allowed for easy access and data capture. The researcher intends to use quantitative approaches, such as surveys, to collect data, with an emphasis on measurement and assessment for thorough results. Surveys, as a quantitative research tool, are supposed to give valuable insights for project evaluation and improvement.

3.1 Results

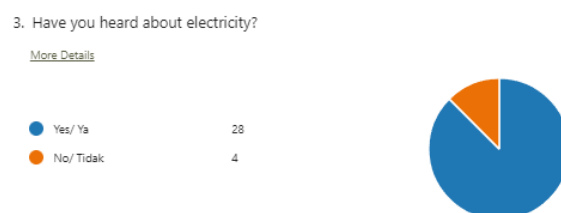


Figure 1: Pie Chart for respondents' knowledge about electricity.

As per overview information, 88% of respondents had known about power. In the meantime, 12% of respondents know nothing about electricity.

17. Do you agree interactive 2D Game are an effective tool in delivering knowledge?

[More Details](#)

[Insights](#)

● Yes/ Ya 31
● No/ No 1



Figure 2: Pie Chart for respondents' findings of the interactive 2d game are an effective tool in delivering knowledge.

The graph in Figure 2 shows that when developers were asked about the efficiency of interactive 2D games in communicating knowledge, 97% highly agreed. This high degree of agreement indicates that the interactive aspect of 2D games allows players to actively participate with both the plot and informative material, which contributes to their perceived efficacy as a medium for knowledge transmission.

18. Are you overall satisfied with your experience in learning about electricity in 2D Game?

[More Details](#)

[Insights](#)

● Yes/ Ya 31
● No/ No 1



Figure 3: Pie Chart for respondents' finding of satisfied with experience in learning about electricity in 2D game.

According to Figure 3, 97% of respondents strongly believe that the 2D game is an effective way to learn about power. Furthermore, just 3% of respondents indicated unhappiness with the game, showing overwhelmingly favourable feedback on its usefulness in imparting information about the subject.

4. Conclusion

The 2D Game: Sains Elektrik Tahun 5 project, following Agile methodology, completed thorough research, successfully developed project chapters, and provides insights and recommendations for future 2D game projects.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

2D Motion Graphic PSA : Lung Cancer Awareness Among Young Adults

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Abstract: The prevalence of smoking and vaping among young adults, along with a lack of awareness regarding the risk factors, symptoms, and preventive measures of lung cancer, emphasizes the urgent need for a targeted 2D motion graphic PSA aiming to educate and empower young adults in Malaysia to make informed choices about their health and well-being, thereby addressing the alarming rise of lung cancer cases and its status as the leading cause of cancer-related deaths. The main research objective is to raise awareness of lung cancer among young adults in their age group by creating and testing the effectiveness of a 2D Motion Graphic PSA on the associated risks. The methodology, based on the ADDIE model, includes comprehensive analysis, iterative design, meticulous development, strategic implementation via digital platforms, and thorough evaluation, with the goal of creating and optimizing a 2D Motion Graphic PSA on lung cancer awareness among young adults. The survey on lung cancer awareness among young adults reveals a diverse demographic with varying knowledge levels, emphasizing the importance of tailored educational initiatives. The success of a 2D Motion Graphic PSA demonstrates the potential of visually engaging content in positively impacting awareness, prompting behavioral change, and garnering strong support for recommendations within the target audience. Future research could delve deeper into the study of both visual and auditory elements in PSAs, with the goal of identifying specific attributes appealing to the target audience and exploring evolving media channels for the most effective and accessible dissemination of health information.

Keywords: 2D motion graphic, public service announcement, lung cancer

1. Introduction

The high prevalence of smoking among young adults aged 15 to 44 is a concerning issue, prompting the need for targeted interventions to address awareness gaps and health risks. This study focuses on investigating and addressing the challenges associated with the increasing prevalence of smoking in this age group. With a sense of urgency, the research aims to understand current awareness levels, design effective interventions, and evaluate the impact of a 2D Motion Graphic public service announcement (PSA). Research questions seek to determine awareness levels, develop interventions, and assess the PSA's impact on knowledge, attitudes, and behaviors related to smoking awareness and prevention.

Recognizing issues like a lack of awareness about lung cancer risks among young adults [1] and the prevalent use of smoking and vaping, known risk factors [2][3], the study sets objectives to raise

awareness, create an engaging PSA, and evaluate its effectiveness. Anticipated outcomes include increased awareness, effective smoking reduction interventions, and an assessment of the PSA's influence on knowledge and behaviors related to smoking awareness and prevention. These findings aim to enhance understanding and contribute to the development of impactful tools for health education, supporting informed decision-making and promoting healthier lifestyles among young adults.

2. Materials and Methods

The materials and methods section, also known as methodology, describes all the necessary information that is required to obtain the results of the study.

2.1 Materials

The materials utilized in this study encompassed various resources essential for data collection and analysis.

- Google Forms: Structured surveys were conducted using Google Forms as the primary data collection tool, facilitating the collection of quantitative data.
- Survey Instruments: The surveys included Likert scales, with participants providing numerical ratings on a scale of 1 to 5, enabling a nuanced assessment of attitudes and perceptions.
- Computing Devices: Participants utilized personal computing devices such as laptops, smartphones, or desktop computers to access and complete the Google Forms surveys.

2.2 Methods

The study collected data using Google Forms, with Likert scales used to record varied participant responses. Participants aged 18 to 40 completed surveys on personal computing devices, resulting in a sample size of around 61 people. Using a quantitative approach, structured surveys were created with four sections that addressed demographic information, current awareness levels, beliefs about intervention effectiveness, and evaluations of the specific Motion Graphic PSA. The quantitative data collected, including numerical ratings and scaled responses, will be subjected to rigorous statistical analysis in order to reach meaningful conclusions. The results will be systematically presented, shedding light on participants' awareness, attitudes, and perceptions concerning lung cancer, along with an evaluation of the Motion Graphic PSA's effectiveness.

3. Results and Discussion

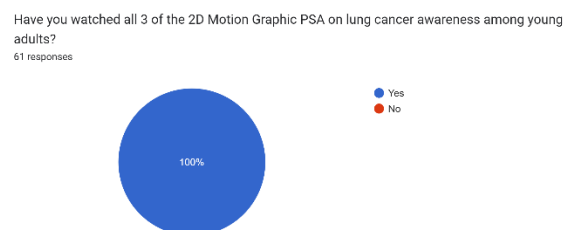


Figure 1 : 2D Motion Graphic PSA Viewership

Based on Figure 1, all survey participants have viewed all three of the PSA series. This suggests that the visual and narrative elements of the PSA successfully captured the audience's attention, laying a strong foundation for achieving the first research objective.

Do you feel more informed about the risks of lung cancer among young adults after watching the PSA?
61 responses

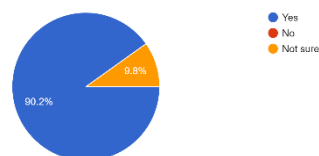


Figure 2 : PSA’s Impact on Knowledge

Based on Figure 2, an overwhelming 90.2% of participants expressed feeling more informed about the risks of lung cancer among young adults after watching the PSA series. This positive outcome corresponds precisely with the goal of raising awareness, demonstrating the PSA's ability to communicate critical information about lung cancer.

On a scale from 1 to 5, how likely are you to recommend the PSA to your friends or family?
61 responses

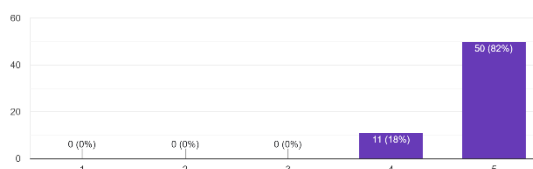


Figure 3 : Likelihood to Recommend PSA

Based on Figure 3, the result indicates that there is a high likelihood of recommendation (82%), showcasing the potential influence of the PSA. This not only reinforces the PSA's positive perception, but it also suggests that it has the potential to exert broader social influence. The likelihood of recommendation is a significant indicator for determining the PSA's potential to raise lung cancer awareness among young adults beyond the study participants.

4. Conclusion

The lung cancer awareness project successfully raised awareness among young adults through a highly engaging 2D Motion Graphic PSA. The PSA not only reached its audience but also left a lasting impression, with 100% viewership and strong participant inclination to recommend it to others. The survey responses highlighted the PSA's significant role in educating about lung cancer risks and encouraging informed decision-making. Overall, the project exceeded its goals by effectively raising awareness and evaluating the impact on lung cancer risks among young adults.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

HACK ATTACK! A 3D Game to Raise Awareness on Data Breaches

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Abstract: Data breaches have become a widespread and serious issue that affect people, businesses, and governments everywhere. A data breach happens when unauthorized people or organizations have access to private or sensitive data either through intentional hacking or unintentional exposure. The majority of Malaysians are unaware of the importance of data security and are unable to take the necessary steps to protect their information. The objective of this researcher is to raise awareness about data breaches and educate individuals on how to protect themselves from becoming victim of this crime. The target audience for data breach awareness could be individuals of younger adults who use technology to store or access sensitive information.

Keywords: Data breach, cybersecurity, personal data protection, games, computer game, education in gaming

1. Introduction

Digitalization has increasingly impacted daily lifestyles over the past two decades. Cyber threats like hacking, phishing, and malware attacks are on the rise as a result of people using digital technology and the internet more frequently. As a result of these attacks, sensitive personal and financial information may be exposed. Data breaches are a growing concern in Malaysia, as in many other countries around the world. There have been several high-profile data breaches in recent years. In 2017, it was reported that the personal data of millions of Malaysians had been stolen from a telecommunications company's database and was being sold online. In 2018, several major Malaysian banks experienced data breaches, exposing the personal information of thousands of customers. In a study by Unisys of 13 countries, Malaysia came in fifth place for having the highest level of concern about cyber security (Swee-Wei Tan et.al 2022).

2. Materials and Methods

The methodology of this project is based on the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation).

2.1 Materials

The materials used in this study included multiple sources required for data gathering and analysis.:

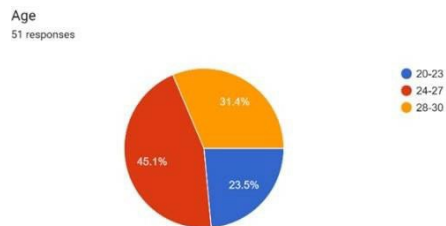
- Google Forms: To collect quantitative data more easily, structured surveys were carried out with Google Forms as the primary tool for gathering data.

- Survey Instruments: Such scales were used in the surveys, allowing respondents to rate items on a range 1 to 5, allowing for a more detailed evaluation of opinions and views.
- Computer Devices: To access and complete the Google Forms surveys, participants used their own laptops, smartphones, or desktop PCs.

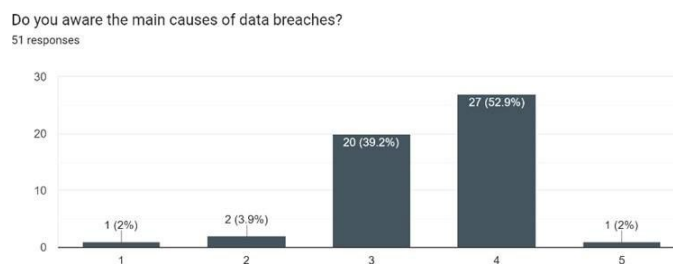
2.2 Methods

The study collected data using Google Forms, with Likert scales used to capture a variety of participant viewpoints. Individuals aged 20 to 30 conducted surveys using personal computer devices, yielding a sample size of roughly 51 respondents. Structured surveys with four components covering demographic information, current awareness levels, and evaluations of the Hack Attack gaming application were created using a quantitative technique. The quantitative data collected, which includes numerical ratings and scaled replies, will be subjected to thorough statistical evaluation in order to provide significant insights. The findings will be presented systematically, revealing insights into participants' awareness, attitudes, and views of the data breach in Malaysia.

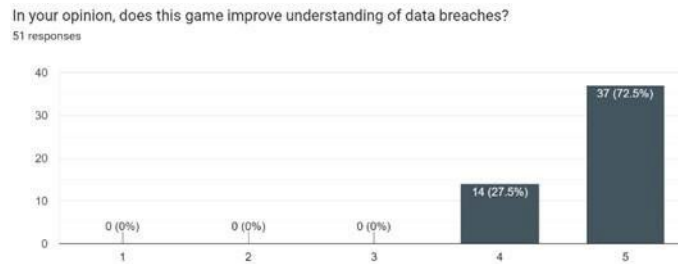
3. Results and Discussion



The survey included a total of 51 respondents, and the age distribution among them is as follows: 23.5% were in the 20-23 age range, 45.1% were between 24 and 27 years, and 31.4% fell within the 28-30 age group. This breakdown gives a summary of the different ages of the people who took the researcher's survey. It helps the researcher see the various points of view and experiences among the surveyed group.



In a recent survey involving 51 participants aimed at gauging knowledge about data breach causes, results indicated that the majority (52.9%) agreed with their understanding, while a smaller percentage strongly agreed (2%). Conversely, 3.9% somewhat disagreed, and 2% strongly disagreed. Notably, 39.2% expressed neutrality on the topic. These findings suggest potential for enhancing information dissemination regarding data breach causes, particularly given the significant number of respondents in the neutral zone. This insight provides a valuable starting point for further exploration into public perceptions of cybersecurity's critical aspects.



In a survey involving 51 participants to assess the game's effectiveness in enhancing understanding of data breaches, results indicate overwhelmingly positive feedback. None of the participants disagreed or felt unsure about the game's clarity in explaining data breaches. A vast majority (72.5%) strongly agreed that the game significantly improved their understanding, with an additional 27.5% in agreement. These findings suggest that the game effectively fulfills its purpose, providing valuable insights into players' perceptions of its contribution to understanding data breaches.

4. Conclusion

In conclusion, the 3D Hack Attack game emerges as an effective and engaging tool for cybersecurity education. Its ability to capture diverse perspectives, bridge knowledge gaps, and maintain participant engagement positions it as a valuable asset in promoting awareness and understanding of data breaches. The study suggests that such projects hold significant promise for effective and engaging cybersecurity education.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

A Robust Scalable Interactive Learning Platform with Advanced Gamification Features using Phaser.js

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Abstract: The rise of online education has brought forth a multitude of benefits to students, but researchers and students themselves have raised concerns over the potential negative impact on social interaction and student motivation. As a result, this project seeks to address the problem by enhancing teaching and learning experiences through advanced gamification, inspiring learners to engage in learning, and increasing social interaction through a collaboration game. This web application is an interactive learning platform that is built using Angular, Node.js, Phaser.js and MySQL database to ensure an optimal architecture that prioritizes modularity, security, and scalability. It encompasses all the fundamental requirements of a typical online learning platform, while also introducing innovative features such as clan-based game, a dedicated module discussion forum, data visualization for educators to track individual learner progress and many more. The key selling point of this application is its clan-based game, featuring leaderboards, attack-defense mechanisms, and the ability to earn points and coins by participating in quizzes created by educators for each module. This engaging mechanism ensures that learners remain consistently involved in the learning process in order to play the game. In addition, the application underwent extensive and robust security testing to address vulnerabilities such as SQL Injection, Cross-Site Scripting, and Cross-Site Request Forgery. Furthermore, a user testing session with 16 learners yielded positive results, with 43.8% rating the application 5/5 for user friendliness and 56.3% rating it 4/5. All participants expressed a highly favorable opinion of the web application and enthusiastically recommended it to other learners. By leveraging the above distinctive attributes, this web application has the potential to revolutionize the online education landscape and become a preferred choice for both educators and learners alike. In the future, with increased resources, the game can be further enhance to better accommodate a wide range of learning subjects, thereby providing a more comprehensive educational experience.

Keywords: gamification, online learning, education, game-based learning, teaching

s

1. Introduction

Online education, also known as online learning, e-learning, digital learning, or computer-based learning, has gained significant attention in recent decades, especially during and after the global

outbreak of the COVID-19 pandemic [1]. Online education provides flexibility that allows learners to acquire knowledge and skills at their own pace and convenience [2][3]. However, one common challenge associated with online education includes reduced social interaction as well as issues related to learner engagement, motivation and self-autonomy according to research studies [3][4]. According to a study, a significant proportion of learners, particularly 84.6%, encounter difficulties in navigating their own learning path during online teaching and learning [3]. Additionally, a substantial 71.4% express experiencing challenges related to feelings of social isolation [3].

In order to solve the problem of learner's engagement and motivation during online learning, gamification is seen as a promising solution to address this challenge. Gamification, refers to a methodical strategy that facilitates a gameful experience to motivate and engage users by introducing game-like elements into non-gaming context [5]. Gamification utilises leaderboards, digital badges, levels, achievements or in-game digital currency to reward users for their efforts and provide valuable feedback [6]. Numerous research efforts have reported positive outcomes in terms of student's motivation and engagement when game-like features is incorporated into educational platforms [7][8].

This paper presents the outcomes derived from the user testing conducted on an innovative gamified learning platform, representing the first of its kind to conceptualize and design such a comprehensive educational tool. It is tailored to diverse learner groups spanning various disciplines and age brackets. This gamification learning platform is characterized by robustness and meticulously crafted architecture that integrates advanced gamification features leveraging cutting-edge technologies such as Angular, Node.js, MySQL, and Phaser.js. By implementing this innovative gamified learning platform, the aim is to enhance and sustain learner motivation and engagement throughout their educational endeavors, while simultaneously delivering essential components inherent to an online learning environment. Thus, this paper will uncover the effectiveness of the final product in meeting its intended objectives and contributing to the advancement of online education.

2. Materials and Methods

2.1 Research Methodology

The research methodology employed in this study combines both quantitative and qualitative approaches to gather comprehensive insights. To facilitate data collection, the survey method was chosen as the primary research technique. This approach allows for the systematic collection of user feedback through a blend of short-answer questions, multiple-choice questions, and rating scales. The survey method enables the extraction of valuable insights essential for future development endeavors by soliciting feedback on user interactions, challenges encountered, and constructive suggestions.

2.2 Data collection

A total of 16 learners participated the 3-hour user testing session through voluntarily signing up. Throughout the session, participants engaged with various functionalities available on the platform, including studying the learning materials uploaded by the instructor, attempting quizzes, discussion forums and exploring the gamification features. Upon conclusion of the user testing, participants were asked to complete a survey via Google Form, providing feedback and sharing their experiences after using this gamification learning platform.

2.3 Limitations

The survey methodology employed in this study offers valuable insights into user experiences with the gamification learning platform. However, it is important to acknowledge certain limitations. One notable limitation pertains to the sample size and variation of participants involved in the user testing phase. As all testers were students from Curtin University, the generalizability of the findings may be

restricted to this specific demographic. Furthermore, with only 16 learners participating in the testing process, the sample size may not fully represent the diverse range of perspectives and experiences that could be encountered in a larger, more heterogeneous population.

3. Results and Discussion

There were a total of 16 participants who were asked about their user experience after using the gamification learning platform. First of all, according to **Figure 1 (a)**, 7 out of the 16 participants (43.8%) rated the platform's tools and functionalities as highly user-friendly, giving it a perfect score of 5 out of 5. On the other hand, the majority of participants (56.3%) rated the platform 4 out of 5 for its usability. These results indicate that the application is a success in meeting user expectations and delivering a satisfactory experience, suggesting its effectiveness in facilitating learning activities and enhancing user engagement.

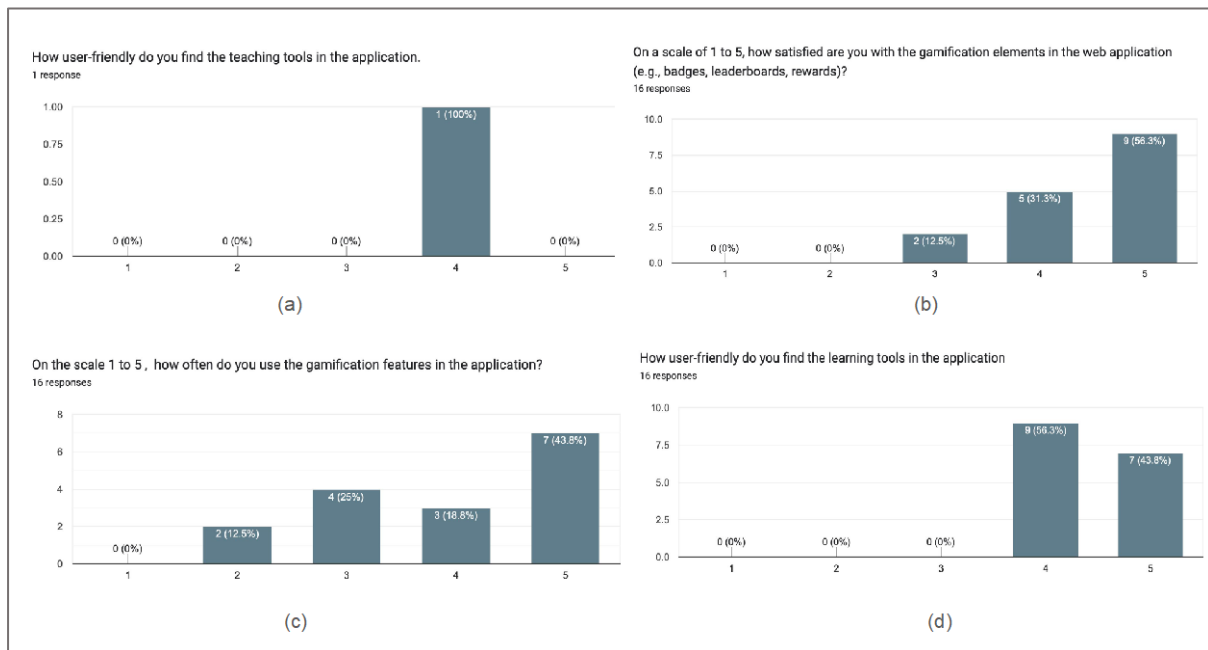


Figure 1: (a) Participants rating on user-friendliness of the learning tools in the application (b) Participants' rating on satisfaction level with the gamification elements in the application (c) Participant ratings on frequency of utilizing gamification features in the application (d) Participant ratings on ease of use for gamification features in the application

The results depicted in **Figure 1 (b)** provide valuable insights into participants' satisfaction levels regarding the gamification elements incorporated within the learning platform. The majority of participants (56.3%) awarding the highest rating of 5 out of 5. This result suggests a strong positive perception of the gamification features, indicating that these elements effectively enhance user engagement and overall satisfaction. Furthermore, this high satisfaction level aligns with previous research emphasizing the motivational benefits of gamified learning environments, which often lead to increased learner participation and improved learning outcomes. While a substantial portion of participants (31.3%) provided a rating of 4 out of 5, indicating a high level of satisfaction, a smaller proportion (12.5%) assigned a rating of 3 out of 5. This finding suggest that there is still a subset of participants that faced certain limitations and areas that could be further enhanced in the platform.

When queried about the frequency of utilizing the gamification features within the application during learning sessions, **Figure 1 (c)** indicates that a significant majority of participants (43.8%) reported using them very often. Additionally, 3 out of 16 participants (18.8%) rated their usage at 4 out

of 5, while 4 out of 16 participants (25%) provided a rating of 3 out of 5. Conversely, 2 out of 16 participants (12.5%) assigned a lower rating of 2 out of 5.

The results in **Figure 1 (c)** indicate that a majority of the participants are engaged in using the gamification features available in the application. This finding is consistent with previous research where learners' interest is piqued by gamified elements, which can result in increased engagement and participation in the learning process. However, there are still a small percentage of the participants that had shown low engagement in using the gamification features, which could be attributed to the potential barriers and challenges posed by the application. Possible factors contributing to this lower frequency of use could include usability issues, lack of awareness about available features, or preferences for alternative learning methods.

To assess the user-friendliness of the gamification features within the application, participants were asked to rate the ease of use of these features in the survey, as illustrated in **Figure 1 (d)**. The majority of participants, comprising 7 out of 16 (43.8%), awarded the highest rating of 5 out of 5, indicating a high level of perceived ease in utilizing the features. Additionally, 6 participants (37.5%) rated the features at 4 out of 5, signifying a favorable perception of usability. However, a smaller percentage of participants, 2 (12.5%), rated the features at 3 out of 5, suggesting a moderate level of ease. Notably, one participant (6.3%) rated the features at 2 out of 5, indicating lower perceived usability. These findings suggest that while the majority of participants found the gamification features easy to understand and use, there is room for improvement to enhance user-friendliness and usability, particularly for individuals who rated lower on the scale.

In response to short-answer questions, the majority of participants provided positive feedback, expressing satisfaction with the game and its overall quality. Notably, many participants expressed that they encountered no issues or concerns while using the platform. Particularly noteworthy was one participant's recognition of the potential for gamification features to enhance student engagement. Additional feedback included requests for increased animation and suggestions for further development and enhancement of the game. Last but not least, all the participants hold a highly favourable opinion of this web application and are unequivocally enthusiastic about recommending it to other learners. This underscores the platform's effectiveness and wide acceptance among learners, warranting further development and implementation on a larger scale within educational settings.

4. Conclusion

In conclusion, the findings of this study underscore the effectiveness and potential of gamification in enhancing the learning experience within an online education platform. Through user testing and feedback analysis, it is evident that the gamification learning platform succeeded in engaging participants and fostering a positive learning environment. The majority of participants expressed high satisfaction with the platform's usability, gamification features, and overall quality. Furthermore, participants demonstrated enthusiasm in recommending the platform to others, highlighting its potential for widespread adoption in educational settings. However, the study also identified areas for improvement, including suggestions for further development and enhancement of the gamification elements. Moving forward, continued efforts to refine the platform based on user feedback and incorporate innovative features will be essential to ensure its continued success and relevance in the dynamic landscape of online education. Overall, this study contributes valuable insights into the effective integration of gamification in online learning platforms and underscores its role in promoting learner engagement and motivation.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

AR Book Application on Smoking Effects on Lungs Among Malaysians

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Abstract: Lungs are one of the vital organs in the human body, because without them, how do we breathe? Breathing is central to life, as it allows the body to obtain the energy it needs to sustain itself and all its activities. However, the majority of Malaysians seem to take lung health for granted, mostly by smoking tobacco products, namely cigarettes. Research has shown that smoking-related diseases have been identified as the leading cause of disease and death in Malaysia, including lung cancer. Therefore, this study was conducted to develop an augmented reality (AR) book and application to help teenagers better educate themselves about the lungs and the smoking effects towards the lungs. This research also aims to educate society on lung cancer symptoms and prevention, along with the importance of taking care of lung health, and to evaluate the effectiveness of the AR application in delivering knowledge about lungs to society. The ADDIE model was chosen as the main method in developing this research. Teenage respondents evaluated the usability and effectiveness of this application quantitatively using a set of questionnaires. As a result, this AR book and application have improved the understanding of the importance of the lungs and have increased awareness of the dangers of smoking among the youths.

Keywords: Lungs, Health, Smoking, Cancer, Awareness, Augmented Reality (AR)

1. Introduction

Millions of smokers in Malaysia up to 2010 were categorized as minors under the age of 18 according to data from Walser et al. In addition to being a factor in hospitalization and death, smoking is frequently directly linked to lung cancer (Walser et al., 2008). It is one of the leading causes of cancer-related deaths in Malaysia, according to research (2022, n.d.).

Smoking Effects on Lungs among Malaysians is an educational Augmented Reality (AR) book and application targeting teenagers, ages ranging from 13 to 17 years old. The AR book features three chapters which are Lungs, Smoking, and Lung Cancer. In these chapters, the topics that will be covered include lungs and their parts, smoking behavior towards lungs age-wise and timewise, lung cancer among Malaysians, and the importance of taking care of our lungs. This information is essential not just to educate users, but to also create awareness to stop harming the lungs. Additionally, the users can scan the book using the application to get 3D visualization and information on each topic. To make it more engaging and enjoyable, games like quizzes and puzzles are also included. The application is developed using Blender and Unity.

The purpose of this project is to analyze the understanding level of lung health in society. Besides that, is to develop an AR application as a medium to spread awareness of the harm of smoking to the lungs and lung cancer. Furthermore, to evaluate the effectiveness of the AR application in delivering knowledge about lungs to society.

2. Methodology

The ADDIE model is a design framework composed of fundamental steps that are straightforward and simple to understand. This model is one of the most popular learning models because it offers a tried-and-true process for creating training materials suitable for the project to be carried out. It acts as a framework as this model has been shown to be helpful for human learning, it serves as the basis for many different learning models and is easy to measure both time and expense (DeBell, 2023). The project employed the five-step ADDIE technique, analysis, design, development, implementation, and evaluation.

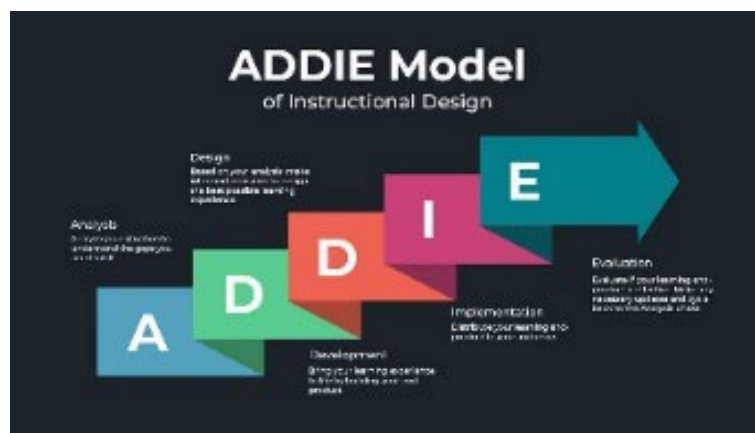


Figure 1: ADDIE Model

When preparing a project, it is essential to consider the target audience to increase the likelihood of success. There are several things to consider. It is important to take extra precautions when selecting the testing tools that will be used to collect data and figure out what needs to be modified. A qualitative strategy for data collecting was chosen for this study. Ultimately, a thoughtfully constructed analytical model is required for the experiment to be successful.

3. Results and Discussion

42 teenage respondents evaluated the usability and effectiveness of this application quantitatively using a set of questionnaires.

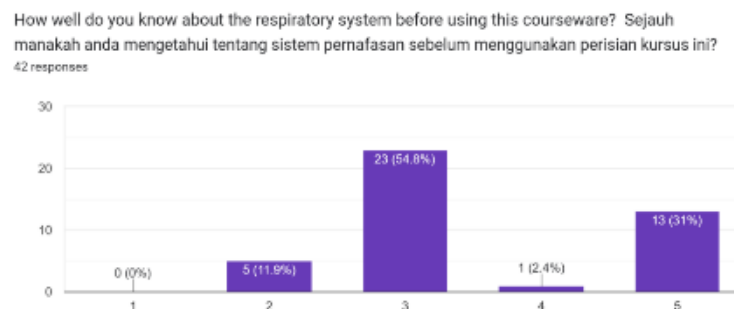


Figure 2: Question 6 Result

The first question on the learnability of the project is how well the respondents know about the respiratory system before the courseware. Respondents were asked to scale from 1 to 5, 1 being not knowing anything at all and 5 being very well. According to the graph above, the highest voted is scale 3, followed by 5, 2, and 4.



Figure 3: Question 11 Result

The following question is how much the courseware has improved the respondents' overall lungs knowledge. Respondents were asked to scale from very little to very high. Most respondents voted for very high, followed by little, high, and moderate. Even though the majority of the respondents' knowledge about lungs are improved, the second highest are the ones who gave 2 out of 5, this means that the content of the AR book and application are within what they already know, or they know extremely well about the lungs and respiratory system.

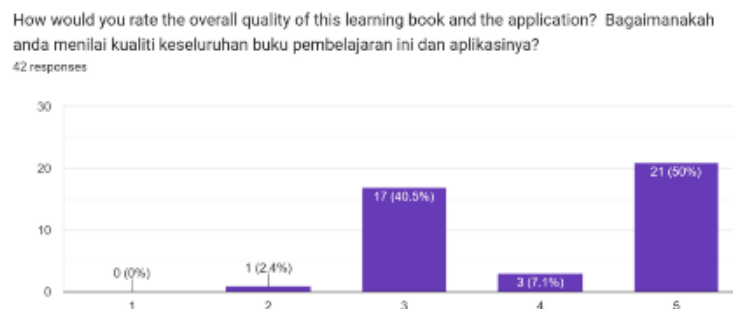


Figure 4: Question 16 Result

The final question is, how would the respondent rate the overall quality of the project, from 1 to 5, 1 being very poor and 5 being excellent. Half of the respondents rated the project as excellent.

Based upon testing, most users concur that the Smoking on Lungs AR book and application allows them to learn and understand more about lung health. Subsequently, it was discovered that the AR application was effective in educating the public about lungs. Users can learn about the lungs, the impacts of smoking, and the symptoms and preventions of lung cancer adequately using the user-friendly and functional AR book and application. Additionally, the project has raised user knowledge of the dangers of smoking and the importance of healthy lungs. The three objectives of the project have been accomplished with this AR book and application. The information and content are all contained in this project. Overall, users are pleased with this project which has been demonstrated through project testing.

4. Conclusion

In a nutshell, the augmented reality (AR) project's development is deemed successful because it was able to accomplish the objectives outlined, which were to better inform teenagers about their lungs and the consequences of smoking, as well as to inform society about the significance of lung health and the symptoms and preventions of lung cancer. Because this augmented reality book and application are so entertaining and educational, the creator hopes that people of all ages will find it useful. Teenage respondents evaluated the usability and effectiveness of this application quantitatively using a set of questionnaires. As a result, this AR book and application have improved the understanding of the importance of the lungs and have increased awareness of the dangers of smoking among the youths.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

MYAR: Preserving Malay Traditional Headwear with Augmented Reality Filter

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Abstract: The focus of this project is to create a Malay traditional headwear filter to expose to the social media user about Malay traditional headwear. AR aims to enable the visualization and simulation of complicated data, concepts, and scenarios. It may be used to build interactive 3D models, virtual prototypes, visualizations, and immersive learning experiences in sectors including architecture, engineering, medicine, and education. The AR application is developed using Meta Spark Studio. Traditional headwear has become a significant symbol and character of Malaysia's Malay people. It also represents the rich cultural heritage and traditions of the Malay community. Malay men and women frequently wear headwear at ceremonial situations such as weddings, religious celebrations, and cultural events. This traditional headwear is forgotten day by day due to the influence of fashion trends, where the traditional attire is no longer seen as relevant today. This research aims to promote knowledge and raise awareness about Malay traditional headwear among social media users. The focus of the research is to identify Malay headwear from all states of Malaysia, develop the AR filter as a platform to promote Malay headwear and evaluate the effectiveness of the AR as a platform for preserving and promoting cultural heritage. ADDIE model is used as the research methodology for developing the AR filter. Adobe Illustrator (AI), 3D Blender, and Meta Spark Studio are used to develop the filters. The Malay AR traditional headwear filters will be implemented to the audience via Instagram, and Facebook.

Keywords: Augmented Reality (AR), cultural and heritage, Malay tradition, traditional headwear, AR filter.

1. Introduction

Malay headwear is a significant aspect of Malay attire, reserved for cultural events and ceremonies. Its origins lie in everyday wear among common people and has evolved into a staple for certain groups. This traditional attire holds cultural importance and should be preserved for future generations. Social media platforms like Instagram and Facebook offer

filters that enhance photos and videos, increasing user engagement by making content more visually appealing. The project aims to showcase Malay traditional headwear on social media using AR technology, which enables visualization and simulation of complex concepts across various sectors like architecture, and education.

2. Materials and Methods

2.1 Materials

The study aims to establish a systematic and scientific approach to conducting research. Research methodology is a set of techniques and tools used to collect, analyze, and interpretation of data in an objective. It is very important to help researchers identify the research design, sampling technique, data collection methods, and statistical analysis technique for the research.

2.2 Methods

MYAR, this project ADDIE model was chosen as methodology flow because this model is appropriate to help this project go smoothly and meet the expectations and purposes. The model consists of five steps, analysis, design, development, implementation, and evaluation[1].

2.3 ADDIE Model

Methodology involves a systematic examination of research methods, analyzing theoretical frameworks, bodily practices, and associated concepts. This research uses both qualitative and quantitative methodologies, employing interviews to gather insights on people's awareness of traditional Malay attire, including headwear[2]. Additionally, the ADDIE methodology ensures a systematic approach to developing an augmented reality project for learning, aligning technology with instructional goals, enhancing learner engagement, and optimizing outcomes[3].

- Analysis

The analysis phase of investigating traditional Malay headwear involves reviewing existing research and data to assess learning objectives and how augmented reality (AR) can enhance learning. It includes identifying the target audience, their needs, and the context for AR use, considering technical requirements, resources, and constraints. Quality analysis aids researchers in defining study goals and objectives, as well as identifying the audience based on the problem statement. The analysis also evaluates audience awareness of Malay traditional headwear and defines the problem statement and project objectives for AR filter development. Data collection involves audience responses to questions about Malay traditional headwear to ensure project goals are achieved.

- Design

In the design phase, decisions are made based on the analysis phase data to develop the prototype and plan how augmented reality (AR) features will enhance the learning experience. Instructional techniques aligned with learning objectives are determined, exploring how AR can support these tactics. The user interface, interaction patterns, and navigation of the AR environment are created, considering how learners will access and engage with the AR content. Suitable tools are selected to optimize results, incorporating details from related literature. Additionally, aspects such as 3D modeling, color, typography, and prototype features are carefully considered. The design process involves

initial sketches followed by the development of 3D models using Blender software and then importing them into Meta Spark Studio for layout adjustments. This design approach aims to facilitate user exploration of knowledge and information, offering an engaging experience where users can try on AR traditional Malay headwear via the application. Ultimately, the design educates and captivates the audience about Malay traditional headwear, emphasizing the importance of understanding Malaysian cultural attire.

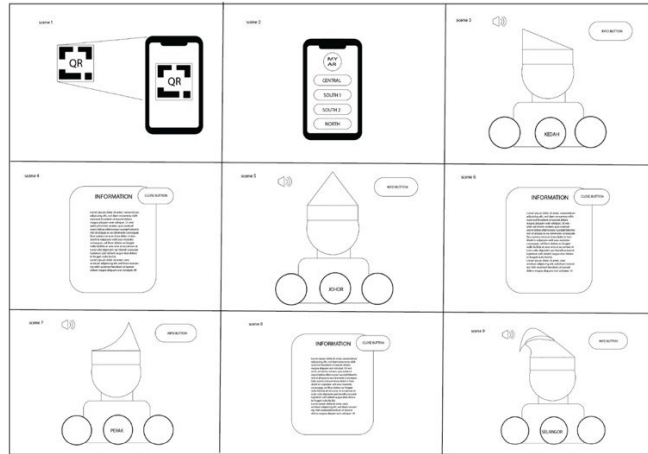


Figure 1: Storyboard

- **Development**

In the development phase, the focus is on creating the product for the audience, including designing visuals, features, and information. AR content is integrated into the application, involving the creation of 3D models, animations, and multimedia. Software like Adobe Illustrator, Blender, and Meta Spark Studio are used to develop the AR experience, ensuring accessibility across devices without special instructions. This phase brings the learning experience to life by translating concepts into tangible products through exploration and trial and error.

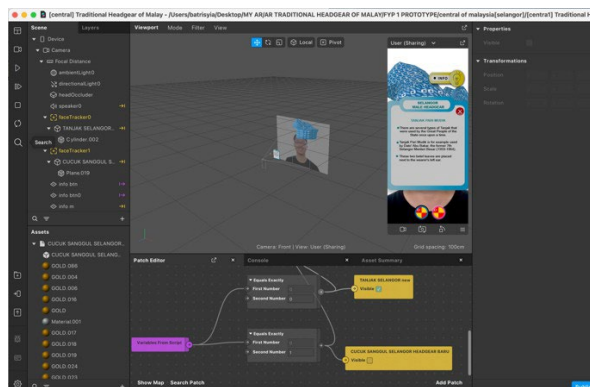


Figure 2: Filter Interface in Meta Spark Studio

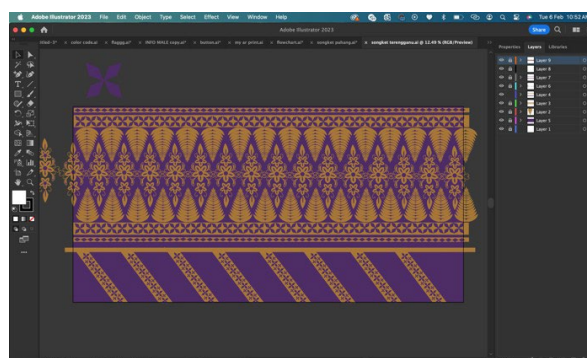


Figure 2: Songket Design in Adobe Illustrator

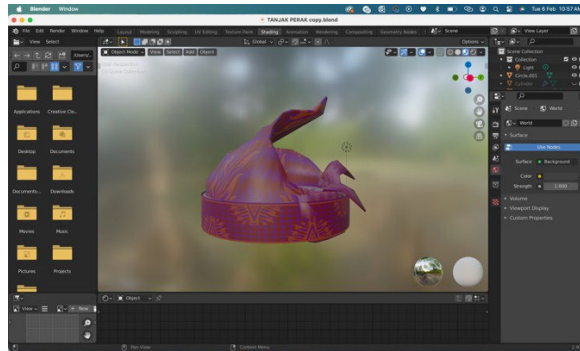


Figure 3: 3D Modeling Process in Blender

- Implementation

During this phase, in the stage following the completion of the project and approval from the supervisor, the researcher moves on to the implementation stage, during which they begin to collect additional data and information from the target audience regarding the completed project to determine whether or not the main objective can be completed. The researcher gathers the data by using questionnaires. To determine user experience and feedback. Based on the data, relevant enhancements and adjustments are performed to maximize the efficiency of MYAR filters.

- Evaluation

In the evaluation phase, the final stage of the ADDIE model is the project release and publishing. Examine the usefulness of the AR learning experience. Collect input from students on their involvement, perceived usefulness, and learning results. Determine if the AR filter met the targeted learning goals. Analyse user data to see how the AR experience affected knowledge acquisition and retention. Make any necessary adjustments or enhancements to the AR filters based on the evaluation findings. The ADDIE model is essential in determining the effectiveness and attractiveness of the AR traditional headwear of Malay project increasing, spreading awareness, and educating the audience about traditional headwear of Malay. This phase is the procedure to evaluate if the end product is effective for the user to explore and learning experience. Other than that, evaluate if the prototype needs to make any necessary updates and cycles that will bring it back to the analysis phase based on the feedback from users. In addition, the project will be considered for refining and improvement for a better user experience.

3. Results and Discussion

This section presents survey results on AR filters for Instagram and Facebook, focusing on MYAR filters and Malay traditional headwear. It assesses respondents' perspectives and experiences with these filters, aiming to gauge their knowledge and awareness of Malay traditional headwear's significance in Malaysia. By analyzing the data, insights are drawn regarding the potential impact of AR implementation. The discussion contextualizes these findings within the existing literature, emphasizing the importance of AR for showcasing Malay traditional headwear.

3.1 Results

3.1.1 Aware of the importance of Malay traditional headwear.

3. Are you aware of the importance of knowing the traditional headgears of the Malay community?

120 responses

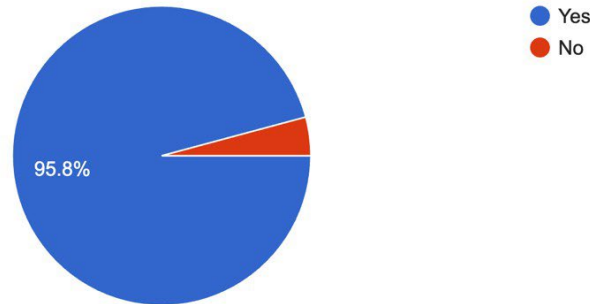


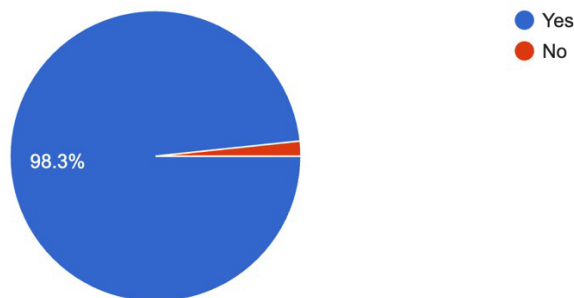
Figure 4: Pie chart of respondents' feedback importance of knowing

According to the figure above shows, after using the Malay traditional headwear filters, most respondents, specifically 95.8%, affirmed that they are aware of its importance. Only a small percentage of respondents, constituting the remaining portion, indicated that they were not aware of its significance. This investigation indicates that the investigated population is well aware of the importance of knowing the Malay community's traditional headwear. It appears that the usage of Malay traditional headwear filters has helped to raise respondents' awareness of and appreciation for this cultural aspect. The significant number of responders who acknowledge the necessity of understanding traditional headwear indicates its cultural relevance in the Malay community. This knowledge could act as the foundation for promoting cultural preservation, developing interest in cultural heritage, and encouraging intercultural thought and understanding.

3.1.2 The effectiveness of MYAR in promoting and preserving Malay traditional headwear.

Figure 5: Pie chart of respondents' opinions about the filter
4. Do you think AR "filter" is a good initiative for social media users to experience wearing the traditional headgears of the Malay community?

120 responses



Based on the survey after using the Malay traditional headwear filters, an overwhelming

majority of respondents, specifically 98.3%, expressed support for this initiative. Only a small percentage of respondents, constituting the remainder, indicated that they do not view it as a positive initiative. Moreover, The results of this research strongly support the idea of social media users wearing traditional Malay headwear. It implies that the implementation of social media platforms to enhance cultural experiences and recognition, such as through virtual testing filters, is generally viewed as beneficial and valuable by the survey respondents.

3.2 Discussions

Further exploration into the factors influencing awareness levels, such as demographic characteristics, educational background, and exposure to Malay culture, could provide valuable insights into the dynamics of cultural knowledge transmission and retention within the broader community. Additionally, initiatives aimed at promoting cultural education and awareness regarding traditional headwear may contribute to preserving and celebrating the cultural heritage of the Malay community.

3.3 Tables

Variables	Frequencies (number)	Percentage (%)
Age		
Below 18 years old	36	30%
18-14 years old	56	46.7%
24-30 years old	14	11.7%
30 years old and above	14	11.7%

Table 1: Demographic and Technology Segmentation

The questionnaire aimed to gather demographic information on respondents' range of ages. It classified respondents into four different age groups: below 18 years old, 18-25 years old, 26-30 years old, and above 30 years old. The total of respondents is 120. A total of respondents at the age below 18 years old 36(30%). Majority of respondents between 18 to 14 years old is 56(46.7%). Next, between 24 and 30 years old in total is 14(11.7%). Lastly, the respondent who participated in this project testing 30 years old and above in total is 14(11.7%).

Variables	Frequencies (number)	Percentage (%)
Social Media Experience		
Yes	111	92.5
No	9	7.5
Social Media Filter Experience		
Yes	116	96.7

No	4	3.3
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Table 2: General Knowledge

The results from the survey regarding user experience if using social media platforms and social media filter experience. Most of the respondents which are 111(92.5%) answered “Yes” and only 9 respondents answered “No”. Besides, 116(96.7%) of the respondents answer “Yes” and the rest of the respondents which is 4(3.3%) answers “No”. Based on this result strongly proves that social media usage is widely used.

4. Conclusion

The overwhelming majority of respondents expressed support for utilizing social media platforms and AR filters as effective ways of conveying information about traditional headwear. This indicates a recognition of the potential of digital platforms to facilitate cultural exchange, foster understanding, and preserve heritage in the modern age.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

ARTIFAK: Visualising Malaysian Islamic Museum Artifacts Using Augmented Reality

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Abstract: The study's significance lies in its contributions to the fields of Islamic historical and cultural artifacts as well as augmented reality. The Artifak mobile app is an Augmented Reality (AR) application that focuses on Islamic artifacts from the Islamic Arts Museum Malaysia. This study addresses the underutilization of Augmented Reality (AR) mobile applications in Malaysian museums. The project aims to develop an Augmented Reality (AR) mobile application for visualising virtual artifacts and enhancing the understanding of historical Islamic artifacts. The application was developed using Unity, while the 3D modeling of the artifacts was done using Blender. This study used ADDIE Instructional Design model as a part of the methodology study, which fixed to assist in achieving the study's objectives. It has been proven that this project has proven to be effective in providing an immersive artifact experience based on the responses we received from respondents.

Keywords: Islamic artifacts, museum, augmented reality, mobile application, culture heritage

1. Introduction

In Malaysia, museums hold a wealth of cultural heritage, yet accessibility for modern audiences remains a challenge. Augmented Reality (AR) technology offers a solution, promising to transform the traditional museum visit. By integrating AR, Malaysian museums can provide dynamic and interactive experiences with historical artifacts. An AR mobile app like Artifak aims to enhance understanding of Islamic artifacts, bridging the gap between visitors and cultural legacy. Despite the potential, AR isn't widely used in Malaysian museums [1]. The project aims to investigate AR implementation, develop an AR app for Islamic artifacts, and evaluate its effectiveness in engaging visitors. This approach responds to the need to adapt preservation methods to modern preferences, ensuring cultural heritage remains relevant in a digital age.

2. Materials and Methods

2.1 Materials

The study draws on insights from two key sources: "Augmented Reality Mobile Application for Malay Heritage Museum" [2] and a research piece focusing on Chinese art pieces [3]. The former identifies language barriers and staff shortages at the Malay Heritage Museum UPM, proposing the implementation of the MTRACR mobile augmented reality application to enhance visitor experiences.

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Feedback indicates positive reception, with users enjoying the entertainment value, simplicity of access, and educational content, suggesting its potential to attract more tourists and educate them about the museum. The latter study highlights the significant potential of AR in providing immersive and educational encounters for visitors, particularly focusing on Chinese art pieces. Through a prototype combining AR, visual aids, interactivity, and learning assistance, the research demonstrates how AR enriches engagement, learning, and emotional connection with artworks, overcoming limitations such as restricted viewing times and overcrowding. These findings underscore the transformative impact of AR on museum engagement and learning, suggesting its broader application in cultural institutions worldwide.

2.2 Methods

The Artifak AR mobile application development adheres to the ADDIE model, a structured approach encompassing Analysis, Design, Development, Implementation, and Evaluation phases. This systematic framework ensures alignment with user needs and project goals, enhancing the museum experience for visitors engaging with Islamic artifacts.

2.2.1 ADDIE Model

The ADDIE model is chosen for developing the Artifak AR mobile app due to its systematic and iterative approach. It provides a well-structured framework, emphasizing analysis, design, development, implementation, and evaluation. This adaptability ensures customization to meet user needs regarding Islamic artifacts. Its repetitive nature allows for continuous refinement based on user feedback, enhancing the overall user experience.

- Analysis

In the initial phase of the ADDIE model for the Artifak AR mobile app, meticulous analysis combines on-site exploration of Islamic artifact museums with a review of existing mobile apps and case studies. This involves capturing artifact photos to understand their visual and historical elements, crucial for authentic AR experience development. This analysis aids in identifying key objectives and ensures alignment with artifact representation. Examining existing apps enriches project context, enhancing the Artifak AR app's efficacy in delivering a compelling educational experience.

- Design

During the design phase, focus shifts to defining the components and features of the Augmented Reality (AR) experience. Learning outcomes are specified to guide content selection and interface design, ensuring visitors gain relevant knowledge or skills. Storyboarding outlines the AR application's narrative flow and interactivity, detailing user interactions with artifacts. UI design ensures intuitive interaction between users and the AR environment. Content production planning involves acquiring multimedia content (text, photos, audio, 3D models) to enrich artifacts and provide context.

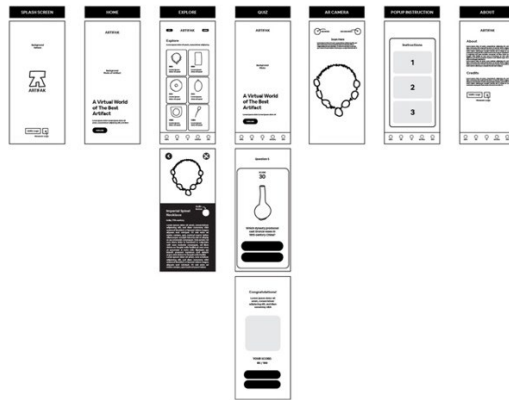


Figure 1: Storyboard

- Development

During development, the design becomes a functional AR application. Multimedia content is gathered from the Islamic Art Museum Malaysia. Tools like Blender and Unity are used for development, with thorough testing for performance and technical issues. Feedback from supervisors and users refines functionality and user experience. Designers create 3D artifacts, and the application is built using Unity, incorporating features like buttons, text, and sound with Unity's C# programming language.

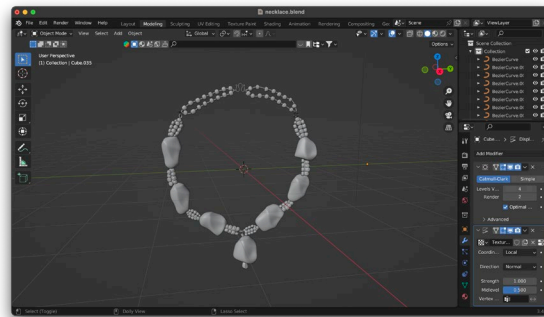


Figure 2: 3D Modeling Process in Blender.



Figure 3: Mobile Application Interface in Unity

- Implementation

The ADDIE framework has four stages total, and the fourth stage is implementation. The guests of the museum need to work together with the researcher by providing feedback as well as fill out a survey set in order to make sure the application can be used. This program for interactive Augmented Reality

(AR) has been developed and distributed as an .apk file, and it will soon be installed on an android phone. The user used an Android phone and a booklet as a target marker in order to test the functionality of the application.

- Evaluation

The Artifak project's evaluation phase assesses Augmented Reality (AR) effectiveness in delivering an immersive artifact experience. Key indicators include user engagement, satisfaction, and depth of immersion. Feedback from users interacting with the app measures involvement and satisfaction during exploration. Analysis covers user interaction patterns, time spent in the AR environment, and AR's potential to enhance artifact understanding and appreciation. This evaluation aims to provide insights into AR's efficacy in achieving project goals, ensuring a profound and enriching experience with showcased artifacts.

3. Results and Discussion

In this section, we analyze the outcomes of a questionnaire exploring the application of Augmented Reality (AR) for artifacts, focusing on participants' experiences and perspectives. The data offers valuable insights into the impact of AR on understanding and engagement with artifacts, identifying patterns and trends in responses. We discuss these findings in relation to existing literature, highlighting the significance of AR in enhancing artifact experiences.

3.1 Results

3.1.1 Using this mobile application can enhance the understanding of historical Islamic artifact.

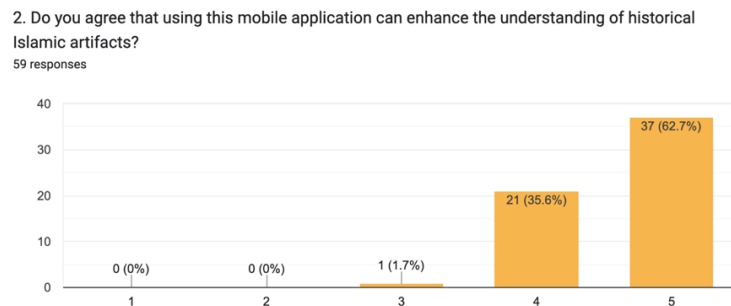


Figure 4: Enhancing Understanding of Islamic Artifacts.

The results show that most people, about 98%, think the ARTIFAK app is good for understanding historical Islamic artifacts. Specifically, around 62.7% feel really strongly about it, and another 35.6% just agree. Only a small 1.7% aren't sure.

3.1.2 The effectiveness of Augmented Reality (AR) in providing an immersive artifact experience

5. Did ARTIFAK application effectively provide you with an immersive experience of historical and cultural artifacts?
59 responses

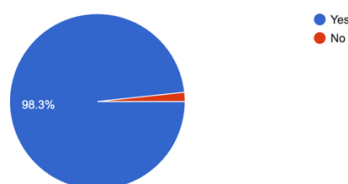


Figure 5: Augmented Reality's Effectiveness in Immersive Artifact Experience

The questionnaire results show a strong consensus (98.3%) on the effectiveness of the Augmented Reality (AR) application in providing an immersive experience with artifacts. This high agreement reflects positive reception of AR technology among participants. A small fraction (1.7%) had a contrasting perspective, indicating some participants didn't find the AR application as effective.

3.2 Discussions

Based on Figure 4, the discussion will explore the minority response to identify reasons for dissatisfaction, potentially focusing on factors like user interface, AR content quality, and alignment with expectations. Further exploration may reveal areas for improvement to enhance user satisfaction. Understanding perspectives of the 1.7% less satisfied can uncover challenges or shortcomings. Overall, the discussion aims to provide nuanced understanding of AR application effectiveness.

Drawing insights from Figure 5, the substantial agreement suggests the Artifak app is valued for learning about Islamic history. The discussion will pinpoint specific app elements users found useful. Attention will also be given to the small group with less decisive responses, exploring reasons behind their viewpoints to identify areas for improvement.

4. Conclusion

In conclusion, the integration of Augmented Reality (AR) technology into Malaysian museums, exemplified by the Artifak mobile application, promises enhanced visitor engagement and understanding of historical Islamic artifacts. The research shows widespread positive reception of the AR application, with 98% of participants finding it effective in enriching artifact understanding. However, the minority of less decisive responses highlights the need for ongoing refinement. Overall, this study underscores AR's potential in modernizing museum experiences and fostering deeper connections with cultural heritage, paving the way for continued advancements in museum engagement strategies.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Augmented Reality (AR) Book : Malaysian Traditional Musical Instrument (Kompang)

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Abstract: The Kompang is a traditional drum used in Malay communities and is considered one of Malaysia's cultural musical instruments. In today's world, technology plays an increasing role in our daily lives, but with children growing up in a digital age, many are gradually losing touch with traditional customs. To address this issue, an Augmented Reality (AR) based approach has been proposed by augmenting the learning encounter with Malay traditional musical instruments, I have been able to gain a deeper appreciation of this fascinating cultural art form.. AR technology has matured to a level where it can be used effectively in the education sector, particularly to provide students with realistic learning experiences. The objective of this researcher is to develop an interactive book an augmented reality application for learning the Malay traditional musical instrument (Kompang). This package is specifically designed for primary school students, allowing them to visualize traditional musical instruments, understand their history, and learn how they sound. The goal of this research is to promote Malay traditional musical instruments for future generations by providing an AR tool that can serve as a valuable resource.

Keywords: Augmented reality, Malay musical instrument, heritage, traditional

1. Introduction

Malaysia is known for its diverse cultures and rich heritage, including various traditional musical arts. One such instrument is the Kompang, a traditional drum believed to originate from the Middle East. It belongs to the membranophone family and is played using a free hand on a wooden-framed, circular, one-sided drum with animal hide skin. Two types of skins, polymeric and animal (goat) skins, are used. Animal skins reduce frequency by 25.34% compared to polymeric skins. Kompang holds significance in Malaysian culture, especially in weddings, where its catchy melody adds to the joyous atmosphere. The drum produces two essential tones: the higher-pitched cerang beat and the lower-pitched lentong beat. Traditional instruments like Kompang are gradually being forgotten, prompting the development of an AR learning system to preserve them. Augmented Reality (AR) projects computer-generated materials into users' perceptions of the real world, enhancing learning experiences. AR technology has potential implications for improving teaching environments, especially for digital native learners. Our research proposes an AR book for primary students to learn about Kompang interactively. This technology allows students to explore and engage with Kompang in a surreal and mythical way, enhancing their learning experience. By integrating interactive learning, students can engage with Kompang in a playful yet educational manner, fostering a deeper understanding of traditional musical instruments. This approach

eliminates the need to visit museums, boosting students' interest in learning Malaysian traditional musical instruments.

2. Materials and Methods

The materials and methods section, also known as methodology, describes all the necessary information that is required to obtain the results of the study.

2.1 Materials

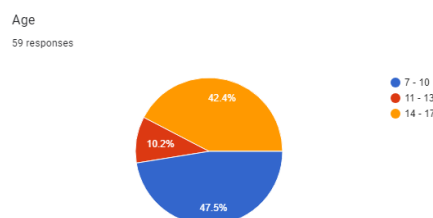
The materials utilized in this study encompassed various resources essential for data collection and analysis.

- **Google Forms:** Structured surveys were conducted using Google Forms as the primary data collection tool, facilitating the collection of quantitative data.
- **Survey Instruments:** The surveys included Likert scales, with participants providing numerical ratings on a scale of 1 to 5, enabling a nuanced assessment of attitudes and perceptions.
- **Computing Devices:** Participants utilized personal computing devices such as laptops, smartphones, or desktop computers to access and complete the Google Forms surveys.

2.2 Methods

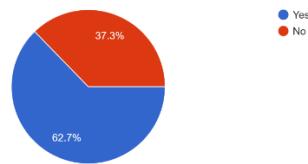
The research utilized Google Forms to gather data, employing Likert scales to capture diverse participant opinions. Surveys were completed by individuals aged 7 to 17 on personal computing devices, resulting in a sample size of approximately 59 respondents. Structured surveys, comprising four sections covering demographic details, current awareness levels, beliefs regarding intervention effectiveness, and evaluations of the AR Kompang application, were designed following a quantitative approach. The quantitative data obtained, including numerical ratings and scaled responses, will undergo rigorous statistical analysis to derive meaningful insights. The findings will be systematically presented, offering insights into participants' awareness, attitudes, and perceptions regarding the traditional musical instrument, Kompang.

3. Results and Discussion



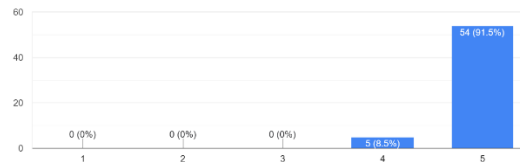
This section provides an overview of the age distribution among the 59 respondents. Most participants were between 7 and 10 years old, accounting for 47.5% of the total respondents. Meanwhile, the age group 11-13 years old accounts for 10.2% and the age group 14-17 years old accounts for 42.4% of the surveyed population. This summary highlights the varying age groups contributing to the overall demographic profile of the surveyed individuals.

Are you aware of the musical instrument called Kompang?
59 responses



This section examines the familiarity of 59 respondents with the musical instrument called “Kompang”. This majority, 62.7%, were familiar with the instrument, while 37.3% of respondents said they were not familiar with “Kompang”. This distribution provides an overview of the level of awareness of the surveyed population about this musical instrument.

On a scale from 1 to 5, how effective do you find the 'Hit The Beat' AR application in helping you understand and appreciate Kompang?
59 responses



Participants were asked to rate the effectiveness of the AR app “Hit the Beat with Kompang” on a scale of 1 to 5 in helping them understand and enjoy Kompang. The vast majority, 91.5% of respondents, found the app to be extremely effective (5), while 8.5% found the app to be very effective (4). No participants showed lower effectiveness ratings (1-3). These results highlight a particularly positive perception of the effectiveness of the AR app “Hit The Beat With Kompang” in increasing the understanding and appreciation of Kompang among the surveyed population.

4. Conclusion

In conclusion, the research results show that the AR project, “Hit the Beat with Kompang”, is effective and committed to raising awareness, interest and understanding of traditional Malay musical instruments, especially Kompang. Positive feedback from respondents regarding the app's effectiveness, usability, and impact on interest highlighted its potential as a valuable educational tool. The unanimous agreement on the positive impact of interactive elements and the ability to recommend the app further reinforces its perceived effectiveness. Based on these findings, the integration of advanced technologies, such as augmented reality applications, can play an important role in preserving and promoting cultural heritage. The positive results of this AR project show that similar initiatives can be explored and expanded to enrich educational experiences, foster cultural appreciation, and bridge gaps awareness, especially in younger age groups.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Exploring Nature Through Augmented Reality (Ar) Flashcard: An Introduction To Animals For Preschool Children

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Abstract: Nature is the physical world and everything in it that was not manufactured by humans. Animals are one of nature's natural resources that are highly significant to be learnt and recognized by people, especially among preschool students. Regrettably, some youngsters developed a great hatred for animals and to believe that they find animals to be unattractive. They will lose interest in learning about animals as a result of this matter, and their awareness of nature's resources will also decrease. Besides, children of all ages today are heavily dependent and addicted on gadgets technology which many kids now spend more time interacting with screen media than they do with books. Therefore, by producing an Augmented Reality (AR) project, it would be attainable to motivate kids to learn. By that, the goal of this research is to develop an Augmented Reality (AR) Flashcard about Animals in Nature, specifically for preschool students, to teach them about animals also to examine AR performance in educating them. This is because we already know how important early education is for developing children, as well as how essential it is to make them aware of the value of learning with the appropriate tools. In addition, the ADDIE model is used as the methodology for developing this project since it ensures that the project proceeds successfully by following to each phase. The research methodologies tools that will be used for this project plan to include a questionnaire which will have certain questions that are based on the objectives of the project, and the data that is gathered from the responses will be presented as numerical or statistical results. It will be possible to assess whether or not the student understands the topic that is being taught, which is animals in nature, and whether or not this topic and technique is being presented effectively.

Keywords: Animals, Augmented Reality (AR) Flashcard, education, nature, preschool student, ADDIE Model, questionnaire

1. Introduction

(Mincemoyer, 2014) highlighted that the term "STEM," an acronym for science,

technology, engineering, and mathematics, has become increasingly significant in discussions on global business, competitiveness, and educational strategies. This expression is also employed to describe careers in related fields and is used with learners ranging from preschool to postgraduate studies. STEM (Science, Technology, Engineering, Mathematics) terms is the research cluster that will be develop in this project but prioritize on the science part which is Animals in Nature. As talk about nature, it means all the naturally existing elements on this world, including all the plants, animals, occasions, activities, and everything produced by the earth that were not created by humans. Besides, the animal world is a massive collection of millions of distinct animal types (species), and regardless of their appearance, size, or mode of living, they all share some traits. They have many cells making up their bodies, as well as nerves and muscles that allow them to move and react fast to their environment also animals consume food to obtain the energy they require to survive. Other than that, A technology known as Augmented Reality (AR) combines real life information with virtual word. It employs a variety of technological instruments, such as multimedia, modeling in 3D, real-time tracking and registration, smart interaction, and sensing, among others. As stated, (Yunqiang Chen, Qing Wang, Hong Chen, Xiaoyu Song, Hui Tang, Mengxiao, 2019), the concept involves mimicking the real world through the use of computer-generated virtual data, including text, images, 3D models, video and music before applying it to the real world to improve the way the real world is conveyed through technology.

Ultimately, based on the findings of the entire study, this project shall for emphasize developing an augmented reality (AR) project about animals in nature, especially for preschool students by utilizing flashcards as the marker-based component of AR. The science component—animals in nature—was prioritized while choosing this topic based on STEM (science, technology, engineering, and mathematics) terminology. Preschoolers are the target audience for this project, so certain crucial learning tactics will be implemented on the AR flashcard, such as including the animal's name, image, spelling, sound, and some background information. The preschool student or users can scan the flashcard to see the AR outcome, and there will be some game, button, and sound as the interaction, for the flashcard's final appearance and functionality.

1.1 Problem Statement and Project's Objective

Presently, using digital media to learn is quite advantageous, especially for preschool students. Based on that assertion, there are a few resulting that led to the creation of this project. First off, children of all ages today are heavily dependent and addicted on gadgets technology. (Mogg, 2011) is concerned, stating that numerous children currently devote more time to engaging with screen media than they do reading books. Thus, by producing

an augmented reality project, it would be attainable to motivate kids to learn. In addition, (KUBIATKO, 2012) stated the youngsters developed a strong aversion to animals and thought that they rated animals as being unattractive. With the presence of several interactive elements in this project, it will help to dispel the dread they might have. (Qdeesworldwide, 2020) also stated that the child will be able to catch up with classmates and succeed in their academics with the correct resources and learning techniques. Besides, says (Bachani, 2021), it might be challenging to learn such great names at such a young age because children tend to learn simple things in their early years. Enough that, it is easier for preschool students to learn with this innovative AR learning method. In conclusion, this project have some goals to achieve such as to investigate students' preferences for AR learning methods, to develop an interactive AR flashcard about animals in nature for preschoolers, also, to evaluate AR performance in educating preschool student.

2. Materials and Methods

In the making of this project, ADDIE model was chosen as instructional design that consists of five main phases which will be as guides for develop this project by follow each of the phases. Besides, to conclude either this project was successful or not, beta testing will be conduct with the target audience. They will be use tablet that have provided to do the testing on this project and questionnaire will be other materials that will use to collect all the data for result from the target audience.

2.1 Materials

To determine the success of the project, beta testing was carried out targeting preschool students aged 4 to 6 years. This phase involved providing participants with a questionnaire divided into three parts which is demographics, objectives & user experience (UX) design, and user interface (UI) design, for them to complete. Participants were given a tablet preloaded with the APK file of the project, enabling them to engage with the augmented reality features while they can play the quiz game as well. Following the project testing, participants were required to complete a survey that providing the developer with data and feedback for analysis.

The questionnaire is structured into three distinct sections to gather comprehensive feedback such as demographics, objectives & UX design, also UI design section. In demographics part, it collects basic information about the respondent, such as name, age and kindergarten's name as well as some question about their level of understanding about animals. After that, in objective & UX design section is to evaluates how well the project

meets its objectives and assesses the user experience (UX) design's effectiveness. It seeks to understand the users' interaction, navigation ease, and overall satisfaction with the application. Lastly, the UI design section focuses on the visual and interactive aspects of the application, including layout, button design, 3D models design and audio. Figure 2.1 shows the example of questionnaire that use for collecting data.

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**AUGMENTED REALITY (AR) FLASHCARD
ABOUT ANIMALS IN NATURE FOR PRESCHOOL STUDENT**

Name : Age :

School :

Section A : Demographic

	No ☹️	Not at all 😐	Yes 😊
I do not know about the types of animals			
I am not fluent in spelling and reading			
I am afraid of animals			

Section B : Objective & UX Design

	No ☹️	Not at all 😐	Yes 😊
I understand about type of animals in nature			
I prefer to learn using gadget rather than book *			
Learning by using Augmented Reality (AR) Flashcards are very interesting *			
This method of learning is very effective *			
I like to learn with this method			

Section C : UI Design

	No ☹️	Not at all 😐	Yes 😊
The animation in this project are very attractive *			
All buttons work well *			
The audio in this project is heard clearly *			

Note : (*) To be filled by guardian / teacher

Figure 2.1: Questionnaire

2.2 Methods

As mentioned above, ADDIE model is one of the research method that used in making this project which stands for the five main phases of the instructional design process such as Analysis, Design, Development, Implementation, and Evaluation. It is widely considered to be the most significant and influential model for instructional design. Furthermore, the ADDIE model is used since each phase's procedure appears to be very clear and comprehensively, which is highly useful in developing this project.

2.2.1 Analysis

The analysis phase is the starting point for every instructional design project, since it is where the goals, content, target suitability, and success of the overall learning and teaching model are

determined. To correlate this component with this project, identifying the ideal title for project development was the initial step required which Augmented Reality (AR) Flashcard about Animals in Nature for Preschool Student was the ultimate title. . Furthermore, the research problem related to the chosen topic has been determined, and the objectives that must be met have been set as well. For example, many children today spend more time connecting with screen media than with books. As a result of this issue, it may encourage youngsters to use gadgets for entertainment rather than studying. That is why this project was created to assess how well the AR approach works with pre-schoolers even more from learning aspect. The whole planning process for developing this project had been arranged and one of the methods used in for the process is by preparing Gantt chart.

2.2.2 Design

Following the analysis phase is the second phase of the ADDIE model, which is the Design phase. The completed design phase is intended to identify and establish instructional ways that will be used in the project's development. Since preschool children are the project's intended audience, the design should be exciting and joyful. Design is extremely important to them because it influences their interests. For this project, storyboard is used for designing the outcome that will be implement. There will be the design for main page, game page and the Augmented Reality (AR) page which the design for the outcome when the users scan the flashcard. Images, button design, background music, and sound effects are typically used into game creation, which is then followed by the design of instructional games for pre-schoolers.

2.2.3 Development

The third phase of the ADDIE model is the development phase, which is responsible for the creation of the subject matter and learning assets based on the plan of action that was developed in the design phase. For this project, the animation for the main page, the game page, and the augmented reality page will be prepared throughout the development period. After that, some software that supports the procedure will be used to modify the sounds, including the voice over, sound effects, and background music.

2.2.4 Implementation

Implementation is the next phase for ADDIE model and at this point in the process, the project is extremely close to being finished since everything that was planned and created in earlier stages is being put into action. Converting the design needs and specifications into a form that can actually be implemented and used is an essential stage. This project is going to go through alpha testing with the supervisor, followed by beta testing with the target audience that it is primarily aimed at, which is the preschool student. Besides, testing the project component was another part of this procedure that intended to improve the resources that were presented for the

outcome.

2.2.5 Evaluation

The fifth phase, which is known as the Evaluation phase, is going to be carried out as a method for testing and assessing the appropriateness of the project that has been produced. Questionnaires will be used to collect information throughout this project's evaluation phase. This implies that participants will be asked to complete out a form which is questionnaire that contains questions pertinent to the project's stated objectives. At the same time, it will be possible to assess whether or not the student understands the topic that is being taught, which is animals in nature, and whether or not this topic is being presented effectively.

3. Result and Discussion

For the result, the developer conducted a beta testing phase with the target audience using questionnaire. The primary aim of this testing was to determine the effectiveness of the "Animals in Nature" project on preschool students while ensuring that all project objectives were met. The collection of results and data from this testing was carried out with the approval of the participants solely for the purposes of this research.

3.1 Research Question 1: Were the preschoolers like to learn using AR method?

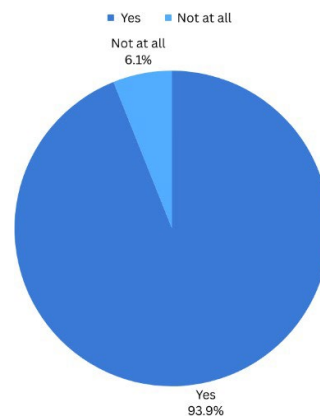


Figure 3.1: I like to learn with this method's result

From the figure above, about 93.9% respondent answered that they like to learn with this method and other 6.1% respondent said not like at all. Before that, they need to testing the project first and continue with answering the survey. This important discovery provides a straightforward answer to our original study question on preschoolers' interest in augmented reality learning. Furthermore, this result is in line with one of the project's objectives, which is to investigate students' preferences for using augmented reality (AR) in educational settings. To conclude the

finding, most respondent like to use this method as learning tool other than using books.

3.2 Research Question 2: What are the effectiveness components for teaching preschool students about animals in nature?

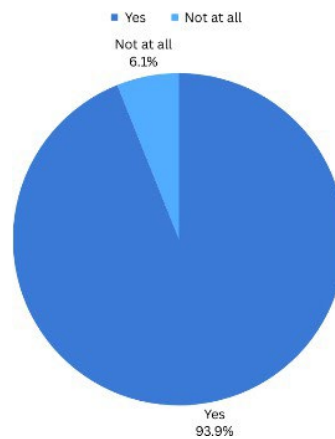


Figure 3.2: Learning by using Augmented Reality (AR) Flashcard is very interesting's result

For research question about the effectiveness components for teaching in preschool, there are question in questionnaire that can answered for it which is "Learning by using Augmented Reality (AR) Flashcard is very interesting" question. 94% of target audience regarding the result answered that learning using AR flashcard very exciting and interesting. The creation of interactive AR flashcards as educational tools demonstrates their potential as an effective means of instruction. The overall outcomes affirm that this initiative has successfully met the project's second objective, which was to create an engaging AR flashcard system focused on animals in nature for preschool-aged children. Utilizing AR flashcards enables the intended audience to engage with the content by scanning and interacting with 3D models of animals, as well as experimenting with buttons to hear animal sounds and learn about spelling and pronunciation.

3.3 Research Question 3: Are kindergarteners learning effectively when using this augmented reality (AR) method?

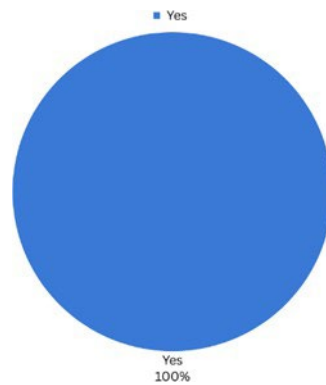


Figure 3.3: This method of learning is very effective's result

In response to the question, "This method of learning is very effective?" all respondents unanimously agreed that the AR method is highly beneficial for learning since this question successful got 100% rating. This outcome fully meets the final objective of the project, which was to assess the effectiveness of AR in educating preschool students. Consequently, this addresses the research question regarding the efficacy of using AR in early childhood education. Given the prevalent use of gadgets among children today, developing this project offers significant educational benefits, particularly in enabling them to learn about Animals in Nature through augmented reality.

4. Conclusion

In conclusion, this project has successfully demonstrated the potential of Augmented Reality (AR) technology in enhancing early childhood education, specifically through the "Animals in Nature" AR flashcard application. Based on the overall observations, it is possible to conclude that every project objective has been satisfactorily met after developing an Augmented Reality (AR) flashcard for preschoolers about animals in nature. Learning using Augmented Reality (AR) is engaging and has the potential to be one of the most effective methods of education, according to responders' feedback. From concept to execution, the development process brought to light the value of interactive and captivating educational resources for young children. The project succeeded in delivering a new teaching experience, even in facing a variety of obstacles including platform compatibility issues and software constraints. Preschoolers' participation in the beta testing phase not only confirmed augmented reality's effectiveness in the classroom, but also provided opportunities for additional improvements.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Augmented Reality (AR): For Learning Tajweed Made Easy to Educate Student

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Abstract: Tajweed is the set of rules and principles that govern the proper pronunciation and recitation of the Quran. It encompasses the precise articulation, phonetics, and intonation required to recite the words of the Quran in a melodious and accurate manner. It is the individual's responsibility as a Muslim to learn tajweed and practicing it in reading the Quran. Many youngsters in Malaysia struggle to read the Quran correctly due to the lack of fluency in pronunciation following the rules of tajweed correctly among students. Current learning techniques for children, such as books and classrooms, are helpful for improving reading but ineffective for improving pronunciation and understanding. Besides, the majority of these methods are based on one-way communication, which means that learner cannot engage with the system. This study attempts to design an innovative educational tool embodying augmented reality (AR) for learning tajweed. We implemented AR apps with learning cards in order to help memorize the five basic rules of tajweed. Users could use the learning cards as AR marker, and the 3D visual aids will appear in the device screen. Interactive elements are also provided in the quiz section where users need to scan and interact with the AR module interface. The researcher utilized the ADDIE model in this study as the main methodology. We tested the AR modules towards 36 users among children of 10 years old from Lembah Klang and mostly received positive feedback. All respondents agree that the developed application will benefit and effective in the learning the rules of tajweed in reciting the Quran.

Keywords: Augmented Reality (AR), tajweed, Quran

1. Introduction

In current digital era, augmented reality (AR) a contemporary and widely utilized multimedia technology, is employed as an engaging and interactive learning tool in modern mobile technology. Tajweed Made Easy is an innovative approach to teaching the rules of tajweed to students in primary school. Augmented reality (AR) technology that scan on based and virtual objects onto real-world scenes [3]. Therefore, this application can be developed by using a smartphone or tablet camera for 2D project of the tajweed verses onto the real-world.

According to research from the Malaysian Ministry of Education (KPM), many primary school graduates do not know how to read the Quran when they are in secondary school [1]. By AR, Tajweed Made Easy offers a unique and engaging way for students to learn tajweed knowledge. This technology makes it easier for them to visualize and understand the rules of tajweed in a more immersive way. Additionally, this application can provide real-time feedback on a student's pronunciation and helping them to improve their recitation skills. In summary, the use of an AR in Tajweed Made Easy offers an innovative and engaging way for students to learn and apply the rules of tajweed, leading to a deeper understanding of the Quranic text.

Nevertheless, numerous young individuals in Malaysia encounter difficulties in accurately reading the Quran. Many are unfamiliar with the proper pronunciation of letters and their characteristics. Consequently, reading with incorrect pronunciation can alter the conveyed message in the Quran, potentially resulting in misunderstandings. The significance of understanding tajweed in safeguarding the accurate recitation of Allah's word is evident in Surah Al-Muzzammil, verse 4 of the Quran.

أَوْ زِدْ عَلَيْهِ وَرَتِّلِ الْقُرْآنَ تَرْتِيلاً

Meaning: Or add to it and recite the Qur'an with measured recitation.

Research shows that memorizing the five fundamental rules of Tajweed poses a challenge [8]. Most existing methods rely on one-way communication, limiting learners' ability to actively engage with the system.

The objectives of this research are below:

- To design an AR application so that students can easily memorize tajweed.
- To develop an AR application to improve the rules of tajweed among students.
- To evaluate the effectiveness of augmented reality in getting interest for tajweed.

1.1 Research Project

According to research conducted by [7], augmented reality (AR) represents a groundbreaking computer graphic technology that presents visual graphics in a manner that appears real. As indicated by a study conducted by [3] augmented reality offers numerous potentials and advantages that can be harnessed within the educational realm. AR experiences can be delivered through various devices, including smartphones and tablets. AR can enhance learning experiences by providing interactive and immersive educational content.

2. Materials and Methods

In the realm of designing augmented reality (AR) applications, the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model remains a favored option owing to its thorough and structured approach. This research papers delve into the advantages associated with employing the ADDIE model for instructional design and technology development. In this section, each phase involved in the development of AR *Mudahnya Tajwid* will be thoroughly discussed

2.1 Materials

- Analysis Phase

This phase involves comprehending the learning objectives, target audience, and context of Tajweed learning. It entails analyzing the proficiency levels of the learners and identifying any

specific challenges they may encounter in comprehending and applying Tajweed rules. Additionally, it involves defining the scope and content of the augmented reality (AR) learning experience.

The initial step of this project focused on selecting a suitable title to effectively convey the research topic on Augmented Reality for Learning Tajweed Made Easy to Educate Student also known as AR *Mudahnya Tajwid* app. The primary concerns revolve around the insufficient fluency in pronunciation and adherence to tajweed rules among students. This analysis aims to ensure the efficacy of augmented reality (AR) in generating interest in tajweed learning.

- Design Phase

During the design phase, intricate details of design stages, functions, and processes are delineated. This includes drafting storyboards, selecting colors, and typography. In terms of user requirements, the initial design is based on a personally crafted storyboard, the sitemap and additional virtual objects intended for use in the AR application. Throughout the design phase, careful attention is paid to user interface design, including aspects such as color, typography, and layout, ensuring a user-friendly and engaging experience for learners.

- Development Phase

In the development phase, the developer will create the AR-based Tajweed learning system based on the design specifications. This process entails designing and generating virtual elements, 3D models, animations, and interactive components that will be integrated into the application. Additionally, it ensures that the content of the AR application is fully functional and optimized for specific devices and platforms. To guarantee that the project moves forward within the timeframe specified, the developer should aim to complete at least 80% of the model. This AR mobile application utilizes Vuforia for developing augmented reality features and Unity as the application engine. C# serves as the primary scripting language for the development process. All animations are created within the Unity environment. Additionally, 3D modeling is accomplished using Blender software to generate the necessary 3D models for the application's content.

- Implementation Phase

After completing the AR-based tajweed learning system, it will be deployed within an authentic educational environment. The researcher will carefully choose a sample group of students who meet the predetermined criteria. These students will actively participate in the AR learning sessions and interact with the system. Throughout the implementation phase, the researcher will closely observe the student interactions, gather data, and document any challenges or enhancements required for the system. This phase aims to provide valuable insights into the real-world application of the AR-based learning system.

- Evaluation Phase

The concluding phase of the ADDIE model involves assessing the effectiveness of the AR learning experience and implementing improvements. This phase includes evaluating the learning outcomes and obtaining feedback from learners regarding their engagement, understanding, and application of tajweed rules. Assessment tools and analytics are utilized to measure progress and pinpoint areas for enhancement. Subsequently, the AR application and instructional design are revised based on the evaluation results to improve the overall learning experience.

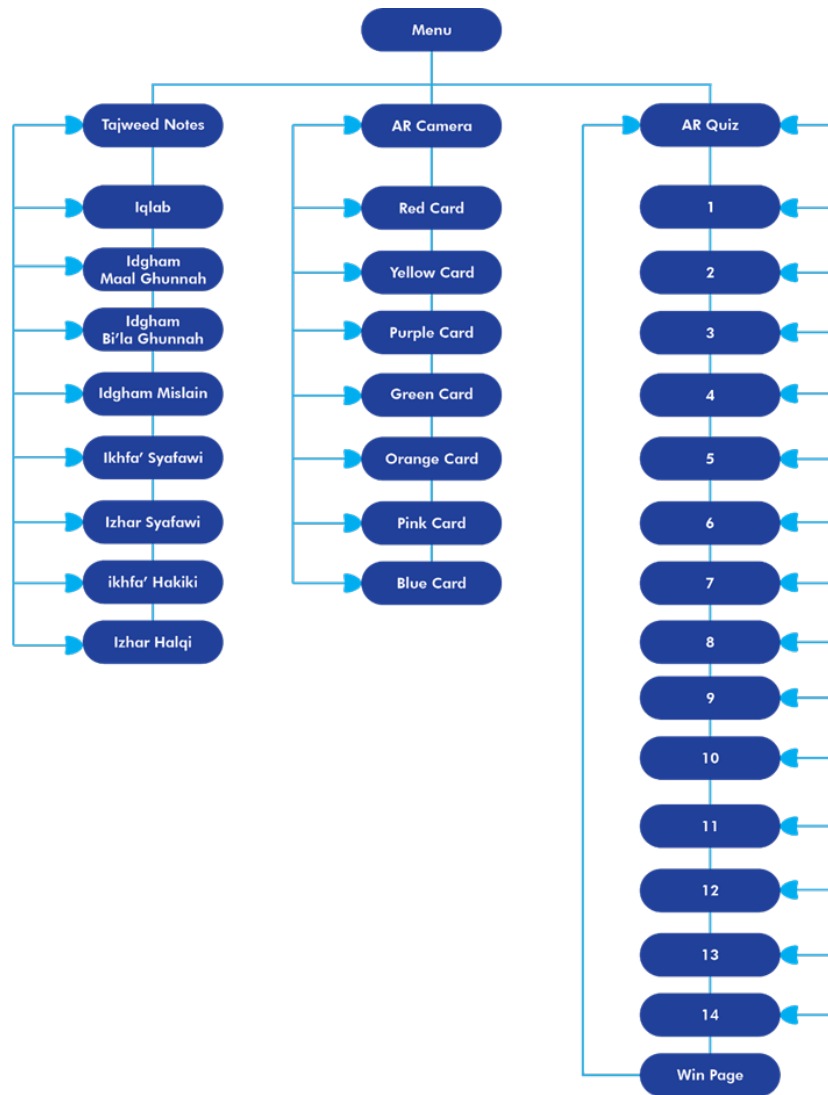


Figure 1: Sitemap

3. Results and Discussion

The AR Mudahnya Tajwid application underwent thorough functionality testing to validate its effectiveness, with a focus on optimizing its performance before release to end users. Subsequently, a survey was conducted using Google Forms, targeting standard 4 students as the primary audience, to gather feedback on usability and overall experience. This comprehensive approach aimed to evaluate how well the application met the needs and expectations of standard 4 students, ensuring it effectively serves its intended purpose for this age group. The insights gathered from the survey will be utilized to further enhance the application, improving its user friendliness and overall benefits for the target audience. Data was successfully collected from 36 respondents by the developer. Below are a few of the results from the respondents.

3.1 Results

Alpha testing and beta testing were carried out this project reached the goal and fulfilled the main objective. The researcher used a questionnaire to collect data from respondents. The researcher prepared the questions into three sections. Please refer to appendix A for raw data.

No.	Section	Number of Question
1.	Section A: Demographic	1 question
2.	Section B: Interest & understanding	6 questions
3.	Section C: AR application interactivity	16 questions

Table 1: Section of question

3.2 Data Analysis

Below are a few of the data from the respondents.

Aplikasi ini dapat meningkatkan minat saya terhadap tajwid.

36 responses

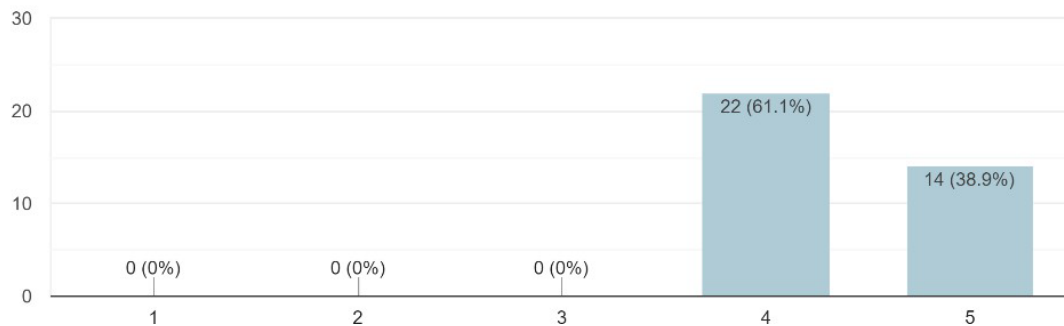


Figure 2: This application can increase my interest in tajweed.

Based on the figure 2 shows, the responses concerning the application's potential to increase interest in tajweed are 61.1% of respondents strongly agree that the application can enhance their interest in tajweed, with an additional 38.9% agreeing with this assertion. These findings indicate a favorable perception among respondents regarding the application's capacity to stimulate interest in tajweed.

Adakah anda pernah menghadiri kelas tajwid sebelum ini?

36 responses

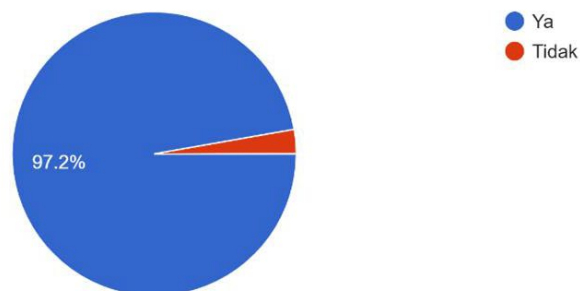


Figure 3: Have you ever attended a tajweed class before?

As shown in figure 3, the data regarding attendance at tajweed classes reveals a high proportion of affirmative responses. More specifically, 97.2% of respondents have attended a tajweed class previously, whereas only 2.8% have not. These findings suggest that a significant majority of respondents have prior experience with tajweed classes, while only a small minority have not participated in such classes.

Aplikasi ini dapat membantu saya dalam memahami dan mengamalkan tajwid.

36 responses

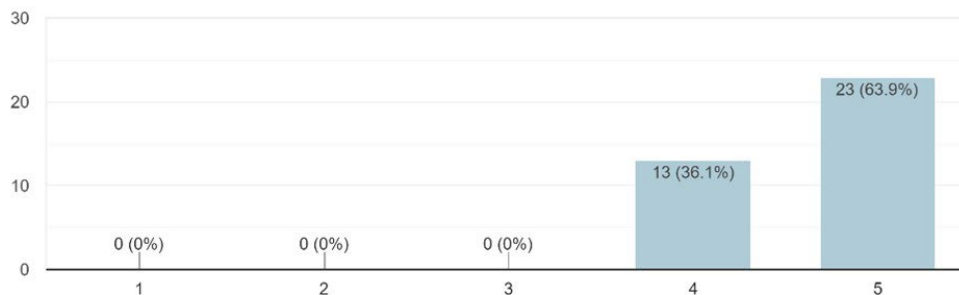


Figure 4: This application can help me in understanding and practicing tajweed.

According to the data presented in figure 4, the majority of respondents, accounting for 63.9%, expressed strong agreement with the statement, indicating a notable level of confidence in the application's capability to aid them in comprehending and practicing tajweed. Additionally, 38.1% of respondents agreed with the statement, reinforcing the positive perception of the application for its effectiveness in Tajweed learning and practice.

Saya mudah belajar dengan mendengar rakaman suara dalam aplikasi.

36 responses

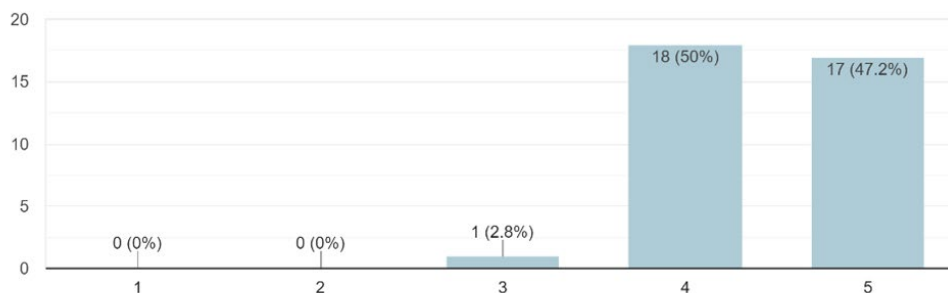


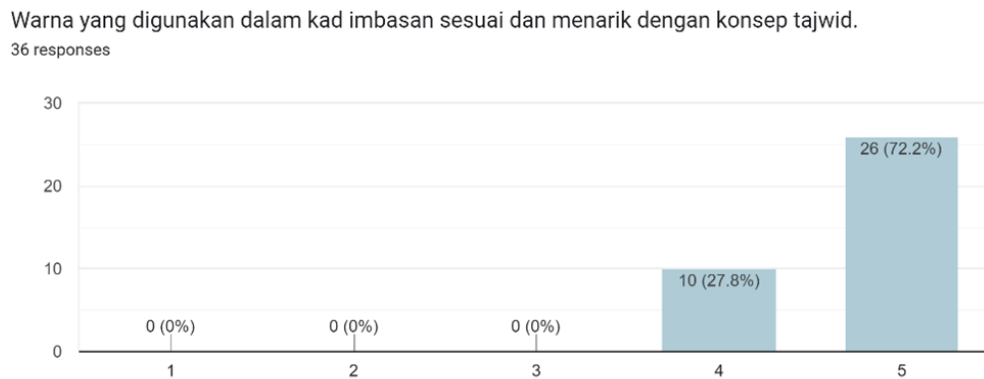
Figure 5: I easily learn by listening to voice recordings in the app

Based on the data show in figure 5, a significant consensus among users is evident, with 47.2% strongly agreeing that learning through voice recordings was highly effective. This suggests that the voice recordings were likely clear, well-paced, and informative, aiding in understanding and retention of the content presented. Furthermore, the percentage of respondents who agreed, at 50%, further

supports the positive sentiment towards learning through voice recordings.

The small proportion of respondents who were neutral, at 2.8%, may indicate a minority of users who neither strongly agreed nor disagreed with the effectiveness of learning through voice recordings. Nonetheless, the data indicates that the majority of respondents have a positive perception of the application's effectiveness for learning through voice recordings.

Figure 6: The colors used in the flashcard are suitable and attractive with the concept of tajweed.



The results in figure 6 shows that, regarding the suitability and attractiveness of the colors used in the flashcards in accordance with the concept of Tajweed, indicate a notable consensus among users. Specifically, 72.2% of respondents strongly agree with this notion, while a further 27.8% agree to a lesser degree.

4. Conclusion

In conclusion, the augmented reality (AR) learning tajweed project has proven to be a groundbreaking initiative in the realm of education and technology. By seamlessly integrating augmented reality into the study of tajweed, this project has not only enhanced the accessibility of learning for students but has also revolutionized the traditional methods of teaching this intricate discipline. The immersive experience provided by AR technology enables students to engage with the material in a dynamic and interactive manner, thereby facilitating a deeper understanding and retention of tajweed principles. Furthermore, the project's success in bridging the gap between traditional Islamic education and modern technological advancements underscores its significance in meeting the evolving needs of learners in the digital age. Moving forward, the widespread adoption and continued development of AR learning platforms such as this hold great promise for enriching educational experiences and empowering learners worldwide.

Appendix A

Timestamp	Jantina	Adakah anda pernah mer Tajwid merupakan aspek	Aplikasi ini dapat meringi	Aplikasi ini dapat membu	Penggunaan aplikasi AR	Aplikasi ini dapat membat	Mudah memahami fungsi	Setiap halaman dalam ap	Saiz butang adalah bersa
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21/01/2024 00:37:14	Perempuan	Ya	5	5	5	5	5	5	5
21/01/2024 00:37:56	Perempuan	Ya	5	4	5	4	4	5	4
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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Augmented Reality Storybook: To Preserve Traditional Theatre Mek Mulung Among Young Generation

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Abstract: Mek Mulung can be categorized as a performance combining dance, music and drama that has existed for over 400 years. Mek Mulung was declared as Kedah state heritage in 2014, but unfortunately, with the changing times and the rapid development of technology, the presence of Mek Mulung began to fade and become less familiar to the young generation. In addition, the use of AR in introducing traditional theater is relatively less. This study is being conducted to identify Mek Mulung theatre tradition presentation through Augmented Reality, to develop an augmented reality storybook application as an awareness on the existence of Mek Mulung tradition and to evaluate the effectiveness of using Augmented Reality to enhance teenagers' experience in learning the theatre tradition. ADDIE Model of methodology is applied as the approach to develop the project. Development tools such as Adobe illustrator, Vuforia SDK, Visual Studio 2019, Blender and Unity 3D are used in developing this project. As a result, it is expected that the origins of Mek Mulung can be more widely introduced to the young generation.

Keywords: Augmented Reality, Mek Mulung, Performance, 3D, Future generation, less familiar, Interactive

1. Introduction

Mek Mulung can be defined as traditional Malay theatre that combine dance, music and drama originates from Kampong Wang Tepus, Jitra, Kedah. The name Mek Mulung comes from the affectionate terms "Mek" that referring to a young woman, and "Mulung", refer the forest where the dance was first performed. It has become one of the unique performances and it was introduced during its conflict with Siam in the 18th century. Mek Mulung was declared as 'Traditional Art Heritage' in Oct 2014 by The Kedah Government, YAB Dato Seri Haji Mukhriz Tun Mahathir, however without a clear transmission and little interest shown by the younger generation, the tradition is struggling to sustain itself and is gradually disappearing from the village.

AR is thriving as an important trend in recent years, and there will be over 2.4 billion Augmented Reality active users worldwide (Sweta Sinha, 2021). AR technology is also increasingly becoming a trend in many fields. Initially, in the education sector. Augmented Reality was chosen because it offers unique features to enhance regular books by adding graphics, animations, videos, and audio to the pages. By using AR technology, teenagers can not only have fun but also improve their concentration, memory, imagination, and problem-solving skills. An article written by (Yaser A. Alkhabra et al., 2023) highlighted how AR serves as a tool to blend play and learning, where users can use it to develop both their mental and cognitive abilities.

1.1 Problem Statement

1.1.1 Mek Mulung is unfamiliar to the younger generation.

As stated by JKKN director Mohd Rizal Ismail in Berita Harian newspaper (Ariffin, 2023). According to The Star newspaper, the reason for this lack of familiarity among the younger generation is due to the popularity of modern entertainment such as television and movies.

1.1.2 The use of AR in introducing traditional theater is less explored.

A study conducted by conducted by (Widyawan et al., 2020) found that there are only a few studies that have explored the use of AR in traditional theater. The studies found that AR was able to enhance the user's experience and understanding of the context.

1.2 Research Objective

Three objectives have been developed to achieve the aim of this research, which are as follows:

- I. To identify Mek Mulung theatre tradition presentation through augmented reality (AR) for young generation
- II. To develop an augmented reality storybook application for users as an awareness of the existence of Mek Mulung tradition.

1.3 To evaluate the effectiveness of using Augmented Reality to enhance teenagers' experience in learning the tradition. Research Question

The research was guided by the following questions:

- I. What are the suitable methods used to present the Mek Mulung Theatre tradition to the young generation through AR?
- II. How to develop an AR book that helps users recognize the existence of the Mek Mulung tradition?
- III. What is the effectiveness level from the use of augmented reality to improve teenage experience in learning the tradition?

2. Materials and Methods



Figure 1: ADDIE Model phases

The concept of the ADDIE model approach has been applied to complete the overall development process as a guiding for the workflow of the study. ADDIE model can be a helpful approach in creating a variety of learning solutions, especially the development of AR applications where it consists of five phases: Analysis, Design, Development, Implementation, and Evaluation.

2.1 Analysis

Throughout the analysis phase, critical project background information was defined, including the source of the issues, determining objectives focus on R01 and understanding the project scope.

2.2 Design

Designing phase is the longest phase throughout the prototype development process, which involves creating the key themes and conceptual elements for both the booklet and the application. The insights gained from the analysis process will be employed during this phase to strategize the themes and develop content aimed to enhance users' understanding of the tradition.

2.3 Development

Development phase is where the developer will start to develop booklet and AR application. In this phase, the developer started developing a booklet and application elements. Adobe Illustrator software was used to develop booklets while Unity software to develop AR application.

2.4 Implementation

The Implementation phase is the process in which the AR Application will be tested by the user. The key goal of this process is to ensure the successful functionality of the AR application. The application will be exported in .apk format and installed on an Android mobile phone, and the researcher will conduct testing with the teenagers in the Klang Valley area.

2.5 Evaluation

During the evaluation phase, the effectiveness of the development of Mek Mulung AR application's is assessed. The evaluation consists of two types of evaluation, formative and summative evaluation. A Formative evaluation was carried out during the Final Year Project 1 where the assessors will give some feedback and comments in order to improve the project. Meanwhile, the summative test would then be carried out by the distribution of the google form questionnaire to a selected group of 30 target users live in Klang Valley area. The information and data gathered from the respondents will be utilized to enhance the application, ensuring the successful accomplishment of its objectives and goals.

3. Results and Discussion

The result presents data analysis findings and feedback from 30 respondents in Klang Valley area aged between 13-17 years old.

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	Learning with AR made me feel more engaged in understanding Mek Mulung tradition.				7 (23.3%)	23 (76.7%)
2.	I found the AR experience to be enjoyable while learning about Mek Mulung tradition.				7 (23.3%)	23 (76.7%)
3.	AR enhanced learning experience more interactive and engaging.				6 (20%)	24 (80%)
4.	I believe using AR is an effective way to learn and retain information about Mek Mulung tradition.			3 (10%)	24 (80%)	3 (10%)
5.	The interactive features in the AR application allowed me to actively engage with Mek Mulung tradition.				18 (60%)	12 (40%)
6.	I found AR to be a helpful tool in visualizing Mek Mulung tradition.				13 (43.3%)	17 (56.7%)
7.	The app increased my curiosity to explore deeper into Mek Mulung tradition.			7 (23.3%)	23 (76.7%)	0
8.	I found the content in the AR application to be helpful and relevant for learning about Mek Mulung tradition.				15 (50%)	15 (50%)
9.	I found the games in the AR application to be a fun and effective way to engage with Mek Mulung tradition.			4 (13.3%)	23 (76.7%)	3 (10%)
10.	The booklet content is informative			1 (3.3%)	21 (70%)	8 (26.7%)
TOTAL:					80%	20%

Figure 2: Effectiveness of AR in introducing Mek Mulung

50% of the respondents strongly agree and 50% of them agree with the content of booklet and AR application. It is shows that AR is an effective tool to use in introducing Mek Mulung tradition among teenagers in Malaysia especially in Klang Valley area. It is based on the results of the AR effectiveness evaluation which consists of: Question number 1: Respondent's agreement that AR is a best way to give a better understanding for them to know about the tradition.

- i. Question number 2: Respondent's agreement that they find using AR to learn about the Mek Mulung tradition to be an enjoyable experience.
- ii. Question number 3: Respondent's agreement that AR makes learning experiences interactive and fun rather than using traditional method.
- iii. Question number 6: Respondent's agreement that they see AR as a valuable and beneficial tool for visualizing information better than reading a book.
- iv. Question number 8: Respondent's agreement that AR application can be helpful for learning the tradition.

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	Application has user-friendly interface				7 (23.3%)	23 (76.7%)
2.	Overall layout and organization of the AR app were well structured				7 (23.3%)	23 (76.7%)
3.	Attractive background color display				8 (26.7%)	22 (73.7%)
4.	Attractive 3D animated objects				10 (33.3%)	20 (66.7%)
5.	Font size and style used in the app were clear and readable				8 (26.7%)	22 (73.7%)
6.	Marker is easily detected by camera			2 (6.7%)	13 (43.3%)	15 (50%)
7.	Video in the book can be entertaining				13 (43.3%)	17 (56.7%)
8.	Book is a very informative				8 (26.7%)	22 (73.7%)
9.	Application is fully functional				4 (13.3%)	26 (86.7%)
10.	All app buttons are well-functioning				4 (13.3%)	26 (86.7%)
TOTAL						100%

Figure 3: Evaluation of product design

100% of the respondents strongly agree that the design of AR application is suitable to be use by the younger generation. It is based on the result of the effectiveness of the design which consist of:

- i. Question number 1: Respondent's agreement that the application has a user-friendly interface, showing that it was designed effectively to meet user needs and preferences.
- ii. Question number 2: Respondent's agreement that they highly satisfied with the structure design of the AR app.
- iii. Question number 3: Respondent's agreement that the app's background color display is attractive and effective to create an appealing user experience.
- iv. Question number 4: Respondent's agreement that the presence of 3D animated models will improve user experience and makes learning more fun.
- v. Question number 5: Respondent's agreement that the font used by the researcher is clear and readable where can enhance user experience and ensures that people can interact with the app content comfortably.
- vi. Question number 6: Respondent's agreement that AR camera can easily recognizes the marker, which is crucial for a smooth AR experience. Question number 7: Respondent's agreement that videos offer an exciting and engaging experience, where users can see performances in action, observe movements, expressions, and feel the atmosphere and energy.
- vii. Question number 8: Respondent's agreement that they find the book to be highly informative and valuable in terms of providing knowledge and insights.
- viii. Question number 9: Respondent's agreement that the AR app is fully functional.
- ix. Question number 10: Respondent's agreement that they had a positive and satisfactory experience with the application button.

4. Conclusion

In conclusion, the application successfully achieved its objectives of introducing the teenagers to the Mek Mulung tradition by offering them an immersive and captivating experience compared to traditional methods. The ADDIE model served as a valuable guide in creating the app, and each phase was implemented throughout the research. Based on the obtained findings, the application performs

well and has an appealing design that effectively attracts users to explore the tradition. Future research should focus on exploring Virtual Reality (VR) as an alternative approach to enhance the methods of introducing people to the Mek Mulung tradition.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Augmented Reality (AR) Biodiversity of Sabah: Conservation of Tropical Flora and Fauna

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Abstract: Malaysia is a well-liked travel destination. Sabah, in particular, is a major draw for tourists travelling to Malaysia. This is as a result of Sabah's status as a hotspot for biodiversity. Sabah strives to preserve the environment while competing for the title of top tourist destination. It is a well-liked tourist attraction as well as a warning to animals and other living things that their primary habitat is being disturbed. This serves as a wake-up call for everyone to preserve the resources that nature has provided, especially the biological diversity of the region. The use of augmented reality is intended to awaken society and bring this issue to the public's attention. This involves promoting the preservation of Sabah's biodiversity's flora and fauna. Regarding that, Sabah's augmented reality biodiversity is being made in tandem with drawing attention to that issue. We must make an extra effort to focus on the situation because society is already well aware of some of the animals involved in the extinction. In this instance, Sabah's biodiversity, which comprises both plants and animals was selected. Moreover, the ADDIE model functions as the project's development methodology since it ensures that every stage of the project is completed with success. Regarding this approach, one way to get all the information from the particular target group is through the use of questionnaires. When everything is finished, data will be gathered and presented in the form of statistical or numerical results to show how the project is being carried out.

Keywords: Sabah, Biodiversity, Flora, Fauna, Conservation, Campaign, Educate, ADDIE Model, Augmented Reality

1. Introduction

Sabah is well known for the variety of its natural surroundings. This includes the highlights of their diversity, the flora and fauna, as well as their diverse natural landscape and cultural heritage. It is possible to preserve Sabah's intriguing and varied ecosystem, producing a wide range of natural resources that the general public may use. Sadly, they are losing a great deal of them in their haste to preserve biodiversity, and it happened so quickly. Because of harmful human activities that were stopped as they were eradicating the biodiversity that had been built up for more than a century, Borneo's plants and animals

were actually slowly declining and could no longer be found in the usual places. The land and forest are affected by tourism, agriculture, and other entities. When these negative activities are combined, the creatures that inhabit the woods eventually begin to feel defenceless against the destructiveness of humans. This condition impacts not only the habitats but also the surrounding area and environment, such as in certain cases, climate change.

Since augmented reality (AR) has the potential to increase public awareness of Sabah's biodiversity, which includes its flora and fauna, it will be introduced to attract attention in this particular case. AR can be centralised because it will enable the general public to observe in 3D what can be done to conserve Sabah's biodiversity, what is causing the habitats to be ambushed, and what kinds of animals and plants are involved. Not to mention raising awareness of the problems, AR can be used to preserve cultural heritage. This is due to the fact that its values encompass both historical and economic values. In Sabah City, there are two unique forms of intangible cultural heritage. More precisely, intangible cultural heritage is embodied in people's beliefs, attitudes, and manner of life in relation to Sabah heritage and community, while tangible cultural heritage is seen in the form of buildings and artefacts. (2015, Carreiro).

This augmented reality technology will provide 3D graphics, sounds, details about the original habitats of flora and fauna, and games related to Sabah's biodiversity. It will inevitably increase public awareness of Sabah Tourism in particular and contribute to the preservation of the area's flora and fauna for years to come.

1.1 Problem Statement

This is due to reports that further losses from deforestation could result in the suitable habitats for nearly half of Borneo's mammals shrinking by a third or more in the upcoming decades (Press, 2015). This refers to all of the plant and animal habitats and the potential effects that human activity may have on them, including harm to the land, the water, or any other area where they depend on for their livelihood. The project's production will inspire Malaysians of all ages and backgrounds. Turning now to the challenges mentioned, (Ulu Segama Malua SFMP, 2013) listed biological diversity concentrations that are noteworthy on a national, regional, or worldwide scale. These include endemic species and rare, threatened, or endangered (RTE) species. As previously stated, the concentration of the flora and fauna will be highlighted by a variety of groups, who will also be monitoring the effectiveness and introducing the matter to ensure that the public is aware of the challenges that could worsen if the problem is allowed to persist.

Aside from certain species' overpopulation, the majority of people can voice their concerns about the devastation of the forest. As a result, the number of animals, plants, and all of their habitats is decreasing. Furthermore, according to the Sabah Biodiversity Conservation Strategy (2012), the ease of access has increased the exposure and vulnerability of wildlife species to forest felling, which is done for agricultural purposes and results in the destruction of forests. Due to the illegal destruction of the forest by participating parties, they are somehow granted the chance or ability to hunt and poach animals or personal property. (Rautner, 2005) also notes that the development of roads and logging trails has facilitated wild poaching, which is endangering Borneo's endangered species.

1.2 Research Objectives

For conservation efforts, augmented reality (AR) presents exciting opportunities, particularly for comprehending and safeguarding biodiversity. A project in Sabah intends to raise awareness and interest by showcasing the tropical plants and animals of the area through augmented reality. Assessing the effect of this augmented reality application is essential to determine whether it genuinely motivates individuals to properly protect and preserve the environment.

2. Materials and Methods

Ensuring the organisation and effectiveness of the project depends heavily on the research methodology. As this chapter discusses, selection requires careful attention to the stages of the selected model. Readers are given the tools to evaluate the validity and reliability of studies in this section. The objective of this chapter is to investigate Malaysians' comprehension of Sabah's biodiversity and to encourage the broad application of augmented reality (AR) technology in education. This will advance project objectives and support conservation initiatives. The ADDIE model was chosen because it is a good fit for identifying an AR project's potential.

2.1 ADDIE Model

The ADDIE model serves as a versatile instructional design framework suitable for various projects, ensuring efficiency and adherence to timelines. It can be utilized in both face-to-face and online settings, offering simplicity and flexibility for creators to navigate through each phase and make adjustments as needed. Initially employed in planning instructional design courses, the model proved beneficial for students developing multimedia projects. Emphasizing learner-centered approaches, all five phases of the ADDIE model were successfully completed in sequence, ensuring clarity and organization in project delivery. Its systematic process is renowned for its effectiveness in instructional design. Chosen to conclude this study, the ADDIE model facilitates project explanation at each phase's conclusion. The model comprises five phases: analysis, design, development, implementation, and evaluation.

- Analysis
- Design
- Development
- Implementation
- Evaluation

Each phase contributes to the project's overall planning and execution, with specific emphasis on exploring Augmented Reality's application in modern society. Hardware and software usage are typically addressed in the development phase, while implementation focuses on target audiences. Evaluation, the final stage, assesses project success through data gathering, ensuring comprehensive review of project completion.

2.2 Methods

ADDIE Model of Instructional Design

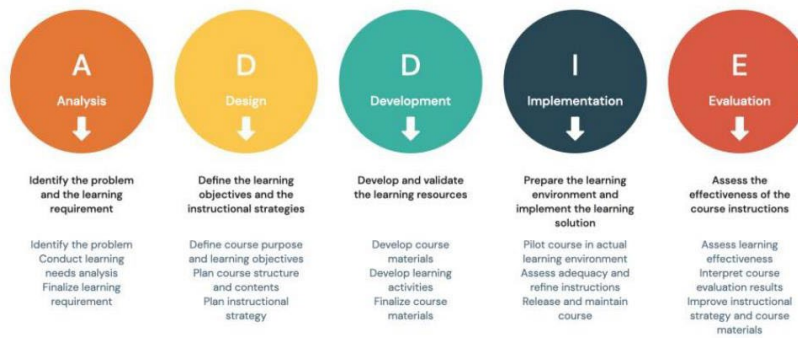


Figure 2-1: ADDIE Model

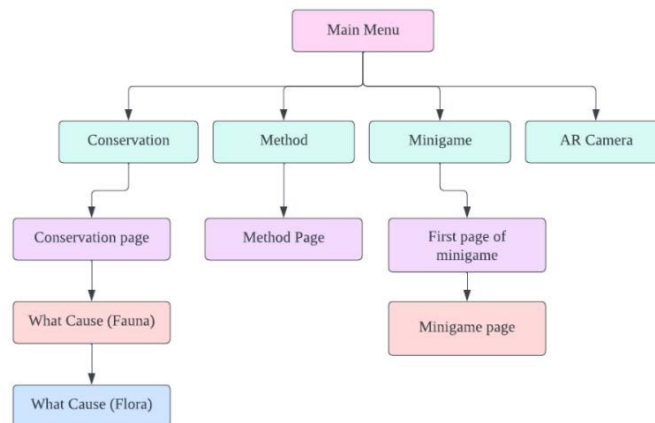


Figure 2-2: AR Application Sitemap

As for scope of the project, researchers must compile in-depth data on conservation initiatives, completed studies, and general knowledge in order to improve Sabah's biodiversity and boost tourism. With a specific focus on the Klang Valley, this project caters to young adults between the ages of 18 and 25. This choice was made after it was noted that some age groups are not as familiar with Sabah-related matters and are not exposed to the conservation of the local flora and fauna. University students are the project's ideal target audience because they will not only gain from the project but will also have the opportunity to participate in the protection of Sabah's tropical forests, waterways, and lands.

The project's limitations are mostly related to language and platform issues. In the very first place, the audience will only hear the project presented in English. Second, with regard to the platform, a book will serve as the interaction medium and a marker-based approach will be used. Using this method, readers can interact with technology in the real world by scanning the book's marker. Consequently, this approach recognises the limitations of language and platform within the project's scope and seeks to stimulate the audience's interest in diverse instructional modes.

3. Results and Discussion

The procedure for obtaining information from respondents who fit the project's target audience is described in this chapter. Important steps included investigating possible uses for augmented reality technology in the future and evaluating the adequacy of the data through result analysis and discussions. 16 closed-ended questions covering the user interface, augmented reality comprehension, project overall, and demographics were utilised in the quantitative methods of data collection and analysis. Through the use of a Google Form survey, respondents were asked to share their experiences with the application. A total of thirty-two respondents were gathered in order to guarantee thorough feedback.

3.1 Results

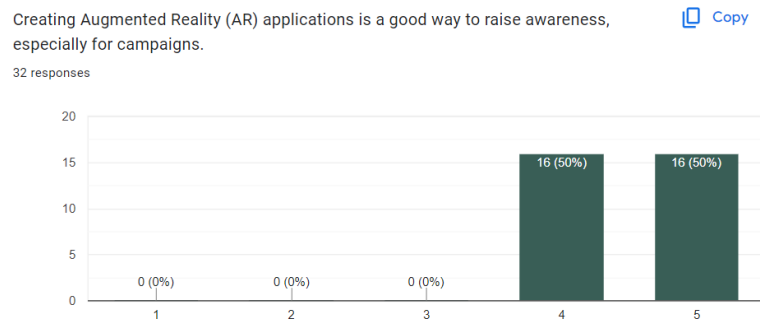


Figure 3-1: Creating Augmented Reality (AR) applications is a good way to raise awareness, especially for campaigns.

5.5.13 Every piece of information provided makes conservation easier to understand and more knowledgeable via Augmented Reality (AR).

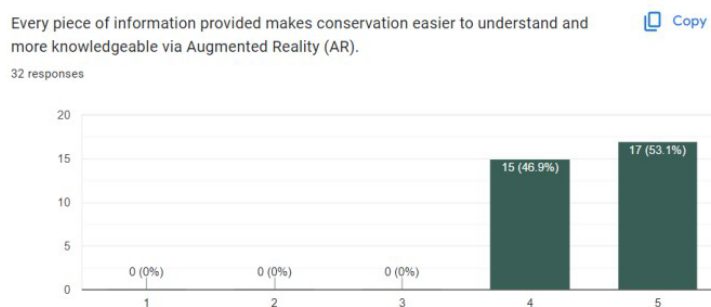


Figure 3-2: Every piece of information provided makes conservation easier to understand and more knowledgeable via Augmented Reality (AR).

5.5.14 Do you believe that using Augmented Reality (AR) to raise awareness can be helpful?

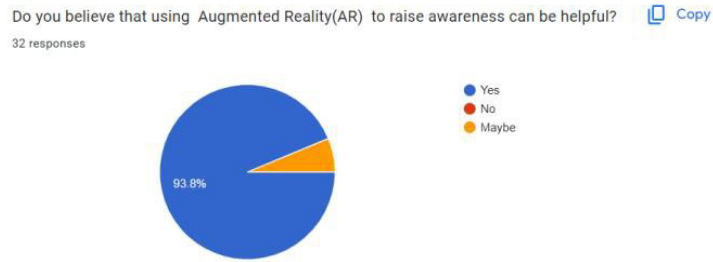


Figure 3-3: Do you believe that using Augmented Reality (AR) to raise awareness can be helpful?

3.2 Discussions

After collecting data from the questionnaire, discussions revolve around respondents' understanding and agreement with augmented reality concepts, the significance of the project overall comprehension. It's evident that most questions regarding project background and content are easily understood, enabling clear responses. In the user interface section, all aspects such as button selection, font, and color scheme received unanimous agreement. The project's information is deemed comprehensible, facilitating easy navigation through the application. Respondents generally express agreement with the project's content, with only a small percentage remaining neutral, indicating some uncertainty or curiosity.

For last section, it prompts thought-provoking responses, with most agreeing on the thorough integration of augmented reality into society, especially for educational and awareness purposes. The feedback highlights augmented reality's diverse applications, spanning from marketing to personal use, underscoring its importance beyond recent advancements.

3.3 Tables

Table 1: Do you believe that using Augmented Reality (AR) to raise awareness can be helpful?

	Number of Respondent	Percentage
Yes	30	93.8%
No	2	6.3%
Total	32	100%

Table 1, displays the number of individuals who voted "Yes," indicating that using augmented reality (AR) can be one method of increasing awareness. Given that this project focusing on the educating the youngster about the biodiversity of Sabah which also includes the spreading awareness of the augmented reality technology. On the other hand, about 2 out of every 32 respondents choose "Maybe" as their response. All things considered, it can be said that increasing awareness through augmented reality will help to

bring the technology to the attention of the public.

Table 2: Every piece of information provided makes conservation easier to understand and more knowledgeable via Augmented Reality (AR).

	Number of Respondent	Percentage
4 (Agree)	15	46.9%
5 (Strongly Agree)	17	53.1%
Total	32	100%

Table 2, displays the estimated percentage of respondents who agreed that each piece of information made available through AR makes conservation more understandable and knowledgeable. According to the results, 46.9% of voters chose "Agree," with the remaining percentage choosing "Strongly Agree" for this particular question. In order to make sure that all the data and information provided about conservation are understandable and can be used for educational purposes via augmented reality, this question reflects back to society and the end user when they tried the application.

Table 3: Creating Augmented Reality (AR) applications is a good way to raise awareness, especially for campaigns.

	Number of Respondent	Percentage
4 (Agree)	16	50%
5 (Strongly Agree)	16	50%
Total	32	100%

The input for both of the gathered votes is displayed in **Table 3**. The question "creating AR applications is a good way in spreading awareness, especially for campaigns" received equal votes from both categories. Therefore, it can be concluded that the question can be applied to society as half the votes indicated Strongly Agree with the statement and the other half indicated Agree.

4. Conclusion

To sum up, the purpose of this project was to demonstrate the advantages of Augmented Reality (AR) technology, specifically in the areas of education and environmental awareness. Most respondents agreed that AR has a valuable place in society, particularly for the younger generation. The study effectively achieved its goals by examining the function of augmented reality and creating an AR experience for the preservation of Sabah's biodiversity. One limitation is that there are no sound effects for the habitats, which could indicate room for improvement in terms of entertainment value, particularly for younger audiences. Engaging the audience with an interactive video about habitat conservation techniques proved to be successful. These results highlight the

potential of AR in conservation and education and emphasise the need for ongoing innovation and development. Ultimately, conserving Sabah's biodiversity can be aided by using doable strategies and spreading awareness via augmented reality technology. 93.8% of participants, based on their feedback, think AR can effectively raise awareness among present and future generations.


4.1 Novelty

Upon investigating the notion of novelty in this project, a number of novel characteristics surface. AR offers more interaction than traditional media, such as videos, which encourages more involvement. Furthermore, by integrating it with digital technologies, Sabah's flora and fauna can be instantly identified in addition to rare species being preserved. Furthermore, adding gamification improves understanding of conservation initiatives. This conversation explores the innovative features of augmented reality, emphasising how it can revolutionise environmental advocacy and education.

4.2 Recommendations

One of the recommendation and suggestion for the project is to include virtual nature walks guided by augmented reality, which would provide users with immersive experiences. This feature lets you explore endangered species and see plants and animals as they would be in their natural environments using augmented reality technology. It's also a strong idea to incorporate cooperative augmented reality experiences. To support community-driven conservation efforts, this entails integrating tools that allow users to share their experiences and insights via the AR platform. With these improvements, the project should become a flexible resource for teaching individuals and groups about Sabah's ecosystem conservation.

Appendix A
Questionnaire



Augmented Reality(AR) Biodiversity Of Sabah: Conservation Of Tropical Flora and Fauna



Salam and Greetings.

My name is Nur Irwani binti Iskandar Sani, and I am in the final semester of my Bachelor of Multimedia Technology (Hons.) in Interactive Multimedia Design at the Universiti Kuala Lumpur Malaysian Institute of Information Technology.

As part of this project, I'm conducting a questionnaire survey to collect respondent and feedback regarding the Augmented Reality(AR) which the title is Biodiversity Of Sabah: Conservation Of Tropical Flora and Fauna.

Your cooperation to this project is greatly favored and appreciated. Thank you for your time and cooperation.

irwaniiskandar10@gmail.com [Switch account](#)

 Not shared 

Next Clear form

Section A: Demographic

Gender *

- Male
- Female

Age *

- 18-19
- 20-21
- 22-23
- 24-25

Have you heard about Augmented Reality(AR)? *

- Yes
- No

Back

Next

Clear form

Section B: User Interface

The UI is neat and straight forward *

- Yes
 No

The font and color usage are readable and clear *

- Yes
 No

All navigation buttons are functioning *

- Yes
 No

The 3D model and animation are both realistic and appealing *

- Yes
 No

From narration to information, all of the information provided is beneficial *

- Yes
 No

Back

Next

Clear form

Section C: Content

The information provided is clear and concise, making it easy to understand what * they are attempting to convey.

	1	2	3	4	5	
Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Agree

I'm keen about discovering more about AR and how the content is implemented. *

	1	2	3	4	5	
Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Agree

The offered game is entertaining to play and is suitable for the project's title. *

	1	2	3	4	5	
Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Agree

Creating Augmented Reality (AR) applications is a good way to raise awareness, * especially for campaigns.

	1	2	3	4	5	
Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Agree

Every piece of information provided makes conservation easier to understand * and more knowledgeable via Augmented Reality (AR).

	1	2	3	4	5	
Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Agree

Back

Next

Clear form

Section D

Do you believe that using Augmented Reality(AR) to raise awareness can be helpful? *

- Yes
- No
- Maybe

Do you believe that Augmented Reality(AR) conveys content more realistically and entertainingly? *

- Yes
- No
- Maybe

Do you think that Augmented Reality(AR) fits in in modern society?

- Yes
- No
- Maybe

[Back](#)

[Submit](#)

[Clear form](#)

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Bee Adventure: An AR English Grammar Game for Primary School Students

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Abstract-Teaching and learning in schools with traditional methods may lead to an uninteresting learning environment for the students, especially at the elementary level. This affected the motivation of the students to study. Game-based Learning (GBL) has proven its effectiveness in assisting students in learning while having fun. This research was developed in collaboration with an English teacher and students from Sekolah Kebangsaan Marian Convent (SKMC) students. The school has a problem with low passing rates in English subjects, specially building sentences with correct grammar. This research aims to create a serious game to assist students in SKMC to learn English using Augmented Reality (AR) technology. Based on previous research, AR may help in boosting the learning experience and make the learning activities more interesting and fun. The objectives of this research are to investigate the problems in learning English among the students in SKMC, develop a game to assist learning activities in the classroom, and evaluate the effectiveness of the developed game among the students in SKMC. The game used adventure and exploration as the gameplay genre. It lets the students explore one place to another in finding the quest of constructing English sentences with the correct grammar. A bee was created as the avatar representing the player during the quest. Each quest uses AR technology to get the mission. Students use a tablet to play the game. The activities help increase the student's motivation to play and learn. This research used a mixed method of qualitative and quantitative. Testing will be carried out on the targeted students in SKMC.

Keywords: primary school, English, game-based learning, serious game, augmented reality

1. Introduction

English holds a significant place in Malaysia as the second language and is widely used in daily conversations. With the increasing influence of technological advancements in our lives, there is a growing need to adapt educational methods to engage learners effectively. A review on the integration of augmented reality in education highlights that the use of Augmented Reality (AR) as a platform cannot motivate students to explore new topics and gain fresh perspectives, enhancing their learning experience [1]. The adoption of such technology has the potential to significantly enhance the effectiveness and enjoyment of the teaching and learning processes within our country [2]. The application seeks to address the existing issues of disengagement and lack of motivation in traditional language learning methods.

Additionally, it is likely that a significant number of children in rural areas possess only a basic grasp of the English language [3]. This is a contributing factor to the reported low usage of English among elementary school students. Moreover, the constrained classroom environment with minimal interactivity could be a key factor in the limited use of the English language among elementary school children. Mark Bilingshurst suggests that students seated together at a table engage in communication and discussion about their respective topics of study, utilizing sensory inputs like sight, hearing, speaking, and accompanying gestures [4]. Additionally, feedback from teachers and students will be collected to refine and improve the application for future use.

1.1 Problem Statement

Contemporary education can be tedious for children, and games offer an alternative, making learning engaging and challenging. Interactive methods foster skill development, boost confidence, and enhance communication abilities.

Elementary students, attracted to gadgets, benefit from a textbook-based RPG with AR element. This fun, educational approach addresses safety concerns and aligns with governmental initiatives, providing eligible students with tablet aid for access to educational applications.

Merging technology with education creates an engaging and effective learning environment. Gamified platforms capitalize on children's natural affinity for technology, ensuring a more enjoyable and productive learning experience, aligning with contemporary educational challenges.

1.2 Research Objectives

This study explores challenges in English learning for elementary students at Sekolah Kebangsaan Marian Convent, aiming to identify and understand specific issues hindering effective language learning. This research addresses challenges by developing an educational game to enhance learning at Sekolah Kebangsaan Marian Convent, aiming to bring excitement and overcome obstacles in traditional sessions. The study aims to assess the impact of a developed game on students at Sekolah Kebangsaan Marian Convent, offering insights into gamified approaches to enhance language learning for elementary students.

2. Materials and Methods

The selection of the ADDIE model for this project was based on its suitability. Among academics, the ADDIE model has gained widespread recognition as the most appropriate approach for developing products of this nature. This choice is justified by the model's emphasis on rigorous technical work, ensuring the product is manufactured with high-quality standards.

Artificial intelligence systems, digital educational games, virtual reality environments, and various online applications have been incorporated into the educational process, providing adaptability and personalized learning experiences[5]. Furthermore, a study has indicated that the ADDIE model is not only applicable but has also been employed for curriculum development in various fields [6]. Moreover, the ADDIE model, recognized as a prevalent instructional design framework, proves instrumental in establishing effective learning environments. Moreover, this model not only aids in the creation of efficient learning systems but also contributes to enhancing the overall learning process, thereby positively impacting learner performance [7].

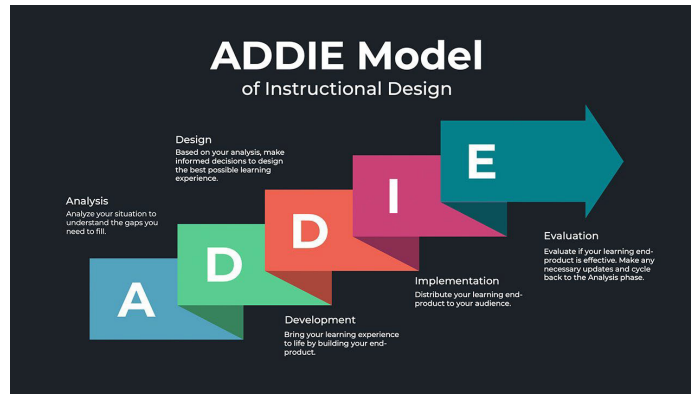


Figure 1 ADDIE model diagram © waterbearlearning

2.1 Materials

Specifications and properties of equipment, and other resources utilized in this study are:

- Game assets created using Blender and Unity.
- 3D models for game assets and Augmented Reality (AR) elements.
- User Interface (UI) design tailored for elementary school kids.
- Hardware suitable for the type of application.

2.2 Methods

- **Analysis Phase:** In the ADDIE model, analysis gathers info on the audience, needs, preferences, and tech capabilities. Defining objectives and thorough research, including AR, is crucial for successful implementation.
- **Design Phase:** In the design phase, a systematic approach is vital for crafting game mechanics with AR elements, emphasizing user-friendly UI/UX. Storyboarding aligns visuals with educational goals, documented for progress tracking.
- **Development Phase:** Development creates game assets, programs user interaction, and integrates AR elements. Tailored UI design for kids, testing, debugging, and ongoing maintenance ensure functionality.
- **Implementation Phase:** In the fourth phase, developers prepare for user interaction, adjust based on testing, refine design through iterative testing, and ensure accessibility.
- **Evaluation Phase:** In the final ADDIE phase, evaluation ensures AR game quality. Assessment covers mechanics, user experience, technical aspects, identifying improvements, and focusing on AR engagement.

3. Results and Discussion

The responses gathered indicate a diverse range of interests when it comes to AR-enhanced learning games. Each user expressed unique expectations and preferences for this type of gaming application, highlighting the varied appeals and choices made by individuals in their use of AR-enhanced learning games.

3.1 Results

The responses gathered indicate a diverse range of interests when it comes to AR-enhanced learning games. Users express varied expectations and preferences, showcasing a multitude of elements they anticipate in such game applications. The appeal of AR-enhanced learning games is evident through the distinct choices made by each user, highlighting the broad spectrum of options in this domain.

How often do you engage with augmented reality applications or game-based learning application?
40 responses

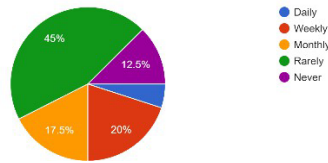


Figure 2 Bee Adventure Questionnaire

3.2 Discussions

The study emphasizes Bee Adventure's positive impact as an AR grammar game for elementary students, showcasing the potential of game-based learning.

4. Conclusion

Bee Adventure, an educational tool, underwent significant gameplay improvements, enhancing the user experience with a strategic redesign for increased challenge and entertainment. The intentional design changes create an engaging learning environment, showcasing developers' commitment to enriching educational experiences. Bee Adventure also serves as a valuable resource for teachers, seamlessly integrating fun and education.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Cardiovascular Diseases (CVDs): Knowledge and Awareness Among Malaysians

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Abstract: In Malaysia, cardiovascular diseases (CVDs) have accounted for 17% of the 109,155 medically confirmed deaths in 2020 (Statistics on Causes of Death, 2021). This is really worrying as CVDs has also become one of the leading causes of death in Malaysia along with the high rates of hospital admissions due to CVDs. But then, most CVDs can be avoided by addressing all the behavioural risk factors. Therefore, this study aims to propose a mobile application to increase the community awareness of CVDs among Malaysian.

For this project, the RAD methodology will be used. There were 4 phases in RAD methodology including requirement planning, user design, construction, and cutover. In requirement planning, all possible requirements for the system to be developed are recorded in this phase. The system design was prepared during the next phase which is user design phase. With the inputs from the system design, the system is developed using Kodular. The last phase is cutover phase which the entire system is tested for bugs and errors.

The outcomes of those system testing then show that all respondents would like to use this application frequently, this application was easy to use and the various functions in this application were also well integrated. Not only that, the application's objective of raising community awareness of CVDs among Malaysians has been met as well.

In conclusion, Healthy Cardio has its own set of strengths and weaknesses. Thus, some suggestions such as adding a back to the top button were then provided to improve this application. Another suggestion is that Healthy Cardio can also collaborate with health-related organizations as well. Through this collaboration, Healthy Cardio can work together with health care experts to increase knowledge and awareness about CVDs among communities and encourage all to live healthier at every stage of their life.

Keywords: Cardiovascular disease, CVDS, Heart, Death, Awareness, Knowledge

1. Introduction

1.1 Introduction

CVDs often known as heart and circulatory disease, is a broad term that refers to a variety of illnesses that affect the heart and blood vessels. Stroke, heart failure, hypertension, rheumatic heart disease, cardiomyopathy, irregular heart rhythms, congenital heart disease, valvular heart disease, carditis, aortic aneurysms, peripheral artery disease, thromboembolic illness, and venous thrombosis are some examples of

other CVDs. High blood pressure, an unhealthy diet, high cholesterol, diabetes, air pollution, obesity, cigarette use, renal disease, physical inactivity, dangerous alcohol use, and stress are just a few of the socioeconomic, behavioural, and environmental risk factors that might cause it. A person's risk of CVDs is also influenced by their family history, ethnic background, sex, and age.

CVDs have become one of the major health burdens worldwide. World Health organization (WHO) has stated that CVDs killed an estimate 17.9 million people in 2019, accounting for 32% of all global deaths. 85% of those deaths were caused by a heart attack or stroke. While in Malaysia, CVDs have accounted for 17% of the 109,155 medically confirmed deaths in 2020. (Statistics on Causes of Death, 2021) This shows that there are still millions of people died because of CVDs.

Even so, most CVDs can be avoided by addressing all the behavioural risk factors. But sadly, the low level of knowledge and awareness of the modifiable CVD risk factors have led to minimal practice of risk mitigation behaviour. Amini (2018) Consequently, this will lead to treatments delays and an increased risk of sudden death. Awareness of CVDs risk factors plays an important role in the prevention of CVDs and its complications.

Therefore, this study aims to propose a mobile application to increase the community awareness of CVDs among Malaysian. Aside from that, this study also focused on to assess the level of community awareness of CVDs in Malaysia, as well as to test the usability of the mobile application.

1.2 Problem Statement

A. CVDs are the leading cause of death in Malaysia

According to the Department of Statistics Malaysia (DoSM) latest Statistics on Causes of Death, Malaysia, 2021, CVDs deaths in Malaysia has reached 17.0% of the 109,155 medically certified deaths in 2020. Datuk Seri Mohd Uzir Mahidin, chief statistician, has also said that unhealthy lifestyle practices and diet are among the current contributors to death from heart disease. This is supported by a statement from the Ministry of Health, which states that Malaysia is classified as a non-healthy country due to low public awareness of health issues, as well as relatively high rates of heart disease and obesity.

B. High rates of hospital admissions due to CVDs

According to the official website of Hospital Serdang, (2022) The Cardiology Department workloads are extremely heavy due to the high prevalence of heart disease among the population. Every day, the Cardiology Clinic and Non-Invasive Cardiology Laboratory treat up to 250 patients, while the Invasive Laboratory treats 25-30 patients with invasive treatments such as Angiograms and Coronary Angioplasty. After the National Heart Institute, this is the heart centre with the highest workload. The expertise force, on the other hand, is more limited, with only two consultants and five clinical experts.

C. Lack of knowledge and awareness about CVDs among the community in Malaysia

Few published studies examining the public's knowledge of CVDs and risk factors in Malaysia have shown that this statement is correct. Amini (2018) discovered that the residents in Kuala Lumpur, Malaysia, had poor level of knowledge and awareness about modifiable CVD risk factors. Not only that, the practice of risk reducing behaviors was also minimal. Surprisingly, one study that was carried out among the public in Pahang, Malaysia has also discovered the same problem. Ahmed (2020) discovered that awareness of risk factors among the public in Pahang for heart attack appears to be poor, where most of

the respondents recognized only one modifiable risk factor.

1.3 Literature Review

A. The public's awareness and knowledge of CVDs

In Malaysia, there have been few research on the public's understanding and awareness of CVDs.

However, there are several points of view on this subject.

One study found that the patients attending outpatient clinic in Kuantan, Malaysia has good knowledge and attitude toward CVD risk factors. Haque (2018) According to the findings, nearly half of the subjects could answer at least half of the general CVD questions.

Jamaludin (2019), on the other hand, believes differently. Referring to his study regarding the Knowledge, awareness, and perception of coronary heart disease (CHD) among residents in Kuantan, Pahang, Malaysia, the study findings indicated that there was still limited knowledge regarding CHD symptoms and risk factors. Therefore, the healthcare provider and the government should conduct public health education targeted population at high risk of CHD. Thus, with the right basic knowledge about CHD, people are able to make lifestyle changes and it will lead them to the optimal health of their lives.

B. The risk factors of CVDs

The exact cause of CVDs is unknown, but there are numerous factors that can increase the risk of developing it. These are referred to as "risk factors." The more risk factors someone have, the more likely they are to develop CVDs.

Numerous studies have shown comprehensive knowledge of a wide variety of CVD risk factors. One of it, "Self-Reported Modifiable Risk Factors of Cardiovascular Disease among Older Adults in Malaysia" study found that men in the 60–69 age group, urban dwellers, those with no formal education, unemployed/retirees, and those who are physically inactive are the vulnerable subgroups susceptible to modifiable CVD risk factor clustering. Chan (2021)

Similarly, the other studies have also highlighted that same CVDs risk, which is age, gender, location, socioeconomic status, ethnicity, and other comorbidities. Those CVDs risk have been shown to affect the likelihood of hypertension. More specifically, those who were older, male, unmarried, lived-in rural areas, had lower socioeconomic status, Malay ethnicity, had diabetes, hypercholesterolemia, and excess body weight were more likely to have elevated blood pressure level.

C. Prevention of CVDs

According to WHO (2021), most cardiovascular diseases (CVDs) can be prevented. Measures can be taken to aid in the early prevention of CVDs. This can be done by controlling the modifiable risk factors.

Yet, one study titled "Knowledge and Practices of Cardiovascular Diseases Prevention Among Patients with Type 2 Diabetes Mellitus at Hospital University Sains Malaysia" shows that respondents' healthy lifestyles practices to prevent the disease were still insufficient. Maisarah (2021)

The other study titled "Modelling knowledge, health beliefs, and health-promoting behaviors related to cardiovascular disease prevention among Malaysian university students" suggest that perceived barriers, perceived benefits, family history of cardiovascular disease, and intention to screen enable young adults to engage in health-

promoting behaviors. Lim B.C (2021) Indirectly, this action can be counts as one of the ways of preventing CVDs.

2. Materials and Methods

2.1 Data Source

In order to determine the requirements for this system, respondent information must be collected first. To obtain such information, there were several techniques that can be used. Those techniques include interviews, questionnaires, observation, study of existing organizational documents, forms and reports and prototyping. However, the type of technique used in gathering information may vary based on the type of information sought, as well as the people providing the information.

For this project, questionnaire surveys have been chosen as the techniques used to gather some essential information. For that, Google forms were used to create the questionnaire. The questionnaire contains some questions that is related with the objective and purpose of this study. It was then categorized into few sections namely demographic, knowledge and awareness about CVDs, preference media to get CVDs awareness and lastly CVDs awareness resources that are most reliable. With that, a lot of information can be gathered and used in deciding the requirements for this system.

2.2 Data Analysis

From the questionnaire surveys, a total of 106 respondents has responded to the surveys. Out of all respondents, 64% of them are women, 69 were between the ages of 40-49, 86 respondents are married, 40 respondents have a degree, 76 respondents are working, 103 respondents are Malay, and 55 respondents were from Selangor. 26 of them also has normal BMI, 93 respondents are also non- smoker, all 106 respondents do not drink alcohol at all, 62 respondents exercise regularly, and 60 respondents eat healthily, while some of their family members has history of diabetes (43 respondents), hypertension (40 respondents), and also dyslipidaemia (23 respondents).

In section B of knowledge and awareness of CVDs, 53.9% of them argues that the level of heart/cardiovascular diseases (CVDs) in Malaysia is critical. Chest pain (54.9%) is just one of the many symptoms of this diseases. Also, there a numerous factor that contribute to the development of this diseases but most respondent agrees that high cholesterol are one of them. When asked how to prevent heart/cardiovascular diseases (CVDs), 42.2% answered monitor other health conditions such as diabetes, high cholesterol, or high blood pressure.

While in section C for information on cardiovascular diseases (CVDs), 79.4% respondents choose the internet/social media as one of the platforms where they get information about heart/cardiovascular diseases (CVDs). 77.5% choose video as their preferred medium to learn more about this disease, and 98% of them believes KKM is a reliable source of getting heart/cardiovascular disease information.

For section D, cardiovascular diseases (CVDs) awareness mobile application, 65.7% believe that a cardiovascular mobile application can help in raising awareness about heart/cardiovascular related diseases among the community. 87.3% of respondent choose ways to prevent cardiovascular diseases (CVDs) as one of the contents that should be included in the mobile application and 95.1% agree that the Cardiovascular Disease Awareness Mobile Application should be created to increase heart/cardiovascular disease

awareness for the community in Malaysia. Procedures can be described using flowcharts and algorithms, in which case the chart will be considered as a figure (see section 3.4). Include the appropriate references to standards. Authors can also explain the scope and limitations of the methods.

2.3 System Development Model

In this project, the RAD methodology will be used. Rapid Application Development (RAD) is a development model that supports rapid prototyping and feedback over lengthy development and testing cycles. It is designed to adapt to changes and to accept new inputs, such as features and functions, at all stages of development. There were 4 phases in RAD methodology.

The first phase is the requirements planning. During this phase, the problem statement, literature review and data analysis from the previously distributed survey will be used to determine all possible system requirements. The goal is to define the requirements as clearly and precisely as possible. The second phase is the user design phase. The requirement specifications of the first phase are being studied and the design of the system will then be prepared in this phase. This system design helps to specify hardware and system requirements and to define the overall architecture of the system including the use case, sequence diagram and class diagram.

The third phase is the construction phase. Following the preparation of the system's design, the system will then be developed using Kodular and using Firebase database. Finally, the last phase is the cutover phase. The finished product is being released during this phase and there will be some issues in the future. Thus, to address these issues and improve the product, such maintenance as testing the entire system for bugs and errors is critical to prevent the problem from recurring in the future. The planned testing will include unit testing and integration testing.

3. Results and Discussion

3.1 Project Features

The target user(s) of the project is people with CVDs.

- i. A survey about the community awareness will be collected according to the demographics, BMI, lifestyle, and health on Heart Related Diseases in Malaysia.
- ii. As a result of the collection of information, infographic reports will be issued to provide an overview of the results of the study.
- iii. The system will then provide link to a recommended website of the heart disease expectations calculator (using the Framingham model) and also annual report from the National Cardiovascular.

3.2 Screenshot of the UI

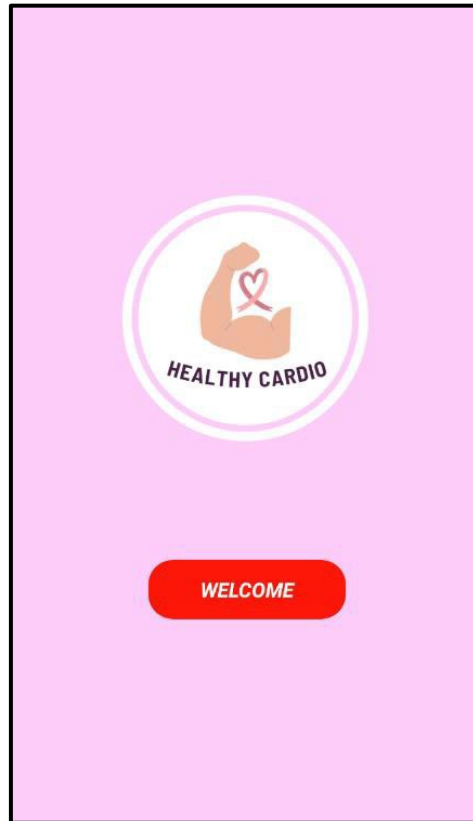


Figure 1 (Welcome screen)

Figure 1 above shows the welcome screen for this mobile application. Welcome screen or also known as splash screen is an introduction page that appears briefly when users open up any application. It is typically displayed to welcome new users.

Usually, users may see the company logo accompanied by some text or more imagery on the welcome screen. With that being said, Healthy Cardio also got the same common design of welcome screen that includes the application name, logo, and a welcome button.

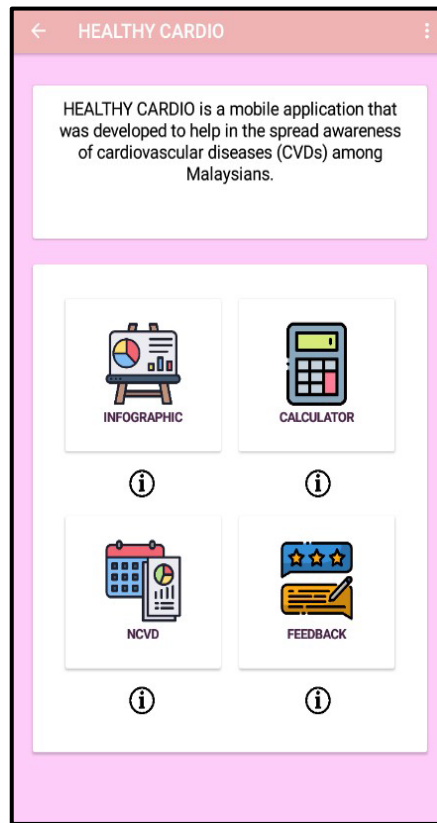


Figure 2 (Home page)

The home page of Healthy Cardio is shown in Figure 2 above. Home page is considered as the main page of a mobile application, simply because It's the screen users interact with the most.

Just like any other mobile application, every home screen has some crucial visual elements such as a search field or buttons and also navigation elements, like a menu. This is to ensure a smooth user experience.

For Healthy Cardio, the home page consists of shortcuts to the four main pages which is infographic pages, calculator page, NCVD pages and also feedback page. All those main pages that represent the functionality of this mobile application are made accessible from the home page.

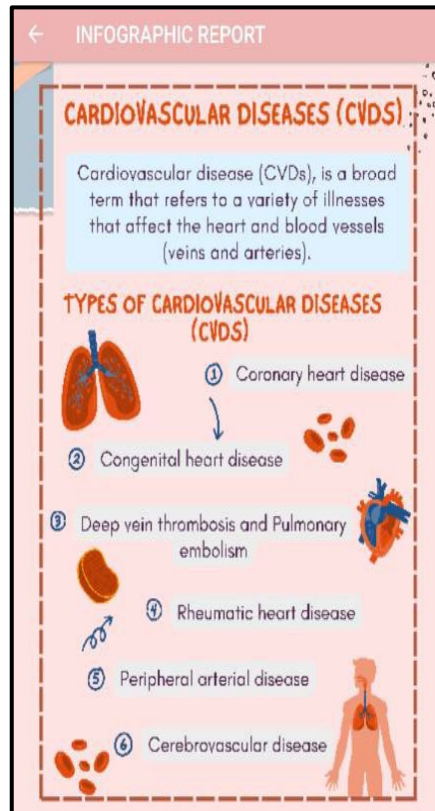


Figure 3 (Infographic page)

Figure 3 above represents the infographic page of Healthy Cardio. This infographic page is dedicated specifically to provide important information of cardiovascular diseases (CVDs).

Some of the important information that is being included in this infographic page are the definition of cardiovascular diseases (CVDs), causes of cardiovascular diseases (CVDs), and lastly ways to avoid the risk of cardiovascular diseases (CVDs).

With that, the user can view and get some information of cardiovascular diseases (CVDs). Indirectly, this will help to raise awareness on Heart Related Diseases among the community in Malaysia.

← FRAMINGHAM RISK CALCULATOR

Framingham Risk Score Calculator for Coronary Heart Disease

This Framingham risk score calculator estimates the 10-year coronary heart disease risk of any person based on certain criteria like gender, age, cholesterol and systolic pressure. You can discover more about this heart disease scoring system and about all the cardiovascular risk factors involved below the form.

Gender:*

Age:*

Total cholesterol (mg/dL):*

HDL cholesterol (mg/dL):*

Under hypertension treatment?

Systolic blood pressure (mmHg):*

Smoker?

Figure 4 (Calculator page)

The Framingham risk model was used in the calculator page in Figure 4. It is widely used to determine a person's chances of developing cardiovascular disease within a given time frame, which is usually in the upcoming 10 years. The calculation will be based on the values entered by the user.

Therefore, users must enter some information such as their gender, age, lifestyle, and also health condition including total cholesterol, HDL cholesterol, and systolic blood pressure in order to use this calculator.

← NATIONAL CARDIOVASCULAR REPORT
SUMMARY REPORT 2006-2019
Report 2018-2019
Report 2017-2018
Report 2016-2017
Report 2015-2016
Report 2014-2015
Report 2013-2014
Report 2011-2013
Report 2009-2010
Report 2007-2009
Report 2007-2008
Report 2007
Report 2006

Figure 5 (NCVD page)

Considering that a lot of people nowadays are getting more and more inattentive towards websites, Healthy Cardio has always wanted to make it easier for users to get information.

Therefore, NCVD page (Figure 5) above is designed. NCVD page is actually a compilation of 2006-2019 annual report of National Cardiovascular Disease Database (NCVD). All those reports were taken altogether from the National Heart Association of Malaysia official websites.

In this way, users who want to know more about cardiovascular disease (CVDs) can now read and get information quickly and easily through a mobile application. With this, it is hoped that a lot of users now are more aware of this cardiovascular disease (CVDs).

The image shows a mobile application feedback form titled "SEND FEEDBACK" and "User Feedback". The form includes a header with a back arrow and the title. Below the title is a welcome message: "We would love to hear your thoughts, suggestions, concerns or problems with anything so we can improve!". There is a link to "Sign in to Google to save your progress. Learn more" and a red asterisk indicating a required field. The form has three main sections: "Feedback Type" with radio buttons for "Comments", "Questions", and "Suggestions"; "Feedback" with a text input field and a red asterisk; and "Email" with a text input field and a red asterisk. At the bottom, there is a progress bar showing "Page 1 of 1", a green "Submit" button, and a blue "Clear form" button. Below the buttons are disclaimers: "Never submit passwords through Google Forms." and "This content is neither created nor endorsed by Google. Report Abuse - Terms of Service - Privacy Policy". The "Google Forms" logo is at the very bottom.

Figure 6 (Feedback page)

The feedback page of Healthy Cardio is shown above. As user feedback is an important part of any application development process, feedback is a popular way to collect it.

With that, developers gain a better understanding of the overall user experience by obtaining feedback. This will assist them in identifying areas for improvement, what users want, and learn about the application's flaws.

Thus, Healthy Cardio provided a feedback page where users could send a message or feedback to admin if they had any questions, complaints, or feedback. In a way, this gives users the freedom of sharing their experience instantly.

3.3 Results

For this project, usability testing was performed specifically to test the prototype. Usability testing is the umbrella term for a variety of user and non-user-based system evaluations that focus on a specific aspect of the design.

Several criteria were used to conduct usability testing, including efficiency, memorability, learnability, errors and error frequency, and satisfaction. Those criteria mainly focused on how quickly user can perform tasks, ease of recall, ease of learning, ease of use, safety, and subjective preferences.

There were two steps that must be completed in order to conduct usability testing. First, have the user test the application. The user here will be the one who would use the application. After the user has finished, have the user complete the usability questionnaire. The questionnaire is being divided into 3 sections including Section A, B and C.

In section B: System Usability Scale, a total of 10 questions were asked to the respondent. All in all, it can be concluded that 66.7% of respondents would use this application regularly, 33.3% of respondents think this application was easy to use, 33.3% of respondents think the various functions in this application were well integrated, 66.7% of respondents think that most people would learn to use this application very quickly, 33.3% of respondents think this application is not cumbersome/awkward to use at all, and 66.7% of respondents think they were confident using this application.

Despite all the good responses, 66.7% of respondents think this application was somehow unnecessarily complex and therefore 33.3% of them still need assistance to be able to use this application especially for the first-time use. Not only that, but 33.3% of respondents also think there was inconsistency in this application as well.

While in section C: Objective, a total of 1 question was asked to the respondent. A question "I found this application helpful in increasing awareness about cardiovascular disease (CVDs)" was asked. Based on the result, all respondents answered agree and strongly agree to this question. This proves that the application's objective of raising community awareness of CVDs among Malaysians has been met.

4. Conclusion

4.1 Strength Of The Project

The strength of this project is that it provides infographic reports based on the collected survey about the community awareness on Heart Related Diseases in Malaysia. Hence, this infographic report is designed to provide an overview of the results of the survey.

Next, this application also provides the heart disease risk expectations calculator using the Framingham model. The heart disease risk expectations will be calculated based on information that are already entered by respondents. The calculation is expected to calculate the occurrence in the upcoming ten years. In addition to that, this application also provides an annual report from the National Cardiovascular official websites.

Lastly, all users are free to use this application without having to register or sign into an account. Nowadays, many users prefer a straightforward application that does not require them to create an account. Keeping this in mind, Healthy Cardio users can freely use this application.

4.2 Weakness Of The Project

There were some weaknesses found in this mobile application, Healthy Cardio. For example, there were no back to top button on the infographic page. Therefore, user need to scroll back to the top manually.

Besides that, the heart disease risk expectations calculator provided are not user friendly. Due to time constraints, the calculator was linked from some recommended websites.

4.3 Suggestion For Enhancement

There are some suggestions for improving this application, such as adding a back to top button.

This button is necessary so that the user does not have to manually scroll back to the top.

Also, the provided heart disease risk expectations calculator should be more user friendly.

Therefore, it is recommended to create a calculator that is more user friendly than this one.

Lastly, Healthy Cardio can collaborate with health-related organizations as well to raise public awareness about cardiovascular diseases (CVDs) in Malaysia. Through this collaboration, Healthy Cardio can work together with health care experts to increase knowledge and awareness about cardiovascular diseases (CVDs) and encourage communities to live healthier at every stage of life.

4.4 Conclusion

Just like any other application, Healthy Cardio has its own set of strengths and weaknesses. Thus, some suggestions were then provided to improve this application. Also, the project supervisor has tested the application and is satisfied with the result. Therefore, it can be concluded that the overall requirement indicated specifically by the project supervisor has been met. Not only has that, all the objectives of this project also been successfully accomplished.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

EMMAR: Exploration of Malaysian Traditional Musical Instrument with Augmented Reality

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Abstract: Traditional music has historically been valued as an intangible cultural asset. Without traditional musical instruments, traditional music cannot be created and performed in the same manner. Traditional musical instruments in Malaysia play an important part in Malaysia's cultural legacy, but few people are aware of them. Museums have the potential to serve as important public attractions to help Malaysian culture and boost the country's tourism industry; however, the lack of newer technology utilization in museums is one of the factors that contributes to some of the local culture being left out and not recognized by Malaysians themselves, including the Malaysian traditional musical instruments. Based on the visit to Muzium Muzik Malaysia, it can be concluded that they do not use modern technologies in an interactive way to draw visitors. To appreciate and preserve the local cultural assets, this project seeks to develop an augmented reality mobile application using the Unity game engine that will be used along with a booklet. The project will use the ADDIE research model and mix both qualitative and quantitative methods in the research. The EMMAR mobile application will present an informative model of traditional musical instruments that are available at Muzium Muzik Malaysia to increase visitor engagement and interaction in the museum. Visitors' interaction with traditional musical instruments, which are typically off-limits to touching, will be improved by this new technology. Following completion of the study, the mobile application will be made available to and evaluated among visitors to the Muzium Muzik Malaysia to gauge its efficacy. A survey is carried out at the end of the study to collect statistical information about the outcomes. It has been concluded that more than 76.3% of the respondents agree that the EMMAR mobile application can be useful to promote the museum and prolong local heritage continuity.

Keywords: Traditional Musical Instruments, Cultural Assets, Augmented Reality, Cultural Heritage, Mobile Application

1. Introduction

In Malaysia, there are a generous amount of traditional music genres that are summarized according to their function; the same goes for the traditional musical instruments that are used in events like wayang kulit (the shadow puppet show), in which stories are told by a dalang (puppet master), in dances like zapin, in special ceremonies including weddings and the celebration of the harvest festival Tadau Kaamatan, and even for spiritually-related purposes. [1] These musical instruments are the Malaysian identity and should not be forgotten by the local citizen. Museums are the best place to promote our local culture and heritage. As stated by the Department of Museum Malaysia, the national museum serves as an institution to preserve, conserve, and propagate the value and knowledge of the nation's

history, cultural, and natural heritage. Heritages are an asset to the country; hence, they need to be preserved and conserved to prevent their extinction in the future.[2] This study will specifically focus on string instruments that were used in the history of Malaysian music and their purposes up until now.

1.1 Problem Statement

Despite examples from other countries, Malaysia has yet to adopt AR applications in its museums. In 2023, the Borneo Culture Museum stands out with 30% interactive exhibitions[3], but overall, Malaysian museums still rely on passive displays like text or images, lacking dynamic methods. As stated in a survey conducted by Muzium Muzik Malaysia, until the year 2023, Muzium Muzik Malaysia had only used the augmented reality features once to present a virtual Gambus exhibition through the Jabatan Muzium Malaysia website. To meet the exhibition needs of the digital age, the museum should use digital interactive features in their exhibition. “Let us be cognizant of the importance of digitalization and innovation in our way of revitalizing the new tourism scene amid this era of technology.” - Dato’ Hj. Zainuddin Abdul Wahab, Director General of Tourism Malaysia’s Marketing Plan 2022 – 2026. [4]

1.2 Research Objective

Other than introducing the value of Malaysian traditional musical instruments to the visitor, this project can also be used as a medium for the museum’s marketing strategy. The research objectives are listed down as below:

- To identify an interactive way to promote Malaysian cultural assets.
- To develop an augmented reality mobile application that helps promote and preserve traditional musical instruments as part of the local heritage.
- To evaluate the effectiveness of the augmented reality (AR) mobile application based on the responses of the target audience.

2. Methodology

The EMMAR project employs a mixed methods approach, combining interviews with stakeholders of Muzium Muzik Malaysia and distributing 80 questionnaires, each containing 30 strategically divided questions. This comprehensive method aims to gather data on visitor demographics, technological approaches, AR technology knowledge, user interface satisfaction, and overall product effectiveness.

2.1 ADDIE Model

The ADDIE model, comprising analysis, design, development, implementation, and evaluation phases, provides a structured approach for research methodology, allowing iterative refinement based on feedback. Widely used in educational multimedia program development, it ensures thorough planning and execution of each phase for continuous improvement.

The ADDIE model usually suggests building a storyboard to help designers visualize big ideas. In the project, the designer uses a site map to visualize the contents of the EMMAR application. This is based on what is obtained and observed at the research site.

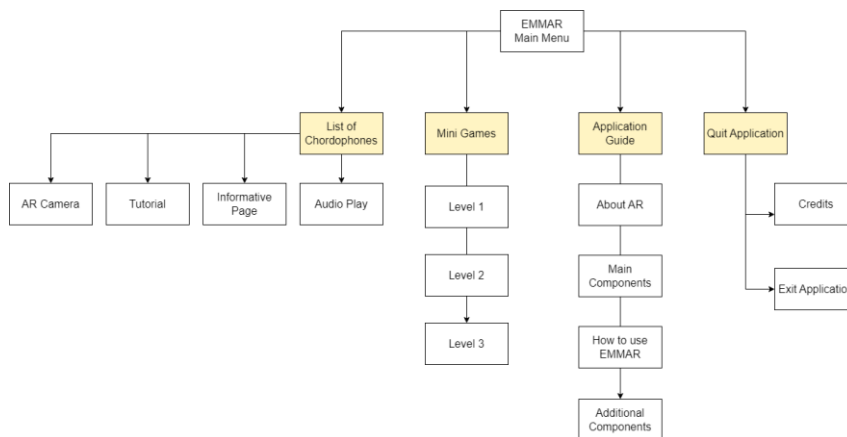


Figure 1: EMMAR Site Map

The EMMAR mobile app features a main menu with four buttons: chordophones list, mini games, app guide, and exit. The chordophones list includes six ethnic groups. Mini games offer three levels to test user understanding. The app guide explains button functions, while the exit button handles application closure and copyright information. Upon selecting an instrument, users access an AR camera page with tutorial, information, and audio playback options.

For this study, Unity, a widely used open-source game engine, will be utilized, particularly for its ease of use and compatibility with mobile app development. Its support for C# programming facilitates script writing, while ample resources aid in integrating AR components.

3. Results and Discussion

The primary objective was to gather feedback through answering questionnaires to both visitors of the museum and students of UniKL MIIT. There are participants from various backgrounds that offer valuable insights and interpretations. Through data analysis, the project will be presented with an evaluation of the effectiveness of the final product and state other key findings.

Table 1: Mean Score Interpretation

Mean Score	Interpretation
1.00-1.80	Very Low
1.81-2.60	Low
2.61-3.20	Medium
3.21-4.20	High
4.21-5.00	Very High

Source: Moidunny (2009).

Table 1 shows the mean score interpretation according to [5]. The table is used to interpret the characteristics of the data collected from a Likert Scale survey questionnaire. The mean score determines the characteristics category of the data.

3.1 Preservation of Malaysian Cultural Heritage

By using the EMMAR mobile application, the user can listen to the sounds of stringed traditional musical instruments that they have never heard of before.
80 responses

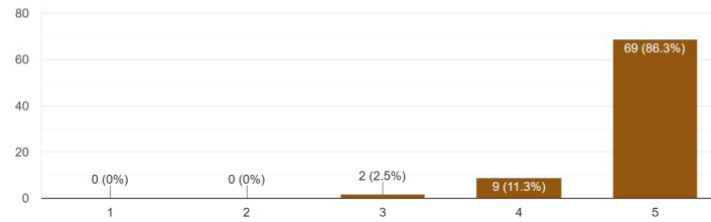


Figure 2: Exposure on Traditional Musical Instruments

The descriptive study has found that by using the EMMAR mobile application, the user can listen to the sounds of stringed traditional musical instruments that they never heard of before. This statement is supported by a very high mean score which is 4.83. 69 (86.3%) out of 80 respondents are observed to strongly agree with the statement. 59 respondents out of them highly suggest that the EMMAR mobile application has shown some of the traditional musical instruments that are rarely seen nowadays in Malaysian music industry.

3.2 Promotes Advanced Technology to Enhance Immersive Experience

Overall, the EMMAR mobile application can increase the visitor's engagement with the artefacts while promoting the museum.
80 responses

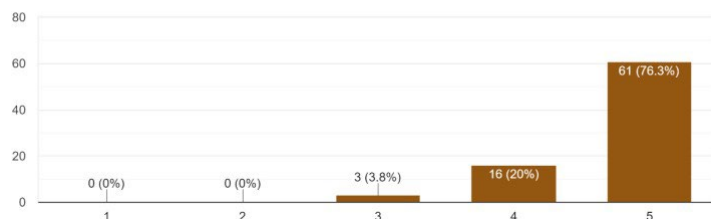


Figure 3: Visitor's Engagement with EMMAR Mobile Application

Figure 3 shows the overview of user satisfaction while using the EMMAR application. 61 (76.3%) of the respondents strongly agree that the EMMAR mobile application can increase the visitor's engagement with the artefacts while promoting the museum. It is followed by 16 respondents that agree (20%), and 3 respondents that have given a neutral answer (3.8%). Out of 61 respondents that admit the statement, 38 of them highly support that museums that do use digital technologies for their exhibitions are more interesting than museums that do not. This statement also has a mean score of 4.72, which indicates that by using the EMMAR mobile application, the museum can promote their exhibition using advanced technology like AR applications to create immersive experiences as well as increasing the visitor's engagement with the artefacts in the museum.

4. Conclusion

Traditional Malaysian musical instruments are culturally significant, but museums face challenges exacerbated by the pandemic. However, augmented reality (AR) offers innovative solutions, enabling museums to engage visitors effectively via digital devices. Embracing AR enhances museum experiences, broadening audience reach, and preserving Malaysia's cultural heritage for future generations.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

EXPLORING AUGMENTED REALITY TO PRESERVE HERITAGE HOUSES OF MALAYSIA

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Abstract: Unique structural designs can be seen throughout Malaysian heritage houses. The Malaysian Heritage Houses were the focus of this study since they had unique architectural styles. This project showcases 13 types of houses that represent one state in Malaysia. The main goal of this study is to evaluate the effectiveness of additional realities that can nurture Malaysian society, so as not to forget the origins of traditional Malaysian houses. This is crucial since many historic houses are in danger of disappearing owing to contemporary development, and it is necessary to inform the public about these priceless cultural treasures, especially the younger generation. By giving users a virtual tour of historical homes, an augmented reality application hopes to transport users back in time. Younger generations can learn about the cultural value and historical context associated with this architectural marvel through this interactive digital experience. To accomplish this, the researchers created an augmented reality (AR) application utilizing the Unity 3D game engine. With the help of this application, users may interact and experience traditional houses virtually just as if they were in the actual thing. A booklet that provides further context and details about the historic houses is also included with the application. Using 3D modeling software called Blender, the researchers were able to properly recreate the architectural elements and textures of the traditional dwellings in the virtual setting. From a research methodology standpoint, the study takes a quantitative approach. Around sixty individuals responded to the survey; the typical individual who has participated in this survey is a student at the University of Kuala Lumpur (also known as UniKL). Of those who responded to the survey, 38 percent agree that the younger generation in Malaysia should be educated about the traditional Malay houses.

Keywords: Augmented Reality, cultural heritage, Malaysian traditional house, cultural heritage preservation

1. Introduction

Cultural heritage conservation has been a global priority in recent years. Heritage houses are valuable historical, architectural, and cultural reminders of a nation's history. Malaysia has several heritage houses that are at risk of being lost due to urbanization, neglect, and natural decay. Thus, innovative methods to protect and develop these priceless assets for future generations are needed now. This study is a concept paper exploring the AR's potential to preserve Malaysia's heritage houses. Augmented reality overlays digital information on the actual environment to improve users' perception and engagement. AR allows for immersive experiences that perfectly blend the past and present, giving people new and fascinating ways to explore and enjoy heritage properties. Recent years have seen

successful AR uses in tourism, education, and cultural heritage preservation. AR's use to protect Malaysia's heritage houses has received little research. This project seeks to address this research gap by examining the feasibility, challenges, and potential benefits of integrating AR technology into the conservation efforts of Malaysian heritage houses[1]. It is also an architectural and cultural heritage that exists in Malaysia, and it is important to maintain it today. Traditional Malay house architecture serves as a visual representation of the religious and cultural beliefs of the community's ancestors, as well as their religious and cultural practices and beliefs[2]. This research will also look at design principles and best practices for creating effective mixed reality experiences. It will also give the designer the ability to use his imagination to build the desired shape by using this technology[3]. The project is still ongoing and the testing phase is expected to be done in January 2024.

1.1 Problem Statement

- The lack of knowledge and understanding about Malaysian traditional houses among younger generation[4].
- That architecture houses nowadays do not like to apply traditional architectural elements[5].

1.2 Research Objective

- To identify how the use of augmented reality (AR) technology can benefit the younger generation in recognising the traditional houses of Malaysia.
- To develop augmented reality applications to raise awareness among younger generations about the declining traditional Malaysian houses.
- To evaluate the effectiveness of augmented reality in nurturing the younger generation, not forgetting the origins of the traditional Malaysian houses.

1.3 Significants of Study

- To protect Malaysia's next generation from traditional dwellings that are in danger of disappearing.
- To improve the youth's understanding about the traditional Malay houses in Malaysia.

2. Materials and Methods

In terms of research methodologies, this study applies quantitative methods. Students from UniKL (University of Kuala Lumpur) will assess the capability of an augmented reality application. The study aims to educate people and the younger generation to preserve heritage houses using the ADDIE model method, which consists of five types of components: analysis, design, development, implementation, and evaluation. The ADDIE model is a well-known framework of instructional design that has been successfully used in a variety of fields, including education and training[6]. This application tool employs the idea of expanded reality as a teaching tool. The steps involved in content development are depicted in **Figure 1**.

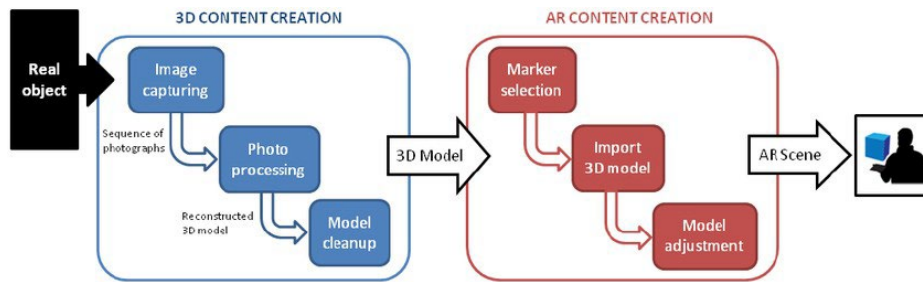


Figure 1: Process involved in creating content for AR[7]

Figure 2, the application uses a wide range of programmers, including Adobe Illustrator, C#, Unity 3D, Blender, and Vuforia. In figure 3, these are the reversals of the platforms that involved to build this project.

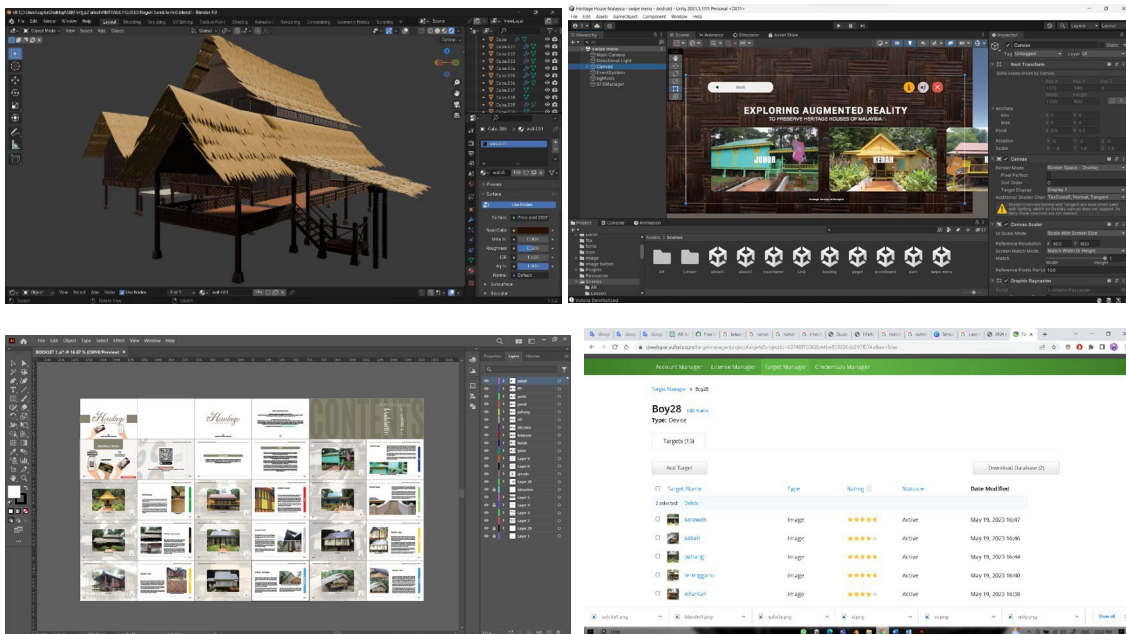


Figure 2: compilation of platform that involved in this project

3. Results and Discussion

Do you think augmented reality can contribute to educating the younger generation about the historical significance of heritage houses in Malaysia?

60 responses

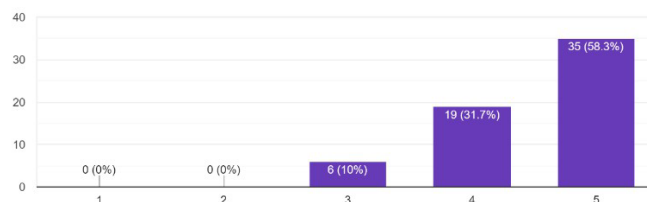


Figure 3: Chart – AR can contribute to the younger generation to preserve heritage houses of Malaysia.

Figure 3, augmented reality (AR) shows great promise for educating youth about Malaysia's heritage houses. With 58.3% fully supporting its role and 31.7% indicating frequent use, the average score of 4.5 confirms strong approval. This collective agreement highlights AR's potential to engage and immerse students in learning about architectural history. By merging virtual elements with real-world settings, AR offers interactive experiences that make heritage education more accessible and impactful.

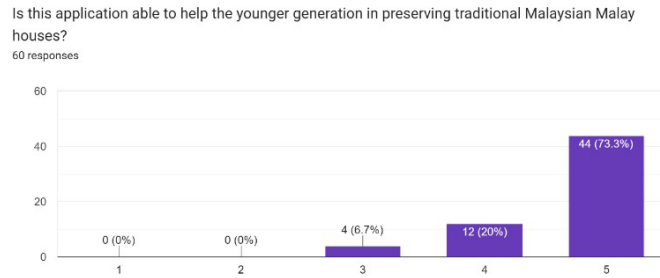


Figure 4: The application able to help the younger generation.

Figure 4, The application has shown significant potential in helping the younger generation preserve traditional Malaysian Malay houses, with 73.3% of respondents agreeing it always aids preservation and 20% saying it does so very often. The mean score of 4.7 indicates strong agreement with its effectiveness, suggesting widespread consensus on its utility for fostering cultural awareness and heritage conservation among youth.

4. Conclusion

In conclusion, our augmented reality project to preserve Malaysia's heritage houses has been a success. The developed application effectively engages and educates the younger generation, highlighting the importance of cultural preservation. By blending technology with tradition, we ensure that Malaysia's rich heritage endures for future generations to appreciate.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Flipped Classroom 2.0: Redefining Learning Roles

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Abstract: The traditional classroom model is undergoing a transformational change, giving rise to more innovative teaching methods involving blended learning amidst the unprecedented COVID-19 pandemic. This project aims to redefine the conventional flipped classroom model by introducing a more advanced and participatory framework. Adopting the concept that students learn best by teaching, our initiative aims to transform students into active contributors and creators of educational content under the supervision of the lecturers. Students can take on the role of content creators, creating materials that resonate with their peers and fostering a collaborative and engaging learning environment. Various platforms such as TikTok, Instagram, Facebook and X are now available where students from different institutions are able to communicate, contribute their ideas and deliver information, especially post-COVID-19 pandemic. Findings from a previous review in 2022 have confirmed the practicality of blended learning in various disciplines however, to maximise efficiency, it is essential to make independent efforts to redevelop both curriculum and pedagogy. Some of the benefits of flipped classrooms include the provision of flexible learning schedules for students, the integration of both asynchronous and synchronous teaching methods, the fostering of twenty-first-century skills, and the improvement of the overall quality of interactions between students and teachers. Using the advanced flipped classroom model where students take on the role of content creators, students' critical thinking and communication skills can be enhanced. By creating content, students develop crucial skills such as research, problem-solving and the ability to convey complex ideas. These skills are not only beneficial in academic settings but also essential in real-world situations.

Keywords: Flipped classroom, COVID-19, blended learning, content creator

1. Introduction

The coronavirus disease (COVID-19) pandemic has led to a significant shift in the education sector, with blended learning becoming a predominant form of learning. The literature on blended learning in the context of COVID-19 emphasises the various methodologies, technology tools, impacts, and challenges associated with this approach. A study by Divjak et al. (2022) explored the impact of the flipped classroom model on students' academic performance during the COVID-19 pandemic. The study found that the flipped classroom model was effective in improving students' academic performance and engagement in the learning process.

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The COVID-19 pandemic has had a significant impact on the education sector, leading to the introduction of distance and blended learning approaches. Blended Learning combines the best of online and face-to-face learning, offering a flexible and personalised approach to education (Singh et al., 2021). The development of blended learning is driven by the increasing use of technology in education and the need for more flexible learning environments. The pandemic has accelerated this trend, with many institutions turning to distance and blended learning to continue their studies despite isolation and social distancing measures (Coleman 2021).

Several studies have examined the effectiveness of blended learning in various educational contexts, including during the COVID-19 pandemic (Topping et al., 2022). These studies have shown that blended learning can have a positive impact on student's academic performance, independent learning skills and attitudes towards learning (Tong, Uyen & Ngan 2022). In the context of teacher training, high-quality blended and online teaching and learning practices have been identified that can be applied in schools, universities and higher education institutions (Online and blended delivery in further education - GOV.UK).

Despite its potential benefits, blended learning also presents challenges, such as the digital divide, which has been exacerbated by the pandemic. This divide refers to the disparities in access to technology and the internet, which can make it difficult for students to participate in remote learning. To address these challenges, institutions must strive to ensure equity for all students by providing access to necessary technology and support (Coleman 2021).

Blended learning has emerged as a key educational approach during the COVID-19 pandemic. Its effectiveness in promoting academic achievement and supporting personalised learning highlights the potential of blended learning to shape the future of education however, bridging the digital divide and ensuring equal access for all students remain major challenges that must be addressed to fully realise the potential of blended learning in a post-pandemic world.

The flipped classroom model is a pedagogical approach that reverses the traditional elements of classroom learning. In this model, students independently review their reading before class and participate in conversations, problem-solving and active learning during this time. The flipped classroom model becomes more effective through the use of learning management systems (LMS), content repositories, collaboration platforms, podcasts and video creation tools. Online review tools like Clicker and instant response platforms like Kahoot provide real-time feedback and increase engagement (Baig & Yadegaridehkordi 2023). The use of augmented reality (AR) technology in flipped learning has been shown to increase students' critical thinking skills, self-efficacy, and motivation (Dutta 2023). The flipped classroom model has been found to promote student creativity, particularly in terms of fluency, flexibility and novelty (Al-Zahrani 2015). There are several types of flipped classroom models, including standard flipped classroom, micro-flipped classroom, discussion-oriented flipped classroom, and evidence-based flipped classroom (Thakare 2023). The flipped classroom model offers numerous benefits, including increased student engagement, better critical thinking skills, and more frequent teacher-student contact. However, the flipped classroom model also presents some challenges, including the need to provide students with access to technology and the need for teachers to create high-quality instructional materials (Baig & Yadegaridehkordi 2023; Akçayır & Akçayır 2018).

The integration of technology platforms in the flipped classroom model offers several advantages. Firstly, it enhances engagement and interactivity between students and faculty, fostering a more dynamic learning experience. Additionally, technology facilitates convenient access to learning resources, enabling students to explore materials at their own pace, thereby promoting better comprehension and retention of content. The flexibility provided by technology platforms is another notable advantage, granting students the freedom to learn at their preferred times and locations with an internet connection, accommodating diverse learning preferences (Sims et al., 2022).

However, there are also notable disadvantages associated with the use of technology platforms in

collaborative learning within the flipped classroom model. One significant drawback is the potential limitation of face-to-face interaction. While online collaboration is feasible, it may lack the richness and immediacy of direct communication in traditional classrooms. Technical difficulties pose another challenge, with issues like internet connectivity problems and software compatibility potentially impeding the smooth implementation of collaborative learning through technology platforms (Sims et al., 2022). Additionally, the use of such platforms may inadvertently create a more impersonal learning environment, as students might miss out on the social and emotional aspects inherent in traditional classroom interactions. Importantly, the effectiveness of the flipped classroom model, especially when employing technology, may not universally translate to higher student satisfaction compared to more conventional approaches (Dong et al., 2021). It is crucial to recognise that the impact of these advantages and disadvantages can vary based on the specific educational context, the implementation of the flipped classroom model and the preferences of the students involved.

2. Materials and Methods

A cross-sectional study was conducted among 38 undergraduate UniKL RCMP pharmacy students who are taking the elective course Cosmeceuticals during the January 2022 semester to investigate their satisfaction level towards one of the assignments under the course. The assignment involves the incorporation of video creation as a component of the assignment. The purposive sampling technique was used to collect the sample for this study. The data collection was conducted after the completion of the course when the students were in their final year.

The survey instrument was a self-administered online questionnaire. Each participant would receive the questionnaire via Microsoft Form and answer it anonymously. Before starting to answer the questions, the participants were given an explanation regarding the study and clicked "I agree" after confirming that they had read and fully understood the information given for the study and that they decided to participate. Should they have any questions, they would have the opportunity to ask the investigators.

The 9-item questionnaire consists of two (2) different sections. Section A inquired about the demographic profile while section B comprised seven (7) main evaluations of students' satisfaction level towards the assignment. Section B requires the students to answer the following questions:

1. How would you rate your overall experience with the video creation assignment?
2. Please provide a specific reason for your rating above.
3. To what extent do you believe video creation enhanced your understanding of cosmeceutical concepts?
4. How effective do you find the incorporation of video creation in learning cosmeceutical concepts?
5. Did you face any challenges during the video creation process?
6. If "yes" to Question 7, explain the challenges you encountered during the video creation process?
7. On a scale of 1 to 10, how satisfied are you with the overall incorporation of video creation in the assignment?

All statistical analyses were performed by using a statistical package for social sciences (SPSS), version 22.0 (SPSS, inc., Chicago, IL). The categorical variables were summarised in frequency (n) and percentage (%). A descriptive analysis was used to assess the level of satisfaction.

3. Results and Discussion

3.1 Results

Data was collected through the distribution of questionnaires via online survey form with a response rate of 100%. Consequently, 38 undergraduate Pharmacy students who took the elective Cosmeceuticals

course during the January 2022 semester participated. The demographic characteristics of respondents are summarised in Table 1. Out of 38 respondents, 8 (21.1%) respondents were male and 30 (78.9%) were female. 36 (94.7%) of them are Malay and the remaining two (5.3%) are Indians.

Table 1: Descriptive analysis of the demographic characteristics of respondents (n=38)

	Data	Number	%
<i>Gender</i>	Male	8	21.1
	Female	30	78.9
<i>Race</i>	Malay	36	94.7
	Indian	2	5.3

The analysis of feedback from students who participated in the video creation assignment revealed that the majority expressed high satisfaction, with 26% (n=10) indicating they were "Very Satisfied" and 68% (n=26) "Satisfied." Only a small percentage (n=2, 5%) reported being "Neither satisfied nor dissatisfied" (Figure 1). Overall, this suggests that the video creation assignment was well-received among the students.

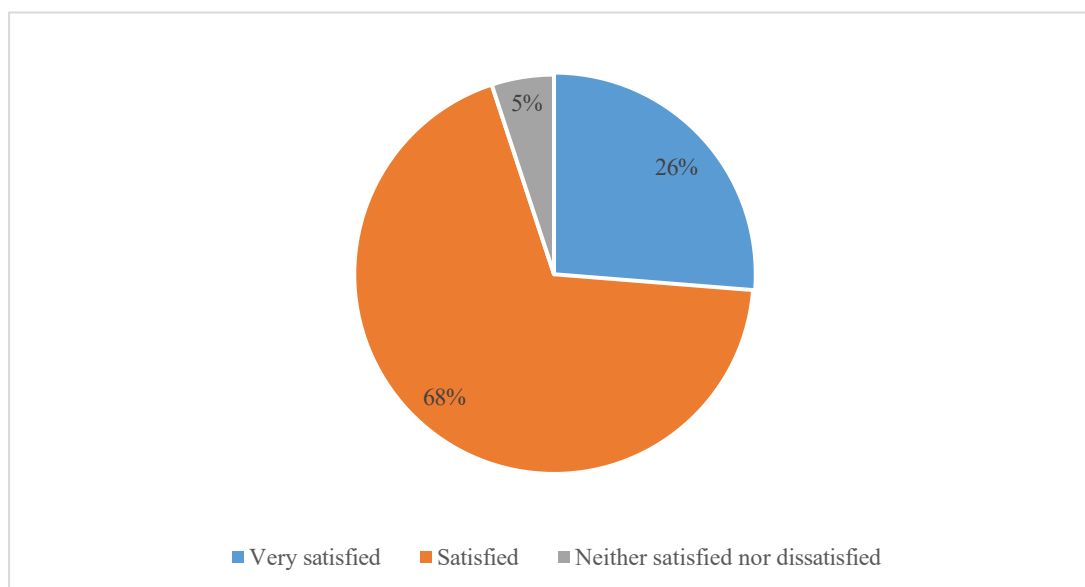


Figure 1: Overall Experience with the Video Creation Assignment (n=38)

A significant 15.8% (n=6) of the respondents praised the flexibility of the carry mark task, stating that it facilitated task performance and allowed for enhanced creativity in delivering information. The majority (n=13, 34.2%) found the experience of creating a video to be fun and interesting while a significant portion (n=4, 10.5%) felt that the method is more engaging than traditional learning methods, such as lectures and project reports. Participants (n=2, 5.3%) also highlighted that creating a video for the cosmeceuticals project provided a practical application of theoretical knowledge, reinforcing their understanding of the subject matter and contributing to a more meaningful learning experience. Collaborating with peers and sharing ideas with team members were one of the valued aspects among 13.2% (n=5) participants and 7.9% (n=3) appreciated the opportunity for skills development and collaboration. While the overall response was positive, a small percentage (n=1, 2.6%) found the process tiring, emphasising the importance of balancing the creative aspects with practical considerations. Additionally, 2.6% (n=1) highlighted the need to ensure that the video fulfils all the assignment guidelines, indicating a desire for clearer instructions or support in meeting project requirements.

Concerning the impact on learning, 68% (n=26) of students felt that the assignment significantly enhanced their understanding of cosmeceutical concepts. An additional 32% (n=12) reported a moderate enhancement, emphasising the effectiveness of the assignment in reinforcing theoretical knowledge (Figure 2).

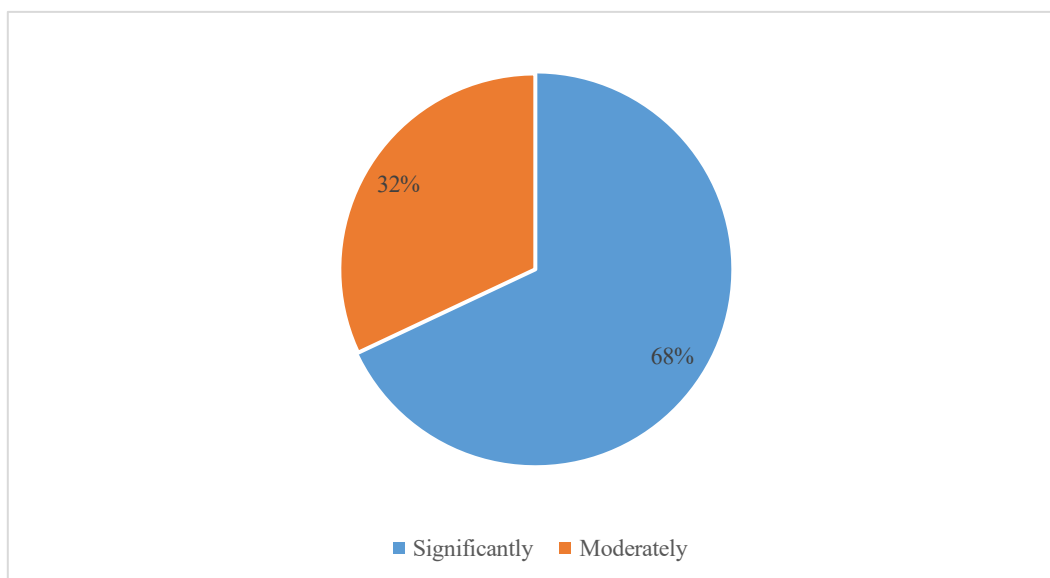


Figure 2: Impact of Video Creation on Understanding Cosmeceuticals Concepts (n=38)

The incorporation of video creation in learning cosmeceutical concepts was considered highly effective, with 24% (n=9) of students rating it as "Extremely Effective" and 58% (n=22) as "Very Effective." This indicates that the use of video positively influenced the learning process, accommodating various learning preferences and styles. The assignment's success is further supported by the fact that only a small percentage (n=7, 18%) found it somewhat effective, suggesting a generally positive impact on learning outcomes (Figure 3).

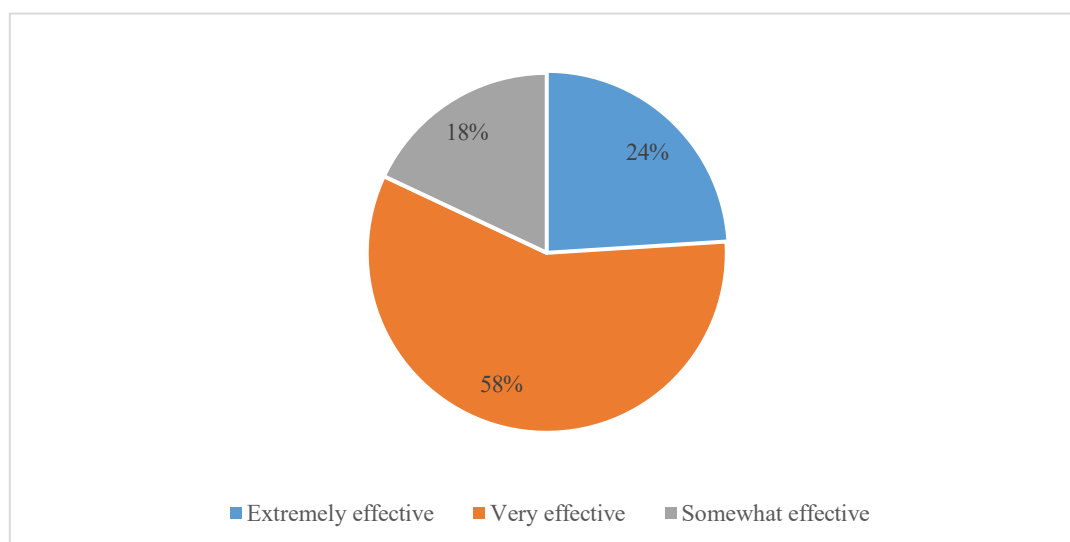


Figure 3: Effectiveness of the Incorporation of Video Creation in Learning Cosmeceuticals Concepts (n=38)

While a significant portion of students faced challenges during the video creation process (n=25, 66%), the specific challenges varied. The most common issues included time restraint (n=9, 36%), brainstorming ideas (n=4, 16%), and technical issues (n=4, 16%). Despite these challenges, students indicated that once the initial brainstorming hurdles were overcome, the video recording process went

smoothly. Limited resources, spending extended hours editing the video and facing problems with file formats highlighting logistical challenges faced by students.

In terms of overall satisfaction with the incorporation of video creation in the assignment, 63% (n=24) of students rated it with a score of 9 or 10 on a scale of 1 to 10. The average score among 38 respondents was 8.61. This suggests a high level of contentment with the use of video in the learning process. The positive sentiments were reflected in students' appreciation for the flexibility of the task, the unique learning experience it offered, and the positive responses received from peers.

In conclusion, the analysis of student feedback indicates that the video creation assignment was a generally successful and well-received learning experience. The positive impact on learning, high levels of satisfaction, and the development of practical skills suggest that incorporating video creation into assignments can be an effective and engaging approach for teaching cosmeceutical concepts. Despite some challenges encountered, the overall positive outcomes support the continued integration of such innovative methods in the educational curriculum.

3.2 Discussions

In a previous study by Rieger et al. (2021), undergraduate nursing students were asked to create an arts-based multimedia knowledge translation presentation to communicate systematic review findings to patients. The study found that most students (68%) were satisfied with the assignment and reported learning (77%) and benefits for their future practice (75%). Factors such as age, enjoyment of and experience with the arts, type of motivation, and valuing evidence-informed practice significantly influenced students' evaluation of the assignment. The study highlights the potential of creative approaches to deepen students' understanding of evidence-informed practice and emphasizes the importance of considering these factors during the implementation of arts-based assignments.

Another study by Lewis et al. (2020), explored the satisfaction of undergraduate nursing students with a video assessment of clinical skills (VACS) that integrated formative feedback. The study used a cross-sectional survey design and collected open-ended responses from third-year nursing students. The findings revealed three major themes: flexibility and reflexivity, editing and repeated attempts, and working together. These themes indicate that the VACS approach demonstrated good utility, acceptability, and satisfaction among undergraduate nursing students. The incorporation of formative feedback through video assessment allowed students to reflect on their performance, make improvements, and work collaboratively.

In the field of dental education, a study conducted by Kenny et al in 2018 focused on the use of video clips to improve the confidence of undergraduate dental students in managing local anaesthetic administration for children. The study involved fourth-year dental students who were randomly assigned to either an intervention group receiving video clips demonstrating behaviour management techniques or a control group. The results showed that the intervention group had significantly higher confidence levels immediately after the teaching intervention and at 4 months compared to the control group. The study confirms the benefits of using video clips as a teaching aid to enhance students' confidence in delivering local anaesthesia to pediatric patients.

In summary, the incorporation of video creation as an assignment has shown positive outcomes and high satisfaction levels among undergraduate nursing and dental students. These studies support the effectiveness of video-based approaches in enhancing students' learning, understanding, and confidence in relevant clinical skills.

4. Conclusion

In conclusion, the findings from the study reveal overwhelmingly positive sentiments among respondents. The assignment was commended for its ability to foster a deep understanding of cosmetic concepts through an engaging and creative process. The flexible nature of the task, the freedom to make

creative decisions, and the opportunity for collaboration were key contributors to this positive feedback. Students appreciated the departure from traditional learning methods, emphasising the value of experiential learning and the practical application of theoretical knowledge. While a small percentage noted challenges, such as fatigue, these did not diminish the overall positive impact of the assignment. These insights suggest that incorporating video creation into academic assignments can be an effective and enjoyable method for enhancing student learning experiences and promoting creativity in the educational setting.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

3D GAME - Fostering self-determination and resilience

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Abstract: In this modern age, gaming is often dismissed as mere entertainment, overlooking its potential for critical thinking and problem-solving. The project aims to reshape perceptions, emphasizing the benefits of gaming. The game storyline, featuring a determined character defying the odds, embodies resilience and empowerment. Using a dynamic third-person viewpoint, the game seamlessly integrates RPG and fighting elements, motivating players to conquer challenges and discover hope amid adversity. This initiative aligns with two key objectives: 1) exploring the psychological and emotional benefits of using a video game to promote self-confidence and determination, and 2) developing a game that enhances mental health and overall well-being. The methodology uses the method of game development life cycle (GDLC), encompassing three phases: pre-production, production, and post-production, to guide the creation of a video game. The results of the project were for the player to become more outgoing, resilient, and empowered, demonstrating the significant impact of the game on psychological and emotional well-being. Additionally, the game was anticipated to inspire players to overcome challenges, fostering a sense of self-confidence and determination. By emphasizing the healing potential of gaming and reshaping perceptions, the project aimed to contribute to a positive shift in the contemporary understanding of gaming, recognizing its value beyond mere entertainment. In conclusion, the project challenged the perception of gaming as mere entertainment, emphasizing its untapped potential for critical thinking and mental health. Informed by research on generational biases, the initiative countered negative beliefs.

Keywords: video game, mental illness, stress, anxiety, depression, resilience, empowerment, self-confidence

1. Introduction

This study looks into the possible medicinal benefits of video games. In particular, the objective is to improve mental health and resilience in response to the COVID-19 pandemic's negative effects on mental health by developing a narrative-driven game called "Nobody." Building on previous research showing the positive cognitive effects of gaming, this study investigates the possibility that interactive game narratives can help people build emotional resilience and coping skills. Our goal is to find out if playing structured games might help players become more emotionally and psychologically strong, which could be an innovative approach to address mental health issues. In an effort to shed light on the topic, this study aims to define the place of gaming in mental health treatment.

1.1 Research Content

Following the COVID-19 pandemic, there has been an increase in mental health problems, highlighting the necessity for easily accessible therapeutic interventions. Our study examines the potential of video games as a workable support system, emphasizing how they might promote mental health and resilience.

1.2 Objectives and Results

The objectives is to explore and develop a video game, 'Nobody,' for enhancing mental resilience and well-being but also to meticulously evaluate its impact on players' attitudes and mindsets. The result is a comprehensive understanding of the game's role as a viable mental health intervention, potentially setting a precedent for integrating interactive digital narratives into psychological support frameworks.

2. Materials and Methods

The study's methodology section highlights the organized process used to create the video game project called "Nobody," with a particular emphasis on the Game Development Life Cycle (GDLC) that was put out by Rido Ramadan and Yani Widyani (2013). This game development life cycle (GDLC) is designed with the unique issues that arise during the process in mind, providing a methodical and effective workflow from conception to release.

2.1 Materials

The creation of "Nobody" involved the use of numerous instruments and materials that were essential to the project's success:

- The Unreal Engine was selected due to its strong development features and superior graphics rendering capabilities, which facilitate the building of immersive gaming settings.
- In order to improve the audiovisual components of the game and enhance the story and gameplay, Adobe Premiere Pro and Adobe Audition are used for voice-over editing and video production.

2.2 Methods

The development of the game was structured using the GDLC, which has include several statges.

1. **Initiation:** This initial phase involved sketching out the basic game idea, which eventually evolved into the 3D third-person game 'Nobody.' This stage was crucial for setting the project's direction and goals.
2. **Pre-Production:** Concentrated on conception, prototyping, and game design refinement. This phase ensured that the game's mechanics, story, and overall design were in line with the project's goals by laying the foundation.
3. **Production:** Centered on asset creation, code generation, and integration. The production phase was critical for developing the game's content and ensuring it met quality standards through balancing and internal testing.
4. **Structure and Refinement:** Aimed to improve the game's playability and enjoyment via playtesting and iterative design. In order to maximize user involvement and accessibility, gameplay features were changed during this phase.
5. **Testing:** Before releasing the game, it underwent beta testing with outside testers to improve gameplay, fix issues, and make sure it fulfilled quality standards.

3. Results and Discussion

The main goal of the evaluation, which is to determine how the 3D game "Nobody" affects players' attitudes and mindsets. By means of data gathering and examination, which encompasses playtesting and a Google Forms questionnaire, the research pinpoints the advantages and disadvantages in accomplishing its goals. Notably, the team used both alpha and beta testing phases in order to improve the game's overall quality and tweak gameplay in response to tester comments. The results of 38 surveys

that were gathered provide useful information about demographic backgrounds, gaming habits, and opinions about the gameplay, visuals, sound, and incorporation of mental health topics in the game.

3.1 Results

The survey's results revealed some significant information. Initially, a wide range of ages participated, but the majority were young adults (18–24), indicating that a wide age range enjoys the game. Secondly, the proportion of male and female players was nearly equal, providing us with a decent general picture of the game's impact on players. Third, varying amounts of game play indicate varying gaming behaviors among the participants. It is evident that the game is technologically advanced because players enjoyed the graphics and music effects so much. Finally, players expressed appreciation for the game's ease of use and seamless integration of mental health themes, indicating that it might be a useful therapeutic tool.

3.2 Discussions

The implications of these findings are examined in the discussion. The participant list for the project "Nobody" indicates that the music is well liked by many, particularly young adults, which implies that it may be able to address this demographic's mental health issues. It is evident from the way the game is played and looked at that the design decisions made have led to happier and more engaged players. Crucially, feedback on the game's mental health themes indicates that it might be a cutting-edge and successful method of offering mental health support. The game appears to have the potential to treat mental health concerns in a meaningful and effective way by helping players develop resilience and self-determination.

3.3 Future Recommendations

For future recommendations, it is advised to collaborate closely with mental health experts, psychologists, and counselors during the development process of the game "Nobody." This collaboration can ensure that the game's content is accurate, respectful, and genuinely helpful for players dealing with mental health issues. Additionally, implementing progress tracking features within the game would allow players to monitor their mental well-being improvements and overall progress throughout their gameplay experience, enhancing the game's potential therapeutic impact.

Conclusion

In conclusion, the evaluation of the game project has accomplished its goals. Positive player comment on the music and design of the game indicates that it not only encourages self-confidence and determination, but it also improves mental health and general well-being, as indicated by praise for its efficacy as a therapy. Additionally, the game project has a good mentality and attitude on players, as seen by the variety of gameplay behaviors and positive reactions to design aspects. Overall, the game surpasses its objectives and establishes itself as a possible instrument for improving mental health, thinking, attitude, and self-confidence. It also has room for growth and creativity through further research.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

INTERACTING WITH “3 EKOR GAJAH” BY YUSOF GAJAH

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Abstract: This paper presents a study conducted from December 16 to 20 Dec involving 63 respondents aged 4 to 12 years old. The research aimed to explore the function of augmented reality (AR) technology in traditional art and reading within Malaysian culture. Specifically, the objectives were to develop children's interest in reading through AR and measure its effectiveness in enhancing reading skills and interest. The project focused on the development of an AR application for children's storybooks, aiming to engage them with Yusof Gajah's illustrations and cultivate a love for reading, steering them away from unproductive digital content. Additionally, it sought to foster creativity, imagination, and an appreciation for Malaysian art and culture, addressing a societal gap in exposure to these elements. Findings revealed significant positive feedback: 76.8% of respondents agreed that AR boosted children's interest in reading and exposed them to naive art through interaction with "3 Ekor Gajah" by Yusof Gajah. Moreover, 65.8% acknowledged AR's role in improving reading skills, while 79.8% found AR applications made reading more enjoyable. Lastly, 58.4% recognized AR's contribution to increasing learning pace and cognitive abilities, particularly through exposure to naive art within storybooks. This study underscores the potential of AR technology to bridge the gap between printed materials and digital platforms, creating an engaging learning experience that combines traditional storytelling with interactive digital elements. By integrating AR into children's literature, educators and parents can harness its benefits to foster a love for reading and cultural appreciation among the younger generation.

Keywords: Augmented Reality, Reading Interest, Reading Skills, Malaysian Culture, Naive Art.

1. Introduction

The historical value of art in communicating messages and emotions is discussed in the study background, with a special emphasis on the simplicity and clarity of "Naïve art," as demonstrated by Malaysian artist Yusof Gajah. It emphasizes how moral principles and creativity may be fostered in youngsters via storybooks, with Yusof Gajah's artwork being especially noteworthy. The issue statement talks about how children's interest in reading is waning, which is partially due to early exposure to digital gadgets, and how augmented reality (AR) isn't being used enough in Malaysian

schools. Research questions investigate how AR affects kids' creativity, engagement, and cognitive abilities. The goals are to determine how augmented reality fits into conventional narrative and assess how well it improves reading comprehension. It is important for maintaining cultural legacy, developing educational technologies, and encouraging literacy.

1.1 Problem Statement

- Current Situation in Malaysia: Limited usage of AR applications for storybooks in Malaysia, as noted by zuki (2019). Lack of experts and less emphasis on educational entertainment (edutainment) for children.
- Issue: Children nowadays exhibit a lack of interest in reading books, potentially due to increased usage of mobile phones at an early age.

1.2 Research Objectives

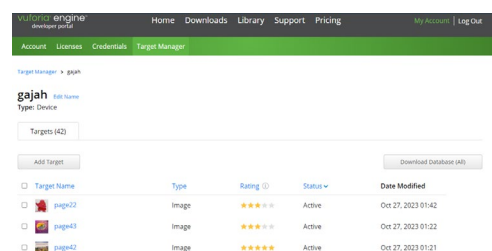
- To identify the function of augmented reality (AR) technology in traditional art and reading in Malaysian culture.
- To develop children's interest in reading through the use of augmented reality.
- To measure the effectiveness of augmented reality(AR) in enhancing the reading skill and interest.

1.3 Significant of Study

- Preservation of Traditional Stories: The project ensures that traditional stories, such as "3 Ekor Gajah" by Yusof Gajah, are passed down to the next generation in a contemporary and meaningful way.
- Enhanced Reading Experience: By integrating AR technology with storytelling, the project adds interactive features to the storybook, making the reading experience more engaging and immersive for young readers.
- Active Participation: AR technology encourages young readers to actively participate with the story, fostering comprehension and appreciation of literature as they interact with the narrative in new ways.

2. Materials and Methods

Before the development process begins, thorough preparation is essential to achieve optimal learning results from educational courseware or mobile application education development. This mobile AR application development process employs the ADDIE Instructional Design Model. The ADDIE instructional system design (ISD) concept is a fundamental approach that may be used to any type of learning solution. the ADDIE paradigm contains five steps: analysis, design, development, implementation, and evaluation.



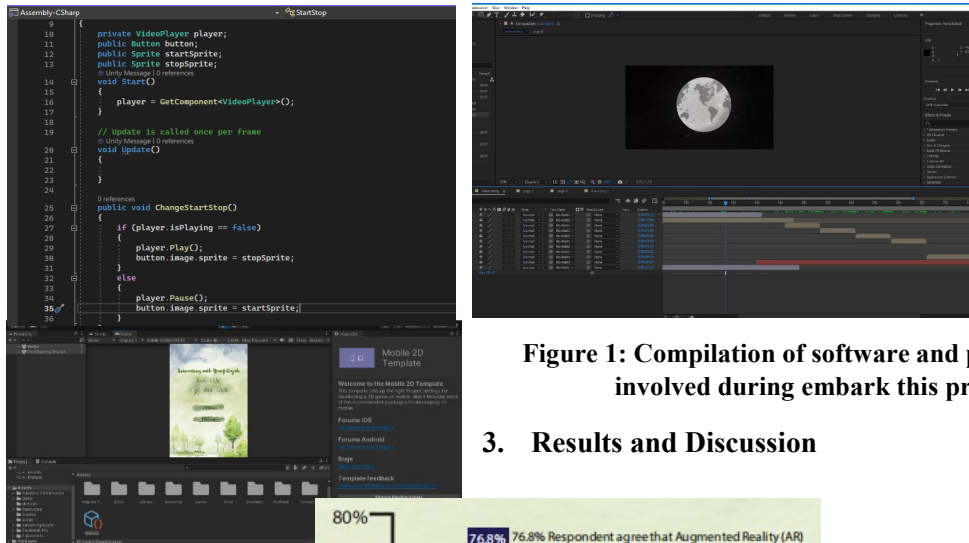


Figure 1: Compilation of software and platform that involved during embark this project

3. Results and Discussion

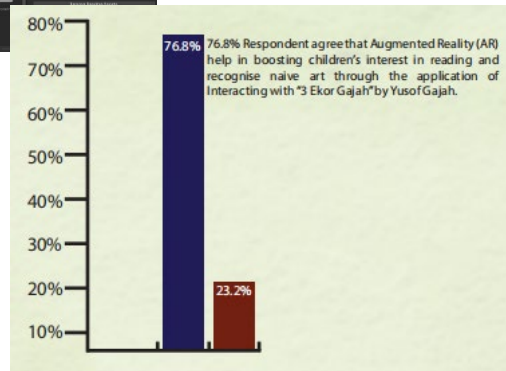


Figure 3: AR help in boosting children interest in reading

Figure 3, Chart Shown that 76.8% Respondent agree that Augmented Reality (AR) help in boosting children’s interest in reading and recognize naive art through the application of Interacting with “3 Ekor Gajah” by Yusof Gajah.

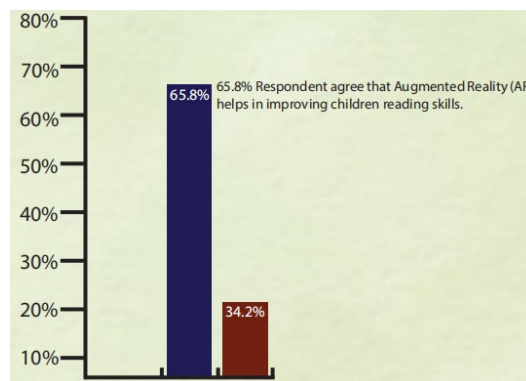


Figure 4: AR helps in improving children skills

Figure 4, Shown that 65.8% Respondent agree that Augmented Reality (AR) helps in improving children reading skills.

4. Conclusion

To summarize, the project's success underscores how AR revolutionizes children's reading experiences, fostering cultural appreciation, cognitive growth, and skill development. It showcases AR's potential to enhance literacy, cultural identity, and education globally.

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Interactive Documentary: Seni Tari Kuda Lumping

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Abstract: Kuda Kepang, a traditional art from Java, has been losing popularity due to modernity and technological advancements. The Javanese people who migrated to the Malay Peninsula in the 20th century brought this culture to the Malay Peninsula. The research objective is to enhance user awareness about Kuda Kepang through a documentary, aiming to revive the art and preserve it for future generations. The methodology used is the ADDIE (Analyse, Design, Develop, Implement, Evaluate) paradigm, which is characterized by exceptional design, clear learning objectives, organized content, controlled workloads, cutting-edge media, student activities, and assessments linked to desired learning outcomes. The interactive documentary on Seni Tari Kuda Lumping has successfully gained user interest and knowledge about the uniqueness of Kuda Kepang dance. The quantitative approach was used to gather data. The results show that most users are impressed with the awareness-related information. To improve the project, an interactive documentary with a virtual reality element will be produced, allowing viewers to experience a Kuda Kepang performance without physically being in the area. This will attract more people, especially the younger generation, to be interested in Kuda Kepang dance.

Keywords: documentary, kuda kepeng, culture and art,

1. Introduction

The Kuda Kepang dance is a traditional art that originated in Java. It is also known by various names, including Jaran Kepang, Kuda Lumping, Jathilan, and Ebeg. According to the Javanese, 'Jaran' means horse, while 'Kepang' refers to weaving. (Siti Shahirah Binti Hamzah, 2016). Kuda Kepang is also a historical art that continues to be developed and preserved, and this culture was brought in by the Javanese people who migrated to the Malay Peninsula in the 20th century (Mohd Kipli Abdul Rahman, 2006). The kuda kepeng performance is a Malay performance art that belongs to the art of dance, involving musicians, lead dancers, and dancers. Kuda Kepang is a woven sculpture shaped like a legless horse, usually presented at public events in conjunction with welcoming dignitaries, weddings, and festivals. The original Kuda Kepang performance is worshiped by the lead dancer to raise the spirit (spiritual) of the dancers who work with the help of gamelan music. (Nur Azimah Mohd Bukhari, Puteri Roslina Abdul Wahid, Nurul Haniza Samsudin, 2020). According to Roslina Abu Bakar (2014), the Kuda

Kepang dance is a folk culture that has aesthetic value and has an impact on the community that surrounds it. In general, it has its own importance in the context of society. Among the Javanese community, the kuda kepeng dance has its own uniqueness that produces aesthetic value in terms of dance movements. The goal of this study is to prevent the community from forgetting about Kuda Kepang's culture. In this study, we will discuss the uniqueness of the Kuda Kepang dance and why it is less popular nowadays. With that, this study can be conducted to provide knowledge and awareness to the community about the Kuda Kepang dance in Malaysia.

1.1 Problem Statement

Kuda Kepang, a traditional Javanese dance in Batu Pahat, Johor, was once used to lift ancestors' spirits, show heroism, and perform wedding rituals. However, its popularity is declining, and some even perform it for entertainment, raising concerns about its cultural contradictions with Sharia. (Lukhman Hakeem Kamarulzaman, 2021) conducted a study on the Kuda Kepang dance. People are more interested in supernatural or ritualistic things in Kuda Kepang performances. The main reason that elements or aspects of traditional culture become less popular is due to modernity. Few of the younger generation nowadays are less interested in learning traditional dances, especially the Kuda Kepang dance. (Siti Shahirah Hamzah, 2016). This is because today's young generation is more influenced by various types of modern games, such as computer games or video games. In fact, the art and culture of this Kuda Kepang are also less introduced in the mass media, which results in a few people not knowing the existence of this Kuda Kepang dance. According to Mohammed Azemi (2013), in terms of attitudes and views towards society, it is now considered that this traditional game is out of date and should only be used as an exhibition or in a museum. In fact, some people think that foreign art or culture is more interesting.

1.2 Research Objective

The objective of this research is to enhance user awareness about Kuda Kepang by using a documentary. So that we can preserve the Kuda Kepang dance in Malaysia through community outreach. Then, to attract the public's interest in this documentary, we will produce an interactive documentary about Seni Tari Kuda Lumpung. Lastly, to get an evaluation of the uniqueness of Kuda Kepang from thirty students at Universiti Kuala Lumpur, Malaysia.

2. Materials and Methods

The methodology encompasses the processes employed to complete the research. This approach includes the essential steps and strategies required to accomplish the objectives of the project. In order to accomplish this objective, the entire project was directed and centered around the utilization of the ADDIE (Analyze, Design, Develop, Implement, Evaluate) paradigm. The ADDIE approach was chosen due to its robust association with outstanding design, well-defined learning objectives, structured material, managed workloads, innovative media, relevant student activities, and assessments that are closely aligned with the intended learning results.

2.1 Analyze Phase

Analysis projects involve understanding existing scenarios and planning future phases to achieve project goals. The analysis projects are where the researchers gain insight into existing scenarios, such as learning objectives, website scouts, interview scripts, future phase planning, and project development techniques.

2.2 Design Phase

During the design phase, all of the lessons learned from the previous stage are applied. The data or information is collected in order to make informed decisions. This is the phase in which the storyboard is created and the filming and image creation for the project begin. It also involves dubbing, voice and sound processing, color and transition effects, and scene-cutting film editing.

2.3 Develop Phase

The completed result will be edited and then imported into software to produce a usable interactive documentary. Following the design phase, each component of the course must be developed. The main idea for the content has already been decided; this will be demonstrated during the design and development phase. This phase provides the project a sense of depth and polish. After all of the processes are completed, the researcher will create a documentary with interactive aspects.

2.4 Implementation Phase

The implementation phase occurs after instructional designers have finished developing the online course and are ready to "implement" it with respondents. It comprises planning the complete learning environment to ensure that all bases are covered and that both instructors and learners are ready to begin the course.

2.5 Evaluate Phase

Once the prototype is complete, it is time to distribute and test it. One of the easiest strategies to avoid difficulties during the implementation process is to run a pilot test before publishing the material. The evaluation stage consists of two parts: formative and summative. Formative evaluation occurs at the creation or development stage and serves as the initial assessment.

3. Results and Discussion

The project's evaluation phase has been completed. A questionnaire is employed for this assessment process. There were four sections in the questionnaire that were answered by 58 respondents. This phase will present the data analysis findings and feedback in four categories. The first section will focus on demography, where the researcher collects the data from respondents. The second section is about the evaluation of documentary video. The aim of this section is to get the respondent's evaluation of the documentary video. The video link will be provided in the questionnaire to give respondents an easy-to-do evaluation. Overall, the respondent gave satisfactory feedback and strongly agreed that the documentary is suitable to be shown to the public.

The third part is about understanding the Kuda Kepang dance. In this section, discuss the respondent's level of knowledge about the Kuda Kepang dance. Overall, the respondents gave very satisfactory feedback on what they knew about the Kuda Kepang dance. The respondents also agreed that this culture needs to be preserved for future generations. Last but not least is about the conservation of Kuda Kepang dance in Malaysia. Due to the lack of interest of the younger generation in this traditional culture, the kuda kepang dance became less popular and almost forgotten. Overall, the respondents gave very satisfactory feedback to preserve this Kuda Kepang culture from being forgotten.

4. Conclusion

With the use of video documentaries, project development has been accomplished with success. In the interactive documentary of Seni Tari Kuda Lumping, the results and testing have been done successfully. Most of the viewers agree that they can gain knowledge and information regarding the uniqueness of the Kuda Kepang dance. The overall testing of the result reveals that the majority of users are impressed with the awareness-related information. The community, especially the younger generation, is expected to be passionate about the culture as well as the art of Kuda Kepang. so that this art can continue to be preserved and not forgotten. In addition, documentaries can still be an effective

means of disseminating knowledge; the project will be improved or produced to a high level, such as an interactive documentary through a virtual reality element. So that the viewer can have the experience of watching a Kuda Kepang performance without having to be in the actual area. So that it can attract more people, especially the younger generation, to be interested in Kuda Kepang dance.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Mobile Application: AquaDreams

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Abstract: This research concentrates on the aquatic environment and advocates for aquascaping as a recreational pursuit through a mobile app. Aquascaping involves using plants to craft a self-sustaining ecosystem within an aquarium. Plants, along with fish, shrimp, and snails, play a crucial role in this type of landscaping. Currently, there is a lack of information in Malaysia regarding aquascaping, resulting in difficulties for users in handling it. To achieve a successful aquascape, various factors need to be balanced within the aquarium. To address this gap, a mobile app called AquaDreams was developed to offer users an interactive way to learn about aquascaping. This includes a simulation feature to create an aquascape within the user's budget, aiming to spark interest in the hobby and impart knowledge. The study followed the ADDIE approach for instructional design, involving analysis, design, development, implementation, and evaluation stages. The app was created using Unity, with a simulated aquascape to assess its effectiveness, alongside a survey to gather statistical data.

Keywords: aquascape, ecosystem, mobile application, simulation, ADDIE

1. Introduction

Aquascaping, the art of crafting underwater landscapes within aquariums, has surged in popularity recently as a means of creating visually striking and natural habitats for aquatic flora and fauna. Aquascaping serves as a method for enhancing the visual appeal of residential or office spaces by arranging various aquatic elements such as plants, soil, sand, wood, and rocks in diverse configurations, ranging from simple to intricate compositions [1].

To facilitate learning about aquascaping, the development of a mobile application named AquaDreams was undertaken. This application provides users with a comprehensive platform to delve into the realm of underwater landscaping, offering guidance on the care and maintenance of aquariums. AquaDreams is structured into two primary sections: "create" and "learn." The create function enables users to simulate the construction of their aquascape, considering factors like tank size, budget, suitable flora and fauna, and decorative elements. Meanwhile, the learn section furnishes valuable insights into aquascaping techniques, plant and fish care, water parameters, and troubleshooting common issues.

By incorporating various multimedia elements such as images, audio, video, and animations, AquaDreams aims to engage users and enhance the learning experience. Targeting individuals aged 17 and above, the app caters to those interested in exploring a new hobby or refining their aquascaping skills. It serves as an educational tool for beginners, guiding them through setup and maintenance procedures, while also providing a platform for experienced aquascapers to experiment with innovative designs.

Despite the increasing interest in aquascaping, there remains a notable absence of user-friendly

smartphone applications dedicated specifically to this pursuit. This gap presents challenges for both novice and seasoned aquarists in accessing information and honing their skills, underscoring the necessity for educational resources in this field. The study seeks to address this gap by investigating existing information on aquascaping and developing a dedicated mobile application for simulated learning experiences. Through providing educational benefits and serving as a cost-effective platform for testing aquascape designs, the application aims to empower users to create vibrant and personalized underwater landscapes.

2. Materials and Methods

2.1 Methodology

The methodology for assessing this project will employ the ADDIE model, which encompasses analysis, design, development, implementation, and evaluation stages. Widely recognized in instructional design, the ADDIE model serves as a framework for creating successful designs. It aids instructional designers, material developers, and instructors in crafting efficient and effective teaching designs by following the ADDIE model's procedures. The ADDIE model is a valuable technique for guiding the development of instructional products [2]. This methodology offers a streamlined and focused approach, incorporating feedback loops for ongoing refinement and improvement (refer to Figure 1).

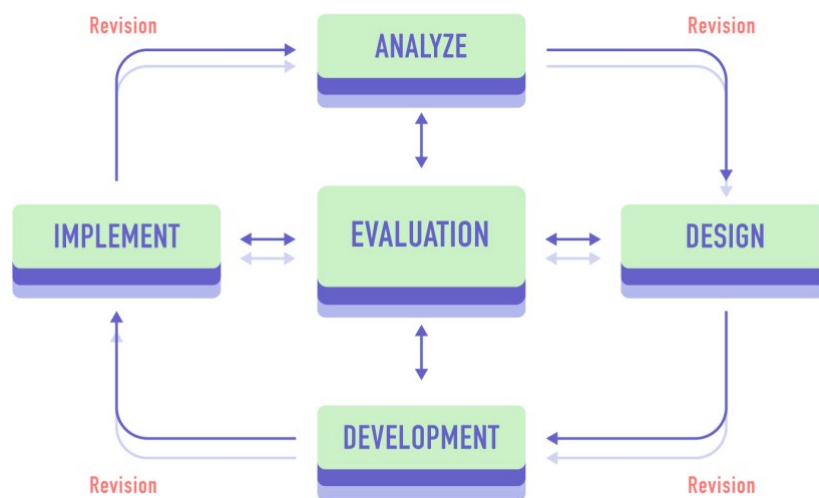


Figure 1: ADDIE Model

A) Analysis

The initial phase of the instructional design process is the analysis stage in the ADDIE model. Its purpose is to gather information and identify crucial elements that will influence the design and development of a training program. The developer conducted research on aquascaping and aquatic environments to determine learning objectives and requirements. After exploring suitable platforms for the project, the developer opted for a mobile application. The project's goal is to create a mobile app for aquascaping, providing users with a simulation for a new experience. The app translates aquascaping knowledge into a digital format.

To assess the mobile application's effectiveness, a simulation of aquascaping is presented to

engage users in a virtual experience. The target audience for the app includes young adults to the elderly, aged 17 and above, aiming to attract both new and existing aquascaping enthusiasts. The app serves as an educational tool for beginners, offering guidance on aquarium setup and maintenance, while experienced aquascapers can use it for planning and experimenting with new ideas. The analysis process revealed key findings such as project goals, problem description, target audience, and content. However, limitations were identified, including platform compatibility issues, as the mobile application is only available for Android users.

B) Design

In the design phase of the ADDIE model, the information gathered during the analysis phase is translated into a learning design. The importance of conducting the design process systematically and following a set of principles [3]. The data obtained in the analysis phase serves as input for the design phase, helping instructional designers choose effective instructional techniques and resources tailored to the learners [4].

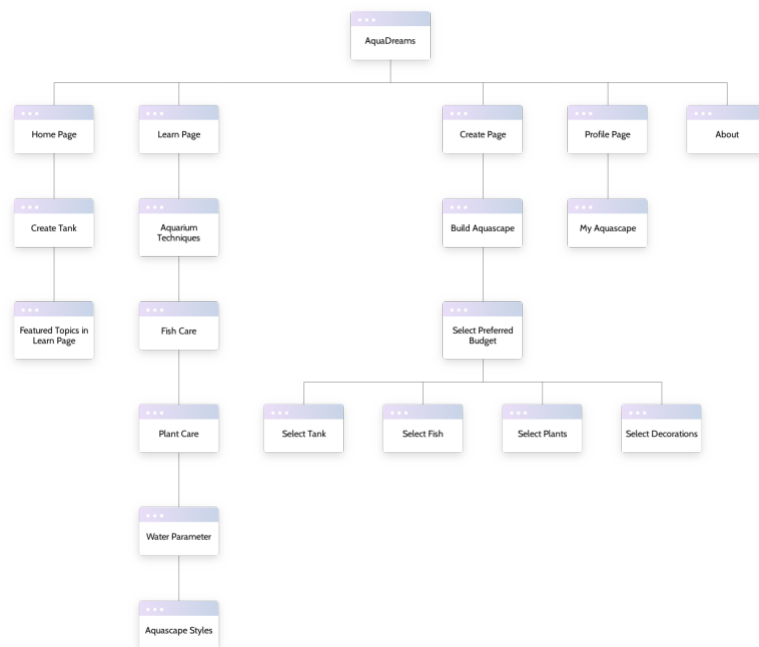


Figure 2: Site Map

A mobile app sitemap (refer to Figure 2) typically outlines the various screens and functionalities of the app, highlighting the sequential flow of screens and user interactions. This is essential because mobile applications generally follow a more linear and interactive structure compared to webpages.

The subsequent stage involves developing a storyboard (refer to Figure 3) and the wireframe for the application, which is a critical aspect of the design phase. By following this process, the AquaDreams mobile application aims to achieve an attractive and user-friendly interface, incorporating instructional materials, design tools, and aquarium simulation features. These design choices are intended to provide aquascape enthusiasts with a comprehensive and enjoyable experience, fostering their learning, creativity, and engagement.

Storyboard

Mobile Application: AquaDreams

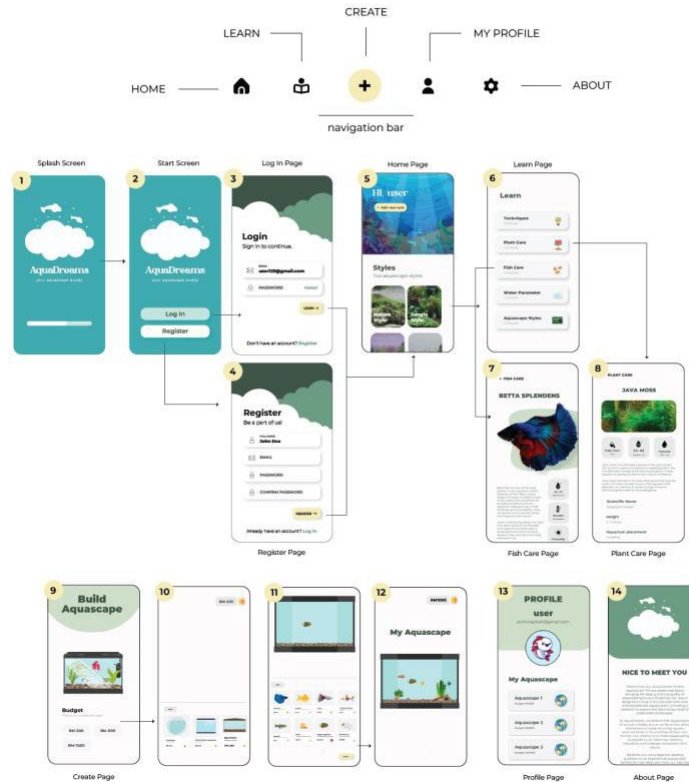


Figure 3: Storyboard

C) Development

The assets and resources identified in the earlier design phase are brought to life by developers during the development phase. After the planning and ideation stages, the development phase focuses on putting the plan into action. The interface and digital images are crafted using Adobe Illustrator, and the application development is carried out using the Unity development platform. The systematic process of developing, creating, and integrating the visual and interactive elements of a mobile application is referred to as interface design. This method aims to enhance the user experience by ensuring that the application is not only aesthetically pleasing but also functional and user-friendly.

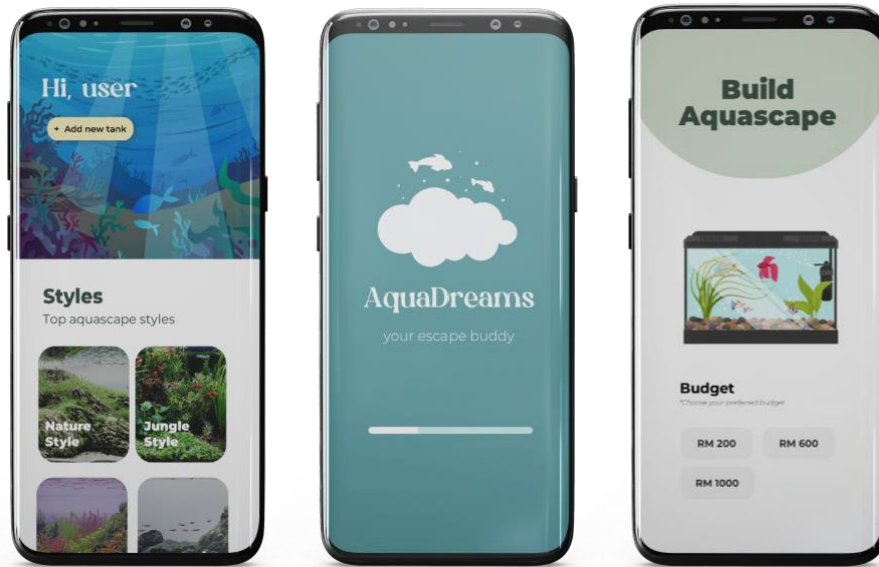


Figure 4: User Interface Design

Figure 4 displays the user interface of the AquaDreams application, developed on the Unity platform, encompassing tasks such as coding, constructing user interfaces, integrating multimedia elements, and ensuring overall functionality.

D) Implementation

In this stage, the developer translates the wireframe designed in Adobe Illustrator into actual code within the Unity software, utilizing the programming language C#. The completed application is then exported into an Android Package Kit (APK) file and pre-installed on smartphones. Testing is a crucial aspect of the implementation phase, and the use of alpha and beta testing can be beneficial.

Once the files are converted into an APK file, the application is uploaded to Google Drive to generate a link. Users can conveniently download the application directly to their mobile phones by scanning the QR code linked to this URL.

3. Results and Discussion

Following the data collection through the survey instrument, the next phase of this study involves a comprehensive and systematic data processing procedure. The quantitative data obtained from multiple-choice and rating scale items will undergo statistical analysis to determine the prevalence of specific viewpoints and experiences. Simultaneously, the qualitative data from open-ended questions will be examined to identify recurring themes and delve into detailed narratives.

3.1 Demographic

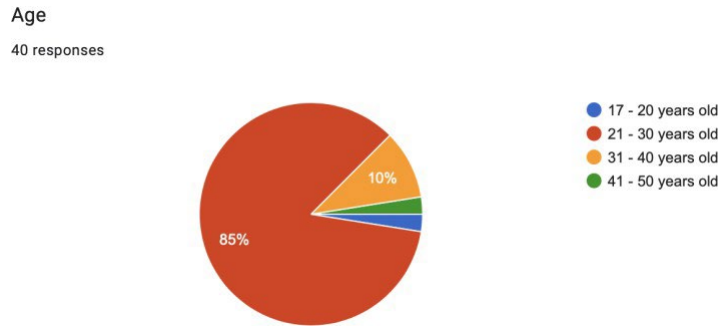


Figure 5: Participants' Age

The age categories are illustrated with different colors. The predominant segment, shown in red, comprises individuals aged 21-30, making up 85% of the total. The next significant segment, depicted in yellow, pertains to the age group 31-40, constituting 10%. The smaller segments, represented in green and blue, correspond to the age groups 17-20 and 41-50, with each accounting for 2.5% respectively.

3.2 Existing Knowledge and Experiences

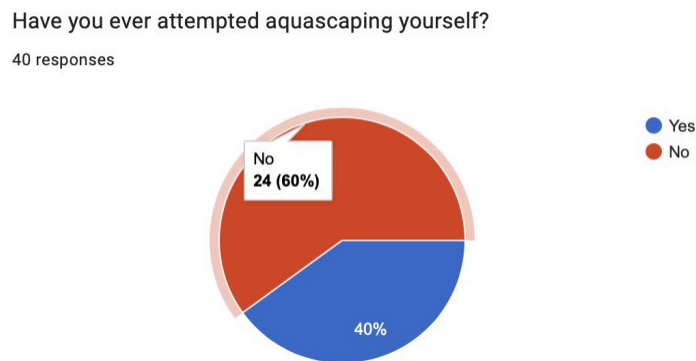


Figure 6: Participants' Familiarity of Aquascape

Figure 6 depicts respondents' responses when asked about their previous attempts at aquascaping. The results show that 60% answered in the negative, indicating no prior experience, while the remaining 40% have engaged in aquascaping before.

3.3 User Interaction

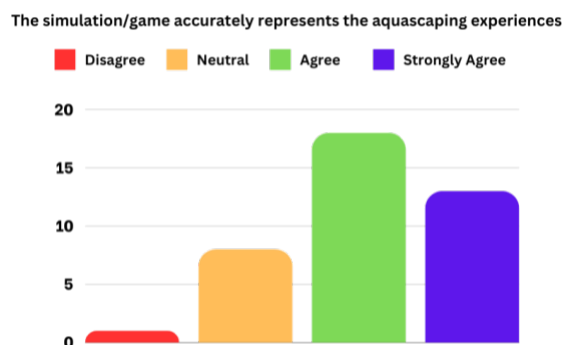


Figure 7: Accuracy of the application

In Figure 7, the chart illustrates the evaluation of the simulation/game features in the mobile application regarding their accuracy in reflecting actual aquascaping experiences. Specifically, 18 respondents agreed with the statement, and an additional 13 respondents strongly agreed. Eight respondents maintained a neutral stance, while the remaining participants disagreed with the statements.

3.3 Application Effectiveness

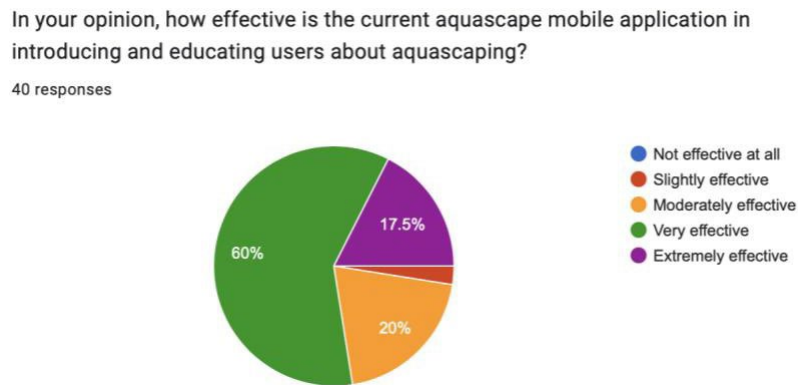


Figure 8: Effectiveness of the current application

In Figure 8, respondent opinions regarding the effectiveness of the current AquaDreams mobile application in introducing and educating users are displayed. A notable majority, comprising 60% or 24 respondents, agreed that the mobile application is very effective. Another 20%, totaling 8 individuals, believe it is moderately effective, while 17.5% (7 respondents) find it extremely effective. The remaining respondents opted for slightly effective.

4. Conclusion

The AquaDreams project has created and launched a mobile app to meet the needs of a diverse user base, spanning from young adults to the elderly. This app is immersive and engaging, thoroughly tested for optimal performance. The project's foundation is built on insights from the literature review. Successful outcomes, as demonstrated by the comprehensive survey results, indicate the project's achievement. The survey, carefully administered and analyzed, affirms the project's effectiveness. The instructional design model used was the ADDIE Model, known for its iterative stages of Analysis, Design, Development, Implementation, and Evaluation.

4.1 Contribution and Implication of Study

The study systematically contributes by identifying and addressing essential content for developing a mobile application dedicated to aquascaping, serving as a simulation tool for users to gain new experiences. The integration of Mobile Application technology enhances the efficiency of content delivery, bringing an innovative approach to aquascaping. This research adds value to the field by successfully creating a mobile application specifically designed for aquascaping beginners. The work establishes a practical framework for creating an engaging user experience, acting as an educational tool to enlighten users about aquascaping. Additionally, the simulation/game features in the mobile application significantly contribute by helping users enhance their knowledge and understanding of aquascaping within real-world constraints, including budget considerations.

4.2 Recommendations for Future Research

Building on the insightful findings from the AquaDreams Mobile Application research, it is recommended that future research should focus on specific aspects to deepen understanding and implementation. Developers are encouraged to concentrate on specific improvements to enhance the

overall functionality and user experience of the AquaDreams mobile application. Firstly, integrating animations during the aquascape tank-building process can enhance interactivity, and improving fish movement through animations is also advisable. Secondly, expanding the categories of tank sizes, types, and shapes, as well as including a broader range of fish and plant categories, is suggested based on feedback from respondents. Additionally, incorporating a QR code option to facilitate easy sharing of pre-existing aquascapes among fellow enthusiasts is recommended. These enhancements can further enhance the user experience and contribute to the effectiveness of the AquaDreams application in the aquascaping community.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

NAGA the Tasik Chini Dragon

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Abstract: This research addresses the underrepresentation of Malaysian folklore in the gaming industry through the development of a 2D platform game based on the lesser-known myth of the Naga Tasik Chini. Despite the popularity of 2D platform games since the 90s, the narratives of Naga Tasik Chini have often been overshadowed by more widely recognized folklore stories in Malaysia. The objective was to create a captivating PC and mobile game that imparts the cultural significance and moral values associated with the Naga Tasik Chini myth, appealing to both children and adults in alignment with Malaysian values. The study encompassed the comprehensive development of the game, emphasizing User Interface (UI), User Experience (UX), gameplay, game design, environment, and narrative. Utilizing Unity, Adobe Illustrator, and Adobe Photoshop, the 2D game was tailored for Android users, with the Game Development Life Cycle (GDLC) model guiding the methodology to ensure a systematic approach to game creation. In evaluating the completed game, assessments were conducted among selected target audiences aged 6-12 and adults aged 12-25, primarily college students. The findings highlighted the game's effectiveness in conveying Malaysian history and cultural values, providing an interactive and educational gaming experience. This research significantly contributes to the limited pool of games incorporating Malaysian folklore, paving the way for future developments in preserving and disseminating cultural heritage through gaming. Suggestions for future work involve expanding the scope of folklore-based games and further refining game elements to enhance the overall gaming experience, thus setting a precedent for fostering a deeper connection between gaming and cultural preservation

Keywords: Malaysian folklore, Naga Tasik Chini, game development, GDLC, cultural heritage, Malaysian Values, interactive storytelling

1. Introduction

The gaming industry has long been a medium for storytelling and entertainment, yet it has often overlooked the rich tapestry of Malaysian folklore. Despite the popularity of 2D platform games since the 1990s, Representation of diverse cultures and backgrounds has been a long-standing issue in the gaming world, with many games portraying only the mainstream culture[1]. narratives rooted in Malaysian culture have remained underrepresented . This underrepresentation prompted the development of "Naga Tasik Chini," a 2D platform game that seeks to bridge this gap by immersing

players in the lesser-known myth of the Naga Tasik Chini. The Naga Tasik Chini myth, deeply entrenched in Malaysian folklore, presents an opportunity to explore and preserve the cultural heritage of Malaysia. By integrating this myth into a captivating gaming experience, this project aims to address several key motivations, Mythical creatures, legendary heroes, and evergreen moral values that are embedded in our very history and upbringing [2].

The primary motivation is to create a digital platform that not only entertains but also educates players about valuable life lessons [3]. Through the narrative of Naga Tasik Chini, players will embark on a journey that combines historical context with engaging gameplay, fostering a deeper appreciation for Malaysia's rich cultural tapestry. Furthermore, the project aims to fill the void in the gaming industry regarding representations of Malaysian folklore, contributing to the preservation and dissemination of cultural heritage in a digital age, In the digital era, safeguarding cultural heritage has become a vital concern. [4].

1.1 Research questions

The research questions revolve around understanding the effectiveness of "Naga Tasik Chini" in conveying Malaysian history and cultural significance. The goal is to explore how the game integrates Malaysian folklore with gameplay mechanics to engage players of different ages and backgrounds., The aim to assess the players to evaluate the impact of video games on culture [5].

1.2 Problem statements

The problem of underrepresentation of Malaysian folklore in the gaming industry poses a challenge to cultural preservation efforts. Without adequate representation, there is a risk of cultural erosion and loss of identity among younger generations. Serdeczny et al. (2018) argues that the loss of cultural heritage has been observed to 'correlate with loss of social cohesion and a decreasing resilience to climate change [6]. "Naga Tasik Chini" endeavors to tackle this problem by providing a platform for the preservation and promotion of Malaysian cultural heritage in an interactive and accessible format.

1.3 Objectives

The objectives of this project are twofold: firstly, to develop a captivating 2D platform game centered around the Naga Tasik Chini myth, and secondly, to evaluate the game's effectiveness in conveying Malaysian history and cultural values. History games will benefit from this systematic review and analysis of current educational history games [7]. By achieving these objectives, we aim to set a precedent for future developments in preserving and disseminating Malaysian folklore through gaming.

1.4 Expected outcome

The expected outcome of "Naga Tasik Chini" is to offer players an immersive and educational gaming experience that not only entertains but also enriches their understanding of Malaysian culture. By engaging with the myth of Naga Tasik Chini, players will develop a deeper connection to Malaysian folklore and heritage, thereby contributing to the ongoing efforts of cultural preservation.

2. Materials and Methods

The strategies of this research are going to be mentioned in this chapter. There'll even be an outline of the product's restrictions and limitations. The project to be accomplished is creating a Naga Tasik Chini 2D platform game. The target demographic for the initiative is young adults and adults. To be successful, the project would just use a software system. A budget is needed to shop for the mandatory software system, like a portable computer, as well as some Adobe software and some assets at Unity that i need.

2.1 Materials

In this section, the specifications and properties of materials, equipment, and other resources used in the development of the Naga Tasik Chini 2D platform game will be described.

- Software:
 - i. Purchase of licenses for Unity game engine.
 - ii. Acquisition of Adobe Creative Cloud subscription for access to Adobe Illustrator and Adobe Photoshop
- Hardware:
 - i. Procurement of a high-performance laptop capable of running game development software smoothly
- Unity Assets:
 - i. Allocation for purchasing additional assets from the Unity Asset Store to enhance the visual and interactive aspects of the game.

2.2 Methods

This chapter will outline the research strategies, discuss the limitations of the product, and detail the project's focus: creating a 2D platform game called Naga Tasik Chini. The target audience includes young adults and adults. The project will rely solely on software, requiring a budget for purchasing necessary items such as a laptop, Adobe software, and Unity assets.

2.3 Methodology

The project relies on a limited set of planned methods and conclusions to achieve its goals. The chosen analysis method aims to ensure the study's success and meet the audience's expectations by producing high-quality results. This is the example of the Addie model :

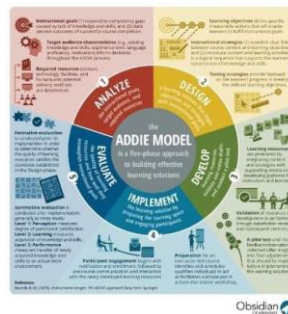


Figure 1 Addie Model

3. Results and Discussion

In this chapter, the outcomes of the research are discussed, focusing on the creation of an engaging 2D platform game called "Naga Tasik Chini." The aim is to explore effective game development methods, with a focus on providing a captivating gaming experience rooted in the Naga Tasik Chini narrative. Each research objective, from identifying development strategies to evaluating player engagement, is systematically addressed in subsequent sections. The analysis presents quantitative data collected through various methods, highlighting the success and impact of the Naga Tasik Chini game.

3.1 Results

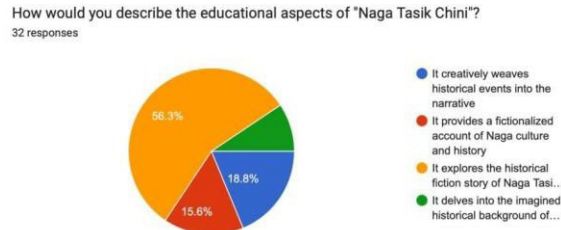


Figure 2 Evaluation of Naga Tasik Chini Game

Figure 2 aims to understand the perceived educational aspects of "Naga Tasik Chini." The responses show varying opinions. The majority of participants (56.3%) chose the yellow option, indicating that they believe the game explores the historical fiction story of Naga Tasik Chini. A significant portion (18.8%) chose the blue option, suggesting that the game creatively incorporates historical events into the narrative. The red option, stating that the game provides a fictionalized account of Naga culture and history, was selected by 15.6% of participants. Interestingly, the green option, suggesting the game explores the imagined historical background of Naga Tasik Chini, received no votes.

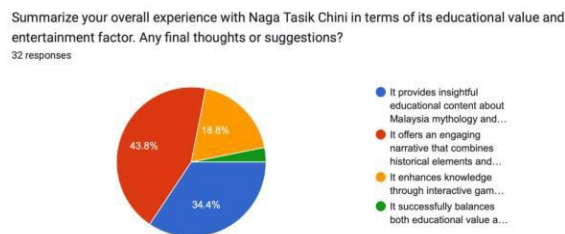


Figure 3 Evaluation of Naga Tasik Chini Game

In response to figure 3, participants shared insights into their experience with "Naga Tasik Chini," focusing on its educational value and entertainment. The majority (43.8%) found the game's narrative engaging, blending history with entertainment (red option). Additionally, a significant portion (34.4%) appreciated its educational content about Malaysian mythology and culture (blue option). Another group (18.8%) recognized the game for enhancing knowledge through interactive gameplay and storytelling (yellow option). Interestingly, no one selected the green option, indicating the game successfully balances education and entertainment, as per participant feedback. Overall, responses reflect positivity towards "Naga Tasik Chini," with participants praising its engaging narrative and educational content.

3.2 Discussions

In the context of the project "Naga Tasik Chini," the findings demonstrate the successful achievement of the research objective: developing an engaging 2D platform game based on the narrative of Naga Tasik Chini. Feedback from participants through various survey questions provides valuable insights into the game's reception and impact. The responses confirm that "Naga Tasik Chini" effectively delivers an enjoyable gaming experience, with positive feedback on enjoyment, educational aspects, user interface, and character design, engaging players and staying true to its narrative. The incorporation of historical and cultural elements resonates positively with the audience. Favorable ratings on recommending the game and intentions to replay it highlight its potential for broader appeal and sustained player interest, contributing to its overall success in meeting the research objective. In

summary, the feedback indicates that "Naga Tasik Chini" not only achieves its primary goal but also promises further impact as an entertaining and culturally rich gaming experience. Its positive responses emphasize its significance in providing an engaging platform for players and exploring the narrative of Naga Tasik Chini.

4. Conclusion

In summary, the evaluation of the 2D platform game "Naga Tasik Chini" confirms the successful achievement of the research objective: creating an engaging game based on the narrative of Naga Tasik Chini. The game effectively provides an enjoyable experience, with positive feedback on enjoyment, educational content, user interface, and character design. Player participation and responses demonstrate the game's ability to captivate its audience, suggesting broader appeal and continued interest. However, acknowledging limitations is important for future development. Strategies to enhance outreach, such as through social media and collaborations, should be prioritized. Despite challenges, iterative design processes, like the ADDIE model, have refined the game based on user feedback. Continuous improvement and exploration of emerging technologies are recommended for future developers to sustain innovation and relevance. "Naga Tasik Chini" represents creative efforts contributing to cultural and entertainment landscapes.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Orang Lidi: A Malay Mobile-Based Application

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Abstract: Orang Lidi is an innovative educational mobile application that uses an engaging and interactive learning experience to help primary and secondary school students improve their Malay vocabulary. Students, particularly in primary and secondary schools, frequently struggle with traditional ways of studying Malay proverbs, resulting in a lack of interest and skill in the topic. The fundamental goal of Orang Lidi is to instil in students an interest in studying and appreciating Malay proverbs in the classroom. Preliminary studies showed a considerable rise in students' engagement levels and improvement in the Malay language. Students were more enthusiastic about learning Malay proverbs in a game environment than in a typical classroom setting. Orang Lidi not only addresses the lack of Malay word games but also helps to preserve the language. The application makes the Malay language more interesting and accessible to younger generations by incorporating interactive gameplay and exposure to a diverse selection of proverbs. Finally, Orang Lidi is a novel way to teach Malay proverbs by leveraging mobile game technology to provide a scalable and effective answer to long-standing educational challenges. Orang Lidi, with its fascinating characteristics and emphasis on language preservation, helps to improve Malay language competency and promotes a newfound passion for the language in students.

Keywords: Mobile Game, Malay Proverbs, Idioms, educational interactive learning.

1. Introduction

Most of Malaysian schools require students to study Malay as a form of communication. Meanwhile, national-type and government-aided schools use other languages as their principal language, such as English, Mandarin, or Tamil. The Malay language is also used as the major language of instruction in most schools. As a result, pupils begin to learn Malay in primary school.

Learning Malay literature is essential, especially for those who want to improve their writing and communication skills. Wilkins (1972) observed, "Without grammar, very little can be conveyed; without vocabulary, nothing can be conveyed." The easiest way to learn Malay literature is in a relaxed and entertaining environment. Traditional methods of learning, however, are ineffective since Malay literature has a diverse syllabus, making it complicated for students to become interested in learning Malay literature. Furthermore, students lose interest in the Malay language because the learning process bores them due to the subject's excessive material (Jalaluddin, Kasdan, & Ahmad, 2010). As a result, to develop students' enthusiasm for learning Malay, it is critical to establish an engaging environment with distinctive but basic gameplay.

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Learning and comprehending the meanings of proverbs in detail aims to improve students' linguistic skills (Md Nasir & Subet, 2023). Students' language skills can be measured by their ability to apply proverbs in learning activities. Therefore, if the students use accurate and appropriate proverbs, their essays will be more aesthetic and of high quality, indicating that the students have highly developed language skills ((Hamzah & Hassan, 2011; Hassan & Jaafar, 2016; Jalaluddin & Kasdan, 2010; Jalaluddin & Nopiah, 2011; Musanif et al., 2011).

2. Methodology

This study developed a mobile game application named Orang Lidi. Figure 1 shows the overall system flow for Orang Lidi, which illustrates the system's functions and the flow for each user. This application was developed using Flutter, Dart language, Android Studio, and Firebase on a laptop and deployed on a smartphone.

The Orang Lidi game application has a few modules as follows:

- i. Administrator
 - a. Login – This module is for the administrator to log in to access the application.
 - b. Game – This module is for the administrator to manage the game.
 - The administrator can view game level and category.
 - The administrator can add, view, update and delete games in each category.
 - c. Issue – This module is for the administrator to manage issues reported by players.
 - The administrator can view and delete issues reported by players.
- ii. Player
 - a. Registration and login – This module is for the player to create an account and log in to access the application.
 - b. Profile – This module is for the player to update their username and profile picture.
 - c. Game – This module is for the player to play the game.
 - The player can view the game guide and select game level, category, and mode.
 - The player can play games in each category, view answer, and retry the game.
 - d. Score – This module is for the player to view player ranking and their score for each category.
 - e. Issue – This module is for the player to report issues relating to the application.

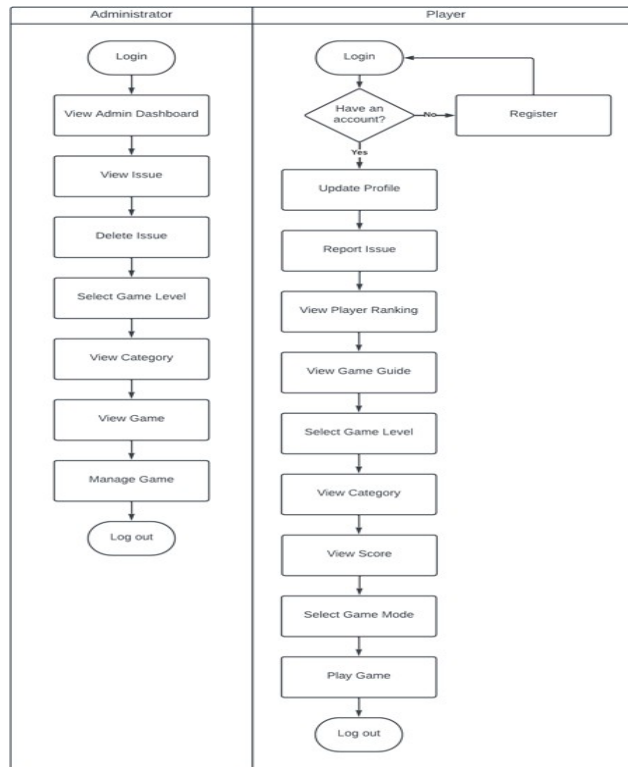


Figure 1 Orang Lidi mobile application system flow

3. Prototype of Orang Lidi Game Mobile Application

The development prototype of the Orang Lidi game mobile application user interface is constructed based on the system flow as shown in Figure 1. The user interface features of the Orang Lidi word game mobile application are shown in Table 1 to Table 3.

Table 1 shows the administrator's interface which include the front page, login page, dashboard page, issue page and add game page.






 <p>a) Front page</p>	 <p>b) Login page</p>	 <p>c) Dashboard page</p>	 <p>d) Issue page</p>	 <p>e) Add game page</p>
<p>This is the front page for the administrator and player.</p>	<p>This is the login page for the administrator and player.</p>	<p>This is the administrator dashboard page when logged in.</p>	<p>This is the issue page for the administrator.</p>	<p>This is the add game page for the administrator.</p>

Table 1 Orang Lidi administrator interfaces

Table 2 shows the game details page, delete game page, home page, update profile page, and report issue page.






 <p>f) Game details page</p>	 <p>g) Delete game page</p>	 <p>h) Player home page</p>	 <p>i) Update profile page</p>	 <p>j) Report issue page</p>
<p>This is the game details page for the administrator.</p>	<p>This is the delete game page for the administrator.</p>	<p>This is the player's home page when logged in.</p>	<p>This is the updated profile page for the player.</p>	<p>This is the player report issue page.</p>

Table 2 Orang Lidi player interfaces

Table 3 shows the player ranking page, game category page, game mode page, gameplay page, and victory page.

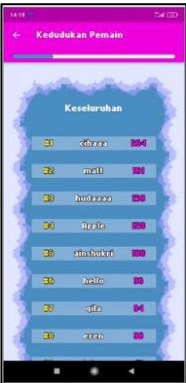
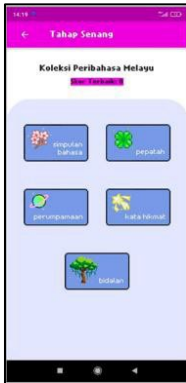
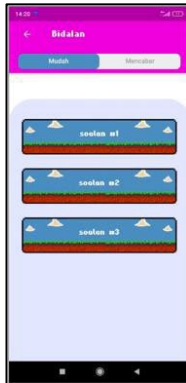


 <p>k) Player ranking page</p>	 <p>l) Game category page</p>	 <p>m) Game mode page</p>	 <p>n) Gameplay page</p>	 <p>o) Victory page</p>
<p>This is the player ranking page which displays the total score for each player.</p>	<p>This is a game category page where players can also view their scores.</p>	<p>This is a game mode page where players can choose between easy or challenge modes.</p>	<p>This is a game play page for the player.</p>	<p>This is the victory page when the player wins the game.</p>

Table 3 Orang Lidi player interfaces

4. Conclusion

This study discovered that the Orang Lidi mobile app is a useful tool for supporting students in learning Malay literature. The tool could overcome the constraints of traditional Malay learning techniques by including interactive games and offering significant exposure. The study's major findings

indicate that the gamified approach assists students of all ages by enhancing their language ability while encouraging a pleasant and engaging learning experience. In the future, this study intends to investigate additional features such as multiplayer capability and the incorporation of many gameplay options to improve the user experience when using the application. To summarise, Orang Lidi not only meets but exceeds the initial aims. This study makes a substantial and valuable contribution to the discipline by proposing a new and effective strategy for language learning.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

The Fire Escape: Virtual Fire Drill Training

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Abstract: Virtual Reality is a simulated environment is created using computer technology. It creates a synthetic, computer-generated world that let people explore through experience. People can learn using immersive learning tools like VR, all from a safe and secure setting. Virtual fire drills training with VR is developed to increase fire activities training to people with various fire scenes. Fire drills play a significant role in assuring emergency preparation as they intended to streamline evacuations in the event of a fire emergency or other prevention of danger. The goal of this project is to develop an interactive virtual fire safety training by using Virtual Reality. Furthermore, this project can be used to evaluate an effectiveness of the Fire Escape as a method to increase public awareness of the need for fire drills. The reasons of the fire breakouts include "human factors," such as ignorance, carelessness, or a basic lack of fire safety awareness. They have limited access to source of knowledge about handling fire outbreaks due to lack of enforcement of fire drill training by management. Moreover, this study uses the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model, which is a well-known instructional design framework, to find a fun and successful way to help UniKL MIIT Staffs to learn about fire drill training. The development of the project using ADDIE model makes sure that people and 3D objects can interact somatosensorily in a virtual simulation environment. The components, software and gear of the proposed platform are explained, including 3D modelling creation with Unity 3D, Blender and Meta Quest 2. Thus, virtual fire drills training is proposed to spread awareness about the importance and give a big impact to all UniKL MIIT Staffs. From this project, it is expected that incorporating Virtual Reality (VR) into fire safety training at UniKL MIIT will help staff be better prepared, more aware, and equipped with practical skills, making the environment safer and more resilient.

Keywords: Virtual Reality (VR); fire drill training; The Fire Escape

1. Introduction

This chapter will explain on developing an interactive virtual fire safety training by using Virtual Reality (VR). This initiative is created specifically for UniKL MIIT staffs as it can be a platform to spread awareness about the importance of fire drill training. VR has shown itself to be an important tool for training in various fields thus, the effectiveness of The Fire Escape project using VR will be carrying out. Next, this chapter will highlight the issue and problem that inspired the author to carry out this project, as well as the research objective, research question, scope, project limitation, and this chapter's conclusion.

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1.1 Research Background

As this is a relatively new technique to training in the field, it is crucial to thoroughly observe and comprehend the essential factors that might affect how this kind of education is evaluated, accepted, and effective [1]. The Fire Escape: Virtual Fire Drill Training using Virtual Reality (VR) will offer an adventure of virtual fire drills with an objective of establishing exact smoke environment for effective and useful virtual training. UniKL MIIT has been chosen as the platform for this study and will be focused more on UniKL MIIT staffs.

1.2 Problem Statement

"Human factors," such as ignorance, carelessness, or a simple lack of fire safety awareness, cause fire outbreaks. The most effective method to raise public awareness and prevent fire events is through the development of VR applications [2]. They are not well educated in handling fire outbreaks as they have limited access to sources of knowledge about it. With all information provided in the project, it can help the targeted users to gain knowledge as VR is widely recognized for its effectiveness in teaching essential skills related to fire drills [3]. Annual fire drills are crucial for emergency because they increase staff awareness of fire hazards and their ability to respond quickly to them [4].

1.3 Objectives

The objectives of this project are twofold: firstly, to expose a new method of training about fire safety; secondly, to develop a virtual fire safety training using virtual reality technology; and thirdly, to evaluate the usability of The Fire Escape as a method for creating awareness among UniKL's Staff about fire drill training.

1.4 Expected Outcome

The anticipated outcome of "The Fire Escape" is to provide users with an immersive and instructive virtual reality experience that goes beyond mere entertainment, enhancing their comprehension of fire safety protocols. Through interaction with The Fire Escape, users will cultivate a heightened awareness of fire safety practices, contributing to the broader goal of fostering a culture of safety and preparedness within UniKL MIIT and the wider community.

2. Materials and Methods

In this chapter, we will outline the research strategies employed and discuss the limitations and constraints of the project. The primary objective is the development of The Fire Escape, a virtual reality fire safety training program. The target audience for this initiative is UniKL MIIT staff members. To execute this project effectively, specific software and hardware resources will be required. A budget allocation will be necessary for acquiring essential software licenses, such as Unity for game development and Adobe Creative Cloud for design purposes. Additionally, procurement of a high-performance computer capable of handling VR development tasks will be essential.

2.1 Materials

This section will outline the specifications and properties of the materials, equipment, and other resources employed in crafting The Fire Escape virtual reality training program.

- Software

- i. Acquisition of licenses for Unity game engine to facilitate the development of The Fire Escape virtual reality training program.
 - ii. Procurement of an Adobe Creative Cloud subscription for access to essential design tools such as Adobe Illustrator and Adobe Photoshop.
- Hardware
 - i. Purchase of a high-performance PC or Laptop suitable for running VR development software smoothly, ensuring efficient development of The Fire Escape.
 - Main Hardware
 - i. Acquisition of Meta Quest 2 hardware to enable testing and optimization of The Fire Escape virtual reality training program.

2.2 Methods

In this chapter, we will delineate the research methodologies, address the constraints of the project, and elucidate the primary objective: developing The Fire Escape virtual reality training program. The intended audience comprises students and staffs of UniKL. The project will predominantly utilize software resources, necessitating a budget allocation for essential items such as a PC, Adobe software subscriptions, and Meta Quest 2 Hardware.

2.2 Methodology

This chapter outlines our project's methodology, focusing on the ADDIE model, a structured approach to instructional design. The study, "The Fire Escape: Virtual Fire Drill Training Using Virtual Reality (VR)," targets UniKL MIIT staff. We used questionnaires for quantitative data collection. The ADDIE Model, with its phases of Analysis, Design, Development, Implementation, and Evaluation, guides our systematic approach throughout the project's development.



Figure 1: Addie Model

3. Results and Discussion

In this chapter, we'll look at the evaluation summary and what we've learned from the testing phase. After completing the planning and development stages in "The Fire Escape" project, the next critical step was to test the application thoroughly. Our goal was to make sure that the features and user interface are suitable for the end user. To do this, we distributed questionnaires and collected data after the design and development work was finished. This evaluation process is essential for refining and improving the project based on user feedback and experiences.

3.1 Results

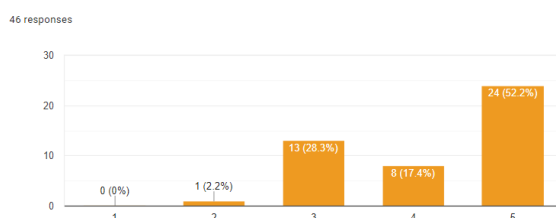


Figure 2: Evaluation of The Fire Escape

The question is “I think that I would like to use this Virtual Reality frequently”. Based on the findings presented in Figure 2, it appears that there is a considerable inclination towards the frequent utilization of Virtual Reality (VR) among the participants. Specifically, the data reveals that the majority of respondents, totaling 32 individuals, exhibit a strong preference for frequent engagement with VR, accounting for approximately 69.6% of the surveyed sample. Conversely, a smaller subset of respondents, comprising 14 individuals or approximately 30.5% of the participants, express a neutral stance regarding the utilization of VR.

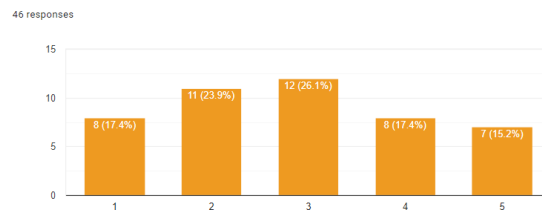


Figure 3: Evaluation of The Fire Escape

The question is “I felt that using the Virtual Reality system was a bit complicated”. Figure 3 presents insightful data regarding the perceived complexity of utilizing the Virtual Reality (VR) system among the surveyed participants. Upon analysis, it becomes apparent that there exists a range of perspectives on this matter. Specifically, the findings indicate that 15 respondents, constituting approximately 32.6% of the participants, perceive using the VR system as somewhat complicated. In contrast, a notable portion of the respondents, comprising 12 individuals or approximately 26.1% of the sample, adopt a neutral stance regarding the complexity of VR usage. Furthermore, the data reveals that a total of 19 respondents express disagreement with the statement, suggesting that they do not find using the VR system to be complex. These diverse responses underscore the varied perceptions and experiences regarding the complexity associated with VR technology. While a significant portion of participants acknowledge a certain level of complexity in utilizing VR, others hold differing opinions.

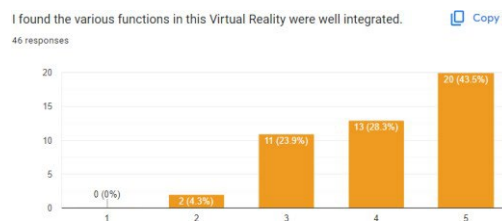


Figure 4: Evaluation of The Fire Escape

The question is “I found the various functions in this Virtual Reality were well integrated”. Based on Figure 4, a significant majority of participants, totaling 33 and representing 71.8%, affirm that they observe the various functions in the Fire Escape project as well integrated. In contrast, 11

respondents, comprising 23.9%, maintain a neutral stance regarding the integration of project functions. Furthermore, a total of 2 respondents' express disagreement with the idea that the functions are well integrated. In conclusion, a significant majority of participants, constituting 71.8%, perceive the Fire Escape project's various functions as well-integrated. This positive response from the majority suggests that the project has effectively incorporated its functions, indicating a favorable reception among participants.

3.2 Discussions

The Fire Escape VR project plays a pivotal role in emphasizing the critical importance of well-established fire escape procedures to enhance overall campus safety. By harnessing the capabilities of Virtual Reality (VR) technology, users are provided with immersive experiences that effectively simulate various emergency scenarios. This approach not only offers a risk-free learning environment but also ensures consistency and cost-effectiveness in training procedures. The immersive nature of this VR-based learning experience is designed to foster a heightened sense of realism, allowing individuals to engage with emergency situations in a virtual setting. This, in turn, contributes to the development of more resilient and innovative individuals within the domain of fire safety technologies. Through this innovative approach, The Fire Escape VR project aims to revolutionize fire safety education, creating a more informed and prepared community within the Virtual Reality world of technologies.

4. Conclusion

In conclusion, the journey of developing The Fire Escape VR project has been a tremendous learning experience. This project became a crucible of new knowledge and skills, pushing the boundaries of our understanding and competence. Collaboration with UniKL safety officers and relevant departments emerged as a critical turning point, ensuring that the project aligned seamlessly with the existing safety protocols and guidelines. Looking forward to the project's success opens avenues for collaboration with other UniKL campuses, fostering a culture of shared insights and best practices in safety education. The incorporation of realistic environmental factors, such as weather effects and time of day, becomes a pivotal next step, elevating the project's realism and relevance. Lastly, as this chapter comes to an end, there's a sense of bittersweet closure. The journey of The Fire Escape using Virtual Reality project has been both challenging and rewarding.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

VR “GASING”: A Traditional Game In Virtual Reality

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Abstract: Traditional games hold significance within the Malay community as they represent customs, culture, and identity. However, the advent of technology has led to a decline in their popularity. This study aims to explore the potential of Virtual Reality (VR) in reintroducing traditional games to the younger generation, focusing on "Gasing." Unlike modern spin-top games, "Gasing" differs in appearance, materials, and production. The study follows the ADDIE model stages: Analysis, Design, Develop, Implement, and Evaluate, ensuring a systematic development process. VR "Gasing" will be created using the Unity 3D engine. Its effectiveness will be evaluated through a survey among young participants at Universiti Kuala Lumpur (UniKL), assessing their engagement, interest, and cultural connection. Preserving traditional games is crucial for heritage recognition, and this research aims to leverage VR technology for this purpose. VR "Gasing" has the potential to revive interest in this aspect of Malay culture, ensuring its continuity. The survey results indicate that over 90% of respondents view VR "Gasing" as an effective medium for introducing traditional games in VR, indicating its potential success in preserving and revitalizing Malay cultural heritage.

Keywords: virtual reality, cultural heritage, traditional game, “Gasing”, preservation

1. Introduction

Virtual Reality (VR) refers to a computer-generated environment that simulates physical presence in real or imagined worlds. VR is the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence [1] Virtual” Gasing” Traditional game in VR develop in immersive virtual reality (VR). Immersive VR aims to completely immerse the user, giving them the impression that they are in a virtual environment.

Traditional games are an invaluable cultural heritage of the Malay community. This is because traditional games symbolize the customs, culture, and identity of a nation. Gasing originally comes from the state of Kelantan Traditional games are also played during leisure time. Traditional games are popular among the Malay community such as *Batu Seremban*, *Congkak*, *Galah Panjang*, *Gasing*, *Guli*, *Ceper*, and *Wau*. *Gasing* is a well-known Malay traditional heritage game. For this project, the traditional game "Gasing" was selected.

1.1 Problem Statement

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Despite their profound significance in cultural heritage, traditional games are increasingly disregarded, particularly among younger generations, as modern entertainment options hold greater appeal. This shift towards digital pastimes, driven by technological advancements, poses a significant threat to the preservation and appreciation of traditional games. According to Mohd Nasir Ismail, a teacher, individuals born in the 2000s lack familiarity with folk games because they were not introduced to these activities at a young age [2]. Due to technological advances, traditional games have become less popular among younger generations, especially as today's youth have grown up with game consoles, computers, and electronic gadgets [3]. Additionally, tablets and mobile phones have become popular gadgets among the younger generation due to their small size, light weight, interactivity, and portability.

1.2 Research Question

1. To study the immersive technology among the target audience.
2. To develop Virtual Gasing Traditional Game in Virtual Reality (VR).
3. To evaluate effectiveness the medium Virtual Reality (VR) to introduce the game of gasing. traditional games to the new generationnd the second level.

2. Materials and Methods

This chapter provides an overview of the methodology that will be used to develop the application Virtual “Gasing” Traditional Game via Virtual Reality (VR) feature. the methodology serves as a guiding framework to ensure a smooth progression within the specified timeline.

2.1 Research Methodology

This research investigates the attitudes and perceptions of the young generation towards VRGASING: A Traditional Game of Spinning Top in Virtual Reality,' utilising a quantitative survey research method conducted with 51 respondents among the young generation. Surveys have been conducted to collect data on respondent’s attitudes, behaviours, or perceptions. The survey includes closed-ended questions with Likert scales. The ADDIE model, utilized for developing this application, comprises Analysis, Design, Development, Implementation, and Evaluation stages. Through comprehensive analysis and evaluation in each phase.

2.2 ADDIE Model

A. Analysis

The Analysis phase of the ADDIE model involves gathering information about the project's goals, target audience, learning objectives, and technical requirements. Review existing content related to traditional gasing gameplay, including historical context, cultural significance, and gameplay mechanics. Determine how elements of traditional gameplay can be seamlessly integrated into the VR environment while maintaining authenticity and engagement. Analysis of existing VR gaming platforms, traditional gasing gameplay mechanics, and user experiences. Identify emerging trends, competitor offerings, and opportunities for innovation within the VR gaming landscape.

B. Design

The Design phase, the instructional and visual design of the VR experience is planned. This includes defining the overall structure, storyboard, user interactions, and learning activities within the VR environment. Designing for VR requires careful consideration of spatial design, user interface, navigation, in adobe illustrator Additionally, considerations were made for user interface design, ensuring an intuitive and immersive experience for players.



Figure 1: Site Map

C. Develop

During the Development phase of a VR project, the focus is on translating design specifications into a fully functional VR application. This involves tasks like creating 3D models and environments, programming interactions, and integrating audiovisual elements. Designers use software tools like Blender to craft detailed 3D models, which are then enhanced with lighting and shading for realism. Programmers write code to enable interactions like object manipulation and movement controls, ensuring a seamless user experience. Integration of audio and visual assets, including music and visual effects, enhances immersion in the virtual world.

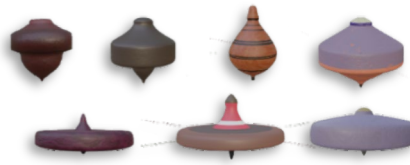


Figure 2: 3D Gasing Model

D. Implementation

During the Implementation phase, attention is given to meeting the hardware requirements necessary for smooth operation of the VR application. This involves ensuring compatibility with various VR devices such as headsets, controllers, and tracking systems. Furthermore, specifications for computer hardware, including CPU, GPU, RAM, and storage, are evaluated to ensure optimal performance of the VR experience. The VR application is then deployed and made accessible to the target audience, facilitating interaction with the environment. This may entail distributing the application through VR platforms or setting up VR hardware for user access.

E. Evaluate

The Evaluation phase focuses on assessing the effectiveness and impact of the VR application. It involves gathering user feedback, conducting usability testing, and evaluating the achievement of learning objectives. The data collection took place within the UniKL MIIT lobby, which provided insightful information about VRGasing: A Traditional Game of Spinning Top in Virtual Reality.

3. Results and Discussion

Implementation of the product involved delivering the VR Gasing application to selected participants for testing purposes. Testing the product was crucial to evaluate its functionality, usability,

and overall effectiveness in achieving the project's objectives. The testing process involved selecting a group of participants, primarily UniKL MIIT students, these 51 participants were chosen to represent the target demographic of the application.

3.1 Results

This research presents the findings and discusses a detailed analysis of the responses obtained from a specific group of participants, primarily consisting of students from Universiti Kuala Lumpur (UniKL) at the MIIT campus. A total of 51 UniKL MIIT students participated in the research. Data collection was conducted in the lobby of UniKL MIIT, offering valuable insights into VRGasing: A Traditional Game of Spinning Top in Virtual Reality. A survey is carried out it have been concluded that more that 90% of respondents agree that VR” Gasing” is effective medium to introduce traditional game in Virtual Reality.

3.2 Discussion

The tools used for administering the questionnaires included Google Forms or other similar online survey platforms, which allowed for easy distribution and collection of responses. Once the questionnaires were completed by participants, the responses were processed and analysed to extract meaningful insights. Quantitative data was analysed using statistical methods to calculate averages, frequencies, and correlations, providing a quantitative measure of user satisfaction and experience.

3.3 Table

Table 1: Is the medium Virtual Reality (VR) effective.

Yes and no	Total of Respondent
Yes	94.1%
No	5.9%

Table 1, Number The survey results the response, with 94.1% agreement from 51 participants, provides a compelling insight into the effectiveness of VR as a medium. VR is renowned for its ability to create immersive experiences, transporting users to virtual environments. The high agreement suggests that the medium successfully achieved this immersive quality, contributing to its perceived effectiveness. Consider exploring whether participants found VR effective not only for entertainment but also for educational or experiential purposes. Understanding the diverse applications of VR can provide deeper insights. The positive response could imply that using VR for cultural preservation is a promising approach. The medium's effectiveness might contribute to the successful conveyance of cultural elements. the positive response could imply that using VR for cultural preservation is a promising approach. The medium's effectiveness might contribute to the successful conveyance of cultural elements. This affirmation not only contributes to the understanding of VR's impact but also offers valuable insights for potential applications, including cultural preservation and immersive experiences.

3.4 Figures

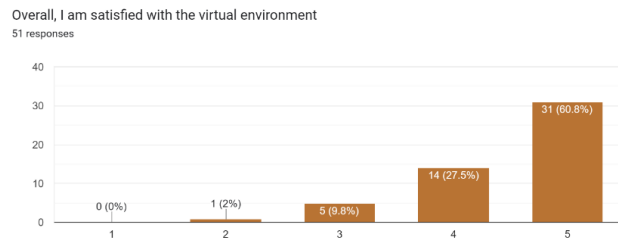


Figure 4: Satisfaction with Virtual Environment

Figure 1, The data shows that the high mean score of 4.63 for the statement "Overall, I am satisfied with the virtual environment" reflects a consensus among respondents regarding their positive assessment of the virtual environment. This score suggests that most participants were notably satisfied with their experience, as evidenced by their ratings leaning towards the higher end of the scale. Such high levels of satisfaction imply that the virtual environment effectively met the expectations and needs of the respondents. It indicates that the immersive experience provided by the virtual environment was engaging, enjoyable, and fulfilling. Participants likely found the environment to be immersive, interactive, and visually appealing, contributing to their overall satisfaction. This positive reception underscores the success of the virtual environment in delivering an experience that resonated with the preferences and desires of the respondents. It suggests that the design, features, and overall execution of the virtual environment were well-received and effectively catered to the needs of the target audience, resulting in a highly satisfactory experience for most participants.

4. Conclusion

In conclusion, the VR Gasing project represents a significant stride in combining traditional cultural games with modern technology. The endeavor aimed at creating an immersive and engaging Virtual Reality (VR) experience for users, with a specific focus on the traditional game of Gasing. Throughout the project, several key accomplishments and recommendations emerged.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Enhanced Fire Intercom System with ESP32 WiFi Camera Microphone and Blackbox Integration

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Abstract: It is well acknowledged that fire authorities bring vast knowledge about fire behavior and its challenges during outbreaks in buildings and provide valuable insights on fire safety design based on their expertise in firefighting. This is viewed as imperative in increasing the survivability of the occupants and emergency responders while decreasing property losses. This connection necessitates a review of the design of the fireman intercom system. The system provides clear and reliable communication in high-pressure situations, allowing for efficient coordination of rescue and firefighting efforts inside the building. This system despite being an indispensable safety feature in any building, did not undergo modernization in tandem with the rapid advancement of technological development.

The primary objective of this research is to enhance the functionality of fire intercom systems by integrating modern technologies to provide real-time visual and audio information during emergencies in view of providing better support for forensic investigations. Thus, the project makes the following contributions: 1) deploy WiFi camera to capture high-quality images and video frames to effectively gauge visual and audio surveillance, 2) integrate black-box unit to securely record distress call conversations in a MicroSD card and upload them to a web application for authorized access and post-incident analysis.

Collectively, the project utilizes material ESP32 WiFi camera to capture and transmit crucial data for emergency response; MicroSD cards, and a secure web application. The tested system is able to capture images and recordings ranging from 10 seconds up to a maximum of 4 minutes in jp5 format. The uploaded videos and images can be downloaded from the web application on any device. Multiple ESP32 cameras can be integrated into each fire intercom station through the chain network and the live feed can be observed from the web application, allowing emergency responders to have real-time visibility into multiple locations within a building.

Keywords: Emergency Response Technologies, ESP32, Black-box

1. Introduction

Ensuring the safety of occupants inside of the building is more critical than ever. The rise in demand for high-rise buildings brings unique challenges and risks, especially during emergencies such as fire. During a fire, flames and smoke can spread rapidly causing severe damage to humans and properties. Therefore, effective fire safety measures and procedures are important and can save lives

[1]. Therefore, robust fire safety measures to mitigate this kind of situation is essential due to the complex and dangerous situation mentioned above.

Despite high demand and innovative advancements in high-rise buildings, the fire intercom system hasn't improved much over the years. Our project aims to address this gap by assisting the forensic department with data collected from our system and ensuring safe evacuation during a fire. With advanced communications and surveillance systems in our system, significant improvements toward the awareness and response of building occupants can be guaranteed.

2. Materials and Methods

2.1 Literature Review

Fires in buildings are predominantly linked to either human error or human negligence. Tragically, these incidents result in fatalities, with a concerning annual increase of 61%, and 48% of the total fire injuries each year.[2]

Despite their critical role in emergency communication, these fire intercom systems often lack the necessary features to adapt to evolving fire safety demands. The current system relies on manual activation, requiring occupants to break glass to access the emergency button, a process prone to risks and delays during emergencies.

2.2 Materials

The following materials and equipment were utilized:

- Breadboard
- ESP 32 CAM
- Conference microphone
- Push button
- 2x Servo DC Motors
- ESP 32
- Raspberry pi 4, 2GB
- Plastic cover
- 3-D printed Box
- Red spray paint

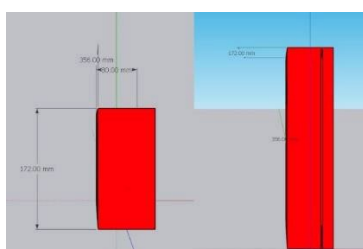


Figure 1: Top and Side View of System Box

Figure 1 depicts the fire intercom system designed according to the specifications set by BOMBA Malaysia.

2.3 Methods

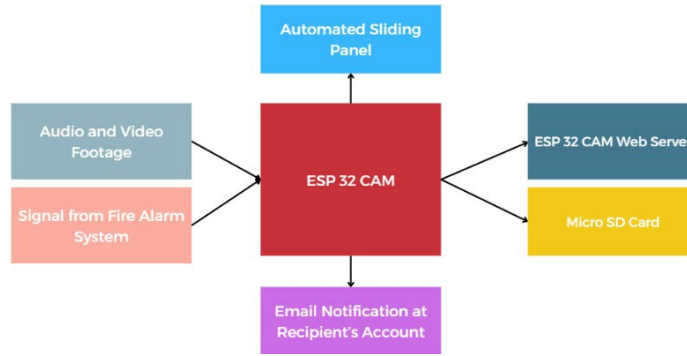


Figure 2: Block Diagram of Enhanced Fire Intercom System

Figure 2 illustrates the block diagram of the system design. During a fire emergency, our enhanced fire intercom system operates seamlessly to ensure a swift and effective response. Once the alarm is triggered, the automated sliding panel slides up to reveal the emergency button, which upon being triggered, sends an email alert to the safety officer for immediate evacuation using the ESP32 module. The ESP32 module can access the SMTP server via WiFi, enabling the system to send immediate email alerts to the designated safety officer.

Additionally, when the panel slides up, the Occupants can utilize the conference microphone for clear communication with emergency responders, while the ESP32Cam streams visual and audio data in a video format over WIFI for detailed real-time surveillance. This footage is further stored in an SD card for post-incident analysis and to provide valuable insights for improving emergency response procedures in the future, as well as aid forensic investigation.

3. Results and Discussion

This chapter presents the results obtained from the testing of the system. The ESP32 Cam has successfully streamed the image of the surroundings to the web server to capture images and recordings ranging from 10 seconds up to a maximum of 4 minutes in jp5 format. This system proves to be efficient in streaming live data, which is crucial for emergency response efforts. The enhanced fire intercom system is presented in **Figure 3**.



Figure 3: Enhanced Fire Intercom System

In addition to the successful streaming of images to the web server, the ESP32 Cam also demonstrated its capability to record high-quality video footage onto a microSD card. This feature provides an invaluable resource for post-incident analysis and forensic investigations. Overall, the integration of video recording functionality adds a critical dimension to the system's effectiveness in supporting emergency response efforts and advancing fire safety practices.

4. Conclusion

In conclusion, our project represents a significant step forward in fire safety technology, addressing critical gaps in existing systems while supporting Sustainable Development Goal 9: Industry, Innovation, and Infrastructure. By integrating advanced features such as the ESP32 CAM for live streaming and video recording, automated sliding panels for quick access to emergency assistance, and conference microphones for improved communication, our system increases building safety during fire emergencies. Through multiple rounds of testing, we have demonstrated the effectiveness and reliability of our solution in providing real-time information and facilitating quick response actions. This innovation holds potential to be integrated into larger scale applications to create safer, more resilient built environments, aligning with global efforts to improve infrastructure and promote innovation.

5. Acknowledgement

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Enhancing Parking Efficiency: A Smart Parking System

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Abstract: The increased usage of private automobiles in metropolitan areas has resulted in an increase in parking demand, necessitating effective parking management. The goal of this research is to create a smart parking system that employs sensors, a microprocessor, and the Blynk app to give users real-time parking availability information. The method is intended to address the issues of restricted parking spaces and the time-consuming process of seeking parking spots. The system can monitor and send precise occupancy data by inserting sensors into parking spots and linking them to a microcontroller. This data is then sent to the Blynk app, which allows vehicles to rapidly identify available parking places. A database is also installed to record and manage hourly and daily parking data, allowing parking managers to optimize space utilization and make data-driven choices. It is expected that by deploying this smart parking system, drivers will have shorter search times, less traffic congestion, and improved overall user comfort. Parking companies will also profit from increased efficiency in managing parking spots. The findings of this study illustrate smart parking systems' potential to change urban mobility. These technologies encourage eco-friendly mobility practices while also optimizing space utilization, encouraging smarter and more livable communities. As cities expand, the deployment of intelligent solutions like these is critical for long-term urban growth and enhanced quality of life for inhabitants and commuters alike. Furthermore, the smart parking system has advantages that go beyond basic convenience. It reduces carbon emissions and traffic congestion by minimizing the time spent looking for parking, thus contributing to a greener, more sustainable urban environment.

Keywords: Smart Parking system, automobile, sensors , urban environment

1. Introduction

The use of private vehicles has increased, particularly in cities, as the global economy expands. The demand for parking spaces has significantly increased as a result of this [1]. There are not enough parking spots so finding one might be challenging and time-consuming [2].

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The growing need for parking may be efficiently met by innovative parking solutions. Among the choices is the smart parking system, which makes use of sensors to provide real-time information on parking availability [3]. Through the use of hardware and software components, a smart parking system monitors parking spaces and determines the condition of occupancy [4], [5]. Through the use of an application that offers real-time updates on parking availability, drivers may find parking spot quickly, cutting down on both the time it takes to find a spot and the resulting traffic congestion. Parking operators also could use the parking information to manage efficiency or expand the parking area as needed [6].

The benefits of a smart parking systems include improved efficiency, less congestion, reduced fuel consumption and idle time, enhanced parking management and integration with smart city initiatives [7][8]. In conclusion, smart parking systems can provide a practical solution to the issues discussed above, helping both drivers and urban planners create more, sustainable and efficient urban environment.

2. Methodology

The methodology used for Enhancing Parking Efficiency: A Smart Parking System project is Agile Methodology. This approach involves dividing the development process into small, manageable parts known as increments. Each increment builds upon the previous one, allowing for incremental improvements and progress towards the final system. After each cycle, a new version of the system is created, incorporating feedback and making necessary adjustments. This iterative process continues until the project achieves the desired outcome. Since Enhancing Parking Efficiency Using Wireless Sensor Network project is relatively small in scale, the iterative and incremental methodology is well-suited [9][8]. It allows for flexibility, adaptability, and continuous improvement throughout the development process.

2.1 Requirement

The project planned based on requirement allows the development to find the scope of the project. developed using the data gathered at this stage. The project requirement would be developed using the existing project and solution as a guide. If the project requirement is solving the current issue, it is then finalized. Table 1 shows the project hardware and software requirements.

Table 1: Hardware and Software Requirement

Hardware	Description
Infrared sensors	Sensors to detect objects.
Microprocessor	Nodemcu ESP32
Wires	Connect sensors to Nodemcu
Breadboard	Solderless board
Software	Description
Blynk App	Application that controls Arduino Module via an internet connection.
Arduino IDE	Used to write code and compile to microprocessor.
MySQL	To store data

2.2 Design

The design phase is essential because it is during this phase that the project development for the requirement implementation was planned. The project's effectiveness and quality will be decided by its design. In order to ensure optimal results, design tools such as flowcharts are employed. The flowchart design are shown in Figure 1.

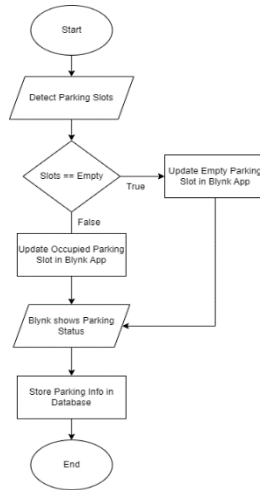


Figure 1 : Project Flow Chart

2.3 Hardware and Software Development

Figure 2 shows the project prototype. The sensors are connected to ESP32 Microprocessor PIN which is D0, D1, D2 and D3 PINs. The sensors are used to detect cars in the parking slot and send it to ESP32. The ESP32 has a built-in Wi-Fi module that will be used to connect to a network to send data to the Blynk app and database. The sensors are used to detect cars in the parking slot and send it to ESP32. Programming language used in ESP32 is C++. The Blynk apps developed by designing the layout to the reading of the sensors. Figure 3 and Figure 4 displays the layout designed on the Blynk apps.

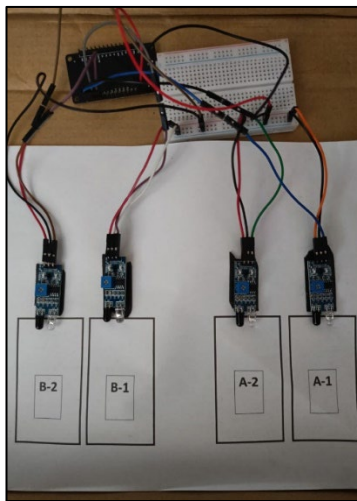


Figure 2 : Project Prototype

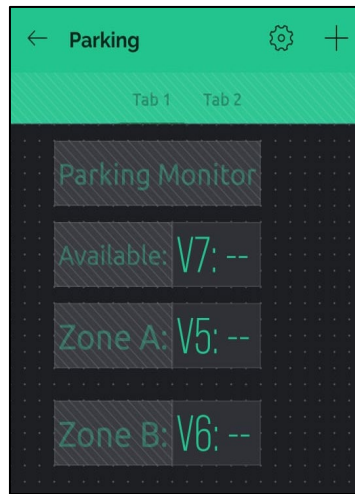


Figure 3 : Tab 1 Blynk Apps



Figure 4 : Tab 2 Blynk Apps

3. Results and Discussion

While conducting tests on the project prototype, there are a noticeable amount of delay from sensors detecting cars to updating parking status in Blynk App. This delay cause by issues related to an unstable internet connection. When having a bad internet connection, the Blynk App may display a slightly inaccurate data of parking availability status. It is important to address and mitigate these connectivity issues to ensure the parking status that shown in Blynk can be real-time and precise.

Another issue that is discovered during the testing is sensors not detecting the cars. Given the diverse range of car sizes and forms, the sensors consistently detect normal or larger-sized vehicles. However, any car that is too small may not be able to be detected by the sensors. The solution to this

issue is to adjust the infrared sensor range. By tuning the range of the infrared sensors, it can enhance the sensitivity so that it can detect any type of car that parked in the parking spot. This adjustment is important so that the Blynk App can show an accurate data of parking status.

4. Conclusion

In conclusion, the development of a Smart Parking System utilizing Blynk technology holds great promise for enhancing parking efficiency. Through the implementation of sensors, real-time data updates, and a user-friendly interface, the system effectively achieves its objectives of monitoring parking slot status, aiding drivers in locating available spots, and maintaining a comprehensive database of parking usage information. Furthermore, future developments such as the integration of a navigation system and the introduction of car identification sensors give chances to further streamline parking operations and increase user experience. Overall, the Smart Parking System demonstrates its potential to revolutionize parking management, mitigate traffic congestion, and create a more seamless and efficient parking experience for all users.

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ESP IDF Programming for IoT: A Blueprint for Facial Recognition in Attendance Systems in IUM

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Abstract: An attendance system based on facial recognition that uses several microcontrollers and microprocessors is studied in this work. The present study introduces the proposed model and afterward discusses the results obtained from different tests conducted utilising a range of microcontrollers. The ESP32-S3 microcontroller is programmed via the Espressif IoT Development Framework (ESP IDF) in order to generate full instructions for the Internet of Things (IoT) device. The incorporation of specific components, such as Pseudostatic Random Access Memory (PSRAM), a camera interface peripheral, and USB peripherals, facilitates efficient connectivity with a camera. The present study highlights the constraints associated with the utilisation of Raspberry Pi 3B, encompassing the issue of device sluggishness and the requirement for USB cameras with lower resolutions to expedite processing. This paper offers valuable insights into the examination and implementation of contemporary advancements and investigations in the field of face and object recognition system development. From this study, approximately 126 students actively participated in the demonstration. The analysis of the results indicates a noteworthy 70% accuracy rate among the participants.

Keywords: ESP32, Face Recognition Attendance System, Raspberry Pi 3B+, USB camera, ESP IDF

1. Introduction

Microcontrollers are used in various applications, including machinery control and management in manufacturing, automation, and robotics industries. Microcontrollers are also utilized in residential

automation systems for overseeing activities like lighting control, temperature regulation, security measures, and functioning of household appliances [1]. This paper explores various facial recognition systems that use different microcontrollers. The Introduction briefly explains the purpose and goal of installing a face recognition attendance system. The Methodology section discusses the current development and research of face and object recognition systems. The proposed model and the results of multiple tests conducted using various microcontrollers are presented in the Results and Discussion section. Finally, the Conclusion section summarizes and concludes the work.

2. Methodology

This project comprises two distinct components, namely the software component and the hardware component. The software components mostly revolve around establishing necessary communication protocols between the camera, ESP32-S3, and computer, utilizing the ESP native environment known as ESP IDF. The hardware component consists of various elements, including a camera, Micro female USB to Universal Asynchronous Receiver/Transmitter (UART) connector, ESP32-S2 and ESP32-S3 microcontrollers, USB hub, power bank, and PC.

3. Results and Discussion

A face recognition attendance system was developed and tested using several microcontrollers. The first attempt using NodeMCU-ESP32 was unsuccessful due to the absence of essential features such as PSRAM, USB to UART connection, and USB peripherals required to stream video from an external camera. The second attempt was made using an ESP32-CAM, which has a built-in camera slot and can switch between two cameras, namely OV2640 and OV7670. While the ESP32-CAM has PSRAM allowing live streaming on a web server, it performs poorly in facial detection features. It has power issues, with frequent brownout detection and overheating, making it degradable. ESP32-S2 was also unsuccessful due to header issues within the chipset. ESP32-S3, on the other hand, can perform facial recognition and image processing with the assistance of a computer. However, it lacks VBUS to provide enough power to the microcontroller board, and its latest chipset is not yet widely distributed and is challenging to obtain. Raspberry Pi 3B+ is a microprocessor that can perform facial recognition on a typical computer. However, the xlutils library used to create and link to an Excel file is not functional. A CSV file can be used instead. Raspberry Pi 3B+ is slow, and the video frame takes a long time to load. A low-resolution USB camera should be used instead of a high-definition camera to speed up processing. The face recognition system using both ESP32-S2 and ESP32-S3 is the next best approach. According to the training dataset, this system can detect and recognize faces with a smaller setup. Figure 1 depicts the system setup utilizing ESP32-S2 and ESP32-S3, while Figures 2 and 3 provide an overview of the inputs and outputs of this prototype.



Figure 1: System setup using ESP32-S2 and ESP32-S3

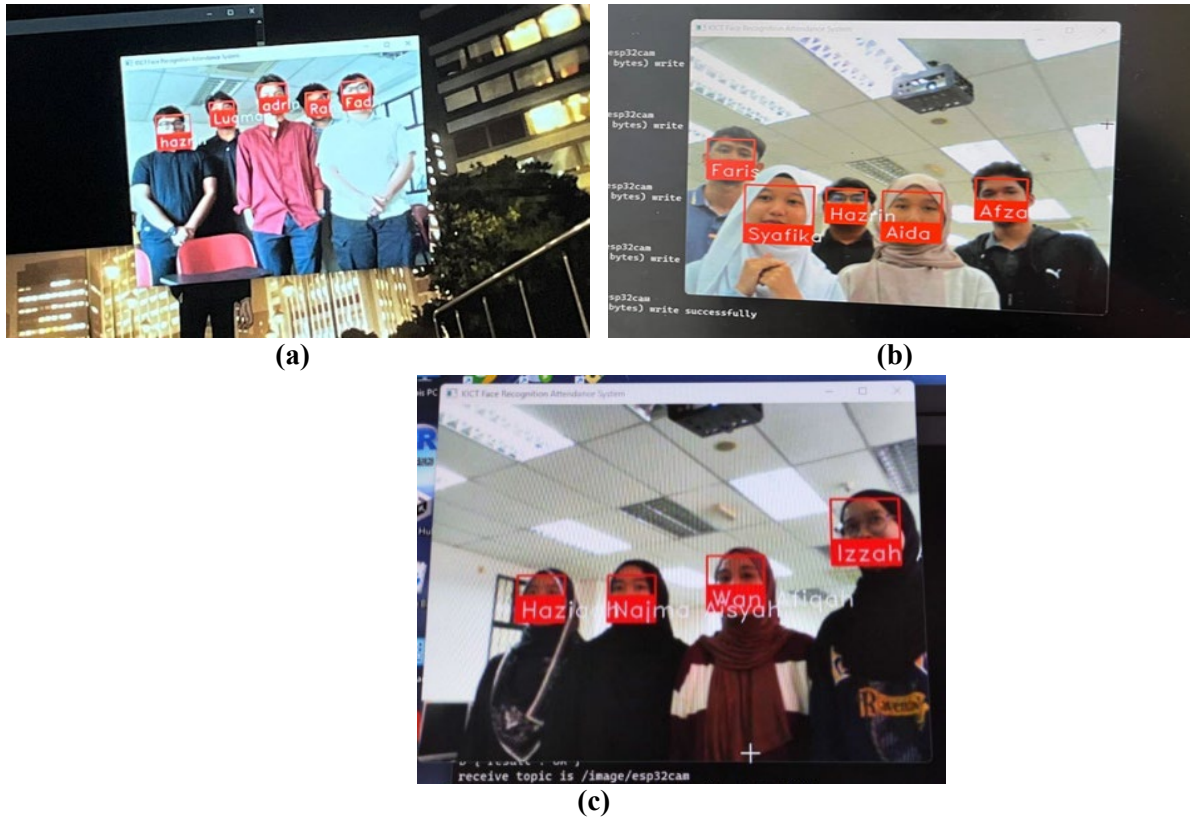


Figure 2: (a), (b), (c) Example of measurement testing of Face recognition Attendance System in a group of students using ESP32-S3.

	A	B	C	D
1	Dr Anwar	Present		
2	Muhammad Hafiz Faruqi	Present		
3	Haziqah	Present		
4	Wan Afiqah	Present		
5	Aina Syazana	Present		
6	Faheyra Ezzah	Present		
7	Muhammad Firdaus	Present		
8	Abdul Ghafur	Present		
9	Muhammad Hafizudin	Present		
10	Muhammad Hussaini	Present		
11	Izzah Atirah	Present		
12	Shahmie	Present		
13	Sultan Ariffin	Present		
14	Muhammad Syahmi	Present		
15	Wan Muhammad Arif	Present		
16	Iman Hakeem	Present		
17	Muhammad Haqim	Present		
18	Muhammad Syafiq	Present		
19	Ahmad Adam	Present		
20	Aizzul Izzuddin	Present		
21	Najma Aisyah	Present		
22	Irfan Zaki	Present		
23	Muhammad Nazmi	Present		
24	Nuramiratul Aisyah	Present		
25				
26				

Figure 3: Example of generate an attendance report from Microsoft Excel consists of the captured student.

4. Benefits to Society

Implementing the face recognition attendance system using microcontrollers and microprocessors offers several benefits to society. Firstly, it significantly enhances attendance management by automating the process, reducing the burden on administrative staff, and improving overall efficiency. Secondly, this system can provide support to educational institutions, for example, in Kuliyah of ICT IIUM, by providing a more efficient learning environment with a contactless and secure attendance solution. This reduces administrative burdens and helps lecturers focus more on teaching while ensuring students benefit from a modern and efficient attendance process. Finally, this attendance system provides a secure and reliable means of identity verification, minimizing the risk of fraudulent activities such as buddy punching. This ensures that attendance records are accurate and trustworthy.

5. Conclusion

In conclusion, implementing the face recognition attendance system on Raspberry Pi 3B+ has demonstrated satisfactory performance in terms of streaming resolution, time frame, and low latency. The face detection algorithm on the ESP32 microcontroller has also performed satisfactorily. However, the ESP32-S2 and ESP32-S3 are better suited for smaller projects. Future advancements in face recognition may be possible with the ESP32-CAM, but it should be developed using the native ESP environment instead of relying on Arduino. Using less than 50 data points for training is recommended as processing more than 50 takes a long time. During testing, the time to identify a face varied between 4 and 24 seconds. A critical issue that emerged was an error related to the undefined frame. This was attributed to configuration issues that caused the camera to fail. Another issue was an out-of-range error, which can occur when accessing elements beyond the valid index range. The suggested solution was to restart the code execution to rectify the index list out-of-range error.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Homestay Asset Security System (HASS)

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Abstract: The Homestay Asset Security System (HASS) addresses the pressing issue of asset theft and monitoring faced by homestay owners. Incidents of theft, such as those reported in Bali and Melaka, underscore the vulnerability of homestay assets, requiring a robust security solution. Traditional inventory tracking methods are labor-intensive and prone to errors, prompting the need for an automated system like HASS. This project aims to implement security measures by alerting the homestay owner and guests via Telegram messages and monitoring asset losses through a Google Sheet database. Using ESP8266, RFID RC522, Google Sheet, and the Telegram app, HASS achieves real-time asset tracking and immediate notification of asset movement. Upon successful implementation, the system automatically updates the online spreadsheet and triggers Telegram messages to notify stakeholders of asset detections. Additionally, HASS generates automated email reports, providing a comprehensive overview of asset losses to the homestay owner. Through HASS, homestay owners can enhance security measures, mitigate asset losses, and monitor asset status remotely.

Keywords: RFID, IoT, ESP8266, RC522, Inventory Tracking

INTRODUCTION

The RFID-based Homestay Asset Security System (HASS) is designed to streamline the supervision and management of physical assets within a homestay setting. This innovative system involves loading RFID tags with pertinent data and affixing them exclusively to high-value household items prone to theft. These items encompass a range of valuable assets, including electrical appliances, luxurious toiletries such as bathrobes and towels, and other items of significant worth to the homestay owner.

By utilising RFID technology, HASS provides automated asset monitoring, ensuring instant updates on asset status if it was to be brought outside the house. Furthermore, the data collection occurs seamlessly as a result of the RFID integrating with the cloud database, reducing effort for the homestay staff to do manual inventory, and enhancing overall accuracy of the record. The cost-effectiveness of RFID technology becomes evident through the utilization of passive tags and cards, which do not rely on external power

sources to activate the RFID system. In summary, HASS is a comprehensive and reliable RFID-based asset security system solution tailored for homestays, providing real-time security system and efficiency in managing valuable assets.

LITERATURE REVIEW

Numerous projects across various industries have benefited significantly from the implementation of RFID technology, as discussed in the literature review. Despite the diverse applications in different fields, the underlying essence and concept of incorporating IoT-based RFID technology remain

consistent. All these projects share a common objective: to enhance product traceability and visibility for effective management and simplify inventory monitoring for end-users. Additionally, what sets RFID apart is its long-lasting and cost-efficient nature compared to other asset tracking tools such as GPS tracking, barcode system and so on. This collective understanding from the literature review paints a clear picture of how RFID can significantly enhance the efficiency and effectiveness of inventory management in various business settings.

PROBLEM STATEMENT

The conception of the Homestay Asset Security System (HASS) is driven by a shared concern among homestay owners grappling with difficulties in monitoring their property's assets, especially when rented to guests. Incidents, such as hotel guests from India caught stealing supplies in Bali, underscore the prevalent issue of asset theft (The Straits Times, 2019). Additionally, valuable electrical appliances, including branded extension cords,

electric kettles, and mini fridges, are at risk of theft, as evidenced by instances like the loss of a fridge, washing machine, and water filter in Ayer Keroh, Melaka (Melaka Hari Ini, 2021). The traditional inventory tracking methods prove cumbersome and costly, particularly when managing multiple homestays. This manual process is prone to errors and inefficiencies because the homestay staff is usually responsible for the job. Furthermore, existing commercialized solutions like smart tag keychains or trackers often incur high costs, demand owner authentication through smartphones, and consume substantial data for asset tracking purposes.

RESEARCH METHODOLOGY

The software and hardware chosen for HASS are NodeMCU ESP8266, RFID RC522, Google Sheet and Telegram app. The ESP8266 offers a cost-effective solution without compromising on performance. Its affordability makes it suitable for students doing Final Year Projects with budget constraints, ensuring learning IoT without incurring high expenses. Just like ESP8266, RC522 module is also cost-effective, aligning well with budget considerations for FYP. The compatibility feature of the RC522 module with passive RFID tags and cards is particularly advantageous as it eliminates the need for an external power source or batteries for the RFID tags. Google Sheet supports automation features that can be leveraged to generate email reports for the homestay owner automatically. By configuring scripts within Google Sheets, the system can be programmed to generate and send daily email reports summarizing asset loss data that is useful for homestay business analysis. This automation simplifies the process of staying informed about asset movements and ensures timely updates for the homestay owner. Lastly, by utilizing Telegram, the system can promptly notify the homestay owner whenever there is a change in asset status, such as removal from their designated location. To facilitate this communication, homestay owners will need to create Telegram bots that can connect to the RFID system at home and IoT devices like the ESP8266.

RESULTS AND DISCUSSION

Upon successful implementation of the HASS project, the system will automatically update the Google Sheet upon detection of an asset passing by the RFID reader at either entrance. Subsequently, a Telegram message will be triggered to notify both the homestay owner and guests of the event in the Telegram group. This immediate notification ensures prompt awareness of any asset movement within the premises, enhancing security and allowing direct communication from the homestay business owner to the customers. In addition to Telegram alert, HASS will generate automated email reports for the homestay owner. These reports will be sent at predefined trigger events, providing a comprehensive overview of asset losses from the homestay. The emails will contain detailed information, including the

date and time of each asset detection event and the visualization in the form of bar chart to summarize the number of asset losses in each category.

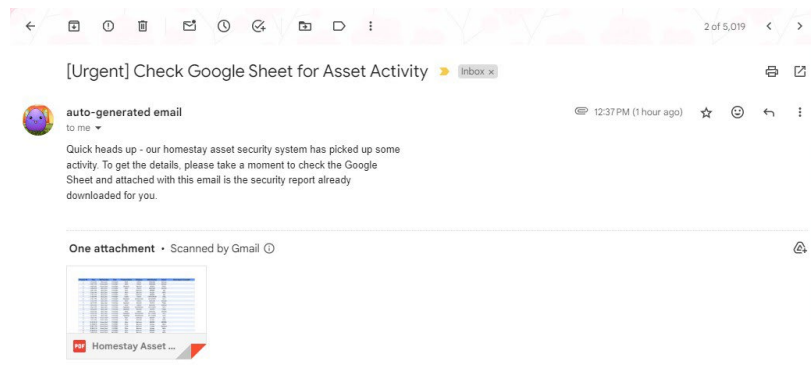


Figure 1. Email notification generated by HASS.

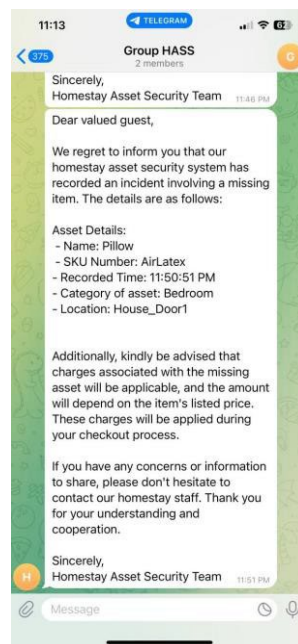


Figure 2. Telegram message from Google Sheet.

CONCLUSION AND RECOMMENDATION

In conclusion, the objectives set forth for the development of the Homestay Asset Security System (HASS) have been successfully achieved. Through the integration of RFID technology, the project has demonstrated its efficiency in asset security within a homestay setting. HASS also has met the project requirements, delivered on schedule as illustrated by the Gantt chart and maintained within the budget plan.

The selection of RFID technology was proven to be optimal for asset monitoring in the homestay environment as it offered a cost-effective and reliable solution using the RC522 module from Arduino. The system's ability to automatically update Google Sheets and send notifications via Telegram and email ensures timely awareness of any asset movements, alerting homestay owners with the means to maintain oversight and security. In addition, homestay guests will also receive Telegram messages

notifying them of their responsibility for any lost assets, which will be added to their bill during checkout.

For future improvement, the incorporation of additional IoT protocols such as Bluetooth Low Energy (BLE) and Ultra-WideBand (UWB) can also be applied for enhancing asset tracking capabilities indoors (inside the homestay itself). By utilising both technologies, tracking can extend to indoor areas, providing more comprehensive coverage and enabling more precise localization of assets. This improvement would add more value and versatility to the homestay asset tracking system, ensuring even greater security and efficiency for homestay owners.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

IoT based Smart Fingerprint Outing System for IKM Lumut Student using NodeMCU ESP8266

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Abstract: The IoT-based Smart Fingerprint Outing System (SFOS) for IKM Lumut students, employing NodeMCU ESP8266, AS608 fingerprint sensor, and OLED display, represents a transformative solution to challenges in managing student outings. By associating each student's fingerprint with their outing card, the project enhances security, discipline, and overall institute management. With a comprehensive scope covering hardware design, fingerprint sensor integration, and MySQL database implementation on IKM Lumut servers, the system aims to streamline outing attendance recording and analysis through a website while implementing a real-time monitoring system displaying students' departure and return times. This Final Year Project emphasizes the development of an efficient and secure outing management system, utilizing IoT technology. The project's focus on hardware, including NodeMCU ESP8266, ensures robust data capture and processing through an AS608 fingerprint sensor. The integration of an OLED display and a web-based database application enhances real-time access to outing attendance data. The project is cost-effective, with a total hardware cost of RM206, leveraging free MySQL database and mobile application services, as well as open-source tools like Arduino IDE and Apache Cordova. The literature review explores the landscape of IoT-based smart fingerprint outing systems, highlighting adaptability in database selection, addressing limitations in fingerprint data collection, and discussing bi-directional data transfer methods using MQTT protocol. Critiques of existing systems underscore the importance of flexibility, scalability, and user-friendliness, providing valuable insights for the SFOS project's development. In conclusion, the SFOS project stands as a paradigm of innovation in student outing management. It not only revolutionizes traditional processes but also exhibits significant potential for growth by incorporating cutting-edge advancements like facial recognition and voice authentication. As a testament to the transformative power of IoT systems, the SFOS project ensures continued relevance in the dynamic technological landscape, promising enhanced efficiency and convenience for student outing management at IKM Lumut.

Keywords: Innovation, Internet of Things, Biometric Technology, Modern Technology, Fingerprint Technology, Collage Technology

1. Introduction

The IoT-based Smart Fingerprint Outing System for IKM Lumut Students, powered by NodeMCU ESP8266, signifies a shift towards modernizing security and convenience for students. By integrating a robust fingerprint identification system, this project eliminates the need for traditional keys or access cards, offering students a secure and hassle-free means of accessing the institute's premises. The focus on creating a cost-effective and efficient IoT-based solution underscores its commitment to enhancing security while streamlining user experience.

In essence, the project not only marks a departure from conventional access control methods but also addresses the risks associated with unauthorized access, demonstrating a significant step forward in leveraging technology for the benefit of IKM Lumut students. The seamless integration of NodeMCU ESP8266 showcases the project's dedication to providing a reliable and user-friendly entry system, aligning with the evolving landscape of IoT applications in educational settings.

1.1 Problem Statement

IKM Lumut faces challenges in managing student outings, dealing with issues like absenteeism, late returns, and outing card mix-ups in its manual system. To address these concerns and improve overall security and management, the IoT-based Smart Fingerprint Outing System is introduced, utilizing NodeMCU ESP8266, AS608 fingerprint sensor, and OLED display. This innovative system aims to combat problems such as students forgetting or neglecting to use outing cards by associating each student's fingerprint with their respective card, streamlining the outing process and enhancing security. By implementing IoT technology, NodeMCU ESP8266, and advanced verification methods, the project seeks to create a secure, efficient, and well-organized institute environment, potentially serving as a model for other educational institutions facing similar attendance and card management challenges.

1.2 Objective

- To design and develop hardware for fingerprint outing system using NodeMCU ESP8266.
- To analyze student outing and return to IKM Lumut using a website.
- To build a real-time monitoring system that display the time student outing and return to IKM Lumut.

1.3 Scope

- To design and build hardware connection and installation of NodeMCU ESP8266.
- To build and analyze fingerprint sensor module and software to connect NodeMCU with sensor.
- To build and design MySQL database and stored on IKM Lumut servers.
-

2. Materials and Methods

This Final Year Project focuses on developing an IoT-based Smart Fingerprint Outing System for IKM Lumut students, utilizing NodeMCU ESP8266, AS608 fingerprint sensor, and OLED display technology, with a primary objective of creating an efficient and secure method for recording student attendance during outings, incorporating a heightened focus on database and mobile application components to streamline outing management, enhance data accuracy, and improve overall efficiency.

2.1 Materials

To develop this system we use only 6 items, the items are:

- NodeMCU ESP8266

- Fingerprint AS608
- OLED Display
- Perf Board
- Router
- PVC Box

To construct the device, a set of hardware items totaling RM206 is required, while leveraging cost-effective solutions, as the project utilizes the free MySQL database and a mobile application. This strategic choice of cost-free services minimizes the overall project expenditure. In terms of software, the project employs Arduino IDE, an integrated development environment for programming Arduino boards, and Apache Cordova, an open-source platform for developing cross-platform mobile applications using web technologies like HTML, CSS, and JavaScript.

The use of these tools, which are available without licensing fees, further contributes to the project's cost-effectiveness, ensuring efficient development without incurring additional software-related expenses.

2.2 Methods

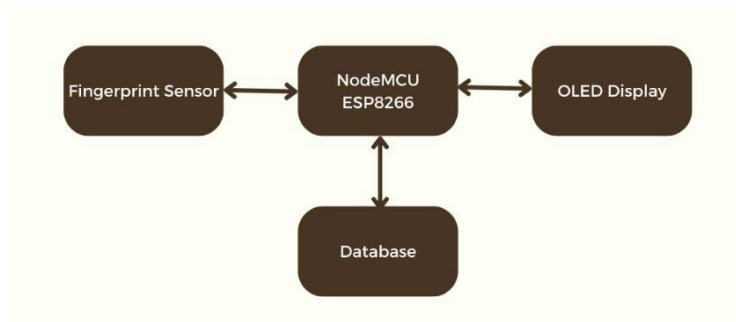


Figure 1: Block Diagram

In the new system, students use a fingerprint scanner connected to a NodeMCU ESP8266 board with an AS608 sensor for accurate data collection. The NodeMCU, equipped with IoT capabilities, makes it easy by connecting to the internet. When a student scans their fingerprint, the NodeMCU captures and processes the data, sending it to a central database accessible online. The database securely stores the fingerprint data along with student details like name and ID. The NodeMCU then retrieves this information from the database and shows it on an OLED display.

This system, using the NodeMCU, AS608 sensor, and a database, allows students to quickly record their fingerprints, keep their data in one place, and see their information on the OLED display instantly.

2.3 Operation Flow

The operation flow starts with students scanning their fingerprints on the product equipped with a fingerprint scanner. Once scanned, the system processes the fingerprint data and displays the student's name on the OLED Display. At the same time, the data is stored in the database for future reference. This streamlined process ensures a quick and efficient way for students to record their attendance using fingerprints, display their names instantly and securely store the data in a centralized database, and the operation is over.

3. Results and Discussion

IoT, or the Internet of Things, connects devices to the internet, as seen in the IoT-based Smart Fingerprint Outing System for IKM Lumut Students with NodeMCU ESP8266. This system makes it easy to transfer fingerprint data to a central database, improving security and efficiency during student outings. This chapter discusses the real results and practical impact of using NodeMCU ESP8266, AS608 fingerprint sensor, and OLED technologies. It highlights how these components have simplified recording student attendance, making it more efficient and secure.

3.1 Results

ID	NAME	PROGRAM	MATRIX NUMBER	FINGERPRINT ID	DATE	TIME IN	TIME OUT
15	TS WIN AHMAD DANIAL BIN HJ RUZMAN	DFD	1	7	2023-10-13	11:06:27	11:06:01
14	MOHD ANISRI BIN MUHAMMAD SAOZI	DFD	2101127	2	2023-10-13	11:00:33	11:00:03

Figure 2: Data in Website

In developing this project, we've created web pages and an application to make the IoT-based Smart Fingerprint Outing System (SFOS) more useful. The SFOS Homepage Website page has the project logo, name, and buttons for different sections like admin page, outing and return forms, About SFOS, and contact info. The About SFOS page explains why SFOS was made at IKML and the problems it solves. The Contact Info page is for emergencies, letting security officers contact technicians or the head warden.

Outing and Return Form pages are for students facing issues like injured fingers. An Admin Login page ensures secure access to important data, leading to pages like Users, Users Log, and Manage Users, providing details on registered users, outing records, and fingerprint management. We've also developed an SFOS Application for security guards to easily fill in specific forms, making SFOS more efficient and user-friendly.

3.2 Discussion

The implementation of the Fingerprint system in this initiative has yielded significant advantages, particularly in addressing the challenge of tracking assets and data within organizations. This cutting-edge technology offers a rapid and reliable method for monitoring individual items, whether related to personal storage or student records. By replacing manual data input with electronic data collection and transmission, the project has effectively reduced transcription errors, minimized data redundancy, and mitigated the risk of missing items. In conclusion, the outcomes of this project highlight the value of incorporating Fingerprint systems for electronic data collection, leading to enhanced precision and efficiency. These advancements contribute to effective decision-making and heightened customer satisfaction, emphasizing the potential of technological innovation in driving improvements in asset tracking and data management within organizations.

3.3 Data Analysis

id	username	matrixnumber	gender	programme	fingerprint_id	fingerprint_select	user_date	time_in	del_fingeric
1	FAIRUL AZAMI BIN ZULKHAPLI	2101125	Male	DFD	6	0	2023-10-13	10:01:00	
2	NURNADHIRAH BINTI RAMLI	2101134	Female	DFD	4	0	2023-10-13	10:03:00	
6	AMIR DARWISH ARIEF BIN MOHD NIZAM	2101120	Male	DFD	5	0	2023-10-13	11:15:00	
9	NURUL AWATIF BINTI ADHAM	2101136	Female	DFD	1	0	2023-10-13	16:26:00	

Figure 3: Users Data

Our project is doing well in achieving its goals and meeting key performance indicators. Our approach effectively handles data issues by using a MySQL database with a primary key system, ensuring data integrity and reducing duplication risks. This structured storage makes it easy to analyze

data and gain valuable insights. Security is also a priority, with server access limited to the administrator. These positive signs indicate success in data management and security. The real-time data capture feature allows quick recording and presentation of student information on the website, improving efficiency and administrative processes.

4. Conclusion

The IoT-based Smart Fingerprint Outing System (SFOS) for IKM Lumut students, driven by NodeMCU ESP8266, represents a transformative technological solution, leveraging the Internet of Things (IoT) to streamline student outing management. The integration of web-based database applications and a user-friendly mobile interface serves as a powerful combination, providing efficient tools for data management and communication. This includes a centralized repository for data storage and a mobile application for security personnel to handle student-related forms conveniently. The project's success is evident in the significant time and energy savings, user-friendly processes, and enhanced communication channels for students and administrators.

Looking ahead, the SFOS project holds substantial potential for growth and innovation. The recommendation to incorporate smart sensing technologies, such as facial recognition and voice authentication, aligns with the evolving landscape of IoT and user preferences. These advancements not only contribute to heightened security measures but also ensure the project's continued relevance and demand. In the rapidly changing technological environment, the SFOS project stands as a testament to the transformative capabilities of IoT systems, poised to further enhance the efficiency and convenience of student outing management at IKM Lumut.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

I-SAFETY: Personal Safety System For Emergency Situations

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Abstract: A primary concern in our world that is becoming more interconnected is safety. The swift growth of technology has made it possible for people to use their smart devices as a form of personal security. The truth is that, due to increased crime rates and the frequency of dangerous situations in which people may not be able to easily contact emergency contacts, people are becoming increasingly reliant on ensuring their own safety and self-defense. In response to these issues, the main goal of the I-SAFETY application is to provide users with a reliable and accessible tool that empowers them to take control of their safety. The proposed system is dedicated to providing safety precautions not only to UIA students but also to a broader audience, with a special emphasis on travelers who are unaware of their surroundings while going about their daily lives. A survey questionnaire was one method used to collect user requirements regarding the features and functionalities of the proposed system. One of the key findings is that many people do not currently use any personal safety apps on a daily basis, indicating that I-Safety has a significant opportunity to bridge a critical gap by providing safety measures for people aiming to use personal safety apps. This demonstrates that people have not yet adopted the use of personal safety apps. Thus, in order for users to effectively use the system, its features and functionalities must meet user preferences and expectations while also making sure that it is easily accessible, particularly in emergency situations.

Keywords: Personal Safety, Security, Emergency, Self-defense, Safety Measures

1. Introduction

Talking about safety is a major problem nowadays. Although the students and people are taking all the necessary precautions needed to be taken for their safety, however as technology is rising people tend to use their phone as the safety measure, with the increased use of technology and smart devices which creates an opportunity for a simple and low-cost safety measure that will assist people to overcome any threat. Thus I-SAFETY application which is a personal safety mobile application designed to assist people overcome when they are in dangerous situations.

The app provides a wide range of features that can help users to connect with emergencies and notify their designated contact members if they are in danger. For instance, it enables users to have real-time tracking on their location as well their friends' location allowing them to notify contact members about their whereabouts for emergency assistance. The identified problems of increasing crime rates and the lack of immediate support during emergencies highlight the critical need for innovative safety measures.

1.1 Project Objectives

- Provide users with a reliable and accessible tool that can help them feel more secure in a potentially dangerous situation.
- To empower users to take control of their safety.
- Provide users with a platform that will not only help them in alerting their contacts but also gives them their location.

1.2 Project Scope and Limitations

I-Safety is committed to offering safety precautions to UIA students and others, especially travelers who are unaware of their surroundings while going about their daily lives. It is secure and has a long-term goal such as improving the app's features and functionality for increased user engagement. One of the services this system offers to users is the ability to track their friends' locations and receive notifications when they are still nearby, informing them about emergency contacts information such as fire station, ambulance and police station contact numbers to dial while in an emergency situation.

There are few limitations with the application. For example, because the system is compatible with Android platforms, there is a potential that it will not work on iOS platforms because their systems have several requirements for app installation and launch.

2. Materials and Methods

2.1 Materials

- i) Development environment: Visual Studio IDE with flutter extensions and plugins installed in windows OS
- ii) Flutter Software Development Kit(SDK) installed in windows OS for developing flutter apps.
- iii) Android Studio: In developing flutter apps android SDK is required to run the application.

2.2 Methods

2.2.1 Extreme Programming(XP) Model

The development approach utilized for I-Safety application was Extreme Programming (XP) as shown in figure 1. This methodology aims to deliver software quickly while maintaining flexibility. There were four stages involved in the XP approach which are planning, designing, coding, and testing. Additionally, it includes short iterations and continuous testing to identify and fix bugs early, ensuring stability and reliability.

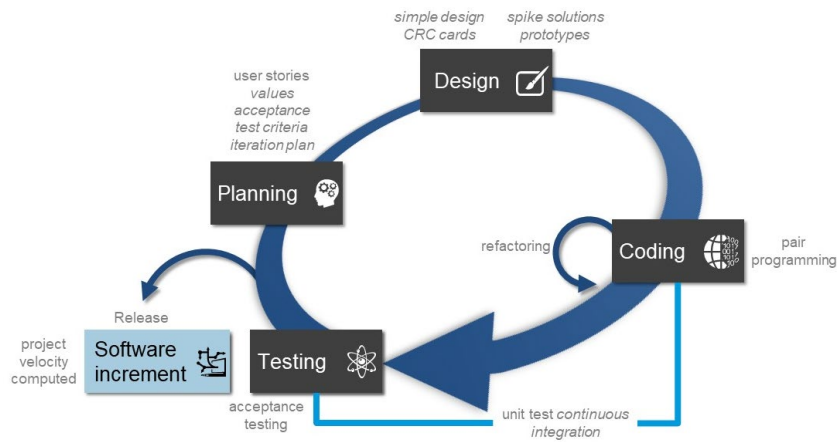


Figure 1: Extreme Programming(XP) Model

2.2.2 System Use Case Diagram And Flowchart

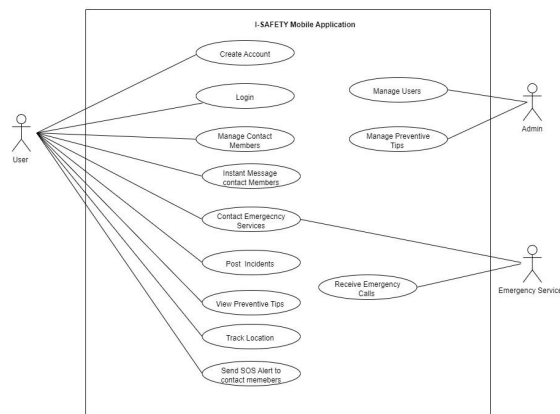


Figure 2: Use Case Diagram

Figure 2 shows the use case diagram that depicting the interactions between the system and its actors while also identifying the system's context and requirements. There are three actors in this system which are users, emergency services and the admin. For the user, they can login to their account using their registered email , track their location , view safety tips, share incidents, contact emergency services, manage contact members, and send instant messages. Meanwhile, for the admin, responsibilities include managing user accounts and safety tips, while emergency services focus on receiving emergency calls from users.

3. Results and Discussion

3.1 Results

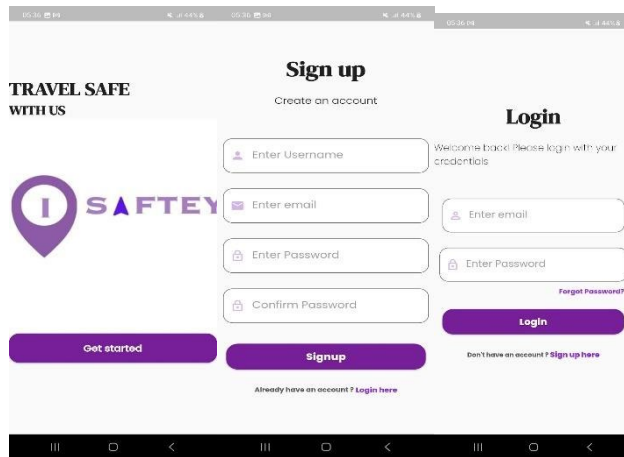


Figure 3: Splash Screen, Registration Screen and Login Screen.

In Figure 3, the app's welcome screen greets users and displays the app's logo. After that, users are directed to a single page where they can either sign up for a new account or log in if they already have one.

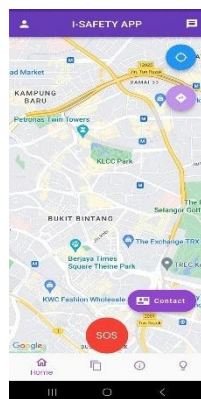


Figure 4a: Home Screen.

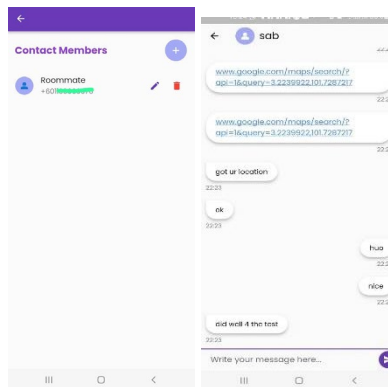


Figure 4b: Message Screen.

In Figure 4a, the Home Screen acts as the main page of the app, where users can find important features like live location tracking and emergency alerts. It's like the central hub of the app, providing easy access to key functionalities. It also shows in Figure 4b, the Message Screen, where users can chat with their contacts in real-time. This screen makes it easy for users to communicate with each other, share locations, and receive notifications for new messages. Together, these screens ensure users can stay connected and informed within the app.

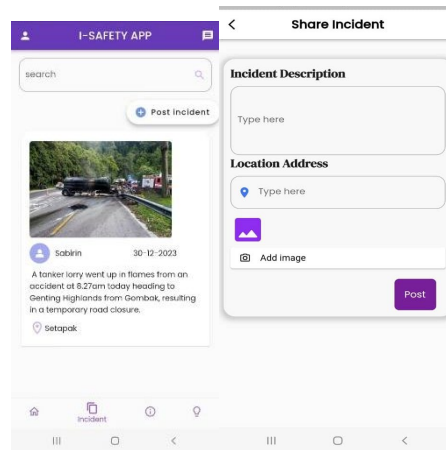


Figure 5: Incident Screen

The Incident Screen, depicted in Figure 5, where users can share incidents with other users. It's like a virtual noticeboard for safety concerns. Here, users can provide details about incidents, upload photos or videos, and specify the location.

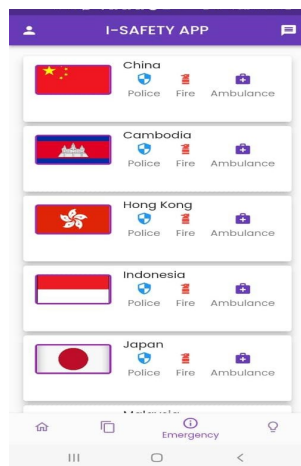


Figure 6a: Emergency Screen

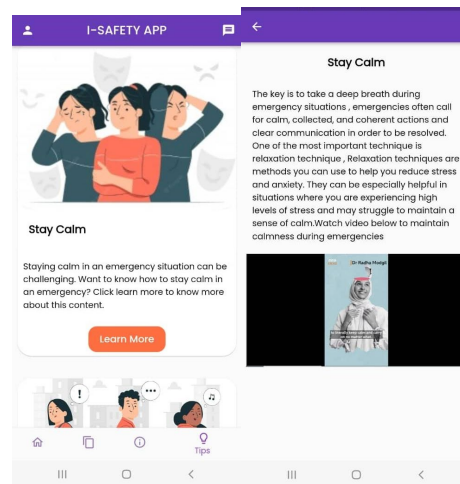


Figure 6b: Safety Tips Screen

Figure 6a shows the emergency screen which users can easily access from the home page of the app. Users have the option to select which country they want emergency contact details. This screen contains information for 15 countries, with an emphasis on East Asian countries. Users will find a list of emergency contact numbers, including police, fire, and ambulance. Meanwhile, users can also access safety tips as shown in figure 6b, where they will find some practical advice and recommendations for staying safe in dangerous situations.

3.2 Discussion

Choosing Extreme Programming (XP) for the I-Safety application brings a crucial advantage to our project. XP's collaborative approach ensures active involvement of users, aligning the app closely with their safety needs. The flexibility of XP is invaluable, allowing us to adapt swiftly to evolving safety requirements and user preferences. Continuous testing in short cycles guarantees the reliability of real-time alerts and emergency features by catching and fixing bugs early in the development process. Pair programming enhances the security and quality of our code, essential for a safety application. XP's

focus on rapid delivery ensures timely releases of safety features, providing users with a quick and effective safety tool. Overall, XP's user-centric design and adaptability make it the ideal choice for creating a reliable and responsive I-Safety application.

Gathering feedback is vital for making the I-Safety app even better. The survey results highlight areas to focus on, like addressing privacy concerns about sharing live locations and boosting user confidence in safety features. Users really care about real-time alerts and easy access to emergency services, so these aspects will be a priority. The interest in preventive safety tips shows that educational content could add value. Following the principles of Extreme Programming (XP), we'll keep getting user feedback regularly to make ongoing improvements. This helps ensure the I-Safety app becomes even more user-friendly and effective in keeping people safe.

4. Conclusion

In conclusion, while the project has made significant progress, it is essential to recognize the areas that require further development. By addressing the identified constraints and implementing the proposed future enhancements, the project will be able to create a safer and more efficient system that effectively meets the needs of its users. Through continuous improvement and innovation, the project can strive towards its goal of providing a reliable and user-friendly application for personal safety.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

MASkyLink: Discovering Astronomy Phenomena

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Abstract: Astronomy, the scientific exploration of celestial occurrences and the universe, encompasses a wide range of captivating phenomena that provide insights into the structure and workings of our cosmos. However, ground-based sky phenomena knowledge and education is not an interesting topic to be delved into depth among people especially students in our country due to lack of awareness. Thus, with the advancements of sensor technology, we demonstrated the capabilities of Raspberry Pi for few astronomical phenomena such as solar eclipse, meteor shower, embedded with visual sky monitoring for real time solar activity or night observation and weather station. This 4in1 astronomical phenomena detection device consists of light to sound sensor, low light Raspberry Pi camera, humidity sensor, temperature sensor and barometric pressure sensor. This cost-effective device also equipped with a 180-degree wide view angle lens enable the camera to capture high-resolution images of the sky and clouds during both day and night. Its compact and simplicity design allows for easy portability enabling installation in various locations without any modifications of existing infrastructure. This device is associated with its designated mobile apps (platform), allowing users to remotely monitor and capture real-time data transmitted through Wi-Fi connectivity. Additionally, we offer an interesting, fascinating and alluring astronomical phenomenon around us by the development of this ‘Smart Astronomical Phenomena Detection Device’ to empower and equip our communities especially young Malaysian learners. This is indirectly giving them an opportunity to learn and explore about astronomy education and implementing digital learning to enhance their knowledge and technical skills.

Keywords: Astronomy, Raspberry Pi, Meteor Shower, Weather Station, Solar Eclipse.

1. Introduction

Astronomy, the scientific exploration of celestial occurrences and the universe, offers insights into our cosmos. Advancements in technology, particularly single-board computers like the Raspberry Pi 2, enable automatic meteor data acquisition and processing using

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affordable, low-light security cameras [1]. Recent hardware and computational improvement have also driven researchers' interest in sensor equipment for earth observation, allowing the study of atmospheric phenomena [2]. High-cost devices, such as space telescopes, provide an even greater level of detail in observing astronomical phenomena. Space telescopes, such as the Hubble Space Telescope and the James Webb Space Telescope, have revolutionized our understanding of the universe [3]. In a recent development, the Ground-based Fireball Observatory (GFO), designed for capturing meteor images, has been developed [4]. However, despite being hailed as a technological marvel, the GFO is encumbered by a complex configuration, leading to its high cost. Thus, it becomes imperative to develop an affordable astronomy instrument. This device should replicate the features of the previously listed advancements, but at a lower cost. It is necessary to create a cost-effective for a few astronomies' phenomenon detection such as a meteor shower, sky monitoring weather station and solar eclipse. To overcome these difficulties, the tool should be simple to operate and open to a variety of users, including astronomy enthusiasts and experts. This device will make it possible for people in general to see any kind of these events and gain useful information. Hence, a solution has been devised to develop a prototype of the smart astronomical phenomena detection device named MASkyLink. It aims to detect meteor showers, monitor the visual sky day and night while providing localized weather status, and feature a solar eclipse light-to-sound function. The Raspberry Pi computer has been chosen for its cost-effectiveness and compact size, enabling it to be embedded with various electronic sensors and cameras. This integration enhances its mobility and convenience, allowing installation anywhere without the need to adjust existing structures. To achieve the project's objectives, three steps were devised. Firstly, Raspberry Pi 4 devices are installed with Raspberry Pi HQ cameras and a few sensors. Next, they are programmed to integrate with the MQTT protocol and its broker. Lastly, the MASkyLink device is accessed remotely via Home Assistant Apps. The project emphasizes the development of a smart astronomical detection device that is all-in- one, user-friendly, and utilizes the Internet of Things (IoT) concept. This initiative has been developed specifically for the education sector, rural, and blind and visually impaired communities.

2. Materials and Methods

2.1 Materials

The properties and specifications of equipment, materials, and other resources used for this particular project are covered in this section. The materials that have been used in this project were divided into three main categories:

- Hardware Implementation: Raspberry Pi 4
- Software Implementation: Home Assistant, AllSky WebUI
- Measuring Implementation: Raspberry Pi HQ Camera, BME280, GY-906, VEML7700.

2.2 Methods

A block diagram was used to illustrate the techniques used throughout the entire process. In this section, the circuit schematics for the entire system have also been provided.

2.2.1 Block Diagram

The device's block diagram shows four distinct components fitting together to form one fully functional system. It consists of Raspberry Pi HQ camera, GY-906, BME280, and light

intensity sensor as shown in **Figure 1**.

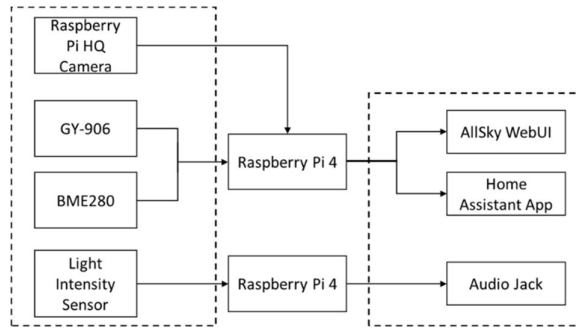


Figure 1: Block diagram of the MASkyLink device

2.2.2 Circuit Diagram

The device's circuitry can be broken down into two key components: firstly, there's the meteor shower detection and sky monitoring, complemented by a weather station; secondly, there's the solar eclipse light-to-sound function. Every component of this complex system works together around the Raspberry Pi 4, which acts as the processing and control center.

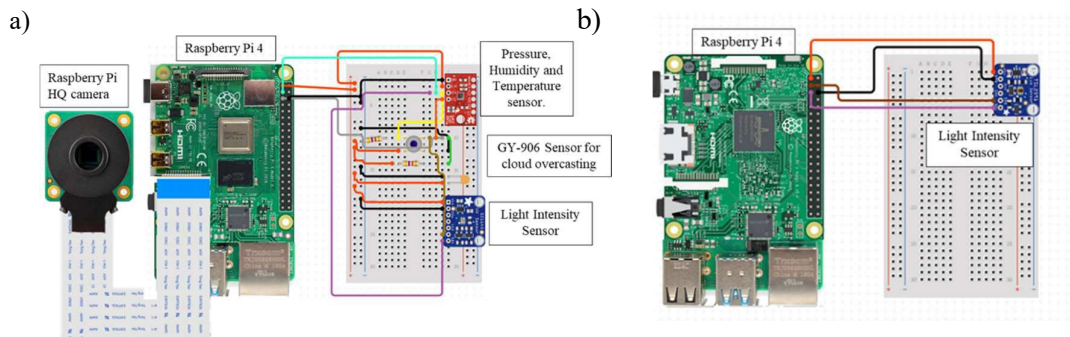


Figure 2: Circuit diagram of (a) the meteor shower detection, sky monitoring with weather station (b) solar eclipse light to sound function

3. Results and Discussion

In this section, the output of the prototype device is presented. All images captured by the device and their respective applications are shown below.

The prototype of the MASkyLink device.

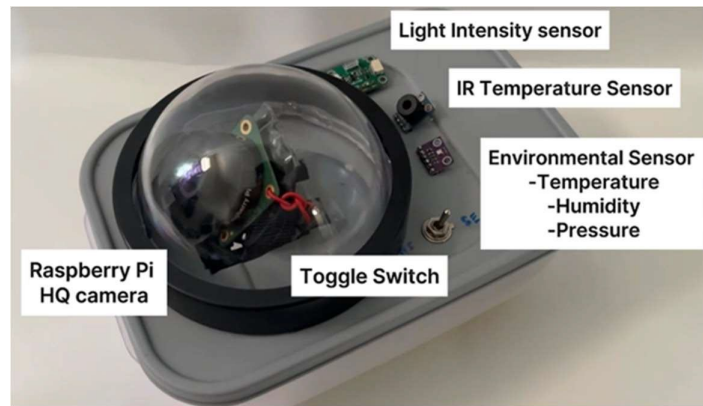


Figure 3: The MASkyLink device prototype with its camera and sensors

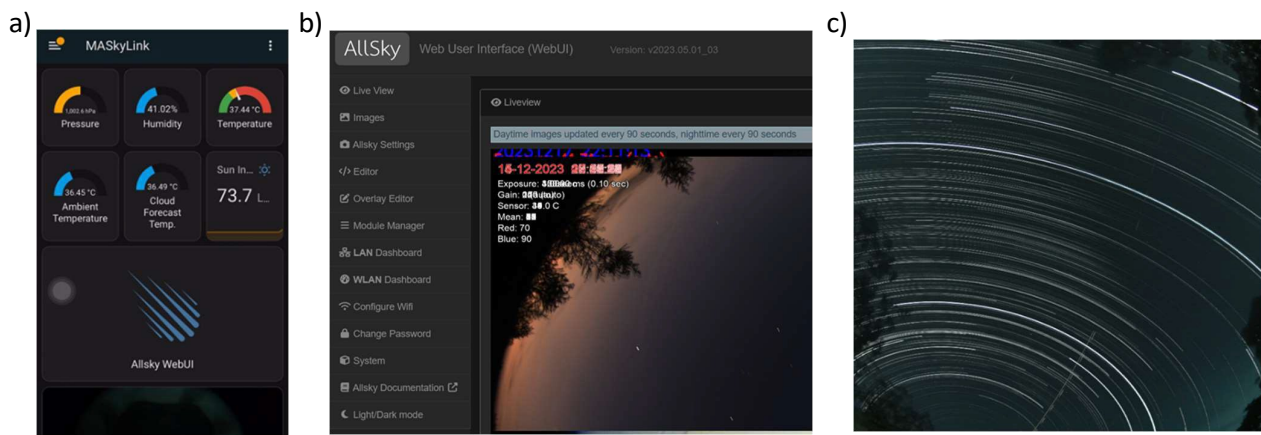


Figure 4: (a) Weather station status and AllSky WebUI shortcut in Home Assistant application's dashboard (b) AllSky WebUI for meteor shower detection and visual sky monitoring (c) Star trail image captured by the device.

4. Conclusion

The primary goal of this device is to provide a cost-effective method of obtaining a variety of astronomical phenomena. Additionally, it gives user access to data through an interactive application that they can operate from a distance using their smart phones. This device removes obstacles like cost, complexity, and cumbersomeness that were present in older astronomy devices. This accessibility helps spread awareness about the study of the universe and celestial activities, especially for young learners who are eager to learn more and put into the realms of astronomy education. This initiative has been developed specifically for the education sector, rural and blind or visually impaired communities. Its abilities have been shown by the MASkyLink device successfully developed. The data gathered indicates that this device can capture meteor shower activity, offering day and night visual sky monitoring, serving as a localized weather station, and having a light-to-sound function during solar eclipses.

Acknowledgements

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Portable Water Quality Inspection System Integrated with TF mini-s LIDAR, pH sensor and IoT monitoring system

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Abstract: Water is utilised for drinking, agriculture, manufacturing, and cleaning. Water must be clean and safe since contaminated water threatens human and aquatic habitats. Malaysia has an abundance of water resources, however the rapid speed of industrialization, urbanisation, and population increase had an influence on water quality. As a result, a water quality monitoring system is regarded as the finest method for providing early detection of contaminants in water. Unfortunately, there are few limitations and problems arise when doing water quality inspection in Malaysia especially for water reservoir and in agriculture area. Currently in Malaysia, many water quality assessment method rely on manual sampling and laboratory analysis which can be time consuming and resource-intensive. In order to overcome the limitations with the present model, a portable water quality inspection system will be introduced in this project. This suggested system included a high-sensitivity optical sensor and a pH sensor for water inspection, as well as IoT data monitoring using an ESP32 microcontroller that transferred data from the system to a mobile phone. The sensor used for this system is TFS mini-LIDAR s, pH sensor to detect the turbidity and pH level in water. Detail analysis for light signal strength of LIDAR will be used to evaluate the water quality examination in this project. Several experiments using different water samples from different locations were conducted using the proposed system. The data gathered from the different locations will be investigate and evaluate using statistical analysis tools. We believe that the suggested system will be able to improve on present water pollution inspection technology by integrating a real-time water pollution detector with an IoT system for early detection of water pollution.

Keywords: LIDAR, IOT, water pollution

1. Introduction

Drinking water quality (DWQ) has an important role in human health and the conservation of other ecological ecosystems. By 2030, the United Nations' Sustainable Development Goal 6 (SDG 6) aims to guarantee universal access to and management of water and sanitation, as well as an end to open defecation[2]. However, rapid economic development has begun to create industrial pollution and urban degradation [3]. Rivers supply 98% of Malaysia's total water use[4]. Although Malaysia is blessed with many water reservoir, but large quantity of water resources available in the catchment unfortunately does not guarantee adequate supply to all users because of the river pollution.

2. Comparison between Modern Water Quality Monitoring System

Many researchers have conducted considerable relevant study in order to more properly monitor

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water quality. The most important new technologies have been based on optical or electrochemical sensors. However, due to the recent advancement of these technologies, additional thorough assessments and evaluations in real-world situations are required to ensure the precision and repeatability of their use[5]. Some researchers have used the Internet of Things (IoT) and long-range technology (LoRa) to create a water quality monitoring platform that can measure and collect important water quality data. These data are transmitted to a server via a network by the LoRa gateway. The approach can then be used to do online monitoring of water quality, and it has produced positive monitoring findings[6], [7]. Many academics have performed research on how to better monitor the water quality of reservoirs. Sendra et al.[6] proposed developing and deploying a LoRa-based wireless sensor network to monitor water quality in coastal areas, rivers, and ditches. The network is made up of numerous wireless sensor nodes that are outfitted with sensors that physically detect water quality metrics like turbidity and temperature, as well as weather factors like temperature and relative humidity. The wireless sensor network is used to monitor the water quality in the target area. Sanya et al.[7] suggested a real-time infrastructure for monitoring water quality based on IoT and LoRa technologies. The platform measures and collects vital data concerning water quality, such as pH, turbidity, and the temperature of the surrounding atmosphere. However, the platform necessitates the deployment of a large number of sensor nodes. To monitor the water quality of the Ganges river, Singh et al.[8] developed a realtime water quality monitoring system. The details of the real-time water quality monitoring system established in the Ganges river were also given, as were the findings of several parameters collected by the system. Blanco-Gómez et al.[9] created a low-cost monitoring device that can be integrated into a tiny buoy and connected to fishing and leisure boats, allowing citizens to collect water quality information (EC and temperature) with their smartphones. Gunia et al.[10] presented an IoT system for real-time monitoring of water quality. This system's data can be sent to the cloud in real time to track the condition of the water body and retrieve real-time quality data for various chemical and biological indicators such as pH, dissolved oxygen (DO), total dissolved solvents, and turbidity. However, the system is expensive.

2. Methodology

All the designs were made by using Solidwork software for suitable and efficient method to simulate the durability suitability of project. Support stand main purpose is to support a cylinder pipe made up of an acrylic tube. The sensor jig is developed by printing two 3D casing for the microcontroller and the sensor. The jig is tied with Velcro tape, using this method, the sensor box can be wrapped around. ESP32 as the microcontroller is placed in a separate casing box mounted at the end of the support stand. Figure 1 shows the final prototype.



Figure 2 The final prototype

3. Results and Discussions

The integration of an Internet of Things (IoT) system into the final module of this project, focusing on real-time data storage and display, followed a structured methodology. The chosen IoT platform for this integration was Favoriot, selected for its robust data storage and streaming capabilities, aligning with the project's data management requirements. To gain access to Favoriot's suite of features, a Beginner account subscription was initiated. Configuration of the Favoriot system was a critical step in

this process. It was essential to ensure that the platform could seamlessly accept data streams from multiple sensor devices concurrently. This configuration allowed for the simultaneous collection of data from various sources, ensuring comprehensive data integration as shown in Figure 2.



Figure 2 The data stored and streamed in Favoriot platform

To present the streamed data to users in real-time, a line chart was implemented for data visualization as shown in Figure 3. This chart not only provided a visual representation of the data but also included critical information such as data values, source sensor identification, and timestamps. This approach enhanced the user's ability to monitor data changes and trends transparently. Furthermore, to extend the project's data analysis capabilities, a mechanism was established to convert the streamed data into CSV (Comma-Separated Values) format. This conversion facilitated the export of data for further analysis using various software tools and statistical methods. The resulting CSV files served as a valuable resource for in-depth data exploration and reporting.



Figure 3 the data are plotted using line chart for analysis process

4. Conclusion

This system integrated with high-sensitivity optical sensor and pH sensor for water inspection and also equipped with IoT data monitoring by using ESP32 microcontroller to transfer data from the system to mobile phone. In this project, light signal strength or light intensity will be used to assess the water quality inspection. The performance analysis for devices under study shows a promising characteristic for further improvement. For the future of the work, several simulation and experiment will be conducted to ensure the constant in reading.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

SIMANIS: A Prototype for Non-Invasive Blood Glucose Monitoring System

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Abstract: Effectively managing hyperglycaemic conditions necessitates frequent blood glucose concentration monitoring. However, the widespread use of invasive procedures, fraught with inconveniences and infection risks, prompts the exploration of innovative solutions. This study addresses these challenges by proposing a non-invasive continuous glucose monitor utilizing an Internet of Medical Things (IoMT)-assisted photoplethysmography (PPG) system. The primary objective is to classify users' blood glucose concentrations into low, normal, or high categories through continuous monitoring. The study encompasses key components to enhance the efficacy of the non-invasive method. Firstly, a prototype enables real-time blood glucose measurement through a non-invasive approach. Secondly, a groundbreaking algorithm is developed to acquire high-quality PPG signals, processed by an IoMT-based microcontroller. Thirdly, the proposed machine learning is employed to generalize spatiotemporal features from PPG signals and is trained across various blood glucose concentrations. The system then infers valid samples into three glucose concentrations using the implemented machine learning algorithm in the microprocessor system. Comprehensive evaluation, involving a dataset of 44 monitored subjects, reveals commendable performance. The system achieves a highest f1 score of 90.4% for classifying valid signals and an average f1 score of 87.5% for estimating blood glucose concentration. These findings underscore the system's reliability and accuracy in continuous non-invasive monitoring. Beyond immediate results, the proposed approach contributes a valuable reference, showcasing IoMT technology's potential in transforming at-home medical treatments. This pioneering research not only advances blood glucose monitoring but sets the stage for broader IoMT applications, enhancing healthcare accessibility. In summary, this study represents a significant leap toward revolutionizing at-home medical care, offering a promising paradigm for future advancements in patient-centric monitoring solutions.

Keywords: Blood Glucose Concentration, Non-Invasive Approach, IoMT, Deep Learning

1. Introduction

Non-communicable diseases like diabetes mellitus are increasing every year, and Indonesia is now ranked third worldwide for undiagnosed diabetes mellitus cases. The number is derived from the 2021 International Diabetes Federation Diabetes Atlas, indicating that 73.7% of the Indonesian population has not been diagnosed with diabetes [1]. The rise in instances of DM is attributed to a lack of awareness, attitude, and behavior toward early identification, as well as challenges in accessing health facilities for regular blood sugar monitoring [2]. Invasive blood collection methods such as venous

[Type here]

puncture, cutaneous puncture, and arterial puncture can be challenging for those with needle phobia, leading to discomfort, agony, and a risk of infections [3].

Biometric measures, such as blood pressure, pulse, and oxygen saturation levels, are often used non-invasive methods to assess a patient's status. Nevertheless, creating a non-invasive technology for continuous glucose monitoring has substantial obstacles. One of the main obstacles is guaranteeing precise and dependable glucose measurements [4]. The CGM sensors need to ensure consistent glucose readings by addressing challenges such as sensor drift, calibration flaws, and signal noise [5]. External variables like temperature fluctuations or drug consumption might affect the precision of CGM measurements [6]. Dealing with non-Independently and Identically Distributed (non-IID) data is an issue that hinders the improvement of decision-making systems. Efficient algorithms and systems are needed to analyze the constant stream of glucose data and offer valuable insights to patients and healthcare professionals [7]. It is essential to tackle the listed obstacles to progress CGM technology, enhancing its accessibility, user-friendliness, and effectiveness in helping people with diabetes proactively manage their disease.

This work uses a IoMT-enabled PPG sensor to monitor Blood Glucose Levels (BGLs) by analyzing red and infrared emissions from two data sensors. The work utilizes AI technology, namely CNN and oversampling techniques, to accurately classify blood glucose trends. The research is expected to significantly contribute to addressing issues in developing sustainable non-invasive blood glucose monitoring technologies, thereby improving the healthcare experience for people with diabetes. The subsequent sections of this work are outlined as follows: Section II contains the materials and techniques, while Section III provides detailed information on the results and commentary. Section IV has succinct conclusions.

2. Materials and Methods

Deep learning (DL) is a machine learning method that use artificial neural networks to analyze extensive datasets, proving especially beneficial in supervised learning assignments. CNN is a type of neural network that is structured similarly to traditional neural networks and is inspired by the operation of human neurons [8], [9]. It is mostly utilized in visual pattern recognition, setting it apart from Artificial Neural Networks (ANN). By incorporating image-specific characteristics into the model's structure, the network improves its performance on image-related tasks [10]. However, class imbalance i.e., non-IID, is a major challenge for prediction systems especially in medical data domain. Data oversampling is a method employed to tackle class imbalance in a dataset that is not uniformly and independently distributed. Oversampling techniques aid in balancing the dataset, leading to improved performance in classification tasks [11] – [14]. As depicted in Figure 1(a), the proposed prototype incorporates a hardware system relying on ESP32 and the MAX30102 sensor system, while the software design involves implementing an AI model based on CNN. Additionally, the coding for this prototype is executed using Google Colab using flow diagram on Figure 2(b).

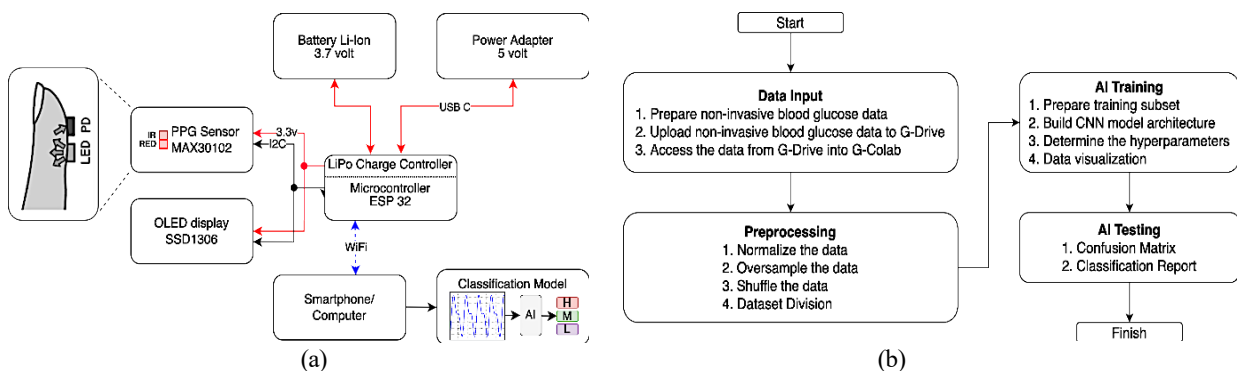


Figure 1. The proposed prototype utilizes (a) hardware system based on ESP32 and the MAX30102 sensor system, while (b) the software design employs an AI model based on CNN.

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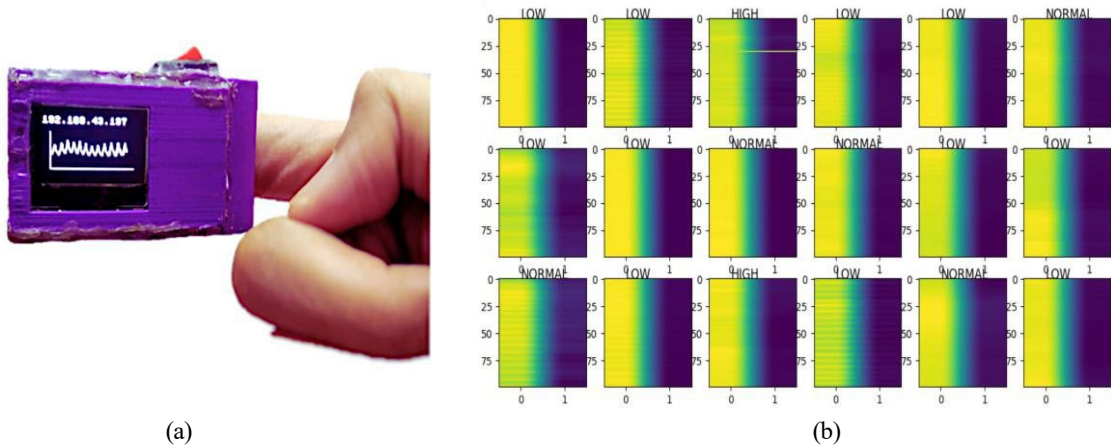


Figure 2. The input data consists of 23 research subjects measured using (a) the GCM prototype, while a gold-standard glucometer is used as a reference for (b) data labeling.

3. Results and Discussion

This study aims to enhance the AI technique by utilizing the CNN model to improve the efficiency of the non-invasive blood glucose categorization system in non-IID environments. The procedure involves measurements using the CGM prototype and a gold-standard glucometer, as illustrated in Figure 2. This research aims to develop a robust and accurate non-invasive blood glucose classification system using an AI model and the CNN model. Random oversampling is used to enhance the performance of PPG data analysis by generating synthetic data points for the minority class, increasing its representation in the dataset. This approach mitigates bias towards the majority class and prevents the model from being overly influenced by its prevalence. The proposed AI model uses the CNN model for BGL prediction, which undergoes preprocessing, visual representation, and fine-tuning of neurons and filters. The CNN model processes the data and classifies it based on the data label, often acquired through a gold-standar glucometer.

In the training scenario without oversampling, the model achieved the highest accuracy of 0.6111, while the lowest loss was 0.9451. The visualization of the training results for 500 epochs shows how the model performance increases with the number of epochs performed. In the testing stage, the optimal model generated from the training stage is used to test the model's performance on the testing data. Using the oversampling method in training DL models significantly improves model performance. Prior to oversampling, the precision, recall, and f1-score of the model only reached 50%, indicating limitations in classifying non-invasive blood glucose data with high accuracy. However, with oversampling, the precision, recall, and f1-score increased up to 100%, indicating that the model is able to classify data well and achieve high accuracy [11], [15], making it reliable in predicting non-invasive blood glucose classification.

TABLE I. THE PERFORMANCE OF CNN_(8,12) WITHOUT OVERSAMPLING

Classification Label	Precision	Recall	F1-score	Support
Low	0.50	0.50	0.50	2
Normal	1.00	1.00	1.00	1
High	0.00	0.00	0.00	1
Overall Accuracy			0.50	4

TABLE II. THE PERFORMANCE OF CNN_(8,12) WITH OVERSAMPLING

Classification Label	Precision	Recall	F1-score	Support
Low	1.00	1.00	1.0	1
Normal	0.80	1.00	0.89	4
High	1.00	1.00	1.00	3
Overall Accuracy			0.88	8

4. Conclusion

The study presents a novel approach to medical data processing using a deep learning framework. It optimizes a deep learning model using a novel CNN technique, enhancing the effectiveness of a non-invasive blood glucose classification system. The model achieves high accuracy in both subset training and validation, with the best results achieved by the CNN(32,48) model. The random oversampling technique increases the number of relevant data samples from 23 to 39, resulting in a 77.27% increase in accuracy. This technique overcomes the issue of non-IID datasets and improves the performance of the non-invasive blood glucose classification system. The study also shows an increase in F1 -Score for class 1 from 67% to over 89% and for class 2 from 0% to 100%.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Smart Bidirectional Bus Passenger Counter (BiBus)

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Abstract: The problem of bus passengers consistently missing buses despite intending to board has become a major concern in public transportation systems. This abstract explores current challenges related to consistently missing bus passengers and proposes potential solutions to reduce this issue. Passengers who consistently miss buses pose various challenges to both passengers and public transportation operators. For passengers, missing buses can lead to delays, inconvenience, and potential disruptions to their daily routines, especially for those heavily reliant on public transportation for their daily commute. For operators, passengers consistently missing buses can result in decreased operational efficiency, increased wait times for other passengers, and potential financial implications. Based on the research in this project, we found that various factors compel us to address the issues faced by bus passengers. This problem is caused by challenges and limitations of traditional manual passenger counting methods in public transportation systems.

Keywords: Bus Counter, Missing Buses

1. Introduction

The integration of Internet of Things (IoT) technologies has revolutionized many aspects of modern life, and one area that has seen significant advancements is in the realm of transportation. Smart cities and urban mobility solutions are leveraging IoT to optimize public transportation systems, and accurate passenger counting is a critical component of this optimization process.

Traditional manual counting methods are often labor-intensive and error-prone, leading to inefficient resource allocation and decision-making. Smart Bidirectional Bus Passenger Counter (BiBus) offers a promising solution to these challenges by leveraging sensors, connectivity, and data processing to accurately and automatically count passengers boarding and alighting buses in both directions.

1.1 Problem Statement

The problem statement of Smart Bidirectional Bus Passenger Counter (BiBus) revolves around the challenges and limitations of traditional manual passenger counting methods in public transportation systems. These methods are often prone to inaccuracies and errors,

resulting in incorrect passenger count data that can lead to inefficient resource allocation and revenue miscalculations. Moreover, manual passenger counting methods are labor-intensive and time-consuming, requiring dedicated personnel to be deployed for counting, which can increase operational costs and cause delays in data collection and decision-making.

Additionally, manual counting methods may not provide real-time data, limiting the ability of transportation authorities and operators to make timely decisions and optimize services. Furthermore, the lack of insights and analytics in manual counting methods can hinder the utilization of passenger data for meaningful insights, such as identifying passenger trends and optimizing bus routes. Lastly, manual counting methods may not be easily scalable or adaptable to different bus types, routes, or changing requirements, limiting their effectiveness in dynamic transportation environments.

Therefore, the problem statement of Smart Bidirectional Bus Passenger Counter (BiBus) is to develop a solution that overcomes these limitations by leveraging IoT technologies to provide accurate, automated, and real-time passenger count data with additional features such as data analytics, visualization, and remote monitoring, to optimize public transportation systems and enhance passenger experience in the era of smart cities and urban mobility.

1.2 Objective

To design and develop hardware for bus passenger counting system using NodeMCU. Integrate sensors into the system for accurately counting passengers entering and leaving the bus. To build a real-time monitoring system that displays the current number of passengers on the bus.

2. Materials and Methods

The introduction provides an overview of the concept of a Smart Bidirectional Bus Passenger Counter (BiBus) and its significance in modern transportation systems. It outlines the objective of the literature review and presents the scope of the study. The development of smart transportation systems has gained significant attention in recent years, aiming to improve efficiency, safety, and passenger experience. One crucial aspect of such systems is accurate passenger counting, which provides valuable data for route optimization, capacity planning, and fare collection. In this literature review, we explore three relevant projects that focus on bus passenger counting but utilize different technologies apart from IR sensors.

2.1 Sensor Project

Xiao-Wei Liu et al. (2012) proposes a novel approach to bus passenger counting using computer vision techniques. Instead of relying on heat sensors, they leverage camera-based systems to detect moving heads within a bus. The authors conducted extensive experiments to evaluate the accuracy and robustness of their approach under various lighting conditions. Their results show promising performance, with an average counting accuracy of over 90% across different scenarios.

The system works by analyzing video frames captured by strategically placed cameras. It utilizes advanced image processing algorithms to track and identify human heads within the frame. The researchers employed machine learning techniques to train their model for head detection, achieving remarkable accuracy. This project offers an alternative solution to traditional IR-based passenger counting systems, showcasing the potential of computer vision in smart transportation applications.

Chao-Ho Chen et al. (2008) proposes a bus passenger counting system that utilizes image analysis techniques. Like the previous project, this approach relies on cameras placed strategically within the bus to capture video footage. However, the emphasis here is on image analysis algorithms rather than specifically detecting moving heads. The authors developed custom algorithms to analyze the video frames and accurately estimate the number of passengers on the bus.

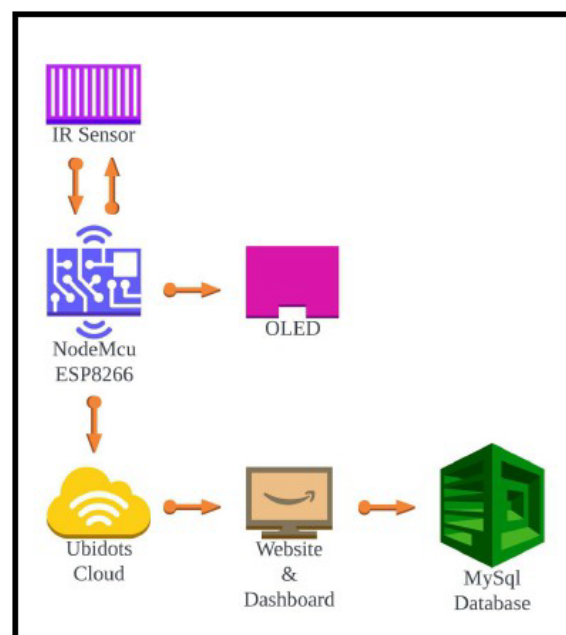
Their experimental results demonstrate the effectiveness of the proposed method, achieving a counting accuracy of over 95% in different scenarios. The system takes advantage of image segmentation and object recognition algorithms to identify and track passengers throughout the video. By integrating these techniques with machine learning algorithms, the authors achieved real-time and accurate passenger counting, enhancing the efficiency of smart transportation systems.

Reza Perkasa et al. (2021) present a unique approach to bus passenger counting using movement analysis. Their project focuses on monitoring the movement of passengers entering and leaving the bus rather than relying on IR sensors or cameras. The proposed system utilizes strategically placed motion sensors and algorithms to detect and count the number of individuals entering or exiting the bus.

The authors conducted comprehensive experiments to validate their approach, achieving accurate counting results even in crowded and dynamic bus environments. By analyzing the data from motion sensors, the system can differentiate between the direction of movement and accurately update the passenger count. This project showcases an alternative method that eliminates the need for cameras or physical contact sensors, providing a cost-effective solution for bus passenger counting.

2.1 Methods

The methodology section of this project focuses on the integration of sensors to detect the number of passengers entering and exiting the bus. Accurately counting passengers in real-time is essential for efficient transportation management and resource allocation. By developing a systematic methodology, we aim to ensure the successful implementation and operation of the sensor-based detection system.



3. Results and Discussion

The results and discussion section presents data and analysis of the study. This section unpacks the outcomes of our Smart Bidirectional Bus Passenger Counter (BiBus) using NodeMCU. We'll dive into the test results, examining how well the system counts passengers in various scenarios. The goal is to present clear insights into what the system can and can't do based on rigorous testing.

3.1 Results

Results can be presented in the oled screen, Oled screen will show the data from counter in and out passenger. The data will save in NodeMcu. Real time data monitoring from smart passenger counter to database.

3.2 Discussions



The successful implementation of the Smart Bidirectional Bus Passenger Counter relies heavily on a robust software foundation. This section outlines the step-by-step process of installing and configuring the necessary software components to ensure seamless functionality. Conclusion

The smart bidirectional passenger counter project, leveraging NodeMCU v2 and integrated sensors, has achieved a milestone in the domain of IoT-based passenger monitoring. Through successful hardware integration and implementation of an IoT communication protocol, the system demonstrates accurate and reliable passenger detection. Insights gained underscore the importance of sensor calibration and considerations for real-world conditions. Looking ahead, future recommendations include exploring advanced sensor technologies, integrating machine learning for enhanced recognition, developing user-friendly interfaces, and investigating system scalability. This project lays a robust foundation for innovative solutions in passenger counting, with the potential for widespread applications in various environments.

Appendix A (Optional)

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Smart Home Monitoring System with IOT Application

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Abstract: A smart home monitoring system is a technology that monitors power factor, voltage, current, and electricity usage. A smart monitoring meter is used to collect data about appliances and to conveniently control the power consumption of appliances from within the room or remotely. By using the smart meter, it will display the information to users so that a clearer picture can be seen in electricity consumption and able to monitor usage and charge bills as well. The main objectives of this project are to monitor and measure the energy consumption for home appliances remotely through an IoT control, and users exactly pay for actual bills. This project will start by turning on the current and voltage sensors connected to the ESP32. Hence, the voltage, current and power readings will be displayed on the LCD. Finally, the value displayed from the LCD will be displayed on the mobile phone in the Blynk application. Monitoring device placement. The device shall be placed at the main live line to monitor the total household consumption. The experiment shows an energy consumption for several type home appliances in real-time where as consumer able to identify the excessive consumption being used or any defects in used electrical devices at home that being used. Therefore, the study promotes new innovated system that measure the usage of energy consumption and user exactly pay for actual bills. In order to support the wide-ranging uses of IoT technology in the information society in the future, a comprehensive application of this field is necessary for future planning.

Keywords: smart home monitoring, smart meter, energy consumption

1. Introduction

The trend of network convergence is moving towards the Internet of Things (IoT). It is a dynamic global network infrastructure, to put it simply [1] [2]. Under this scenario, all objects are able to be uniquely identified and easily integrated into the information network, enabling them to join the Internet. [3] [4]. Many countries reportedly realised how important it was to establish IoT networks and smart houses. To accelerate the growth of the Internet of Things, they have started implementing smart-home initiatives, by taking into an account the national circumstances and financial capacity [5].

A smart home, also referred to an e-Home is a living space with extremely sophisticated automated

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systems. A computer monitors a smart home's daily operations, giving the impression that it is "intelligent" [6] [7]. A smart home uses home networking to integrate a variety of technology to enhance living conditions. A smart home is equipped with sophisticated automated systems that monitor and regulate the lighting, temperature, multi-media equipment, home appliances, security systems, and many other features [8] [9] [10] [11].

As the consequence of digital era in Malaysia, cities in Malaysia will soon be transforming into smart cities. A smart city in an environment and infrastructure which is highly depends upon Internet for communication and services. The motivation behind this paper is to propose a smart home system that a key factor for building smart cities in Malaysia. Therefore, this paper proposed a smart meter monitoring system that provide an automatic meter reading technology facilitates the assessment of energy consumption and analysis of data for billing and payment [12] [13].

2. Materials and Methods

The design and operation of the suggested energy meter monitoring system are covered in this section. It also shows the device prototype and interconnection of components while working in real-time. The architecture of the proposed system is divided into three major parts which are energy meter, IoT based on smart meter and application interface for the customer as shown in Figure 1.

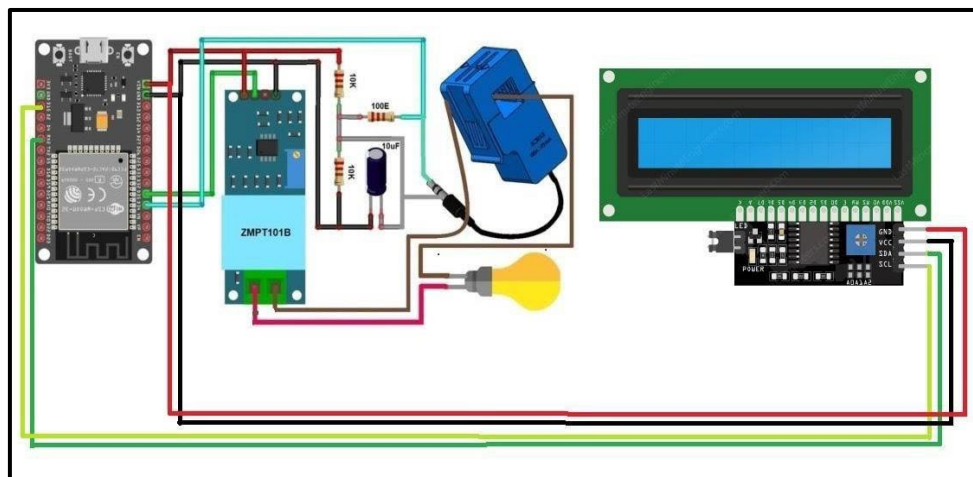


Figure 1: Proposed smart home monitoring system

In this project, an Arduino Uno serves as the main controller to monitor household energy consumption by tracking the blinking LED on the energy meter. The Arduino calculates the units consumed and displays the reading and cost on a dedicated webpage. The devices have been connected with the Wi-Fi network to transfer data in the cloud server. The devices are being mounted on the energy meter to fetch the pulses. The received pulses are being transferred to the corresponding accounts of customers created in the cloud server. Customers can request access to all of their energy use data by registering using the Android application, logging in, and completing an account login.

2.1 Smart energy meter

An electrical device called an energy meter, also known as a watt-hour meter, is used to calculate how much electricity is utilized by users. One of the electrical utilities departments, which place these devices everywhere such as residences, businesses, organizations, and commercial structures to track the amount of electricity consumed by equipment such as refrigerators, fans, lighting, and other household appliances. The energy meter measures the current and voltage at high speeds, compute their product and provide immediate power. This electricity is integrated over a period, providing the energy that was used throughout that time as shown in Figure 2.

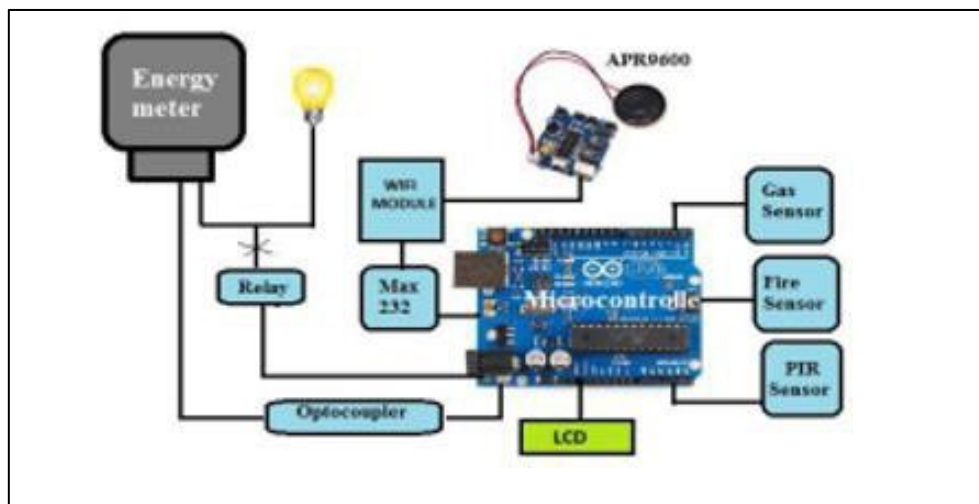


Figure 2: Block diagram of smart energy meter

2.2 IoT based on smart meter

Figure 3 shows a database is created into the cloud server for each device. Each device fetches pulses from the energy meter which is converted to kilowatt using the equation and transferred into the database (Blynk). Blynk simplifies IoT development with a drag-and-drop interface on its mobile app, allowing users to control and monitor connected devices. It is popular for its cloud connectivity, library support for various hardware, and virtual pin concept. In educational settings, Blynk is valuable for teaching IoT concepts, enabling students to quickly prototype projects and gain hands-on experience without extensive programming knowledge.

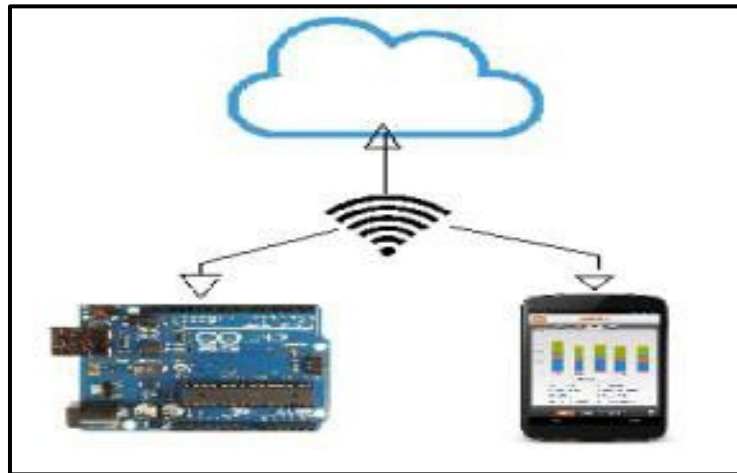


Figure 3: IoT Design

2.3 Application Interface for customer

The study created the Internet of Things (IoT) that enables a smart meter connected to home appliances. The aim of this technology is to reduce the labor-intensive process of manually measuring electrical units and raise user awareness of excessive electricity consumption.. Through an Android application, consumer can view all of the data that is kept in the cloud. By logging into the appropriate accounts, users can obtain information about their registered accounts. As a security precaution, the user must provide their password and user ID in order to log in. The user can check the quantity of units utilised, total cost, and Wi-Fi network details after logging in.

3. Results and Discussion

Data analysis divided into three parts: testing project input functionality, testing the value of an electrical appliance and setting the coding to the input with the data collection. The complete prototype as shown in Figure 4.



Figure 4: Prototype Project

The prototype of this project is completed with the installation of all components. ELCB and MCB are a very important part to protect the ESP32 board and its components to control the voltage. The adapter is used to power the LCD. An empty socket is where the 3-pin plug of electrical equipment is inserted to get the power value.

Table 1: Result of Analysis Data

Home Appliances	Power (W)
Iron	1058.81
Fan	1.77
Vacuum	1321.33
Boiler	1947.67
Turbo Fan	2.84

Table 1 tabulates the result of the proposed real-time system. The recorded data of average energy consumption in several electrical appliances for 7 days. The time difference between each collected data is 24 hours. The developed prototype has been connected to an energy meter to observe the energy consumption pattern of that house. This table helps to make concern of excessive use of energy in their residence. Besides, close observation of collected data can be used to find abnormal consumption patterns and defects in our used electrical devices at home.

4. Conclusion

The proposed study can be reduced customer complaints and raise customers' concerns about excessive electricity use and malfunctioning household appliances. Consumer may simply view the total pulse, total units, and total electricity costs with this technology. The method is dependable and simple to read. In the future, cloud-based data will play a major role in energy meter data mining. Furthermore, close observation of collected data can be utilised to identify abnormal consumption trends and in the electrical appliances we use on a daily basis.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Smart Monitoring Hydroponic System(SMoHS)

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Abstract: The Smart Hydroponics monitoring system is a modern soil-less cultivation method controlled by a Raspberry Pi 3 B+ using Blynk services for data storage and visualization using Dashboard. It enables remote and efficient management by recording the sensor reading such as water temperature, humidity, pH, and nutrient levels. To integrate IoT sensors and predictive analytics for monitoring, this project aim to collect real-time environmental data to improve growth effectiveness to optimize growth conditions. The objectives of this project is to study the integration between smart agriculture with IoT and to develop a precise nutrient management system to customize fertilizer application. Utilizing a Raspberry Pi 3 B+, the project aims to implement sensor usage in the agricultural field and then store the data obtained in the database. The hardware components for this system include a Raspberry Pi 3 B+, water pump, peristaltic pump, TDS sensor, pH sensor, DHT sensors, monitor, Spectrum LED grow light, PVC junction box. Free services like Blynk server for our database to reduce project expenses and it's easy to use. The sensor data collected can provide information related to plant needs, allowing the identification of patterns and fluctuations that are important to maintaining an ideal hydroponic environment. The "Smart Hydroponic Monitoring System" offers a solution to challenges in crop cultivation by providing real-time supervision and management of crucial parameters. By integrating diverse sensors and data analysis, it equips growers with valuable insights for informed decisions, advancing smart agriculture for efficient and sustainable crop cultivation. For future work we hope that this project will provide more sensor with accurate sensor reading and have automatic feature.

Keywords: IoT, Internet of Thing, Hydroponic, Smart Monitoring, Smart Application

1. Introduction

The Smart Hydroponics monitoring system is a modern soil-less plant cultivation project using deep flow technique, controlled by a Raspberry Pi 3 B+. It employs Blynk services for data storage and visualization, recording essential metrics such as water temperature, humidity, pH, and nutrient levels. This system offers remote and efficient management, enabling growers to monitor and assess their plants' performance through user friendly graphical representations.

A. Problem Statement

A solution for hydroponic systems integrates IoT sensors and predictive analytics to automate monitoring. Sensors collect real-time environmental data, enabling system health assessment and

performance insights. Predictive analytics detect patterns and anomalies, offering proactive recommendations to optimize growing conditions. This approach enhances efficiency, minimizes crop damage, and benefits modern agriculture.

B. Project Objectives

The objective of the Smart Hydroponics Monitoring System is to employ advanced sensor technology to accurately detect crucial parameters such as temperature, pH, and fertilizer concentration within the hydroponic tank. This data will be systematically collected and stored for analysis, ensuring the long-term health and growth of the plants. Furthermore, the system aims to facilitate user-friendly remote monitoring and real time tracking, enabling growers to make informed decisions and adjustments for optimal plant development.

C. Project Scopes

The Smart Hydroponics Monitoring System utilizes a Raspberry Pi 3 B+ to manage a sensor network, maintaining ideal conditions in hydroponic systems. It collects and stores sensor data for real-time and historical analysis, fostering optimal plant growth. A user-friendly dashboard provides easy access to data, enabling users to visualize and control their hydroponic setups for successful crop cultivation.

2 Related works

In the realm of IoT applications and smart agriculture, several studies have addressed the integration of various components to enhance system functionality. Yang, Sharma, and Kumar (2021) discuss the use of ThingSpeak as a data storage platform but do not delve into the specific hardware components. On the other hand, Muhammad Azhar Ali and Rina Khatab (2019) present an IoT-based soil pH monitoring system, which effectively integrates pH sensors with an Arduino Uno microcontroller, a wireless module, and a cloud server, enabling real-time wireless transmission of pH data for smart agriculture. Additionally, another project developed a hydroponic system that places significant emphasis on monitoring various parameters, such as water temperature, water level, pH, and nutrient concentration, utilizing sensors connected to an Arduino Uno, while also incorporating ThingSpeak for data storage. Therefore, the combination of these projects demonstrates a strong connection in utilizing the Arduino Uno, ThingSpeak, and the integration of pH sensors with a microcontroller, a wireless module, and a cloud server to enhance IoT based applications and agricultural management.

3 METHODOLOGY

In this project, the components that will be used for hardware development consist of Raspberry pi 3, water pump, peristaltic pump, tds, pH and temperature sensors.

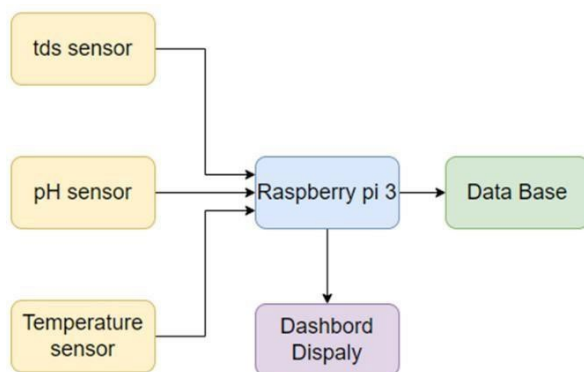


Figure 2.1: Block Diagram

The hardware components for this device are total is RM1238.50, but the project takes advantage for free services such as Blynk to reduce the cost of expenses.

4 Results

This report provides a comprehensive analysis of data collected from a set of sensors deployed to monitor environmental conditions. The sensors include a DHT sensor for temperature(°C)and humidity(%), a Total Dissolved Solids (TDS) sensor (ppm), and a pH sensor. The aim of this data collection and analysis is to gain insights into the dynamics of the monitored environment, identifying any patterns, fluctuations, or potential anomalies that could impact the quality and stability of the environment.

The data was recorded at specific timestamps, offering a snapshot of the environmental parameters over a defined time. Understanding the trends and variations in temperature, humidity, TDS, and pH levels is crucial for maintaining an ideal hydroponic environment. This information is vital to the success of our hydroponic project, as it directly impacts the health and growth of the cultivated plants.

Table 2.1: Sensor reading.

Time stamp	Temp (°C)	Humidity (%)	TDS (ppm)	pH
2023-9-20 10:21:34	25	64	453	5.9
2023-9-20 10:21:49	25	64	468	5.8
2023-9-20	24	65	488	6

10:22:04				
2023-9-20 10:22:19	25	64	468	6
2023-9-20 10:22:34	24	65	468	5.9

5 Conclusion

In summary, the "Smart Hydroponic Monitoring System" presented in this project offers an inventive solution to the challenges faced in hydroponic crop cultivation. By employing IoT sensors and linking a Raspberry Pi 3B+ to the Blynk server, this system enables real-time supervision and management of crucial parameters such as temperature, humidity, nutrient levels, and pH in hydroponic setups. The project meets the need for precision and ease in hydroponic agriculture, where maintaining ideal conditions is pivotal for plant growth and crop yield. Through the integration of diverse sensors and data analysis, it equips growers with valuable insights and tools for making well-informed decisions. Furthermore, the project builds upon prior research in the field, drawing from the experiences of other IoT-based agricultural systems. It highlights the versatility of utilizing sensors, microcomputers like the

Raspberry Pi, and cloud servers like Blynk to enhance agricultural management, providing a cost-effective and dependable solution for the agriculture industry. Overall, this project advances smart agriculture by offering a user-friendly platform for remote monitoring, data visualization, and control of hydroponic systems. With its ability to identify patterns, irregularities, and offer recommendations, it represents a significant step toward more efficient and sustainable crop cultivation, reducing crop losses and maximizing the advantages of modern agriculture.

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INTERNATIONAL

FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Smart Vertical Aquaponic System

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Abstract: This project addresses the need for sustainable and space-efficient agriculture through the integration of vertical gardening and aquaponic, showcasing a system that optimizes resource use and enhances productivity. The proposed solution involves growing plants in vertical gardens irrigated with nutrient-rich water sourced from a fish tank. This symbiotic relationship between plants and fish is facilitated by bacteria breaking down fish waste into nitrates, serving as fertilizer for the plants, while the plants, in turn, filter the water to create a harmonious ecosystem. To further enhance efficiency, the aquaponics system incorporates advanced features such as a pH sensor, water level sensor, automatic fish feeder, and grow light. These components not only contribute to streamlined monitoring but also accelerate the photosynthesis process, resulting in a 25% reduction in plant cultivation time compared to traditional methods. The integration of Internet of Things (IoT) technology enables real-time monitoring through mobile phones, ensuring remote accessibility and efficient system management. The project addresses three primary problem statements: the development of an automated monitoring system for aquaponics, the evaluation of environmental sustainability compared to traditional agriculture, and the assessment of aquaponics for urban food production and food security. By automating monitoring tasks, the system alleviates the limitations posed by human intervention, contributing to the overall health and productivity of both plants and fish. Environmental sustainability is a core focus, as aquaponics minimizes waste, conserves water, reduces energy consumption, and lowers greenhouse gas emissions when compared to traditional agriculture. This study also explores the feasibility of utilizing aquaponics for urban food production, considering factors such as space, cost, energy, and socio-economic benefits. The overarching objectives include a 25% reduction in plant cultivation time, real-time monitoring of key parameters through a dedicated app, and the implementation of an automated fish-feeding system. In conclusion, this innovative approach to vertical gardening and aquaponics not only offers a sustainable and efficient solution for agriculture but also holds promise for addressing urban food production challenges, contributing to enhanced food security and environmental conservation.

Keywords: Vertical Gardening, Aquaponics, IoT

1. Introduction

This modern world, evolves much quicker than five decades ago, the world population keeps on getting larger and will even surpass 8 billion people in the year 2022 [1]. One major problem faced by

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almost every nation is food security. Food security has always been a concern for a developing nation, especially Malaysia. Food security is the ability of individuals and communities to access adequate, safe, and nutritious food to meet dietary needs. It is a complex and multifaceted issue that affects people all over the world. One of the main reasons food security is a major issue is population growth. As the global population continues to grow, the demand for food also increases, putting pressure on food production systems. Additionally, climate change is affecting agricultural productivity and making it more difficult to grow crops in many parts of the world [8].

Food insecurity is also significantly influenced by economic inequality. Low-income households and marginalized communities frequently experience food insecurity because they may lack the resources to obtain sufficient and nourishing meals. Food shortages and higher food prices can result from political unrest and natural disasters that obstruct food distribution and production. Furthermore, it may be challenging to bring food to those in need due to a lack of infrastructure in some locations, such as a lack of transportation and storage facilities [7].

Other than that, rapid urbanization presents a significant challenge to food security, as cities are becoming increasingly crowded, and arable land is becoming scarce. Vertical aquaponics gardening can offer a sustainable solution to this challenge by providing fresh produce in a limited space. Aquaponics is a sustainable farming method that combines aquaculture and hydroponics. In aquaponics, fish are raised in tanks, and their waste provides nutrients for plants, which are grown in a hydroponic system. The plants filter the water, which is then returned to the fish tank, creating a closed-loop system that requires less water than traditional farming methods [6]. Vertical aquaponics gardening takes this concept a step further by utilizing vertical space to maximize the amount of food produced in a limited area. Vertical systems can be installed in buildings, on rooftops, or in any space with adequate light and temperature conditions. In addition to providing fresh produce in urban areas, vertical aquaponics gardening has several other benefits. It can help reduce food transportation costs and emissions, provide a source of local food, and create job opportunities in urban agriculture [4,5].

Therefore, vertical aquaponics gardening is a sustainable and innovative solution for producing fresh and healthy food in urban areas. Rapid urbanization has created a challenge for food security, but with this farming technique, it is possible to overcome the issue of limited space and the scarcity of arable land. The closed-loop system of aquaponics requires less water and fertilizers, making it an eco-friendly and cost-effective way to grow crops. Moreover, vertical systems can be installed in buildings, on rooftops, or in any space with adequate light and temperature conditions, which makes them highly versatile. By reducing transportation costs and emissions, providing local food, and creating job opportunities in urban agriculture, vertical aquaponics gardening can also benefit the local community. Therefore, with its numerous benefits, vertical aquaponics gardening has the potential to play a significant role in the future of urban agriculture and food production [2,3].

1.1 Problem Statement

1. Developing an automated monitoring system for the aquaponics

Several things need to be monitored in an aquaponics system to ensure the health and productivity of both the fish and the plants. Some of them are Ph level and water flow rate. Due to the limitations of human beings, they are not able to check everything at once every day. But with the help of technology, monitor the system easily without being present at the scene.

2. Evaluating the environmental sustainability of aquaponics systems compared to traditional agriculture

The aquaponics system always promotes an environmentally sustainable alternative to traditional agriculture. Aquaponics systems are designed to minimize waste and maximize resource use, resulting in lower environmental impact. This is due to the aquaponics system conserves water, recycles nutrients, is energy-efficient, uses less land, reduces chemical use, and produces fewer greenhouse gas emissions compared to traditional agriculture. Therefore, making aquaponics a more environmentally sustainable option for small to medium-scale farmers and hobbyists.

3. Assessing the possibility of utilizing aquaponics for urban food production and food security.

Aquaponics has the potential to contribute to urban food production and improve food security. The feasibility of using aquaponics for urban food production and food security depends on factors such as available space, cost, energy, climate, food security, and social and economic benefits. By carefully considering these factors, it is possible to create a sustainable and viable aquaponics system for urban food production.

1.2 Objective

1. To reduce the time taken to cultivate the plant by 25% compared to traditional planting methods.
2. To monitor the result of Ph level, turbidity, water level, humidity & and temperature using an app that connects through a WiFi connection.
3. To be able to feed the fish automatically every 12 hours.

2. Materials and Methods

The Smart Vertical Aquaponics System is a compact aquaponics setup integrated with a monitoring system that helps the user monitor the system. This project is a stand-alone solar system in which the supply for the controller and the system to operate, rely upon the electricity produced by the solar panel. Integrating this aquaponic system with the PV system to lead to more sustainable, cost-effective, and efficient farming that produces high-quality organic food. This project highlighted the concept of urban farming, in which the design would be compact and use less space compared to conventional aquaponics. In terms of plant choices, there are a lot of varieties depending on the size of the aquaponics system. In this case, the most suitable plants to plant are leafy green types of plants and herbs. Since this type of plant does not usually require a huge space for growth, it is the best choice for compact aquaponics system. Urban farming usually takes place in urban environments where the amount of direct sunlight is quite restricted, especially for agricultural purposes. As a consequence of this condition, this aquaponics system is equipped with a grow light. A grow light is used to speed up the rate of photosynthesis, therefore it can compensate for the lack of sunlight to yield the crops. As for the controller, this system uses ESP32. The inputs would be the sensors such as pH sensor, temperature & and humidity sensor, turbidity sensor, and water level sensor. These sensors will help for monitoring purposes when it sends signals to the controller which is the Arduino Mega and will display the output in the smartphone. To do so, the controller comes with a built-in WiFi so it would enable us to monitor this project wherever there are WiFi connections.

2.1 Specification

Table 1 : List of Specifications

SECTION	SPECIFICATION
Project Title	Smart Vertical Aquaponic System
Location	GMI, Bangi, Selangor
Power Rating	240V
Input	<ul style="list-style-type: none"> • pH Sensor • Temperature Sensor • Humidity sensor • Water Level Sensor • Turbidity Sensor

Output	<ul style="list-style-type: none"> • AC Water Pump • Dosing pump • LED Grow Light
Controller	ESP32 Wifi
Battery	Rechargeable 12V 55AH Lithium Ion Battery
Charge Controller	I. Rated Voltage : 9V - 40V II. Rated Current : 30A
Rated Solar Power Input	200W
Water Pump	I. Rated Power : 18W II. Rated Voltage : 220V - 240V
Type of LED	4 Feet Horticulture Full Spectrum LED T8 Strip
Operating time	24 Hours
Energy Sources	Solar Energy

2.2 Methods

The principle of operation of the Vertical Aquaponic for urban Farming starts with solar energy accumulated by solar panels. First, the solar panels will convert solar energy into electrical energy. The solar charge controller then helps control the load from the solar panels to the battery for energy storage. The electricity stored in the battery will be used to operate the system. An inverter is connected to the battery to run AC appliances. When the system is turned ON, all the sensors will activate and start scanning to determine the pH level of the water inside the tank and whether it maintains according to our desired value. If the value of the pH is low, the pH sensor will send feedback to the controller. Then, the controller receives the feedback and sends signals to the dosing pump to dose up the water to maintain the pH level to our desired value which is 7.

In addition, a water level sensor is also used to determine the level of water inside the tank. If the water inside the tank is insufficient, the pump will automatically turn OFF and display “Water Insufficient” in the IoT app. Lastly, the data logging of the system is sent to Google Sheets and can be viewed by users with the given link of the Google Sheets. By having this system users can consistently monitor their aquaponics system.

Besides that, this system has a two-timer for two different purposes which are the grow light and fish feeder. The grow light will turn ON mode 6 hours a day and turn OFF mode 18 hours a day which sum into 24 hours. The timer for the grow light will turn ON from 12 p.m. until 6 p.m. and the rest of the day will turn OFF. As for the fish feeder, the feeder will only dispense the food specifically at 6.40 a.m. and 7.40 p.m., which means two times per day, morning and evening. This is done due to the fish metabolism rate being at peak hours during that specific time, therefore it can promote growth and maintain the fish's health condition. The methods of the overall system are shown in Figure 1.

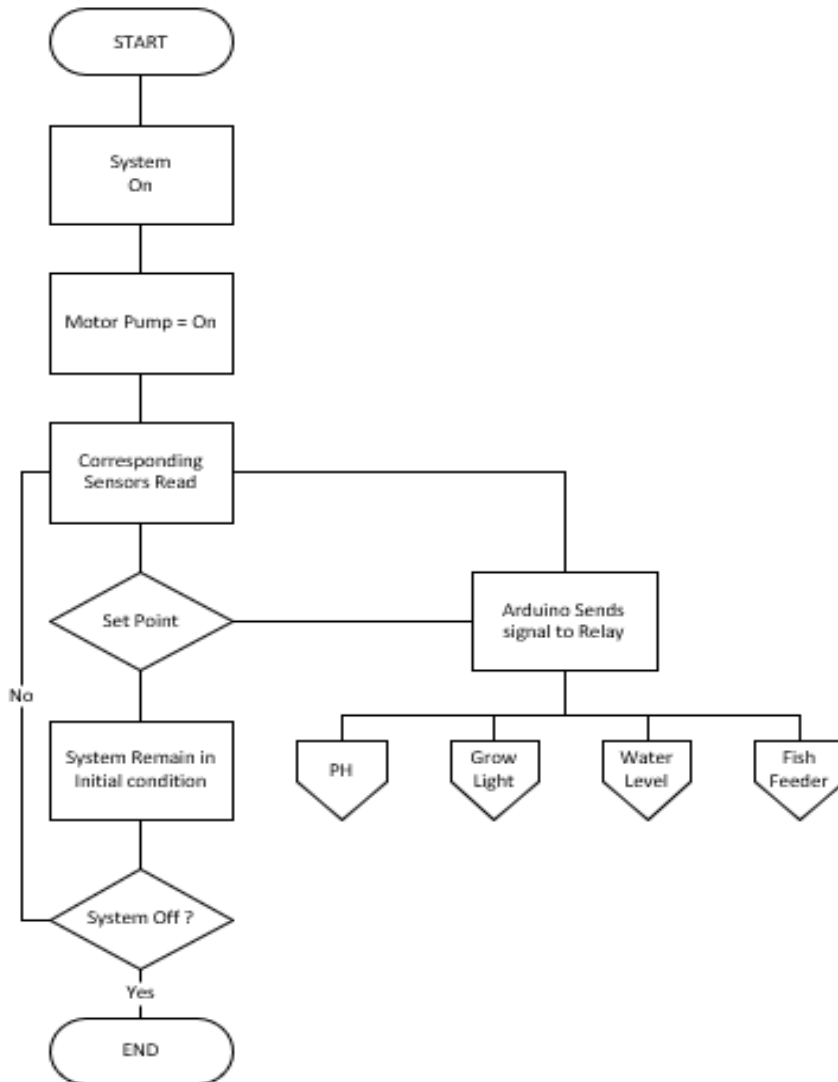
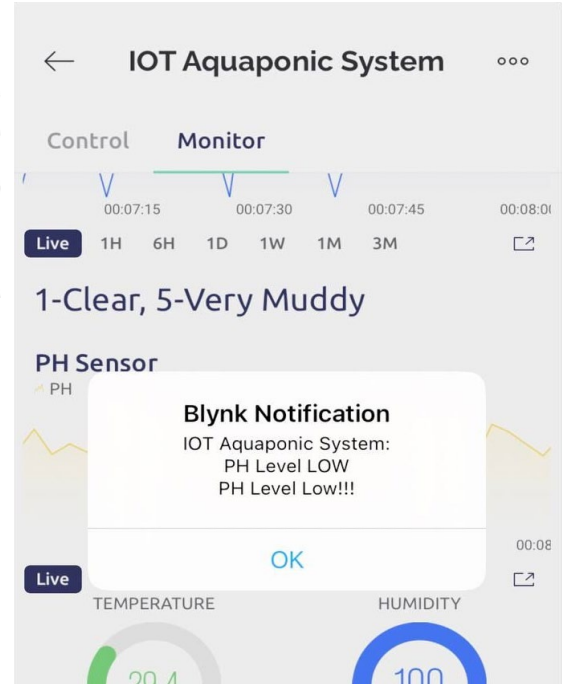
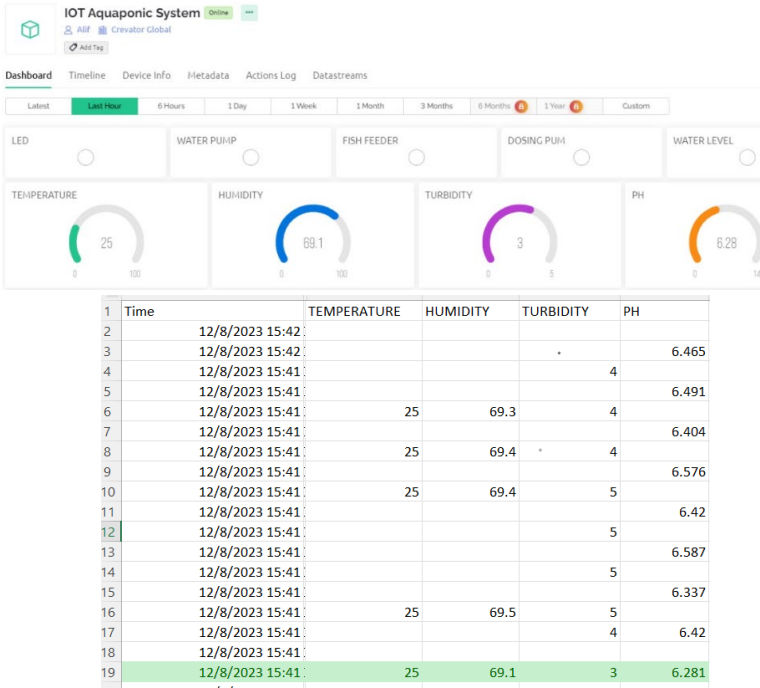


Figure 1: Method of Overall System

3. Results and Discussion

3.1 PH LEVEL, HUMIDITY, AND TEMPERATURE LEVEL

In the Excel sheet, it can be seen that the stream of data is accurate according to the surroundings. Hence, a few conclusions were made from running the system.



12/8/2023 2:44	ONLINE	Online		
12/8/2023 2:43	OFFLINE	Offline		
12/8/2023 2:40	OFFLINE	Offline		
12/8/2023 2:40	WARNING	PH Level LOW	PH Level Low!!!	
12/8/2023 2:40	ONLINE	Online		
12/8/2023 2:12	OFFLINE	Offline		
12/8/2023 1:54	ONLINE	Online		
12/8/2023 1:31	OFFLINE	Offline		
12/8/2023 1:27	ONLINE	Online		
12/8/2023 1:27	OFFLINE	Offline		
12/8/2023 1:26	ONLINE	Online		
12/8/2023 1:25	OFFLINE	Offline		
12/8/2023 1:24	OFFLINE	Offline		
12/8/2023 1:24	OFFLINE	Offline		
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12/8/2023 1:23	OFFLINE	Offline		
12/8/2023 1:23	OFFLINE	Offline		
12/8/2023 1:21	ONLINE	Online		

Figure 3.1 Result from CSV File

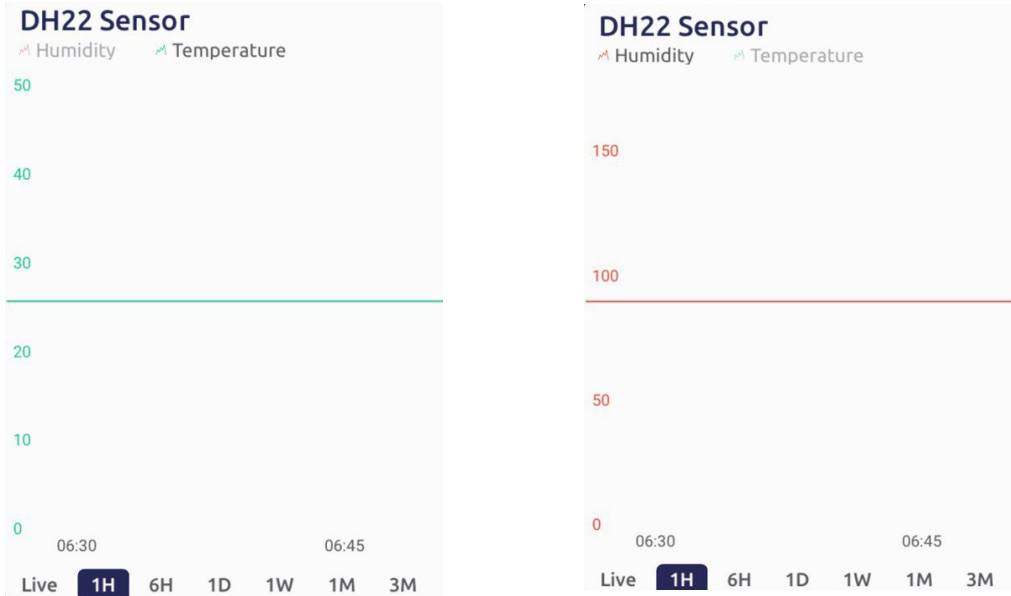


Figure 3.2: Live Data Stream For Humidity & Temperature Sensor

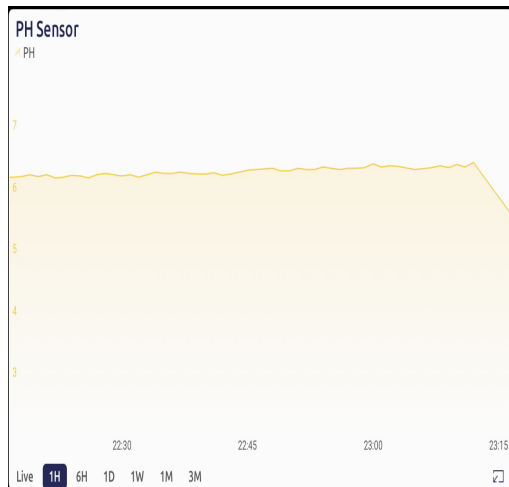


Figure 3.3: Live Data Stream For pH Sensor

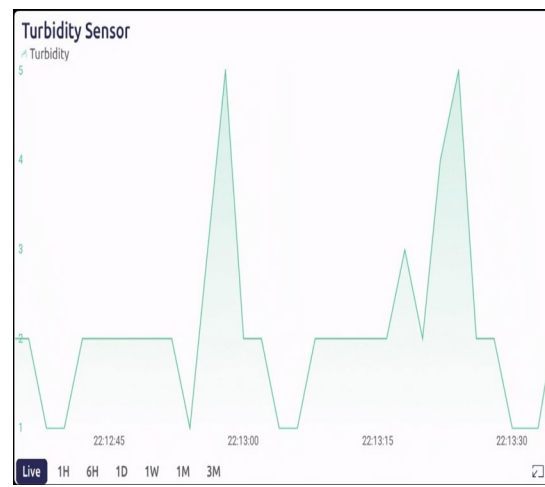


Figure 3.4: Live Data Stream For Turbidity Sensor





Figure 3.1 illustrates how internet connectivity enables real-time data streaming, allowing users to promptly monitor readings, and the Blynk app issues notifications, such as a "PH Level Low" warning, alerting users to changes in pH levels. This feature facilitates informed decision-making and prompts the dosing pump activation for pH regulation. Additionally, Figure 3.2 presents live data on temperature (26.3°C) and humidity (93% RH) from the DHT22 sensor through the Blynk app. Figure 3.3 displays the pH level, typically around 6, with fluctuations based on water usage duration. The dosing pump intervenes to maintain optimal pH. Figure 3.4 portrays the turbidity sensor's data stream, indicating water clarity on a scale of 1 to 5. Notifications are triggered at critical (5) and moderate (2) turbidity levels, signaling users to take action, such as changing the water, in response to potentially adverse conditions caused by fish waste.

3.2 PLANT GROWTH RATE

Comparison of Farming method

The comparison has been made for comparison in planting methods

Table 3.1: Comparison of planting method for lettuce plant

WEEKS	PLANTS TYPE: LETTUCE	
	Aquaponics	Traditional
Week 1~2	 <p>3 leaves</p>	 <p>3 leaves</p>
Week 3~4	 <p>8 leaves</p>	 <p>6 leaves</p>

Week 5~6	 <p>11 leaves</p>	 <p>8 Leaves</p>
-------------	--	---

Table 3.2: Growth rate calculation for lettuce plant

	Aquaponics	Traditional
Leaves	11	8
Differences	3 more	3 less
Percentage	$8/11 \times 100\% = 73\%$ = 27% more = <u>3 leaves more</u>	$8/11 \times 100\% = 73\%$ = 27% less = <u>3 leaves less</u>

Summary of the data and analysis results

According to the first analysis, there is a comparison of planting methods which planting by using system operation and traditional method. The type of nutrient used is not the same as the system used the waste water from the fish but the traditional method only used tap water. The plant types involved are lettuce leaf, pak choy, and basil. For the traditional method, the water cycle given is every 12 hours while for the aquaponic system, the water cycle runs for 24 hours. Other than that, the traditional method uses 12 hours of sunlight while our system uses 20 to 24 hours according to the surrounding conditions. The soil is seen to have poor absorption of water to the seedlings. The growth rate for the soil is 6 to 8 leaves within 5 weeks. This causes the roots to receive less water. The plant growth is disrupted by the inconsistent climate change at the outside compared to the indoor planting. Therefore, unlike utilizing the smart vertical aquaponic system, the plant growth rate is better than using the traditional method. The plants can grow up to 8-12 leaves in 5 weeks. It concludes that plants can survive and grow faster in indoor conditions with wastewater from fish. One of the objectives has been achieved which is that the plant should grow 25% faster than the traditional method of farming according to the calculations that have been made for each type of plant above.

Conclusion

To conclude this documentation, the project aims to reduce the time taken to cultivate the plant by 25% compared to traditional planting methods. The major issue highlighted in this documentation is climate change. Traditional farming relies on soil-based methods, offering a long-established, large-scale approach that sustains crop growth through natural processes. However, it requires substantial land, and water, and often relies on pesticides, which can impact the environment. On the other hand, a smart vertical aquaponics system integrates aquaculture and hydroponics in a closed-loop system, using fish waste to fertilize plants without soil, thus conserving water and space. Although traditional farming boasts familiarity and large-scale production, smart indoor aquaponics offers controlled environments, year-round production, and higher efficiency in resource utilization. Ultimately, the choice between these methods often depends on scale, available resources, and environmental considerations. While traditional farming has deep roots, the innovative approach of smart indoor aquaponics showcases a sustainable and efficient alternative for the future of agriculture. One of the project's objectives is to monitor the result of Ph level, turbidity, water level, humidity & and temperature using an app that connects through a WiFi connection. In this integrated system, other than real-time monitoring it also has additional features including displaying graph data within 1 hour, 6 hours, 1 day, 1 week, 1 month, and 3 months. The system feeds the fish automatically every 12 hours is achieved. The integration of an auto fish feeder into an aquaponic system signifies a significant leap toward efficiency and sustainability in modern agriculture. This technological addition streamlines the feeding process for the aquatic organisms within the system, ensuring a consistent and measured supply of nutrients for both the fish and the plants. Automating this crucial aspect reduces manual labor, maintains optimal feeding schedules, and minimizes the risk of over or underfeeding. This innovation enhances the overall functionality of aquaponics by fostering a more balanced ecosystem and promoting healthier growth for both aquatic life and cultivated plants. The auto fish feeder exemplifies how technology can complement and improve upon natural systems, paving the way for more accessible and efficient methods of food production while promoting sustainability in agriculture.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Traffic Light Monitoring System

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Abstract: Traffic light is a part of road safety measures taken to ensure safety of motorist. Traffic lights are essential to ensure efficient flow of traffic at intersections as well as crossings. However, lack of surveillance system to monitor the function of traffic light can lead to risk of accidents and traffic congestion. Road users need to be alert and report the malfunction of a traffic light to the responsible authorities. Broken traffic light can cause accident and congestion if the administrator is not notified in timely manner so that swift action can be taken to solve the problem. This project is to design and develop a traffic light monitoring system to detect the power supply status and to notify authorities on traffic light malfunctions. The normal traffic light monitoring system requires the developers to check the traffic light pole themselves at the real location. The proposed traffic light monitoring system use relay to sense the presence of current at the pilot lamp. This project is developed by using ESP 8266 Wi-Fi module microcontroller that play the role as the main controller system. The microcontroller used to programme using assembly language. The microcontroller is to control the running light of the traffic light and send signal to the Blynk application for real time monitoring. The purpose and concept of this project is to notify the developer about the condition of the traffic light at that time. The technology can help optimise traffic signal operations, streamline traffic flows, and eventually improve the overall efficiency of transportation networks by quickly identifying and addressing these issues through real-time monitoring.

Keywords: Traffic light, ESP8266, Blynk, Power supply

1. Introduction

Traffic lights are vital for managing road traffic and ensuring safety by providing essential signals to drivers. However, traditional methods of monitoring and detecting issues with traffic lights, such as manual inspections and reports from drivers, often lead to delays in identifying and addressing problems, particularly in remote areas lacking adequate monitoring systems.

The project aims to address these limitations by developing a comprehensive traffic light monitoring system. The system's primary objective is to provide real-time data on the power supply status of traffic lights, detect any issues promptly, and notify the relevant authorities. Leveraging

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advanced technologies like the Internet of Things (IoT) and mobile applications, the system enhances monitoring and communication between traffic lights and administrators.

At the core of the system is a microcontroller-based solution utilizing the NodeMCU ESP 8266 Wi-Fi module controller. This controller detects power supply status and communicates this information to a mobile application powered by the Blynk platform. The application serves as an interface between the monitoring system and authorities, enabling quick response and resolution by providing real-time notifications and precise location data of malfunctioning traffic lights.

Advancements in traffic light monitoring systems have become crucial for efficient traffic management and road safety, especially with rising traffic congestion and vehicle numbers. It's imperative to have effective systems that monitor traffic light power supply, detect failures, and promptly alert authorities. This project collaborates with Majlis Bandaraya Subang Jaya to gather information on faulty traffic lights and potentially implement the system within the council's jurisdiction.

2. Materials and Methods

2.1 Requirement Analysis

A survey was conducted to gather information about faulty traffic lights in Subang Jaya, receiving 15 responses. Respondents included both residents and motorists aged 20 to 30 who frequently use Subang Jaya's roads. Their feedback provides valuable insights into the impact of traffic signal malfunctions on daily routines, safety, and overall quality of life in the community, reinforcing the problem statement.

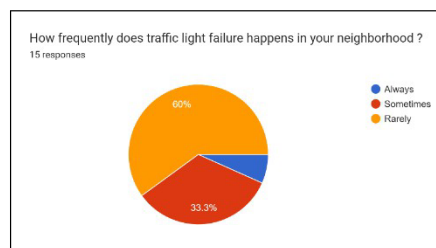


Figure 1: Frequency of traffic light failure

In Figure 1, survey results showed that 60% of respondents indicated that traffic light failures rarely occur, while 33.3% reported experiencing occasional issues with faulty traffic lights. Only 6.7% of respondents stated that they consistently face problems with malfunctioning traffic lights. This data sheds light on the frequency of traffic light malfunctions in the respondents' area.

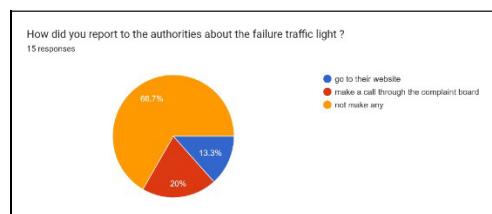


Figure 2: Report method to authorities

In Figure 2, survey results revealed that 66.7% of respondents did not report faulty traffic lights to the authorities, while 20% made complaints via phone calls through the complaint board, and 13.3% used the website for complaints. This lack of reporting hinders authorities from being aware of traffic light issues. Developing an application can facilitate monitoring and notification of faulty

traffic lights to the authorities, improving responsiveness to such incidents.

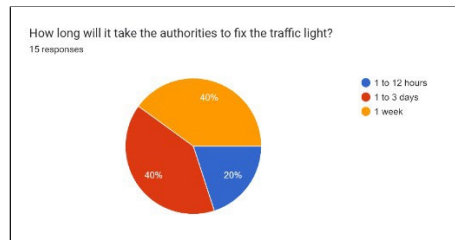


Figure 3: Time taken

In Figure 3, survey results show that many respondents believe it takes authorities about one week or one to three days to address and resolve traffic light issues. Additionally, nearly 20% expect action within 1 to 12 hours. This highlights the need for an automated monitoring system to improve response times. The Traffic Light Monitoring System proposed in this thesis aims to address this by sending real-time alerts to authorities for faster issue resolution.

On traffic light concerns, MBSJ provides an example report from a road user regarding a fault traffic light issue. Majlis Bandaraya Subang Jaya (MBSJ) for their significant assistance in submitting traffic light failure reports. This data is an important reference for my research, increasing its accuracy and efficacy in addressing and mitigating traffic light difficulties in the Subang Jaya area.

BUTIRAN ADUAN LENGKAP		BUTIRAN ADUAN LENGKAP		BUTIRAN ADUAN LENGKAP	
No Aduan:	0741/02/2023-1	No Aduan:	1263/12/2022-1	No Aduan:	0768/02/2023-1
Tarikh Penerimaan:	13-02-23 12:20:23 PM	Tarikh Penerimaan:	21-12-22 08:32:47 AM	Tarikh Penerimaan:	13-02-23 12:47:32 PM
Penerima:	eskandar2 > Bah. Perhubungan Awam	Penerima:	nadhirah2 > Bah. Perhubungan Awam	Penerima:	eskandar2 > Bah. Perhubungan Awam
Saluran Penerimaan:	E-ADUAN	Saluran Penerimaan:	TELEFON	Saluran Penerimaan:	E-ADUAN
Bentuk Masalah:	ADUAN	Bentuk Masalah:	ADUAN	Bentuk Masalah:	ADUAN
Nama Pengadu:	KELAPA OASIS SJ	Nama Pengadu:	UNG K-B	Nama Pengadu:	Onq Sze Cong
Alamat Pengadu:	-- tidak dinyatakan --	Alamat Pengadu:	35, Jalan USJ 18/2C,	Alamat Pengadu:	-- tidak dinyatakan --
Keturunan:	Melayu	Keturunan:	Cina	Keturunan:	Cina
Jantina:	Lelaki	Jantina:	Lelaki	Jantina:	Lelaki
Alamat E-mel:	kelapaaoasisj@gmail.com	Alamat E-mel:	kbung28@gmail.com	Alamat E-mel:	scong82@gmail.com
Mobile:	- tidak dinyatakan -	Mobile:	0163213021	Mobile:	- tidak dinyatakan -
No. Telefon:	- tidak dinyatakan -	No. Telefon:	0	No. Telefon:	- tidak dinyatakan -
No. Faks:	- tidak dinyatakan -	No. Faks:	0	No. Faks:	- tidak dinyatakan -
Kategori Pengadu:	Individu	Kategori Pengadu:	Individu	Kategori Pengadu:	Individu
Taraf Aduan:	BIASA	Taraf Aduan:	BIASA	Taraf Aduan:	BIASA
Jenis Masalah:	ELEKTRIK > LAMPU TRAFIK	Jenis Masalah:	ELEKTRIK > LAMPU TRAFIK	Jenis Masalah:	ELEKTRIK > LAMPU TRAFIK
Kawasan Majlis:	USJ 04	Kawasan Majlis:	USJ 10	Kawasan Majlis:	SS 17
Lokasi Masalah:	persimpangan Persiaran Tujuan dan Persiaran Setia	Lokasi Masalah:	di antara usj 10 dan 11	Lokasi Masalah:	Pedestrian traffic light between ss17 and mcd ss15 drive through/masjid
Huraian Masalah:	Lampu isyarat rosak - lampu merah & orange beryala serentak.	Huraian Masalah:	traffic light rosak	Huraian Masalah:	Pedestrian traffic light not displaying correctly. You can contact me at scong82@gmail.com

Figure 4: Traffic Light Report

Figure 4 show sample reports of malfunctioning traffic lights. These allegations imply that the traffic light's lamp was inaccurate, compromising the traffic signals operation. The standard procedure for authorities to remedy these issues entails road users reporting defective traffic lights on the website.

2.2 System Design Phase

During this phase, all system requirement specifications is translated into a design. The proposed project's hardware and software, system modules, and circuit are described in order to build a prototype for the proposed system.

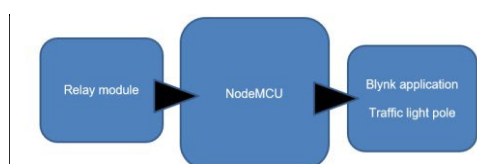


Figure 5: Block Diagram

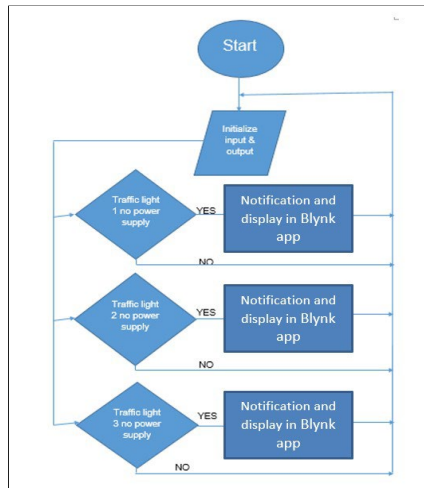


Figure 6: Project Flowchart

Figure 5 shows the block diagram of the project whereas Figure 6 shows the process flowchart of the project. Firstly, relay detect power supply of the traffic light pole. When one of the traffic light is malfunction where there is no power, NodeMCU will detect it and send notification to smartphone. This project has three main parts which is input, controller and output. The operation of this project will begin when the controller section which is NodeMCU and Blynk application receive signal from the input which is Relay module. Then the output which is traffic light pole and Blynk application will receive the signal.

2.3 Building and Prototype

The system's software is primarily constructed using C++. Figure 7 and 8 depict the schematic diagram of the project, including all the components used. The project's operation begins when a switch on one of the poles is pressed, indicating a lack of power supply detected by the relay at NodeMCU. NodeMCU evaluates this and sends information to the Blynk app, which displays the traffic light's status.

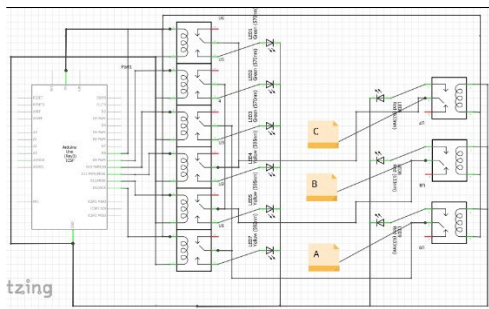


Figure 7: Schematic Diagram of Running Traffic Light

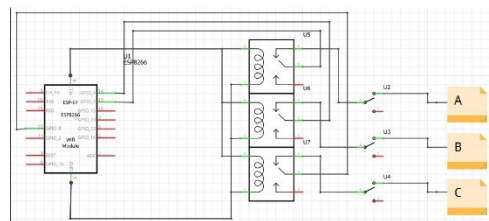


Figure 8: Schematic Diagram of NodeMCU connection

2.4 Evaluation and Refining Prototype

The Traffic Light Monitoring System enables administrators to monitor the real-time condition of traffic lights. By establishing a microcontroller-based system that interfaces with a relay module and connects to a Blynk app on the administrator's smartphone, a device capable of automatically notifying the administrator is created, simplifying the monitoring process. Figure 9 show the prototype of the project.

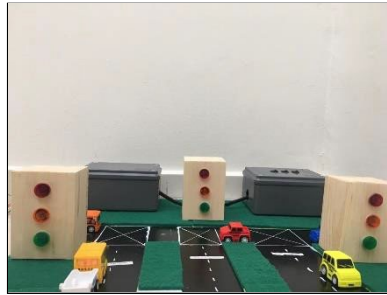


Figure 9: Project Prototype

3. Results and Discussion

3.1 Data Analysis

When the traffic light pole loses power, the mobile application will alert authorities automatically, allowing for a quick response. On the Blynk application, the light will display green if the traffic light pole has power supply. Table 4.1 show data analysis for the Blynk application. These data are gained after made several tests at every pole.

Table 1: Data Analysis of Reaction of Apps of The System

Traffic light	Status	Blynk apps
1,2,3	Have power supply	Only display on apps
	No power supply	Display on apps notification every 15 seconds

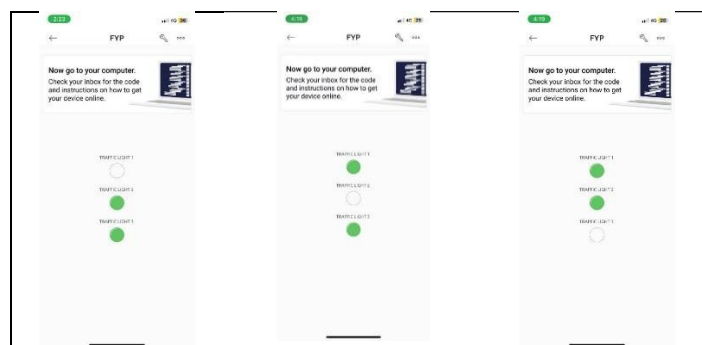


Figure 10: Traffic Light Pole Status

The display within the Blynk app provides varying responses for each traffic light pole. Figure 10 illustrates the result when all three traffic light pole status when the power supply is not available.

3.2 Discussion

The primary finding of the project is that the developed hardware and software system effectively enables authorities to receive mobile notifications and monitor traffic light status in a user-friendly format. This feature holds significant potential for use by organizations like Majlis Bandaraya Subang Jaya (MBSJ) or other local municipal councils in Malaysia, facilitating prompt

responses to malfunctioning traffic lights, even without direct user reports. The system enhances road safety, reduces traffic interruptions, and contributes to the broader goal of embracing smart city initiatives in rural areas.

4. Conclusion

The Traffic Light Monitoring System offers a comprehensive solution to address traffic light issues in Subang Jaya. By integrating hardware components like microcontrollers and relays with the Blynk program, the system enables real-time monitoring, identification, and alerting of traffic light anomalies. Its successful deployment demonstrates its potential to enhance traffic management efficiency, reduce fault reaction times, and enhance road safety. Additionally, the system's scalability presents opportunities for broader applications in other municipalities.

To enhance the Traffic Light Monitoring System's capabilities, recommendations include expanding fault detection beyond power supply issues. Additionally, integrating a GSM module into the system can improve internet connectivity, especially in areas with limited Wi-Fi coverage, ensuring reliable communication and notification of broken traffic signals regardless of Wi-Fi availability. These enhancements will significantly improve the system's functionality, reliability, and adaptability, leading to safer and more efficient traffic management.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Vehicle Sinking Alert System Integrated with Mobile App and IoT Cloud

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Abstract: Car accidents in water can be extremely dangerous and often result in fatalities. To help reduce the number of deaths and injuries caused by this type of accident, Vehicle Sinking Alert System (VSAS) need to be installed in vehicles. When a car crashes into water, there is no information on its location. Usually, family members and authorities are not being informed promptly and, in some cases, even the people who are in close vicinity are not aware of the accidents happening. There is also no visual of the car because of limited underwater visibility. The VSAS is a system that will activate upon contact with water. It will then send notifications and alert authorities. Live location will be updated through IoT Cloud. The focuses of this project are: 1) to develop the VSAS' software and hardware; 2) to integrate it by using Wi-Fi or GSM module to publish data to IoT Cloud; and lastly, 3) to analyze the performance of the system through experiments. The method used in this project is the Sorting Algorithm to differentiate between normal circumstances and real accidents. Two experiment procedures have been done, which are, the single sensor and dual sensor configurations. These two methods were observed by throwing a model into a bucket of water to imitate a real accident and to know which configuration is the fastest to detect water. The experiment resulted in the dual sensor method with front-back configuration as the best configuration with the fastest water detection. This project can be improved by adding a safety system such as an emergency floating tube to let the car float much longer.

Keywords: Car accident in water, alert system, IoT cloud

1. Introduction

When a car crashes into water, a sensor that is placed on the front bumper and rear bumper will detect water. The sensor will send the signal to the microcontroller. After receiving the signal, it will activate an alert system that includes sounding the car alarm and the car lamps will be turned on and off repeatedly. This alert system is to attract nearby people to call for help. Then, the system will use Wi-Fi module to send notifications to close family members and inform the authorities using BLYNK for faster action. It will tell that water detected and location of the accident occurred. The system also will be connected to the IoT Cloud and the mobile app. GSM module can be used as an alternative to send notification to close family members and inform the authorities [1]. This system will help rescuers rescue the victim faster and more lives could be saved. The system will keep updating until the external power supply runs out. [2].

When a car crashes into water, there is no information on its location. Usually, family members and authorities are not being informed promptly and, in some cases, even the people who are in close vicinity

are not aware of the accidents happening. There is also no visual of the car because of limited underwater visibility The VSAS is a system that will activate upon contact with water. It will then send notifications and alert authorities. Live location will be updated through IoT Cloud. The focuses of this project are: 1) to develop the VSAS' software and hardware; 2) to integrate it by using Wi-Fi or GSM module to publish data to IoT Cloud; and lastly, 3) to analyze the performance of the system through experiments.

2. Materials and Methods

Sorting algorithm method have been used in this project. This proposed method involves discussing algorithmic problems generally and using examples to show what abstract "concepts" are necessary to apply particular problem-solving techniques (algorithmic patterns) to a particular problem (Rosiene & Rosiene, 2019) [3]. There are five design patterns that but only two that being used that are:

- 1) Monte Carlo Pattern
- 2) Backtracking Pattern

The pattern was implemented into the coding development to get the algorithm that can differentiate between normal circumstance and real accident [4].

2.1 Materials

This is the circuit and schematic diagram for FYP2. The components that were being used were water level sensor to detect water [5], GPS module to get location reading, GSM module used as an alternative to the wifi module to send data to cloud, OLED to display the condition of the system, buzzer, and LED to be working as the output and lastly the ESP32 as the main controller.

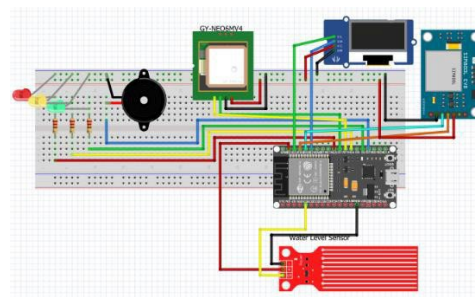


Figure 1: Circuit Design

2.2 List of Components

- ESP32
- GSM Module (SIM800L) (alternative)
- GPS Module (Neo-6M)
- Water Level Sensor
- 0.96-inch 128x64 I2C IIC OLED LCD
- Breadboard
- 220 Ohms Resistor
- 5mm LED
- Buzzer

2.3 Methods

This section shows the workflow of the system after it starts activated. Each of the components will be activated after the water level sensor detects water. The figure below shows the whole process of the system.

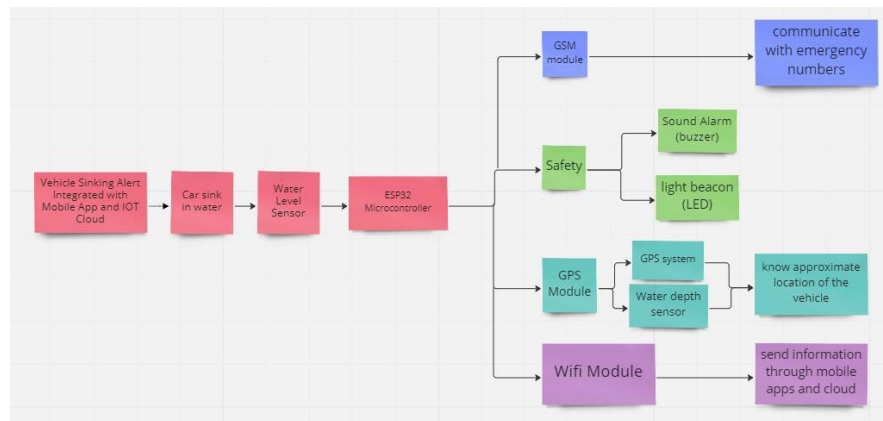


Figure 2: Block Diagram of System Flow

2.3 Analyzing Data

Equations After finishing developing the system, data needs to be recorded for analysis. By using sorting algorithm method, the system can differentiate between normal circumstance or real accident according to coding that have been set. Water will be detected by water level sensor to indicate whether the car is sinking or not. The water level will be classified in four conditions that are:

1. No water detected (level =0)
2. Water detected ($1 \leq \text{level} < 3$)
3. Half of the car sink underwater ($3 \leq \text{level} < 5$)
4. Car sink underwater (level ≥ 5)

3. Results and Discussion

3.1 Sensor Placement for Model

There are 2 methods for getting the best sensor placement. First, one sensor was used by placing it on four different sides of the car while the second method is by using two sensors with two configurations. By using these two methods, the model will be thrown into a container full of water. The model will be thrown at 4 different angle that is facing front, facing left and right, and facing backwards. The fastest water detection will be the best configuration.

3.1.1 Single Sensor Method

Table 1: Single Sensor Method Result

Sensor Placement (configuration)	Direction Thrown				Average
	Front	Left	Right	Backward	
Front	2.74s	2.97s	3.96s	3.06s	3.18s
Right	2.48s	3.17s	2.02s	3.02s	2.67s
Left	3.51s	2.89s	3.19s	3.14s	3.18s
Rear	2.45s	3.29s	2.79s	1.35s	2.47s

Based on the results from **Table 1**, each side of the car has the fastest reaction towards water according to how it was thrown. As for the front configuration, it took 2.74 seconds to detect water when thrown facing front. While for the right configuration has the fastest reading when thrown on the right side, that is 2.02 seconds. For the left configuration, the fastest time recorded is 2.89 seconds when thrown on the

left side. Lastly, for the rear configuration, it only needs 1.35 seconds to detect water when thrown facing backward. To decide which is the best configuration, the average time of each configuration has been calculated. The lowest time taken is the best configuration. So based table above, the best configuration is the rear configuration with only 2.47 seconds.

3.1.2 Dual Sensor Configuration

Table 2: Dual Sensor Method Result

Sensor Placement (Configuration)	Direction Thrown				Average
	Front	Left	Right	Backward	
Front-Back	1.58s	1.62s	1.77s	1.45s	1.61s
Left-Right	2.80s	2.06s	2.02s	2.81s	2.42s

Based on the results from **Table 2**, each side of the car has the fastest reaction towards water according to how it was thrown, like the first method. As for the front-back configuration, it took 1.58 seconds to detect water when thrown facing front and 1.45 seconds when facing backwards. While for the left-right configuration has the fastest reading when thrown on the right side, that is 2.02 seconds and 2.06 seconds for the left side. To decide which is the best configuration, the average time of each configuration has been calculated. The lowest time taken is the best configuration. So based table 4.3.2, The best configuration is the front-back configuration with only 1.61 seconds.

In conclusion, the best configuration is the dual sensor front-back configuration because it took the fastest time to response when have contact with water. Dual sensor configuration also may be more effective in case one of the sensors is damaged in an accident before slipping into water. According to Bernama, when an accident happened, the front, left and right side of the car was damaged. So, with dual sensor front-back configuration, the back sensor will be the backup sensor to detect water. Blynk 2.0 Result

Based on the results, we could see that the serial monitor can display more information than the OLED display. This is because the OLED display provides only small size of display that is only 0.96 inch. So, the OLED can only give information about the water level and longitude and latitude. Other parameters will be proposed to be displayed in cloud on Blynk2.0. The dashboard has been according to the figure below.

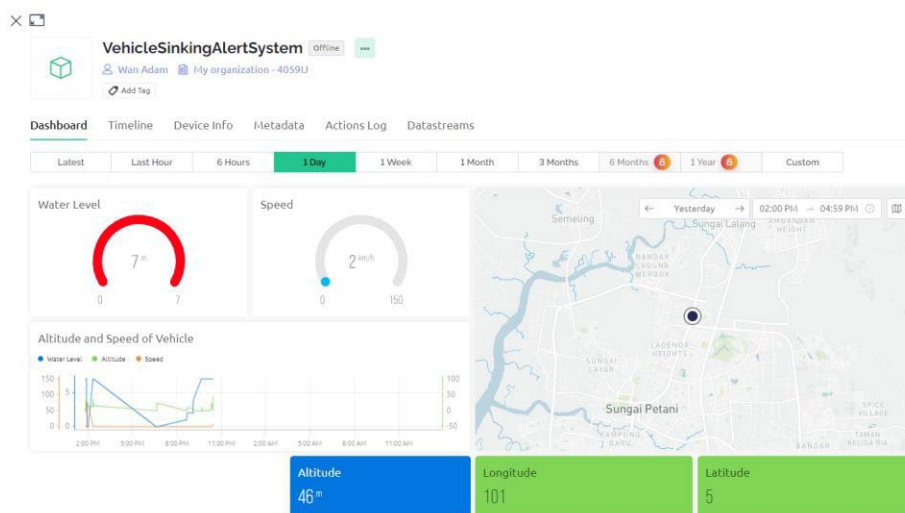


Figure 1: Blynk Web Result

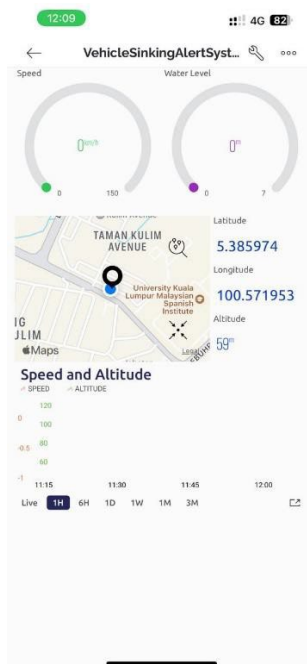


Figure 2: Blynk Mobile App Result

Besides providing important information in the dashboard, it also can send notifications or alerts to mobile phones. The notification will notify the user so they can access all the information through the Blynk mobile app or Blynk Web. This will make detecting car sinking faster and easier to locate the last location of the vehicle. The notification will be updated every one minutes after the sensor detects water.

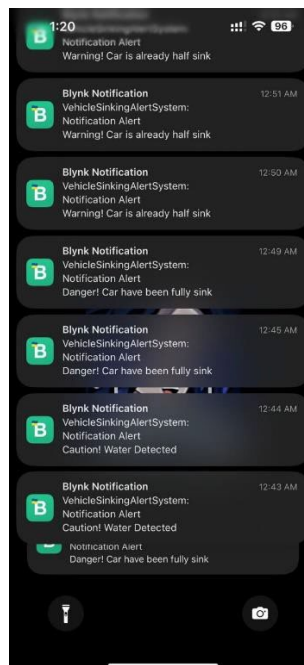


Figure 3: Alert Notification Result

4. Conclusion

In conclusion, all objectives have been achieved, that is develop software and hardware of car sinking alert system, integrating Wi-Fi module with the alert system to publish data to IoT cloud and run experiment to analyze the performance of the system. After testing, more than one platform can display data that is the serial monitor, OLED display, Blynk mobile app and Blynk web. Alerts also will be sent through mobile phone push notification. This is to ensure that information can be received faster and more easily. This can help to save victims faster because all the information is already available. Next is, based on the data from sensor placement experiment, front-back configurations were chosen because it has the fastest reaction for detecting water. This configuration also was considered because it is using two sensors. If one of them was damaged because of an accident before going into water, the other sensor is still functioning well. Lastly is about the GPS module, it has trouble stabilizing its communication with the satellite because buildings nearby are blocking the signal. Even at an open area, the module still has delay to stabilize its connection. To solve this problem, the GPS system will be activated as soon as the car starts.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Cross-Platform Cybersecurity Framework for Application System Implementation

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Abstract: The competition in the IT sector, especially in mobile app creation, has increased due to the market for mobile apps explosive expansion. The goal of this project is to employ the Dart programming language to develop a modern human resources management system (HRMS) by utilizing cross-platform technologies, particularly Flutter. The goal is to address the difficulties that organizations encounter in keeping their HRMS safe and functional, particularly in a mobile context.

The project's emphasis on cross-platform compatibility aims to provide a user-friendly interface accessible across various devices and operating systems. By implementing the Dart Security Framework, the project prioritizes data security, ensuring the confidentiality and integrity of HR-related data. Innovative features such as a Face Attendance System, E-Leave system, and GPS tracking elevate the HRMS to meet the evolving demands of contemporary workplaces.

The project explores current trends in HRM systems, challenges faced by existing systems like MySyarikat, and the critical aspect of cybersecurity in HRMS. The review also delves into the Dart Secure Framework for Cross-Platform Systems, highlighting its overall security approach and a specific package, `dart_secure`, designed to enhance user authentication and data encryption in Dart applications.

The project objectives include investigating current systems, identifying gaps, developing the Dart Security Framework for cross-platform systems, and implementing an HRM system based on this framework.

Keywords: Dart Security Framework, Human Resources Management System, Flutter Framework

1. Introduction

Smartphones are now widely used. Indeed, one of the fastest-growing IT industries is thought to be mobile app development. (Zohud & Zein, 2021). It is crucial to speed up app development while also enabling it to function on a wide range of platforms and hardware due to the intense competition in the mobile app market. The creation of mobile apps is very dissimilar from the creation of traditional desktop and online applications, and it does have its quirks, such as the requirement to work across several platforms. Today, a variety of platforms, including Apple iOS and Google Android can be developed using either native, m-site, or cross-platform technologies (Nunkesser, 2019).

Specifically this project will be focused on Cross-platform technologies and the development of the application for HRM Systems. Because of Cross-Platform immaturity in the market and focus on usability prioritizing a harmonious but less secure user experience, and that is clear in Flutter's (cross- platform technology) slogan "Build apps for any screen" that emphasizes usability which has

been a driving force behind their widespread adoption and success (Flutter, 2023).

We are thrilled to present a modern Human Resources Management System (HRMS) developed with the Dart and Flutter programming languages as we begin our final year project. Given how quickly modern workplaces are changing, having an effective and simplified HRMS is now essential. This application guarantees smooth interaction and accessibility by focusing on a user-friendly interface and cross-platform compatibility. By implementing the Dart Security Framework and utilizing Dart's capabilities, we prioritize data security and ensure the confidentiality and integrity of HR-related data. With innovative features like a Face Attendance System for precise tracking, an E-Leave system for expedited time-off requests, and GPS tracking for real-time location monitoring, this HRMS elevates labor management to a new level. Furthermore, this system provides customizable dashboards that acknowledge the various demands of organizations and enable users to customize their perspectives and highlight pertinent data. The project's main goal is to rethink HRMS by fusing the best aspects of Flutter and Dart, resulting in a feature-rich, safe, and user-friendly platform that enables businesses to prosper in the ever-changing field of workforce management.

Section headings should be left-justified, bold, with the first letter capitalized and numbered consecutively, starting with the Introduction. The introduction can be split into several subheadings if the author finds the need to organize the information into several subtopics. Sub-section headings should also be in the same style as those numbered 1.1, 1.2, etc, and left-justified, but unbolded. All headings should have a minimum of three text lines after them before a page or column break.

1.2 Background

We are excited to present our creative Human Resources Management System (HRMS), created using the skills of the programming languages Dart and Flutter, as we begin our final year project. There has never been a greater need for an effective and simplified HRMS given the shifting dynamics of the workplace today. In addition to having an intuitive user interface, this application is cross-platform compatible, meaning it works on a variety of devices and operating systems. By implementing the Dart Security Framework, the use of Dart improves data security and guarantees the integrity and confidentiality of HR-related data.

1.3 Problem Statement

Organizations face difficulties in maintaining secure and effective Human Resources Management Systems (HRMS) in the modern workforce management environment, especially when these systems are deployed on mobile applications. Since many existing solutions do not have cybersecurity features, HRMS apps are susceptible to hacking and illegal access. Security risks include data interception, unauthorized data access, and potential exploitation of flaws in mobile operating systems when using traditional mobile platforms for HRMS. When handling sensitive HR-related data, such as personnel records, attendance information, and leave requests, these security concerns become even more important. Moreover, the increasing use of mobile devices in contemporary work environments demands a greater emphasis on protecting HRMS software from diverse cybersecurity risks. Organizations may be at danger of data leaks due to inadequate security procedures, which could result in legal and regulatory problems.

1.4 Objectives

- Investigating the current systems and the gaps
- Development of dart security framework for cross-platform systems
- Implementing an HRM system based on the Dart security framework

2. Materials and Methods

2.1 System Development Tools and Techniques

The development of HRMS used a suite of tools and technologies. Each tool plays a unique role in developing a secure and efficient HRMS application.

2.2 Firebase

One of the main tools of this system's backend infrastructure is Firebase. Firebase guarantees safe data storage, easy user authentication, and effective management of backend operations by utilizing its real-time database, authentication services, and cloud features. Firebase's scalability and ease of integration make it a vital element in this project's development stack for the HRMS.

2.3 Dart

This HRMS application runs on the Dart programming language. Favored for its ease of use and efficiency, front-end developers use Dart with the Flutter framework. Because of Dart's interoperability with Flutter, developers can work on a single codebase for both iOS and Android, which facilitates code maintainability and streamlines the development process.

2.4 Flutter

The front-end of the HRMS application is built using the Flutter UI toolkit from Google. With its extensive collection of pre-designed widgets and hot-reload functionality, Flutter improves the user interface development process. Its capacity to produce natively developed desktop, web, and mobile applications fits in nicely with this objective of offering a unified user experience across platforms.

3. Results and Discussion

The HRMS system was successfully implemented on both iOS and Android platforms using Flutter. This validated the effectiveness of using a cross-platform development approach, enabling a single codebase to provide native-quality experiences across mobile operating systems. Flutter's built-in flexibility enables top speed and an integrated user experience, ensuring that the HRMS system runs without any problems on iOS and Android devices. Users can access the HRMS system with the same level of functionality and design on any device of their choice.

Furthermore, the cross-platform method of development drastically reduces time and resources needed for updates and maintenance. A unified codebase makes it possible to make changes quickly and easily, doing away with the requirement for different modifications for the iOS and Android versions. This simplified procedure speeds up the release of new features and enhancements while also increasing the general stability of the system.

4. Conclusion

This chapter summarizes the key conclusions derived from the development and evaluation of a secure mobile HRMS system using the Dart framework. It highlights how the outcomes relate to the growth of social business models.

4.1 Summary of Findings

The project successfully demonstrated the feasibility of building a feature-rich, secure HRMS using Flutter and implementing the Dart security framework. The fusion of these technologies enabled robust data protection without compromising usability or cross-platform availability. Comprehensive

testing validated the system's functionality, security, and ease of use. Personnel could efficiently access key workflows while administrators gained analytics insights and automation.

Overall, the system overcame limitations of traditional HRMS solutions by taking a proactive, holistic approach to security while embracing mobile-first design.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

System of a Down: Incident Response Training Field

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Abstract: The current cybersecurity landscape shows various types and numbers of attacks happening to organizational and enterprise systems. When a cyber-attack occurs, it interrupts business operations, leading to a decrease in profits. To address this issue, every business needs a skilled incident response team. However, the common issue is that only a limited number of training platforms prioritize incident response. This abstract introduces a comprehensive incident response training platform designed to empower users with the knowledge and skills needed to mitigate cybersecurity incidents and focuses on analyzing and identifying incidents. Through a mix of theoretical concepts and hands-on simulations, users gain practical experience in real-world cyber threat environments. The platform includes tools commonly used during incident response and handling cases to train users in handling real-world incidents that often occur in enterprise companies and organizations. The incident response training represents an enhancement of existing training platforms, with a specific emphasis on sharpening user skills in incident analysis. Users will engage in tasks designed for various categories. In the Incident Response Tools category, users will work with widely used tools like Wireshark, Wazuh, Elasticsearch, and Splunk to conduct analyses based on incidents. Other categories involve responding to incidents based on real cases affecting the system, including phishing attempts, malware attacks, and server defacement. This training in incident response encompasses industry-relevant aspects that allow users to enhance skills applicable in various sectors. The advantages of this training include acquiring practical skills and hands-on experience in managing real-world incidents. The system testing and evaluation process for cybersecurity students gives a positive review, indicating that the system is effective in enhancing understanding and improving skills in incident response. In summary, the significance of incident response skills is crucial for both business and system integrity to ensure the continuity of business operations and safeguarding organizational data.

Keywords: Incident Response, cybersecurity

1. Introduction

In the field of incident response (IR), training is vital for computer security incident response teams (CSIRT) to optimize their efficiency in combating diverse and complex cyber-attacks. Incident

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response training enhances CSIRTs' abilities to identify, analyze, and respond to security incidents by exposing them to simulated cyber-attack scenarios. These training programs simulate real-world incidents, ensuring CSIRTs are well-prepared to address evolving threats [1]. Practical exercises and hands-on experience help CSIRTs develop their incident handling skills and implement effective mitigation measures. Training equips CSIRTs with the necessary knowledge and experience to proactively detect, respond to, and recover from security incidents, making it crucial in today's constantly evolving threat landscape [2].

2. Objectives

The objective of incident response training is to sharpen crucial aspects of response plans, particularly emphasizing identification and detection protocols. This involves developing user-friendly training systems for beginners, ensuring accessibility and comprehension. Moreover, the aim is to develop interactive training modules that closely mimic real-world scenarios, enabling practitioners to apply acquired skills effectively in actual incidents, increasing preparedness and response capabilities.

3. Problem Statement

3.1 Lack of incident response training that beginner friendly, based on real-world cyber-attack and interactive in the browser.

The problem is that there is a shortage of incident response training that is easy for beginners to understand, providing practical experience with real-world cyber-attacks and allowing interactive learning through web browsers. This limits the opportunities for newcomers to gain hands-on experience and develop their skills in responding to security incidents effectively.

3.2 Few training modules that focus on the crucial part of incident response are identification and analysis.

Another issue is the limited number of training modules that concentrate specifically on the critical aspects of incident response, which are the identification and analysis of security incidents. These modules are essential for responders to acquire the necessary skills and knowledge to swiftly recognize and assess threats, enabling them to take appropriate actions to mitigate the impact of the incidents.

3.3 The available training only focuses on the technical part and less emphasis on real-world scenario.

The current training options primarily focus on technical aspects, overlooking the importance of preparing responders for real-world scenarios. This means that responders may have a solid understanding of technical tools and techniques but lack the ability to apply their knowledge in practical situations, where contextual understanding and decision-making are equally vital [3].

4. Materials and method

4.1 Incident Response Plan

IR plan is a set of documentation or process which will be done during IR. IR plan will ensure when the event of security breach happens to a company, the procedures that will be conducted during IR will be executed effectively to deal with the threat. Every big company needs to have an IR plan to ensure that the structured investigation can be done properly to provide the cyber-attack victim with quick mitigation and remediation [4].

4.2 Incident Response Tools

Incident response tools are software and hardware solutions that assist organizations in identifying, containing, and recovering from security breaches. The IR tools can help incident responder to view and analyze the log to find the cyber-attack happen during the incident.

1) *Wireshark*

Wireshark is a free and open-source network protocol analyzer. It allows users to capture and analyze network traffic in real-time, to identify and troubleshoot network issues, and to detect and investigate security incidents. One of the main features of Wireshark is its ability to dissect and decode a wide variety of network protocols, making it possible to view and analyze network traffic at different layers of the OSI (Open Systems Interconnection) model. This includes data link layer network layer, and transport layer protocols.

2) *Splunk*

Splunk is a software platform that allows organizations to collect, analyze, and visualize large volumes of data in real-time. It is commonly used for log management, security analytics, and incident response. One of the main features of Splunk is its ability to index and search large amounts of unstructured data, such as log files, network traffic, and system events. This allows incident responders to quickly search for and identify specific events or patterns of activity that may indicate a security incident.

3) *Wazuh*

Wazuh is a comprehensive incident response platform that provides security visibility and compliance capabilities, it can be used to support incident response activities by providing detailed visibility into log data, network traffic and endpoints, and enabling incident responders to quickly identify and isolate security incidents [5].

4.3 Cyber Attack Scenario

Cybersecurity training in a cyber-attack scenario-based approach refers to the education and training provided to cybersecurity personnel and other stakeholders in an organization that simulates real-world cyber-attack scenarios. This type of training is designed to prepare individuals and teams to identify, respond to, and mitigate cyber-attacks in a realistic and effective manner. There are so many benefits of scenario based cyber-attack in incident response training as it provides hands-on exercises and simulations of different types of cyber-attacks, such as DDOS, malware infections, and advanced persistent threats (APTs). The cyber-attack scenario will give user a real experience of handling incident that based on true cyber security cases. By using cyber-attack scenario, it can allow participants to practice incident response procedures and techniques in a safe and controlled environment [6].

5. Result and discussion

The training field underwent a beta testing phase, during which it was made available to a group of students and industry professionals for the purpose of evaluating the incident response challenges. The valuable data generated from this testing phase is recorded within the system and can be accessed by administrators through the statistics pages. This feature enables administrators to gain insights into user performance, track progress, and identify areas that may require further refinement. Based on the statistic, user able to understand and carry out incident response training to mitigate the scenario given by come out with high score.

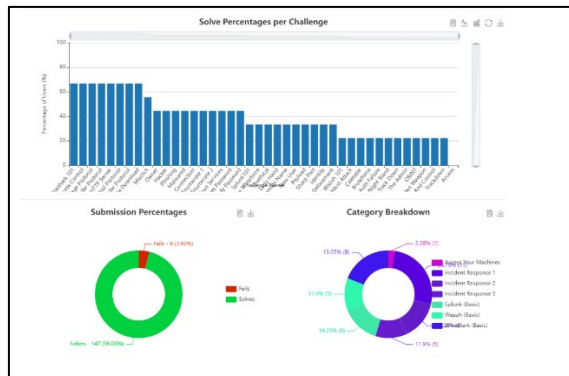


Figure 1: Result from System of a Down

6. Novelty

The novelty of incident response training lies in the Simulation of Authentic Attack Dynamics (SOAD) platform, which offers a training environment mirroring industry standards and real-world systems. Accessible via browser format, it facilitates seamless learning across various devices, ensuring convenience and flexibility for users. Its intuitive and user-friendly interface prioritizes optimal user experience, simplifying complex concepts and enhancing engagement, thereby revolutionizing incident response training methodologies.

7. Conclusion

System of a Down incident response training field provides a valuable platform for users to enhance their knowledge and skills in handling cyber security incidents. Through its user-friendly interface and comprehensive modules, the system offers a hands-on learning experience that simulates real-world scenarios. Users can engage with various incident response tools and techniques, such as Wireshark, Splunk, and Wazuh, enabling them to develop a deep understanding of incident identification, analysis, and mitigation.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

USB Port-Lock Using Password Authentication: Securing USB ports with password encryption to protect sensitive data

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Abstract: This study aims to protect data in the computer and reduce the risk of being attacked by hackers by implementing USB Port-Lock software. This is because an open USB port is not well protected, and data is easily replicated or stolen by unauthorized parties. Additionally, unused USB ports are vulnerable to various attacks. Attackers can exploit existing vulnerabilities to gain access and extract sensitive information through USB ports. Therefore, many measures have been taken to guarantee that security is enforced and also security compromise is reduced. There are several methods that may be used to safeguard user's PCs, and password encryption has been picked as one of them. USB Port-Lock was created to protect data from being stolen and protect devices from being attacked. USB Port-Lock is a programme that disables all Universal Serial Bus (USB) ports on any user's computer. USB Port-Lock uses password authentication security with encryption methods to disable and enable USB ports. The password for USB ports must be specified by the machine owner using this USB Port-Lock. This utility allows users to password-protect USB ports. The user must input the password in order to utilise the USB port. The encryption method used is PBKDF2 (Password-Based Key Derivation Function 2) with 10,000 iterations as recommended by NIST (National Institute of Standards and Technology) in publication "SP800-63B-3" from 02/03/2020 and advanced encryption standard 256 (AES-256).

Keywords: AES-256; PBKDF2; USB Ports; Password Encryption; Password Authentication; Write Protection; Database; Lock and Unlock Ports

1. Introduction

The increasing prevalence of computers in modern society has made them essential for individuals and businesses. The need for information exchange and file preservation has led to widespread computer usage. However, with this increased usage comes the importance of computer security. Users need assurance that their systems are secure, and their data's integrity and privacy are preserved. Data breaches often occur due to human actions, intentional or unintentional, leading to financial and reputational damages. It's important to note that common interfaces like USB ports can be exploited to carry out computer attacks. Many users are unaware of the security risks associated with USB ports, leading to inadequate protection of personal data and potential unauthorized access or theft. Heightened

awareness and responsibility are necessary to address these security vulnerabilities.

A study project offers password authentication features using USB Port-Lock, a USB port blocker programmed. This program blocks all USB ports on a user's computer and needs the machine owner's password. This program allows you to password-protect USB ports, preventing unauthorized users from stealing data. The goal is to build a secure system that protects private data from unauthorized access and defends against external threats..

1.1 Problem Statement

A computer system may temporarily or permanently store essential data for individuals or corporations. Open USB ports are not well-protected, and data can be simply replicated or stolen by unauthorized parties via the USB ports [1].

Unused USB ports are exposed to a variety of attacks. Attackers can exploit existing vulnerabilities to gain access and extract sensitive information via USB ports [2].

1.2 Objective

A USB port lock application's main objectives are to improve system security. To accomplish this, the following objective must be fulfilled:

1. To study on the existing encryption method and the detection of the USB input.
2. To develop a tool to disable USB ports with the password encryption on the user's machine.
3. To test the functionality and security of the USB port blocker.

1.3 Scope

This study focuses on the development of the USB Port-Lock application, which aims to enhance security and protect against unauthorized access and data breaches. It uses the PBKDF2 encryption method with 10,000 iterations and AES-256 encryption standards, as well as write protection functionality. The target users include individuals and organizations. It aims to provide a reliable and user-friendly solution to enhance security and protect sensitive data.

1.4 Significance Study

The USB Port-Lock programme provides a safe way to safeguard USB ports. It essentially locks the USB ports by utilizing password encryption and authentication, limiting unauthorized access and potential security breaches. This feature guarantees that only authorized users with the right password can enable the USB ports and access connected devices. The tool reduces the dangers connected with unauthorized data transfers, virus introduction, and data theft via USB devices by safeguarding the USB ports. The USB Port-Lock programme provides customers with peace of mind by offering a dependable and strong way for securing USB ports and maintaining system integrity.

The USB Port-Lock programme has a write protection function that prohibits unauthorized users from altering or accessing data on the USB drive. This protects the privacy and integrity of the stored information by allowing only authorized users to see the data and prohibiting any efforts to copy, remove, or change the files. The programme adds an extra degree of security by providing write protection, which protects sensitive data from unauthorized changes and ensures its secrecy.

2. Materials and Methods

This section provide detailed descriptions of the materials, equipment, and other resources used in the study.

2.1 Materials

The materials and equipment used in the development of this project include:

- Journal

Journal articles and case studies serve as crucial resources for gathering information and insights relevant to the research objectives. Journal articles provide peer-reviewed scholarly content that offers in-depth analysis, theoretical frameworks, and empirical findings related to the topic of interest.

- Software

Visual Studio, with C# programming, is used to develop both the prototype interface and the full system. It provides tools for design, coding, debugging, and testing. C# is versatile for building the user interface and system functions of USB Port-Lock.

Furthermore, Microsoft SQL Server is used as the database system for USB Port-Lock. It efficiently stores and manages data with features like transaction support and security controls. SQL Server ensures data integrity, availability, and confidentiality, enhancing system security and reliability.

- Hardware

Personal computers (PCs) are the main equipment used in this study. They are essential for running software tools like Visual Studio and Microsoft SQL Server, which are used to develop and test the USB Port-Lock system. PCs provide the hardware and computing power needed for these tasks, allowing researchers to work efficiently on designing, coding, debugging, and testing the system.

Additionally, USB ports and USB drives are crucial for testing the USB Port-Lock system. USB ports connect USB drives to the PC, mimicking real-world situations where external devices might try to access the system. USB drives are used to transfer data and evaluate how well the USB Port-Lock system blocks unauthorized access and prevents data breaches through USB connections.

2.2 Methods

The use of Rapid Application Development (RAD) methodology is important in rapidly developing the USB Port-Lock. RAD is a progressive development paradigm that emphasizes quick prototyping and rapid feedback throughout a lengthy development and testing cycle. Referred **Figure 1** [3].

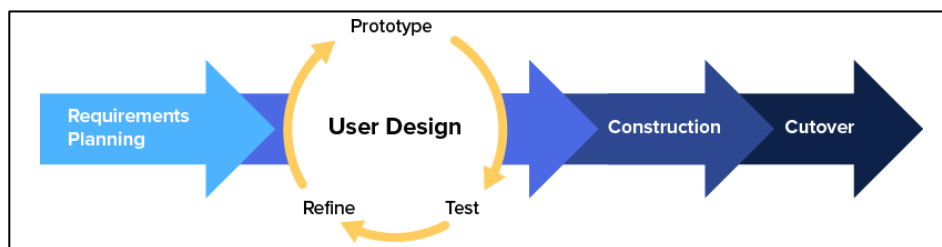


Figure 1: Rapid Application Development (RAD)

The system applied two methods to develop which are password encryption and write protection. Figure 2 shows the architecture of the USB port-lock application. This application uses the password-based cryptography concept, namely PBKDF2 which concludes the salt and iteration count technique plus AES-256 to encrypt and decrypt the password. The salt is an array of bytes which is added to the

message/password prior to digest. The iteration count specifies how many times the hash function will be applied to the message. The system architecture is shown in **Figure 2** below.

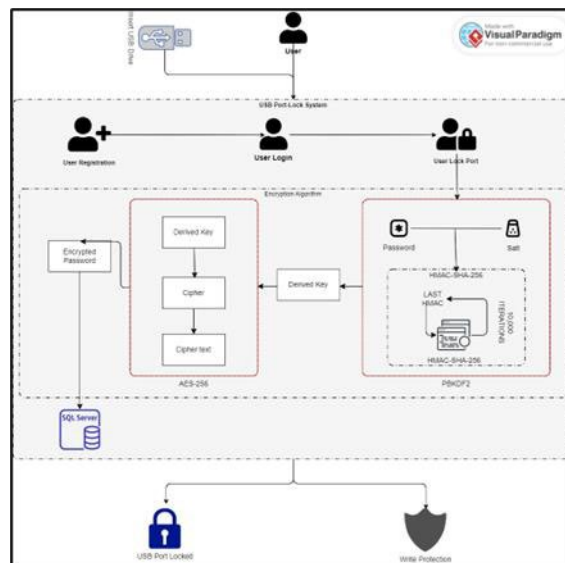


Figure 2: System Architecture

Write protection is a security measure that prevents data from being written, modified, or deleted on a device or file. It is often used to prevent accidental or unauthorized changes to data, or to protect important or sensitive data from being altered or deleted [4].

2.3 Equations

PBKDF2 is a key derivation function that takes a password and a salt value as input and applies a hashing algorithm to them multiple times to produce a derived key. K is the mix of a few component as **Eq. 1**:

$$K = PBKDF2 (PRF, Password, Salt, c, dkLen) \quad \text{Eq. 1}$$

PRF: The fundamental component of PBKDF2 in creating the key derivation function is pseudo-random function [5]. Preferred HMAC function.

Password (P): Password entered by the user.

Salt: A series of bits referred to as cryptographic salt. To strengthen the security of the password, salt, a random number, is added.

Number of Iterations (c): The number of iterations that must be carried out. An iteration count increases the security strength of a password by $\log_2(c)$ bits against trial-based attacks such as brute force or dictionary attacks. Before returning the hash password, the process is iterated many times [6].

dkLen: Generated derived key bit length.

3. Results and Discussion

Functional testing and security testing are made up to ensure the system is secured.

3.1 Results and Discussion

Table 1: Functional Testing Results

MODULE	DESCRIPTION	EXPECTED RESULTS	RESULTS
Registration Module	Users insert email, password and confirm password.	The data stores in database and the password will be saved in encrypted password.	PASS
Authentication Module	Users input a correct information to Login.	Success message will appear, and the system will straight to the home page.	PASS
	Users input a wrong information to Login. And to unlock USB port.	An error message will appear on screen.	
	Users input a correct password to unlock the USB port.	USB port will unlock and write protection will enable.	
Lock Port Module	Users set up password.	USB port will lock, and the password will save in the database.	PASS
Write Protection Module	Users enabled protection function.	Users cannot do any changes on the drives.	PASS
	Users disabled protection function.	Users may do any changes in the drives.	
Forgot Password Module	Users insert registered email to forgot password.	Users received verification code via email.	PASS

Table 1. The functionality of the system has been carefully reviewed and satisfies the required behavior for each module, as evidenced by the fact that all testing has resulted in a pass. A successful functional test assures that the system's features and modules are carrying out their intended functions without experiencing any significant problems, which is a crucial milestone in the software development process.

Table 2: Security Testing Results

MODULE	TEST CASE	EXPECTED RESULT	RESULTS
Password Policy	Input a short password without a combination of numbers, lowercase, uppercase and special characters.	Appearing an error because it is not following the password policy.	PASS
Input Validation	Test with empty input, invalid input, and invalid password.	Appearing an error message.	PASS
Brute Force with Lockout	Trying to attempt with a wrong information more than three time.	The system is lock in a period of times.	PASS
Static Code Analysis	Scan the code formatting, exception handling and SQL Injection using ReSharper.	No potential error and security vulnerabilities.	PASS
Password Encryption	Test whether the plaintext password visible or not in the database.	The plaintext password is not visible in the database.	PASS
Dotnet Package	Scan the project package.	No vulnerable package in the project.	PASS

Table 2. show a table of security testing results. Security testing was tested to ensure that USB port-lock was working as planned. The testing focuses on finding flaws, weaknesses, and possible security risks in the system.

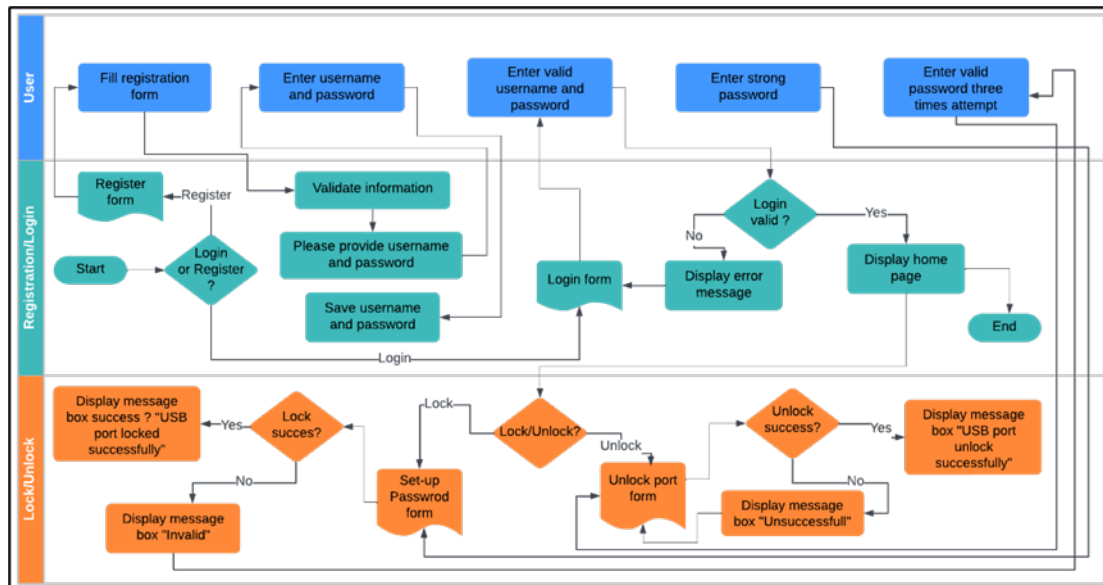
4. Conclusion

USB port-lock software is a strong solution for improving data security and network stability. It includes password authentication and encryption, which ensures only authorized users can connect USB flash drives to the USB ports. The write protection mechanism also improves data integrity and confidentiality. The software's efficacy and dependability are verified by functional and security testing, and it meets industry requirements.

USB port-lock software undergoes extensive testing to ensure its efficiency and security. Functional testing ensures the programme correctly executes its intended purposes, while security testing detects and resolves vulnerabilities and flaws. This testing procedure adds an extra degree of confidence, ensuring the programme secures data and maintains a safe computing environment.

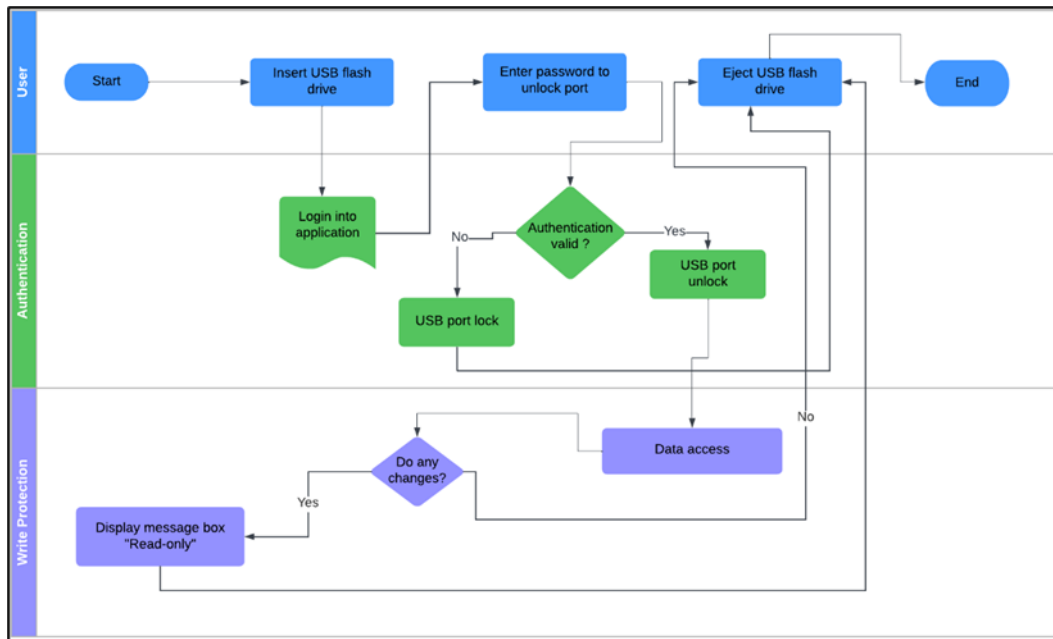
Appendix A

Activity Diagram for Disable/Enable Function



Appendix B

Pop-Up Authentication Activity Diagram



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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

2D Animation PSA – Awareness of Identifying the Signs and Symptoms of Autism Spectrum Disorder (ASD)

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Abstract: According to the statistics by the World Health Organization (WHO) in 2022, about one in 100 children worldwide has been diagnosed with autism spectrum disorder (ASD), a developmental disorder that occurs due to different brain developments and affects how individuals with ASD behave, interact, and communicate with others. The objectives of this research are to analyse the signs and symptoms of ASD, develop a series of 2D animation public service announcement (PSA) videos, and evaluate the effectiveness of PSA about ASD for parents and caregivers. This research employed ADDIE model as the research framework, use multimedia platforms by developing a 2D PSA video to spread ASD awareness in society, particularly among parents and caregivers. Based on the survey done online, the result shows that 74.2% of the respondents strongly agreed that these PSA videos helped parents and caregivers gain more knowledge, while 83.9% strongly agreed that these PSA videos helped parents and caregivers identify the signs and symptoms of ASD. The majority of the respondents recommended that these PSA videos be done in both Malay and English to give the viewers a better understanding of the topic.

Keywords: Autism Spectrum Disorder, Public Service Announcement, 2D Animation

1. Introduction

Autism Spectrum Disorder (ASD) is a neurological condition affecting communication, interaction, behavior, and learning in children aged 2 years and can be mild to severe. The cause is unknown, but it may be caused by genetic factors [1]. ASD symptoms include social communication avoidance, repetitive behavior, and hyperactivity. This research aims to analyze ASD signs and symptoms, develop a 2D animation PSA video to raise awareness and evaluate the effectiveness of public service announcements about ASD among parents and caregivers. Lack of awareness can cause stress and confusion for those dealing with ASD and those seeking treatment for their children [2]. The research aims to create awareness and improve understanding of children with ASD [3].

2. Materials and Methods

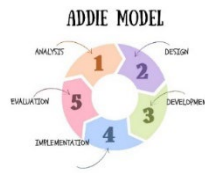


Figure 1 : ADDIE Model

The ADDIE model, as shown in Figure 1, was developed in 1975 at Florida State University [4], is a guide for instructional design [5]. This model consists of five phases: analysis, design, development, implementation, and evaluation. It is chosen for its ease of understanding and effectiveness in each process. The ADDIE model is also easy to modify because each phase has been separated, but all phases are interrelated.

A. Analysis

In the analysis phase, the problem statement, objectives, and research questions are determined. All the analysis needs to be done before proceeding to the next phase.

B. Design

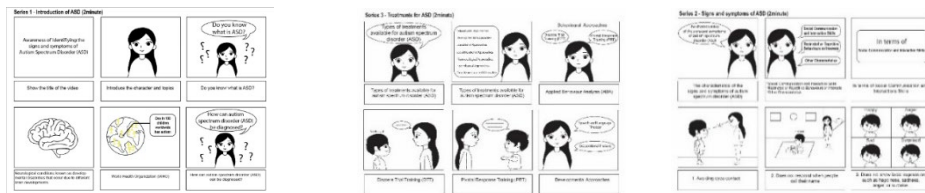


Figure 2 : Storyboard Design

The design phase involves creating a Gantt Chart and a storyboard as shown in Figure 2, for the entire series and guiding the development process.

C. Development

The 2D animation PSA video series, shown in Figure 3, are created using Adobe Animate CC 2021. The series focuses on understanding ASD, the signs and symptoms, and available treatments.

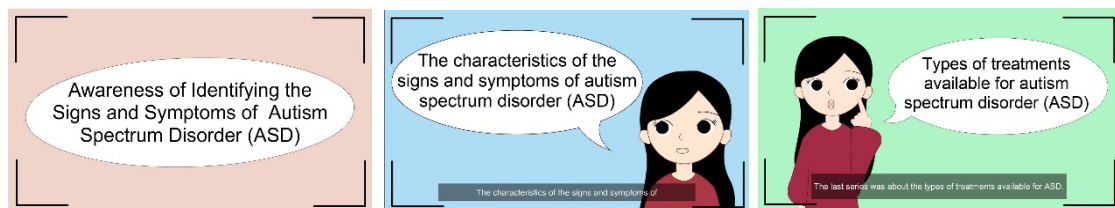


Figure 3 : Video Series

D. Implementation

In the implementation phase, the completed PSA videos need to be double-checked to identify any necessary changes before conducting the test with target audiences, as shown in.

E. Evaluation

For the last phase, which is evaluation, when the PSA videos have been approved, the process proceeds to conduct an online survey using a Google Form with the target audiences to collect data on the effectiveness of the PSA video to spread awareness about autism spectrum disorder (ASD) among parents and caregivers.

3. Results and Discussion

A test was conducted to evaluate the effectiveness of the 2D animation PSA video. A questionnaire was distributed via Google Form, containing open-ended, closed-ended, and scaled questions. The questionnaire was divided into three sections: Section A (Demographics), B (Identify the signs and symptoms of ASD), and C (The effectiveness of the 2D PSA ASD videos). The test is open only to either a parent of ASD child or an ASD caregiver.

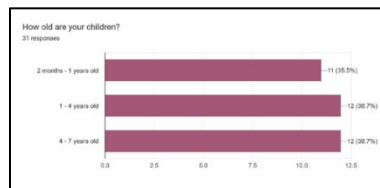


Figure 5 : Bar chart shows number of children according to age

The data shows in **Figure 5** that 38.7% of respondents have children aged 1-7 years old, while 35.5% have children aged 2 months to 1 year old, indicating that the majority of respondents have children aged 1-7 years old.

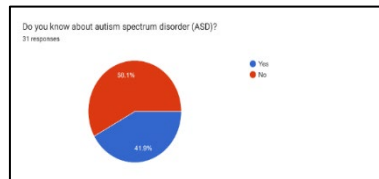


Figure 6 : Pie chart shows the proportion of respondents know about ASD

Figure 6 shows that 58.1% of respondents are unaware of ASD, which shows many are unaware of ASD before watching the videos.

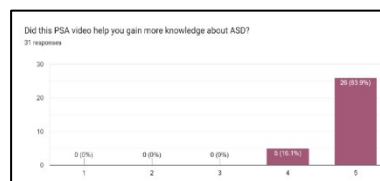


Figure 7 : Bar chart shows the percentage of respondents respond whether the PSA videos help them gain more knowledge about ASD

Figure 7 shows that 83.9% of respondents strongly agree that PSA videos help them understand ASD, indicating a significant increase in understanding of ASD

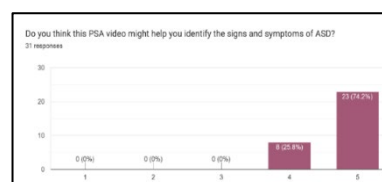


Figure 8 : Bar chart shows the percentage of respondents respond whether the PSA videos help them identify the signs and symptoms of ASD

The majority of respondents (74.2%) as shown in **Figure 8**, strongly agree that the PSA videos effectively help them identify the signs and symptoms of ASD, showing that these videos were helpful to the majority of respondents.

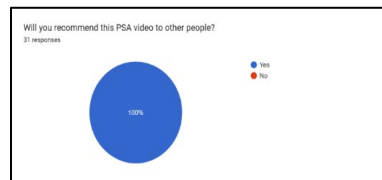


Figure 9 : Pie chart shows the percentage of respondents who will recommend the videos for others to watch

The pie chart in **Figure 9** shows that 100% of respondents recommend the PSA video for others to watch, suggesting this PSA videos effectively create awareness about ASD to other people.

4. Conclusion

The 2D animation PSA videos have successfully spread awareness about ASD among parents and caregivers. There are areas for improvement, such as improving the animation design, the intonation for the narrator, and having the videos in Malay and English. Overall, the PSA has achieved its main objectives.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

The Innovative Development of Unique Natural Fibers for Oil Absorption at UNIKL MIMET Slipway (INNO-NAF-OA)

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Abstract: This innovative project proposes a groundbreaking approach to implement SIX (6) natural environment fibers for efficient oil absorption in oil spills. The objectives of this innovative project are i) to rank the best oil absorption from six different types of natural fiber, and ii) to identify the absorption time and the quantity of absorbed oil from these different types of natural fibers. The different natural fibers are crafted from a synergistic blend of 1) *Fine Sawdust*, 2) *Coarse Wood Dust*, 3) *Coconut Husk*, 4) *Kapok Fiber*, 5) *Sugar Cane Dregs*, and 6) *Cattail*. These natural fibers are strategically combined to construct a highly effective and eco-friendly solution for oil spill remediation. The innovative project explores each component's single oil absorption capabilities, considering their unique physical and chemical properties. The innovative project was steered in a UNIKL MIMET slipway in Lumut, Perak. A 100-gram cattail is more effective to absorb 50 milliliters (1.69 oz) of spilled oil in less than 4 hours, according to the on-site trial. The experiment was conducted manually and observed for the specified duration of time. The result reveals Cattail is the most natural fiber oil absorbent, followed by Kapok, Fine Saw Dust, Coconut Husk, Sugar Cane Dregs, and Coarse Wood Dust, respectively. The trends indicate a thorough analysis of the literature on the ability of natural fibres, such as cotton, nettle, flax seed fibre, kapok, and cattail fibre, to absorb oil. The fibre sorbents can be burned or buried beneath the earth after the experiment. The integration in this innovative project of different unique natural fibers creates a unique synergy, offering effective, environmentally friendly, and economically viable solutions for addressing oil spill incidents. In conclusion, the developed natural fiber composite exhibits great potential as an innovative and sustainable approach to oil spill remediation incidents. This result provides a reference for future study implementation to apply another natural fiber as an oil absorbent.

Keywords: *Oil Spill, Natural Fibers, Oil Absorbent, Marine Pollution, Environmental*

1. Introduction

Common definitions of pollution include contamination of the environment resulting from a threat to its organisms, affecting the rate of growth, breeding plant or animal species, and interfering with human comfort, wellness, and amenities (Osofsky et al., 2016). Oil spills demolish the maritime environment and generate loss (Doshi et al., 2017). It has significant long-term environmental and socioeconomic consequences for marine ecosystems and coastal populations (National Oceanic and Atmospheric [NOAA], 2019). The oil leak harms the marine ecosystem and creates loss. It reports significant long-term impacts on marine ecosystems and coastal populations (Doshi et al., 2017). This oil spill also influences the fishing industry. The fishing sub-sector is a significant contributor to the national economy. The fisheries sector has an annual impact on marine fish landings and aquaculture production (Fisheries, 2011). However, escalating aqua output leads to higher levels of marine pollution. The waste-contaminated oil produced by fishery vessels represents a large source of hydrocarbon. The inflow of hydrocarbons into aquatic environments damages the marine ecosystem, economy, and tourism (Shi et al., 2019).

1.1 The Variation, Transformation, and Alteration Process of Oil After Spilled into the Sea

Marine pollution harms marine life, human health, and ecosystems (Sakhtipriya et al., 2015). It occurs when exogenous elements enter water. Releasing oil from a ship must follow legal guidelines for removing oil from the sea. Oil leak disasters can be caused by canal accidents, oil rigs, and vandalism that cause significant harm to the environment, marine species, plants, animals, and humans over time (Hoang et al., 2018). The spills are divided into three response tiers which are Tier 1, Tier 2, and Tier 3 (Permenkes, 2014). Polluted oil in the sea may contain aromatics, acids, and alcohols that lead to long-term water contamination. Various approaches were tried to recover oil spills including mechanical recovery, burning, bioremediation, solidification, and dispersants (Bernea et al., 2012). The methods chosen were determined by factors such as oil spill kind, frequency, weather circumstances, and environmental impact. Figure 1 illustrates how spilled oil interacts with saltwater under natural conditions.

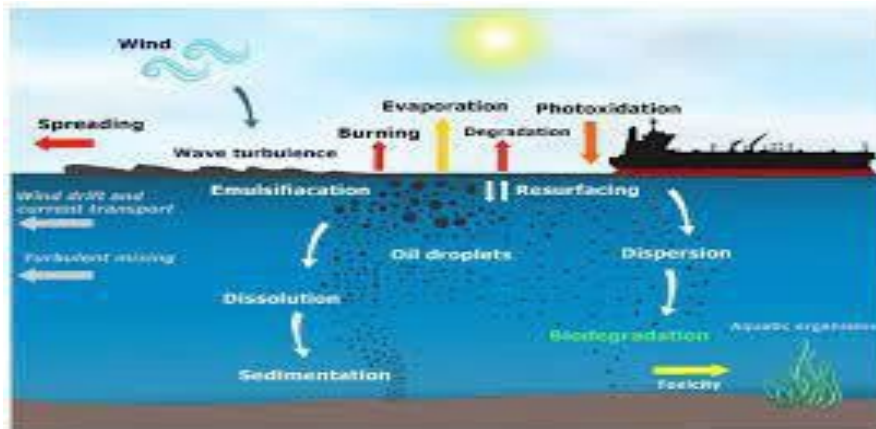


Figure 1. The Variation, Transformation, And Alteration Process Of Oil After Spilled Into The Sea (Hernando, 2022)

2. Materials and Methods

One option for controlling the oil spill is to erect an oil absorbent. It disconnects spilled oil from the water's surface. There are three types of raw materials: inorganic minerals, synthetic materials, and natural organics. As an alternative to synthetic materials, natural organic materials are becoming growing increasingly popular. Natural fibres are inexpensive, easy to acquire and eliminate after use, and environmentally beneficial (Wahi et al., 2013).

2.1 Materials

This innovative project examines six natural materials for oil absorption. This project aims to prevent oil contamination on the water at UNIKL MIMET Slipway. This innovative project aims to rank the best natural fibers for oil absorption and to identify absorption time and quantity. Six natural fiber types were employed in this innovative project such as fine sawdust, coarse wood dust, coconut husk, kapok fiber, sugar cane dregs, and cattail as depicted in Figure 2.



Fine Sawdust



Coarse Wood Dust



Coconut Husk



Kapok Fiber



Sugar Cane Dregs



Cattail

Figure 2. Six Types of Natural Fiber

2.2 Methods

There are a few boats and ships at UNIKL MIMET Slipway. Each vessel discharges around 0.05 liters of oil per day. The boats and ships spill around 1.35 liters of oil daily. The on-site experiment lasted 24 hours with absorption results collected every 6 hours. On-site testing revealed that a 100-gram cattail can absorb 50 milliliters (about 1.69 oz) of spilled oil in less than 6 hours. The experiment was conducted and observed manually.



Figure 3. The On-Site Experiment At Unikl Mimet Slipway

The photographs below depict the on-site experiment at UNIKL MIMET Slipway for six natural fibers.

1. Fine Sawdust



Before

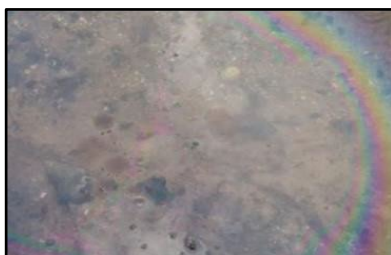


During



After

2. Coarse Wood Dust



Before



During



After

3. Coconut Husk



Before



During



After

4. Kapok Fiber



Before



During



After

5. Sugar Cane Dregs



Before



During



After

6. Cattail



Before



During



After

The experiment conducted on-site proved that cattails are an excellent and efficient way to absorb oil. 10 minutes are required for cattails to absorb oil spills. The on-site experiment was challenging as the oil leak spread quickly due to coastal currents. The cattail absorbs oil without negatively affecting the environment or water. This is due to the cattail's inherent properties. The kapok absorbed the oil leak, however it took longer than the cattail. Meanwhile, fine sawdust, coconut husk, sugar cane dregs, and coarse wood dust did not absorb any oil spill.

3. Results and Discussion

3.1 Results

Table 1. Types Of Natural Fibers And Quantities Of Oil Absorbed

Types	Result	Weight (g)	Motor oil (ml)	Quantities of oil absorbed (ml)
Fine Saw Dust	3	100g	50ml	14ml
Coarse Saw Dust	6	100g	50ml	4ml
Coconut Husk	4	100g	50ml	12ml
Kapok Fiber	2	100g	50ml	50ml
Sugar Cane dregs	5	100g	50ml	8ml
Cattail	1	100g	50ml	50ml

Table 1 shows that cattail and kapok fibre absorbed more oil than fine wood dust, coarse sawdust, coconut husk, and sugarcane dregs. Each type of natural sorbent weighs 100 grams and includes 50 milliliters of motor oil. The experiment is monitored and documented every six hours for a total of 24 hours. Cattail is the most effective natural fibre for absorbing oil (50ml), followed by kapok (50ml) and fine sawdust (14ml), which is sunk in water. Coconut husk absorbs 12ml of oil, sugarcane dregs absorb 8ml, while coarse saw dust barely absorbs 4ml of spilled oil.

Table 2. Hours and Quantities of Absorbing Oil

Time (in hours)	Quantities of absorbing oil (ml)					
	Fine Saw Dust	Coarse Wood Dust	Coconut Husk	Kapok Fiber	Sugar Cane Dregs	Cattail
6 hours	5ml	2ml	4ml	30ml	2ml	50ml
12 hours	10ml	4ml	8ml	40ml	4ml	0ml
18 hours	14ml	4ml	12ml	50ml	8ml	0ml
24 hours	14ml	4ml	12ml	50ml	8ml	0ml

Table 2 shows that cattail is the best at absorbing spilled oil. Cattails take 10 minutes to absorb spilled oil. The experiment's competence to control spilled oil is limited because it spreads swiftly because of water currents. Kapok has the second-greatest absorption rate but requires a longer time than cattail. Fine sawdust, coarse wood dust, coconut husk, and sugar cane dregs did not effectively absorb oil spills. Disposing of fine sawdust and coarse wood dust was challenging due to the natural fiber's affinity to spread to contiguous areas.

3.2 Ranking

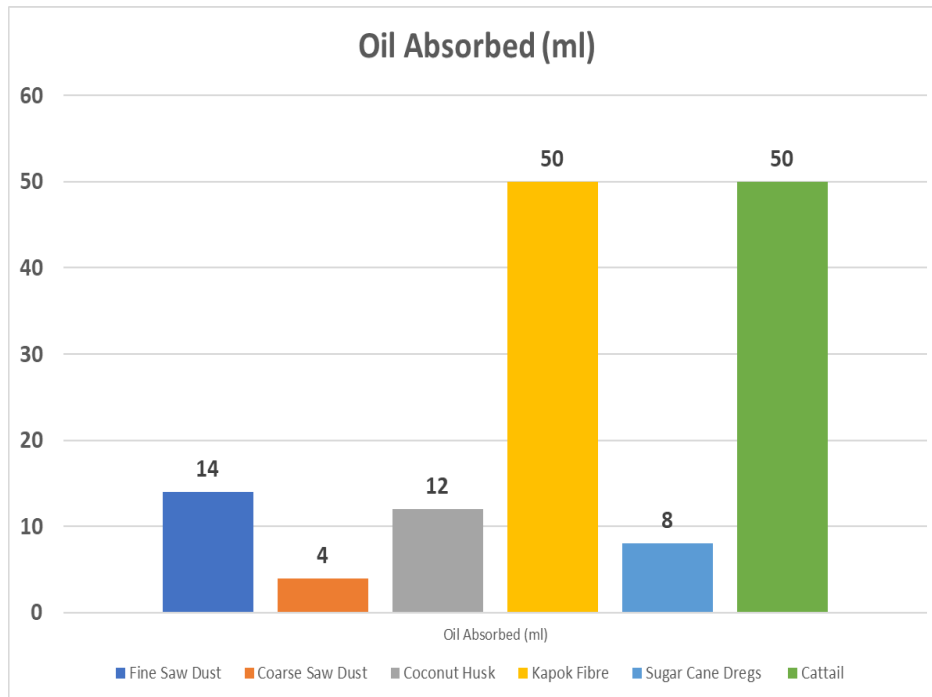


Figure 4. The Quantities of the Absorbed Oil (ml)

Figure 4 explains the absorption rate by indicating a cattail is the best natural fiber every 6 hours for 24 hours.

Table 3: Ranking Of The Highest Oil Absorption

No	Ranking of highest oil absorption
1	Cattail
2	Kapok Fiber
3	Fine Saw Dust
4	Coconut Husk
5	Sugar Cane Dregs
6	Coarse Wood Dust

Table 3 shows the ranking of the highest oil absorption respectively. The ranking of the highest oil absorption is cattail, kapok, fine sawdust, coconut husk, sugar cane dregs, and coarse wood dust respectively.

4. Conclusion and Recommendation

4.1 Conclusion

Cattail fiber was proven to be the extremely effective and fastest at absorbing spilled oil on oil-water surfaces, out of six fiber types tested. Natural fiber is good at absorbing oil spills. The innovative project discovered that cattails are the most effective natural fiber for absorbing oil spills on water surfaces. Cattail is the greatest natural fiber and has no detrimental influence on the marine environment, as exhibited by both in-house and field experiments. Natural fiber is a cost-effective complementary to other techniques for cleaning up oil spills. Cattail fiber outperforms other natural fibers in terms of oil

absorption and buoyancy. Natural fiber's buoyancy inhibits it from sinking in water after absorbing oil spills (Cao et al., 2018).

4.2 Recommendation

Many suggestions can be made to offer a potential solution and proposal based on the results of this creative project, as indicated above. Combating oil leak disasters requires quick thinking, making the right decision, and allocating resources in the most effective method. Any delay in acting may lead to irreversible harm, especially to the marine environment. The spilled oil remains in the environment even though mandatory remediation, mitigation, and clean-up efforts were not completed. Based on this result, it indicates cattail and kapok fiber have the highest rankings in absorption. The researcher is arranging future research which is to merge these two natural fibers to enhance innovation as a new oil absorbent pad.

Acknowledgment

This innovative project is prepared for the Final Year Project at the University Kuala Lumpur Malaysia Malaysian Institute of Marine Engineering Technology with support from the UNIKL supervisor and team members. Without good commitment and cooperation from the team members, it is hard for this innovative project to be completed on time.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

360° Multiple-Outlets Fire Sprinkler Nozzle for Optimal Class A Fire Extinguishment

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Abstract: This prototype is to improve the function of the current fire sprinkler located in an enclosed workplace. The current fire sprinkler is ineffective in distributing the water towards the fire located underneath it. Hence, it requires a lot of time for the water to reach the affected area. The current fire sprinkler requires more water supply to extinguish the fire. The objective of this study is to explore the effectiveness of a newly designed fire sprinkler that uses less water to extinguish fire. The scope of the study is limited to the application of controlling Class A fire in an enclosed space. The development of the prototype was made before it could be finalised for the real application. A biopolymer material called polylactide plastic was used as the prototype material and brass and stainless steel for the final product were selected. The use of the Design of Experiment method was made to optimize the functionality of the design. A tight set of experimental procedures was conducted involving the safety and health executive, the safety and health committee, campus approvals and fire extinguishment apparatus. Verification by experts was made throughout the study. The experimental study shows positive results in the comparison between the actual fire sprinkler and the study units. The data from the S/N ratio through the design of the experiment and verification results shows an outstanding outcome. The multiple-outlet sprinkler nozzle can be promoted for commercial use. Even though this multiple-outlet sprinkler shows positive results, more studies are required in the future, including the cooling fluid and response time.

Keywords: Fire Sprinkler, Multiple-outlets, Design of Experiment

1. Introduction

The fire sprinkler nozzle, sometimes called the fire sprinkler head, has been widely used in industries, commercial offices, education centres, shopping centres and others. This system was required as the first responder before the fire and rescue came to control the spread of the fire to other places [1].

A review highlights water spray's effectiveness in fire suppression, driven by thermal properties, with ongoing research for improvement [2]. It has been highlighted that more studies related to fire

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sprinkler monitoring [3], activation time [4] and spray [5], were made, including modelling [6]. In this study, water was used to cool down the temperature of the burning material, representing a Class A fire.

However, it has been found that there are some limitations to the current design of the fire sprinkler. An accessible amount of water has been consumed to extinguish the fire. During a fire, problems frequently arise because systems were put in place with limited coverage and effectiveness [5]. These are factors contributing to the motivation of this study.

A blend of conceptual design, optimisation modelling, prototypes and experimental tests were made to prove that the new design of the fire sprinkler nozzle produced the optimum distribution, which countered the limitations of the previous product.

Grand View Research states that the fire protection system market size is expected to grow from 2021 to 2028. The growing urban population and the need to safeguard life and the environment from fire emergencies are expected to increase product demand [7]. This shows the potential of a new product to be used for commercial needs.

1.1 Research Question

- How to identify the ineffectiveness of the operation of a fire sprinkler?
- How to develop a fire sprinkler nozzle that estimates the right parameters and works in an enclosed space?
- How to examine the optimum parameters for the fire sprinkler nozzle to operate in an enclosed space.

1.2 Problem Statement

- The current fire sprinkler system works underperformance and uses a high amount of water to extinguish the fire.
- The design of the outlet does not cover the entire area of the space.
- The deflector set on the sprinkler splashing the water makes the fire beneath it cannot receive enough water to extinguish the fire.

1.3 Objectives

- To identify the ineffectiveness of the operation of fire sprinklers for improvement.
- To develop a fire sprinkler nozzle which estimates the right parameters works in an enclosed space.
- To examine the optimum parameters for the fire sprinkler nozzle to operate in an enclosed space.

1.4 Expected outcomes

The water distribution from this study is expected to spread evenly throughout the assigned area. The amount of water used to put out the fire may be reduced and the fire can be put out at a good or better time than the original fire sprinkler, thus optimising the use of the fire sprinkler system.

2. Materials and Methods

2.1. Materials

The specifications and characteristics of the materials and equipment utilized in this research are detailed in the comprehensive Table 1.

Table 1: Parts and equipment required for the development of the fire sprinkler nozzle

Part	Equipment
------	-----------

<ul style="list-style-type: none"> • GI Pipe; 1-inch diameter, 3 meters length • GI T joints; 1-inch diameter • GI elbow joints; 1-inch diameter • Pressure gauge; 0 to 10 bar • PLA Plastic filemen (glow in dark) • Solid Brass, hexagon 1-meter length 	<ul style="list-style-type: none"> • Conventional lathe machine • Vertical drill machine • Measuring tape • Video / Still camera • 3D printer
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2.2. Methods

Initially, in the development of the problem statement, a quality tool called a cause-and-effect diagram or fishbone diagram was applied. It is important to conduct a brainstorming session to identify the root cause of the changes to be tested to improve the problems faced in the operation of fire sprinkler nozzles

Figure 1 illustrates the comprehensive concept behind the development of the 360° multiple-outlet fire sprinkler nozzle for this particular project, as outlined in the primary goals and problem statements at hand.

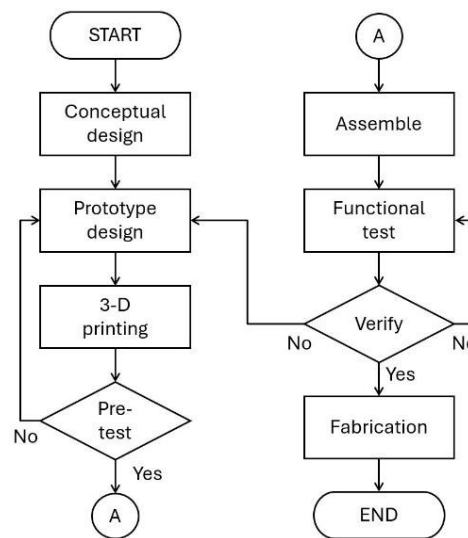


Figure 1: The design and fabrication development of the 360° multiple outlets fire sprinkler nozzle

A systematic conceptual design method using TRIZ was applied in this study to solve fundamental design problems and find fundamental solutions [8]–[10]. TRIZ suggested that any improvement made will result in undesirable consequences in which a parameter will be sacrificed. Therefore, a maximum of four inventive principles might be used for the redesign of this nozzle. For this study, appropriate parameters for redesigning the fire sprinkler head were identified, selected and fabricated. Initially, three effects need to be identified through its function, parameters (reduced temperature) and transforming from one energy to another. The results based on the matrix given were selected for the prototype to be tested and fabricated.

Before the model fabrication, numerous designs were made using CAD. A pre-experimental study was also made to test the functionality of the prototype nozzle operation made using the 3-D printing method [11]. Then the prototype nozzle can be used to select the best parameters used in optimizing the use of water throughout the entire space of a room. Here, the L9 orthogonal array consists of three-factor and three-level parameters, with signal-to-noise ratios where the optimal parameter is determined based on the higher-is-the-best. The higher the S/N ratio, the more desirable the outcome, which indicates the optimum of the response variable under consideration. The parameters involve the angle of the outlet, the number of outlets, diameter of the outlets.

Table 2: Parameters used for 3³ - L9 DoE Taguchi method

Factors		Levels		
		L1	L2	L3
	Outlet angle	10°	20°	30°
	Number of outlets	5	7	9
	Nozzle diameter	1 mm	2 mm	3 mm

The use of sand and cardboard to mark the water distributed to the floor area. With the right parameters assigned, the nozzle can be readily fabricated by either conventional or CNC lathe machining.

To test the functionality of the system, the assembly of the prototype in the pipeline must be according to NFPA and UBBL standards. Finally, a verification by the Fire and Rescue Department will be made.

The experiment is limited to the use of any kind of fire on campus. The use of a fire sprinkler prototype in the system attached to the building was also not made to avoid the whole system being activated by the emergency community systems in Kulim.

2.3 Equations

Bernuolie's equations have been applied in this study [12] to define the pressure and flow rate of the water distributed in the test compartment. From this equation, the distribution of water through the outlets of the fire sprinkler can be predicted and controlled.

$$P_1 + \frac{1}{2} \rho v_1^2 + \rho g h_1 = P_1 + \frac{1}{2} \rho v_2^2 + \rho g h_2 \quad \text{Eq. 1}$$

The equation determines the vertical motion of the fluid that is distributed from the given height.

$$y_1 = y_0 - v_{0y}t + \frac{1}{2} g t^2 \quad \text{Eq.2}$$

Since the final height is on the surface of the ground, the initial height is equal to
Where;

- y_1 is the final height from the outlet nozzle (m)
- y_0 is the initial vertical height of the outlet nozzle (m)
- v_{0y} is the initial velocity in a horizontal direction
- g is the gravitational force (-9.81m/s)
- t is the time (sec)

For the use of the Design of Expert experimental study, the use of the signal-to-noise ratio has been applied, where the calculation of the S/N ratio depends on the experimental objective higher-is-best as stated in Eq.3.

$$\frac{S}{N_{(\text{higher-is-best})}} = -10 \log \left(\frac{1}{n} \sum_{i=1}^n \frac{1}{y_i^2} \right) \quad \text{Eq.3}$$

3. Results and Discussion

3.1. Results

3.1.1. Identifying the problem of the current fire sprinkler design

During the brainstorming session, the team engaged in a thorough discussion to pinpoint the underlying issue with the design of fire sprinkler nozzles, as depicted in Figure 2. Various ideas and perspectives were shared and analyzed to identify the root cause of the problem.

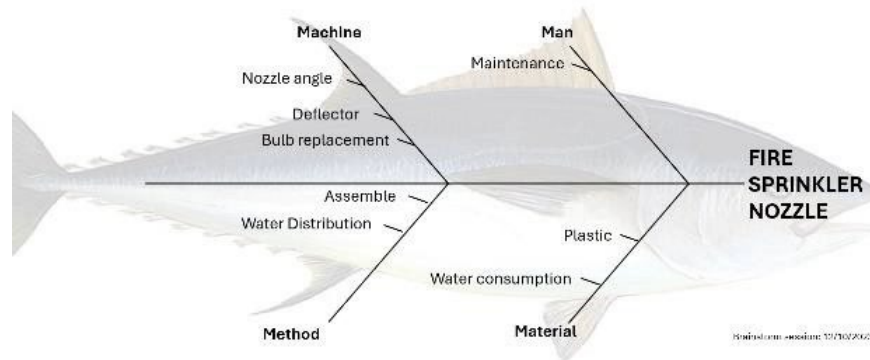


Figure 2: Cause-and-effect diagram of fire sprinkler nozzle design

In Figure 3, the specific fire sprinkler nozzle that is being referred to has been clearly identified. This inclusion of the nozzle in the figure greatly facilitates the process of studying and comparing it in order to identify areas for potential improvement.

3.1.2. Fire sprinkler development

Base on TRIZ Contradiction Matrix for the redesign the fire sprinkler nozzle, it has been summarised that three inventive principles have been suggested. Table 1 revealed the summarized results.

Table 1: Summary of TRIZ parameter setting, changes and results

Improving Parameter	Undesiarable Reslts	Identified Inventive Principles
22. Loss of energy	9. Speed	16. Partial/excessive action 35. Parameter change 38. Accelerate oxidization

The nozzle prototype was then tested using Taguchi's method, with nine experiments conducted. The results revealed that the outlet angle ranked in the top followed by the nozzle diameter and the number of outlets as shown in Figure 3.

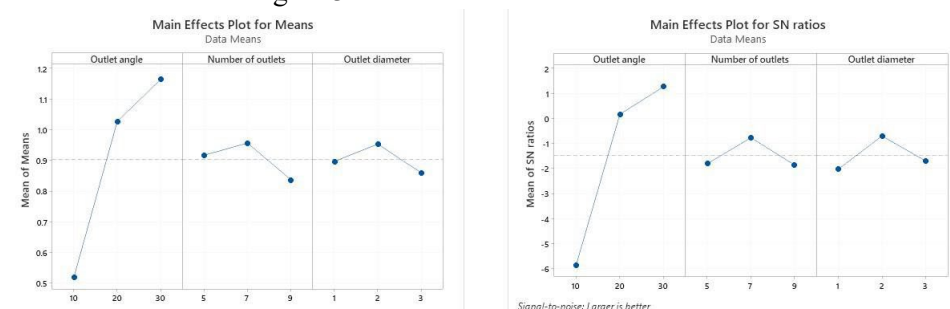


Figure 3: S/N ratio the higher-is-better for the proposed fire sprinkler nozzle

3.1.3. Test results

To get an optimum water distribution using the DoE experimental study, as shown in Appendix A, and water consumption for each experiment, as illustrated in Appendix B.

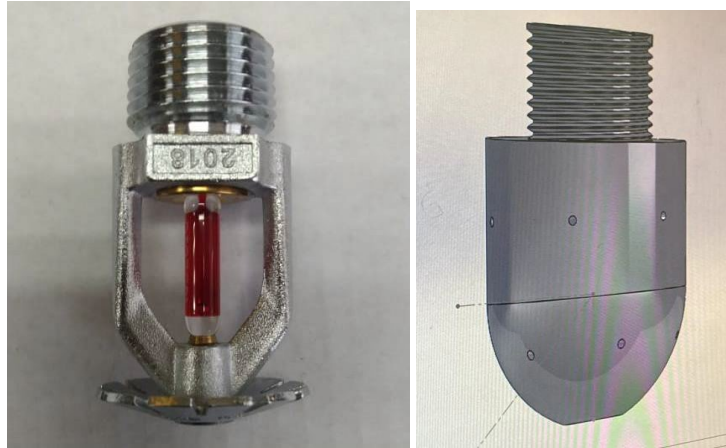


Figure 4: Comparison of current (left) and an example of a fire sprinkler prototype

Based on the design of the experiment results, the best parameters, with the outlet angle ranked first, followed by the number of outlets and nozzle diameter, were projected. The parameters set have been used for the fabrication of the product using lathe-machining operations.

During the experimental test, the nozzle outlet was designed downwards towards the plate and spread in a wide radius, but not in the area where the fire is located underneath the fire sprinkler. This is where the innovation of the 360° multiple-outlet fire sprinkler nozzle comes into play.

Table 2: The improvement made for the nozzle

Item	Specification
Outlet angle	0°, 30°
Number of outlets	7 outlets (1 outlet at 0°, 6 outlets at 30° angle)
Input diameter size	1 inch
Outlet diameter size	2 mm
Distribution radius	1 to 1.2 meter
Flow rate	18 litter/min
Pressure	3 MPa

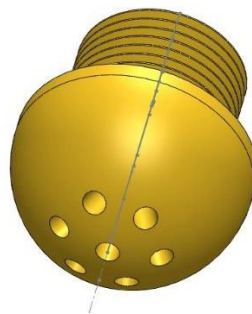


Figure 4: Finalised design and 3D printed prototype

4. Conclusion

The fire sprinkler nozzle developed for this research minimises water, has shorter response times, and distributes water efficiently to the wrapped area, all of which contribute to significant benefits for the future use of commercial fire systems. However, additional improvements are suggested, including the use of glass bulb alternatives, which is critical. Collaborations and partnerships between universities, research funds, government agencies, standards organisations and manufacturers are crucial for bringing this fire nozzle to commercialization.

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Appendix A

Table A.1 Experimental setting, results and S/N Ration

Experiment	Outlet angle	Number of outlets	Nozzle diameter (mm)	Average Results (Coverage)
1	10°	5	1	0.38
2	10°	7	2	0.64
3	10°	9	3	0.54
4	20°	5	2	1.22
5	20°	7	3	0.89
6	20°	9	1	0.97
7	30°	5	3	1.15
8	30°	7	1	1.34
9	30°	9	2	1.00

**Constant fluid flow 18 l/min, Pressure 3 Bar*

Response Table for S/N Ratio

Higher is better

Level	Outlet angle	Number of outlets	Nozzle diameter (mm)
1	-5.8776	-1.8211	-2.0423
2	0.1501	-0.7822	-0.7164
3	1.2520	-1.8722	-1.7168
Delta	7.1296	1.0901	1.3259
Rank	1	3	2

Response Table for Means

Level	Outlet angle	Number of outlets	Nozzle diameter (mm)
1	0.5200	0.9167	0.8967
2	1.0267	0.9567	0.9533
3	1.1633	0.8367	-.8600
Delta	0.6433	0.1200	0.0933
Rank	1	2	3

Appendix B

Table B.1: Average water consumption for each experiment

Experiment	1	2	3	4	5	6	7	8	9	10	Avg
1	16.4	16.2	16.2	16.4	16.4	16.2	16.3	16/4	16.3	16/3	16.3
2	18.1	18.1	18.1	18.2	17.9	18.1	17.9	18.3	18.1	18.2	18.1
3	20.3	20.3	20.3	20.3	20.4	20.2	20.2	20.3	20.4	20,3	20.3
4	18.4	18.3	18.3	18.2	18.4	18.2	18.3	18.4	18.2	18.3	18.3
5	19.8	20.5	19.7	19.7	19.6	19.4	19.9	19.8	19.8	19.8	19.8
6	17.6	17.5	17.7	17.5	17.6	17.5	17.5	17.6	17.3	17.2	17.5
7	18.5	18.6	18.5	18.5	18.7	18.6	18.7	18.2	18.4	18.3	18.5
8	19.2	19.4	19.4	19.5	19.4	19.3	19.5	19.4	19.5	19.4	19.4
9	18.1	18.1	18.2	18	18.2	18.1	18.1	18.2	17.9	18.1	18.1

**Constant pressure 3 Bar*

The constant flowrate of conventional fire sprinkler with the initial pressure 3 bar was recorded = 20l/min..

FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

A CCD-Based Authenticity Testing System for Gemstone

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Abstract: Despite the advancements in hightech methods to differentiate between real, synthetic, and fake gemstones and grade them accordingly, there are still limitations and drawbacks associated with these approaches. For instance, individuals with limited knowledge in the realm of luxury may easily fall victim to fraud by jewelers, especially when distinguishing between real and synthetic gemstones. Additionally, many of the devices mentioned earlier are expensive and large in size. A more reliable approach is required since conventional authentication techniques are prone to human error and required experts. To overcome the above problems, this project aims to develop a portable, user-friendly and cost-effective system for determining the authenticity of gemstones. Using a linear CCD sensor, laser diode and an Arduino Uno, the goal is to develop a small device capable of accomplishing operations similar to existing technologies but in a more compact, portable, cost-effective and capable of identifying between genuine and counterfeit gemstones. The purpose of this project is to look into the attribute of light dispersion in gemstones, with an emphasis on classification and valuation scaling. The setup is designed to establish optimal conditions, ensuring the effective operation of the CCD sensor. It is important to maintain the light intensity, temperature, and input voltage source of the CCD sensor at their respective optimal levels to avoid saturation and undesired results. By enhancing the accuracy and convenience of gemstone authenticity assessments, this initiative seeks to positively impact the gemstone industry.

Keywords: Linear CCD sensor, gemstone, authenticity

1. Introduction

In analyzing gemstones, the current technique depends mainly on the magnification tools such as a loupe, several types of microscopes, and other related tools [1]. The tools are expensive and require specific expertise in their usage to ensure the results can be analyzed accurately. Moreover, other techniques such as the LA-ICP-MS, Raman microscopy, X-ray, and others may disturb the internal environment of the gemstones as the observation is conducted invasively [2] [3] [4].

The combination of clarity, cut, carat, and color are used to determine the gemstones quality and value such as ruby, sapphire and emerald. Except for carat, the other criteria of a gemstone still need professional and experienced gemologists [5] to decide the value and quality of the ruby. This is because these three criteria are difficult to differentiate by human eyesight [2]. In addition, Gemology Tools

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Professional software is used to evaluate gemstones. It comprises almost 542 databases of gemstones, consisting of a series of different estimations of the weight of gemstones, colorful stones, and cabochons, spectral images of gemstones, carat weight charts, and precise gravity calculators [6]. This is another way to classify gemstone characteristics using previous databases as guides for evaluating gemstone [6]. Such methods of visual evaluation are based on years of knowledge from gemologists and gemstone traders. Thus, these methods result in an unstandardized evaluation due to human error [7].

2. Materials and Methods

This project will focus on analyzing the gemstone's clarity without disturbing the internal or external conditions of the ruby. The analysis will use the characteristic of light distribution in gemstone, which involves light reflectance and absorption. Because the CCD sensor is a hard-field sensor that mainly focuses on detecting these two characteristics, the analysis of the clarity of gemstone using the CCD sensor is possible. It is believed that this specific approach will produce a quantitative and standardized grading technique based on the voltage produced by the CCD sensor.

There are three consequences as light moves through a translucent particle: absorbance, reflectance, and dispersion. Dispersion characteristic is neglected due to its particle size of interest which is much greater than the wavelength of the incident light [8]. The following subsection explains the mathematical modeling for light reflectance and absorption.

This project involves light traveling from the source (laser) to the ruby through the air. Light reflectance occurs when light travels from the air and hits the ruby's surface, losing energy. Energy loss happens when light travels through a light reflection interface [8], which in this case refers to the air–gemstone interface. The reflection ratio of light on the surface is referred to as reflectance (R) [8] [9].

$$R = \left[\frac{(n_1 - n_2)}{(n_1 + n_2)} \right]^2 \quad (1)$$

According to the equation (1), n_1 is the transmitted refractive index, and n_2 is the incidence refractive index. The value of R corresponds to the minimal surface reflection from planes on which the light ray is normal to the surface. A greater proportion of light is reflected as the angle of the incident ray increase [8], [10]. This reflection decreases the amount of light emitted through the ruby. The final light reflectance can be obtained using equation (2) [8].

$$I_{final\ reflectance} = I_i - \left[I_i \left(\frac{n_2 - n_1}{n_2 + n_1} \right)^2 \right] \quad (2)$$

Light attenuation is a process when light is attenuated due to absorption and is converted into energy when it passes through a medium. According to the Beer–Lambert’s law, the output light intensity is exponentially attenuated by the object density along the optical path [8] [11]. In this experiment, the light is absorbed by the gemstone, which becomes the effective light that falls on the CCD linear sensor. The light attenuation is represented by the equations (3) and (4) below:

$$I_{out} = I_{in}e^{-\alpha x} \quad (3)$$

$$\ln \left(\frac{I_{in}}{I_{out}} \right) = \alpha x \quad (4)$$

Here, α is the linear attenuation coefficient and x is the distance of the light traversed. α for the gemstone, and x is length of the gemstone. The natural logarithm of the ratio of the incident intensity to

the transmitted intensity is equal to the line integral or sum of the distribution of linear attenuation coefficients within the object [8] [12]. These two equations (1) and (2) are used to find the expected refractive index values for the natural and artificial gemstone when investigated using the CCD linear sensor system.

To prove that the gemstone analyzed in this experiment is either artificial or natural, the gemstone is sent to the Malayan Gemological Laboratory Services (MGLS). The MGLS provides an identification certificate for the analyzed gemstone with the true characteristics of the gemstone.

3. Results and Discussions

The proposed CCD system has been demonstrated to be a reliable tool for assessing the clarity of the gemstone in the form of voltage values, which gives a complete way to measure the light distribution characteristic of artificial and natural gems. The type of laser used as the transmitter, the CCD linear sensor selected as the receiver, and other environmental conditions such as temperature and humidity, are carefully considered to ensure the CCD system works well during the experiments. The results obtained indicates that the CCD linear sensor can recognize the difference in light intensity come from the artificial and natural gems. Finally, the accuracy test where the actual refractive index of the artificial and natural gems is compared to their experimental refractive index also strengthens the reliability of the proposed CCD system with 96.90% percent accuracy when detecting the naturalness of ruby stone. Table 1 shows the analysis of artificial and natural ruby using the proposed method.

Table 1. Comparison between artificial and natural ruby refractive index value and accuracy.

Type of Ruby	Refractive Index		Percentage Accuracy
	Actual Value	Experimental Value	
Silica Glass (Man Made)	1.41	1.49	94.33%
Natural Ruby (Myanmar)	1.76	1.78	98.87%
		Average	96.90%

The CCD system is proven to be more favorable in terms of its non-destructive technique, quantitative results and also does not require specific skills to operate the system.

4. Conclusion

The proposed CCD system has been demonstrated to be a reliable tool for assessing the clarity of the gemstones such as ruby, emerald and sapphire in the form of voltage values, which gives a complete way to measure the light distribution characteristic of artificial and natural gemstone. The results

obtained indicates that the CCD linear sensor can recognize the difference in light intensity come from the artificial and natural gemstone.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

A Secured Private Cloud-based Solution for Flight Data Recorder

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Abstract: A flight data recorder documents critical flight data to enable air crash investigators to determine the causes and sequence of events leading to a crash and thus prevent similar accidents in the future. Currently, the process of retrieving data from a flight data recorder is time consuming, and sometimes it is nearly impossible to retrieve the data. For example, the aircraft may be entirely burnt, in which case the data from the recorder are no longer valid due to the recorder's being heated beyond allowable temperatures. The proposed solution involves both cloud computing and using cryptographic methods to securing the data from the flight data recorder. This project designed a private, cloud-based solution, beginning with flight simulation through Simulink. Cryptographic methods were employed to retrieve the data from Simulink and encrypt them before sending the data to ThingSpeak for storage. The collected data pertained to altitude, with the initial altitude set to 2,000 meters. The simulation ran for 60 seconds and captured the aircraft's altitude every 10 seconds. The project demonstrated the accuracy of cryptographic methods by comparing the original data before encryption with the data after decryption. The results verify that the values are identical before encryption and after decryption. The average encryption time when using the proposed cryptographic methods is superior to times reported in the literature, confirming an improvement in data retrieval using a cloud-based computing approach. The implementation of a secure, cloud-based flight data recorder will help passengers arrive at their destination safely, making the innovative cloud-based flight data recorder and efficient cryptographic methods of paramount importance for the aviation industry.

Keywords: Flight Data Recorder, Cloud-based Technology, Private Cloud, Cryptography Methods

1. Introduction

The flight recorder has been a crucial component in aviation since 1947 [1], often informally referred to as the "black box." It is divided into two sections, such as the flight data recorder (FDR) and

the cockpit voice recorder (CVR). The FDR records essential flight data, including heading, altitude, airspeed, vertical acceleration, and time. Meanwhile, the CVR captures audio recordings from the cockpit, such as flight crew's voices and other sounds like alerts [2]. In the unfortunate event of an aircraft crash, the flight recorder plays a significant role. All the information it records becomes crucial for investigations, emphasizing the importance of retrieving the flight recorder.

However, there are some cases where the flight recorder cannot be retrieved, and this is a cause for concern in the aviation industry. For example, the disappearance of Malaysia Airlines Flight 370 on 8th March 2014, while en route from Kuala Lumpur International Airport in Malaysia to Beijing Capital International Airport in China, is a significant event [3]. The flight was carrying 227 passengers and 12 crew members. According to reports, this plane's flight recorder battery expired in December 2012 [4]. However, the cause of the event is unknown because the flight recorder has yet to be located [5]. Another example is the crash of Air-France Flight 447 into the Atlantic Ocean on 1st June 2009, where 228 individuals lost their lives. It was difficult to determine the sources of the crash because the flight recorder was not found from the ocean floor until May 2011, close to two years later. Furthermore, there was no immediate action taken to fix errors [5]. Hence, these unfortunate events could be avoided through real-time data monitoring, such as cloud-based FDR. The flight safety data can also be saved in real-time on the cloud [1].

1.1 Cloud-based Flight Data Recorder

Cloud technology refers to the use of remote servers, usually accessed through the internet, to store, manage, and process data instead of using local servers or personal computers. Without having to physically own or maintain the infrastructure themselves, this technology enables people and organizations to access and use resources like computing power, storage, and applications when they need them [6]. The concept of transmitting all the data from the FDR to the cloud rather than physically connecting it to the aircraft can improve aircraft flight position tracking and provide immediate flight recorder streaming. The flight position tracking provides information about the aircraft's location, while the flight recorder streaming provides information about what is happening during the flight [7].

This paper modifies and implements private cloud computing, adapting it from the private Google cloud storage architecture. The private cloud hybrid architecture is considered the most applicable for the development of a cloud-based FDR. This architecture incorporates a combination of steganography and cryptography, with the Fernet method used to encrypt flight data. The flight data can then be stored securely in the cloud storage. To address CPU time issues, a "Computing-as-a-Service (CaaS)" model is developed.

2. Tools and Methods

In this project, the tools that will be utilized are Matlab, Python, and ThingSpeak. Matlab is used to simulate flight scenarios, while Python is employed for the development of the cryptography method using the Fernet method. Cryptography method is a method implemented to encrypt the data from the simulation and send to ThingSpeak and decrypt the data from ThingSpeak into readable data. Figure 1 illustrates the flowchart of the methodology for securing the FDR data transmitted to the cloud. The parameter refers to the flight altitude, which is set initially to 2000 meters above sea level. The flight simulation is generated for 60 seconds, and altitude data will be recorded every 10 seconds. This is to fulfill the requirement of achieving a 2 m/s climb rate.

As the flight simulation is generated, the cryptography method will run concurrently. The cryptography method will retrieve the data from the MATLAB workspace and encrypt it into ciphertext. Afterward, it will send the ciphertext, along with the encryption key to ThingSpeak. The performance

of the proposed secured private cloud-based FDR is then evaluated against data accuracy and encryption execution time. The encryption execution time will be compared between AES and SHA-256.

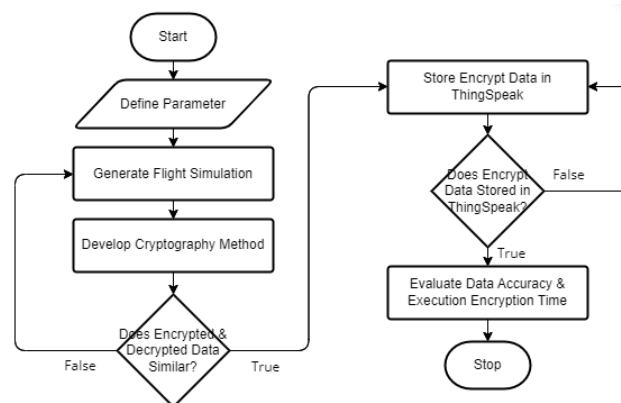


Figure 1: Flowchart of the Proposed Secured Private Cloud-Based Flight Data Recorder

3. Results and Discussion

The data generated by the asbSkyHogg simulation was retrieved in MATLAB. As shown in Table 1, the altitude data is increasing. The collected simulation time also indicates the aircraft’s altitude at specific points in time.

Table 1: Data Generated by the asbSkyHogg Simulation

Time (second)	Altitude (meter)
0	2000.0
10	2010.2
20	2039.7
30	2051.2
40	2050.8
50	2050.5
60	2050.3

Table 2 illustrates the flight altitude data before encryption and after decryption. The accuracy of cryptographic methods is confirmed since both the data before encryption and after decryption show the same value.

Table 2: Comparison of Flight Altitude Data before Encryption and After Decryption

Flight altitude data (in meter) before Encryption	Flight altitude data (in meter) After Decryption	Flight altitude data (in meter): Round Off (1 decimal point)
2000.0	2000.0	2000.0
2010.2	2010.2091635168858	2010.2
2039.7	2039.6969724952737	2039.7
2051.2	2051.1549457509122	2051.2
2050.8	2050.832194275709	2050.8

2050.5	2050.5173061524642	2050.5
2050.3	2050.3038405534503	2050.3

The performance comparison of the average execution time to encrypt flight altitude data is presented in Table 3. The Fernet method demonstrates a 54.5% improvement over the AES method and a 79.6% improvement over the SHA256 method, exhibiting faster encryption times compared to both AES and SHA256. Consequently, the Fernet method is deemed the most effective for encryption. This determination is crucial, as the execution time for data transfer to ThingSpeak also plays a significant role. The total execution time for this process is important in the aviation industry, where even a single second can make a significant difference. Therefore, faster encryption times ensure quicker retrieval when needed.

Table 3: Encryption time comparison between AES, SHA256 and Fernet method

Encryption Method	AES	SHA256	Fernet
Time Execution (sec)	0.209	0.465	0.095

4. Conclusion

In conclusion, a limitation of the current flight recorder is the time-consuming process of retrieving the physical flight recorder after an air crash occurs. This delay can impede investigations into the factors contributing to the air crash. A cloud-based FDR presents a solution to this issue, as cloud technology enables data retrieval anytime and anywhere. Therefore, this project developed a cryptography model to encrypt the FDR data before transmitting it to the cloud, ensuring the security and confidentiality of the FDR data.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Comparative Study of Flow Analysis: Characteristics of Seawater T-Type Tees on Different Fillet Properties

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Abstract: A study on the flow characteristics and energy dissipation in T-type tees within pipeline systems, a critical component of fluid distribution. Emphasizing the rarity of research on convergence flow in seawater cooling system, the paper addresses the tendency of cavitation corrosion and its damaging effects. Employing computational fluid dynamics (CFD) on 3-D dimension pipe models designed in SOLIDWORKS, the study evaluates the parameters of velocity, pressure, and turbulence energy. The simulations, considering water flow and galvanized steel ANSI materials, reveal that increasing the fillet radius from 15 to 30mm significantly reduces local resistance coefficients and energy loss. The optimal curvature radius for T-type tees is determined to be 30mm, based on flow characteristics and pressure distribution. This CFD flow simulation provides insights into fluid dynamics, enabling a detailed analysis of flow behavior, pressure loss, and the turbulent energy of tees in pipeline systems.

Keywords: Pipeline, T-type Tess, Fluid Distribution, CFD, Flow Simulation

1. Introduction

In all types of pipeline systems, there is an inherent decrease in hydrodynamic energy or pressure due to resistance, which stems from friction along the pipe walls and the inherent geometry of local resistances. According to [1] the transmission and distribution systems, the primary cause of hydraulic losses is predominantly associated with the resistance encountered at the junctions of tees. Traditionally, the design of seawater cooling piping systems has primarily focused on fluid transportation with minimal emphasis on the geometric modelling of tee fittings. However, as advancements in computational fluid dynamics (CFD) and engineering design methodologies have accelerated, there is a growing recognition of the substantial impact that tee geometry can have on the overall performance of these systems. According to [2] the overall coefficients can be determined through experimentation or by conducting fluid dynamics (CFD) simulation.

1.1 System Component Loss

It is crucial to position valves, pumps, and turbines strategically to counter pressure drops from other network components. This study was conducted for a significant reason. This study aims to fill the current gap in knowledge and improve tee geometry in seawater cooling piping systems. Emphasizing tee geometry optimization

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aims to improve the efficiency, reliability, and sustainability of these systems. The main objective is to gain a thorough understanding of how tee configurations impact fluid dynamics, pressure distribution, and energy losses in the context of seawater cooling. By incorporating advanced simulation techniques. Energy dissipation within tees in seawater systems is not well documented because it depends on various variables. According to [3], these variables include things like the tee's geometry, seawater flow patterns within the tee, wall roughness, operating conditions, and more. This research is expected to make a significant contribution to the field of marine engineering by providing insights that can influence the design and operation of seawater cooling systems. This research's findings can enhance understanding of the specific resistance traits displayed by T-type tees. This could have a positive effect on the design and operational efficiency of liquid networks in various applications such as drainage, irrigation, building water supply, fertilization, and irrigation. This study combines the development of a strong piping system with a focus on tee geometry optimization to address current engineering challenges and move the field towards more efficient and sustainable solutions. Moreover, this study is in line with current engineering challenges as it combines the creation of a strong piping system with an emphasis on optimizing tee geometry. It aims to advance the field by promoting more efficient and sustainable solutions. This research focuses on educating students on implementing modern mathematical tools, evaluating standard protocols, and utilizing computational fluid dynamics (CFD) techniques to equip them with skills for addressing engineering problems.

2. Methodology

This methodology section outlines the systematic approach and methodologies employed in the development of the seawater piping system. It encompasses various aspects, including system design, material selection, pipe routing, fitting and valve selection, and pipe analysis. By following a rigorous methodology, the project aims to achieve an efficient and reliable piping system that meets the requirements of the maritime industry. The methodology includes a comprehensive design of piping systems, industry standards, and regulatory guidelines to ensure compliance and safety. Additionally, advanced software tools such as Pipe Flow, SolidWorks and CFD Flow Simulation are used to meet the objectives.

2.1 Critical Area

Finding the critical areas in a seawater piping system involves identifying locations where there is a significant pressure drop or potential for flow disturbances. Start by reviewing the detailed piping layout and identify all bends, fittings, tees, valves, and other components that may contribute to pressure loss or disrupt flow. Each of these components has an associated pressure loss coefficient (K value) or equivalent length that contributes to the overall system head loss. The high velocity above 3m/s was take into account for the critical part which is at the discharge from tee fittings as shown Figure 1.

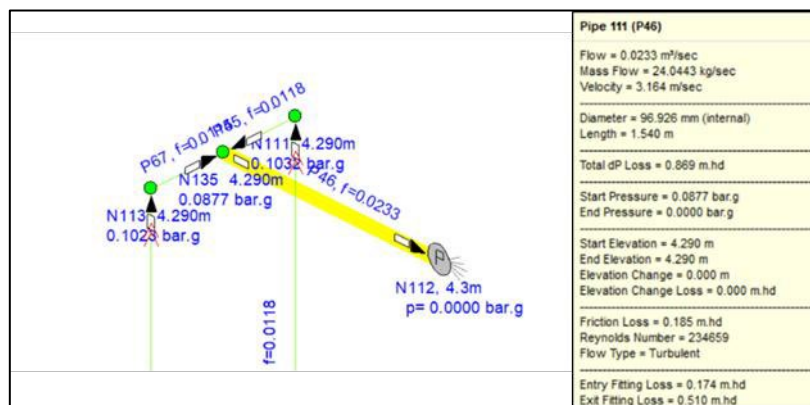


Figure 1: Critical area

2.2 Design Geometry

Designing the tee geometry in SolidWorks involves creating a three-dimensional model of a tee component, commonly used in piping systems, plumbing, and structural designs. SolidWorks is a powerful computer-aided design (CAD) software that offers comprehensive tools for designing, simulating, and manufacturing various mechanical component [4]. This involves sketching the outline of the tee, defining its dimensions, the fillet radius is made from $0.1D_{\text{outer}}$ of the branch. Table 1 shows the parameters regarding the design geometry as shown in Figure 2. Other value can be corparated by following simple ratio guide.

Table 1: Design parameters

PARAMETER	VALUE
Diameter of Pipe, mm	114 (Sch 80)
Length, mm	210
Fillet Radius, mm	0,15,20,25,30
Temperature, K	303
Density of Fluid, kg/m ³	1021.77
Roughness, mm	0.15
Inlet Velocity, ms ⁻¹	1:1
Material	Galvanized Steel ANSI
Outside Pressure	1:1
Reynolds Number	(115000<Re<200000)

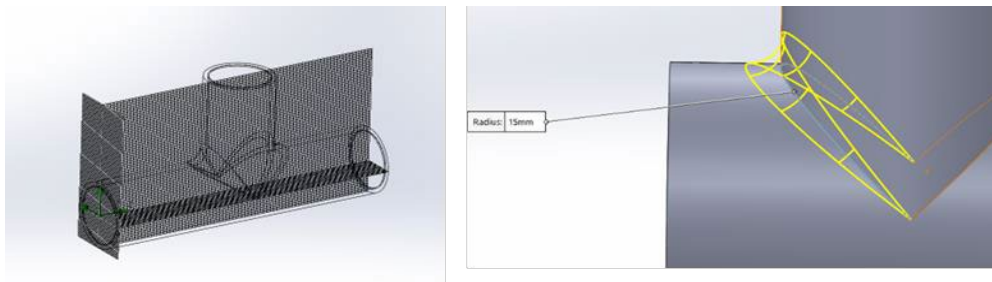


Figure 2: Geometry Configuration

2.3 CFD Simulation

These settings together define how fine or coarse the mesh is in different regions of the simulation domain. A well-defined mesh is crucial for the accuracy of a CFD simulation. The mesh settings should be chosen based on the most important aspects of the physics being simulated, the geometry's complexity, and the available computational resources. Wall boundary condition is defined by inserting same inlet and outlet velocity. The basic mesh generated automatically after defining the refining solid cells using automatic criterion. The Table 2 shows the mesh configuration.

Table 2: Mesh configuration

Global Mesh Setting	Setting Value
Basic Mesh	$N_x=36, N_y=83, N_z=159$
Refining Solid Cells	2
Refining Cells at Fluid/Solid	3
Small Solid Feature Refine	3
Tolerance Level	3
Tolerance Refinement Criterion	0.00072m

The P total is from the different of losses in fitting mainly from the main inlet and the branch. The value is divided by the pressure of seawater and velocity at the junction as **Eq 1**.

$$\xi = \frac{\Delta P_{total}}{\rho V^2 / 2} \quad \text{Eq. 1}$$

Each where g is gravitational acceleration. By the pressure drop in each tee, local resistance coefficients ξ were calculated for different outer diameters of tees D_{out} , different pressures at the tee outlet P and different fillet radius of the main line and outlet as **Eq 2**.

$$h = \xi \frac{V^2}{2g} \quad \text{Eq. 2}$$

3. Results and Discussion

The following section presents the outcomes and analyses derived from the objectives outlined for the study of isometric seawater cooling piping systems. These objectives entailed the development of preliminary layout of piping system, exploration of flow distribution patterns across various tee geometries through Flow Simulation, and the determination of local resistance coefficients and hydrodynamic pressure losses within tee configurations. Through rigorous investigation and analysis, the sections delve into the findings, interpretations, and implications derived from these objectives. The result comparison was done for converging case. Different inlet velocity from each fillet radius.

3.1 Results

The results shown is the overall data from the CFD flow simulation on SolidWorks. Velocities are measured at several points downstream of the junction. The presence of fillets tends to streamline the flow, reducing separation and potentially lowering the formation of vortices [5]. Pressure drop across the tee is recorded for different fillet sizes. Larger fillets may reduce pressure drop by smoothing the flow transition between the branch and the main line [6].

The comparative velocity distribution analysis within a fluidic tee junction with and without a fillet radius highlights the influence of geometric modifications on flow behaviour, as shown in Figure 3 as velocity patterns. The incorporation of a fillet radius facilitates a more uniform velocity profile, as evidenced by the smoother colour gradients in the CFD simulation. This design modification enables a reduction in flow disturbances, particularly in the boundary layer, and mitigates the risks associated with flow separation and subsequent pressure drops. Conversely, the absence of a fillet radius is characterized by a distinct velocity disparity, with a pronounced acceleration of flow at the sharp junction corner, leading to increased turbulence and potential energy losses due to flow recirculation and vortices downstream. The enhanced understanding of these flow dynamics is crucial for optimizing the design of piping systems, ensuring that fluid transport is both efficient and effective, minimizing pressure losses, and preventing structural issues related to turbulent flow impacts.

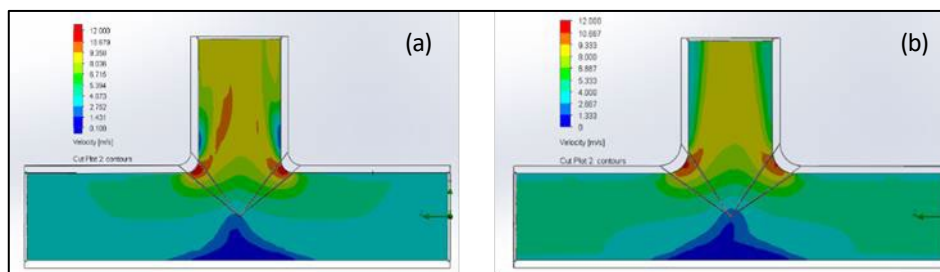


Figure 3: Velocity patterns (a) 15 and (b) 30 fillet

Pressure distribution variations caused by the presence or absence of a fillet radius can significantly impact fluid flow characteristics, as illustrated in Figure 4. The simulation featuring the fillet radius demonstrates a more gradual pressure gradient along the tee's curve. Having a fillet radius usually encourages a smoother change in direction for the fluid, leading to lower high-pressure gradients and stress concentrations. The streamlined shape decreases the chances of flow separation, a frequent reason for higher pressure drops and turbulence. This is evident from the lack of distinct red or yellow areas at the intersection, indicating a more balanced pressure distribution without significant peaks and valleys. Regarding flow distribution without a fillet, it shows more pronounced pressure gradients, especially in areas where the flow changes direction suddenly. When a sharp corner is present, it causes a high-pressure zone due to the fluid being forced to abruptly change direction, resulting in a rise in pressure in that specific area. The more intense red colour in the corner of the tee shows a higher-pressure zone. Moreover, the acute angle may cause flow separation, leading to a low-pressure area right after the corner, as indicated by the yellow to green colour change.

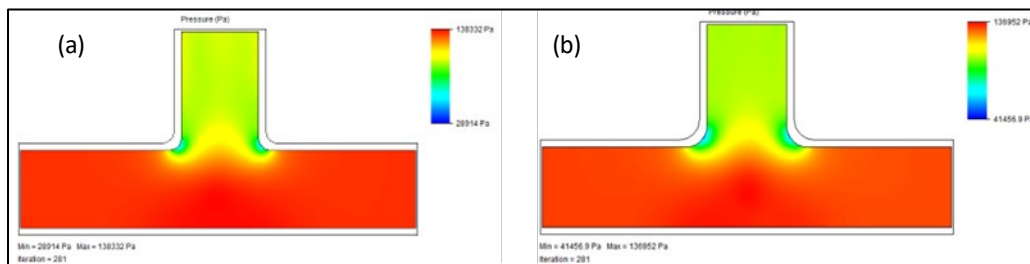


Figure 4: Pressure distribution (a) 15 and (b) 30 fillet

The colour contours represent the intensity of turbulence within the fluid flow, as indicated by the scale which measures turbulent energy in Joules per kilogram (J/kg). The simulation including a fillet radius shows a more contained and lower intensity of turbulent energy as shown in Figure 5. The presence of a fillet radius typically promotes smoother flow transitions, thereby reducing the generation of turbulence. This can be seen in the concentration of lower-energy turbulence (indicated by the cooler colours) and the absence of high-energy peaks (which would be indicated by warmer colours) in the flow. The smooth contour of the fillet helps in maintaining a more laminar flow which dissipates less energy into turbulence. The presence of a fillet radius delineates a substantial reduction in turbulent energy, as indicated by the predominance of cooler colors in the corresponding contour plot. This suggests a smoother flow with diminished energy losses due to turbulence.

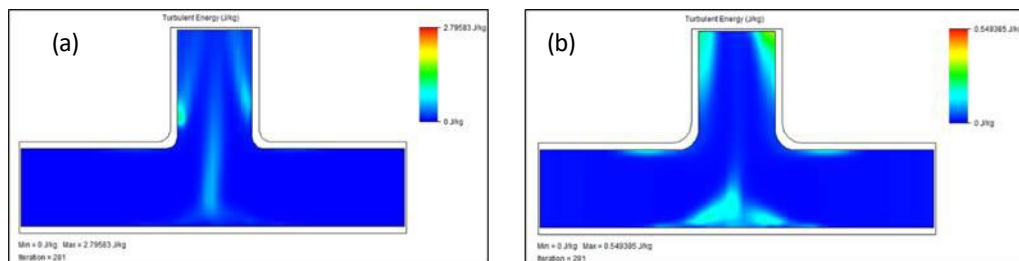


Figure 5: Turbulent kinetic energy (a) 15 and (b) 30 fillets

3.2 Local Resistance Coefficients and Energy Loss

The local resistance coefficients, denoted as ξ , were determined for each tee by evaluating the pressure drop across it [1]. These coefficients were calculated while considering various factors such as the outer diameters of the tees (D_{out}), the pressures at the tee outlets (P), and the different designs of the junction between the main line and the branches. This analysis yielded a total of 16 distinct local resistance coefficient values, which are presented in Figure 6 and Figure 7. By adding local resistance coefficients to equation (2), the pressure (energy) losses, denoted as h , for each tee were computed, with the results also displayed in Figure 6. Additionally, Figure 7 includes the pressure differential values at the outlet of the tees, which were ascertained through CFD (computational fluid dynamics) simulations. The local resistance coefficients, denoted as ξ , were determined for each tee by evaluating the pressure drop across it [1].

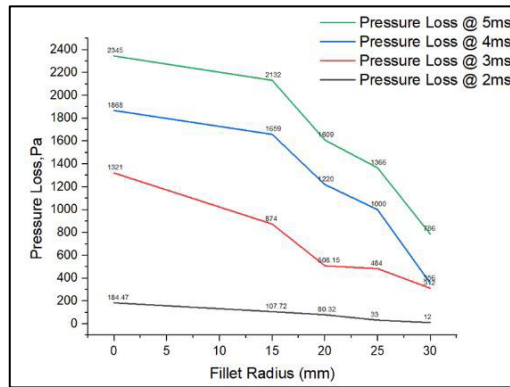


Figure 6: Fillet Radius vs Pressure Loss

Figure 6, The data presented in the graph suggests a strong correlation between the fillet radius of the tee junction and the efficiency of flow as determined by pressure loss. The significant decrease in pressure loss with increasing fillet radius can be attributed to the reduction in flow separation and the subsequent reduction in turbulence, which is more pronounced at higher velocities [5]. At higher flow velocities, the initial pressure loss is more significant, which is expected due to the increased energy of the flow. However, the rate of decrease in pressure loss as the fillet radius increases is also steeper. This indicates that at higher velocities, the impact of an optimized fillet radius becomes more critical to reducing energy loss in the system. The relationship between pressure loss and fillet radius has direct implications for energy efficiency [7]. Lower pressure losses translate to lower energy requirements for pumps or compressors to maintain flow, leading to potential cost savings and reduced environmental impact [8].

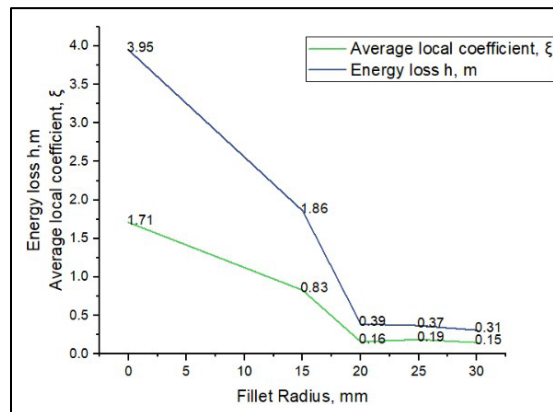


Figure 7: Example of presenting data using a figure

Figure 7, The average local coefficient (ξ) is a measure of the energy loss due to friction and turbulence at a particular point in a flow system, in this case, the tee junction. The observed decrease in ξ with increasing fillet radius suggests that a smoother transition at the junction reduces turbulence and flow separation, which are major causes of energy loss in fluid systems. The energy loss (h), expressed in terms of the height equivalent to the pressure loss, follows a similar trend. The substantial decrease in energy loss with larger fillet radii implies that the flow becomes more streamlined, and the system operates more efficiently, reducing the work required by pumps or other devices to maintain flow.

4. Conclusion

This comparative study revealed the complex nature of seawater flow through T-type tees with different fillet geometries. These tees' hydrodynamic behaviour has been revealed by pipe flow software for preliminary isometric piping layout development and flow simulation for flow distribution pattern investigation. The results show that T-type tee fillet geometry significantly affects flow distribution and local resistance coefficients. Different fillet shapes affect hydrodynamic pressure loss and flow distribution. In seawater cooling systems, small geometric differences in tee design improve flow performance and reduce energy use. When the flow of seawater fully diverts to the branch, it separates

from the wall. This creates recirculation and strong, turbulent vortices with a lot of kinetic energy. This causes significant pressure and energy loss. CFD simulations show that the fillet radius and branch-to-main line transition curve affect tee flow dynamics. After the transition, flow separation, recirculation area, and turbulence kinetic energy decrease, creating a more uniform flow velocity field. These establish the relationship between the local resistance coefficient and the equal-tee geometric parameters. An equation for local resistance coefficients is derived using the main line and branch connection fillet radius and the tee's outer diameter. These coefficients can be used to design seawater system pipelines that divert all main line flow to the branch. The data presented helps engineers and designers determine the best fillet radius for T-type tees in piping systems to reduce energy losses. A larger radius may reduce energy costs and improve flow system efficiency. The data can set industry standards and best practices for T-type tee design and manufacturing, improving uniformity and potentially lowering costs through economies of scale. Research on fillet radius and flow characteristics could improve tee design.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Development of an Ergonomic Hose Reel for a FireFighters

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Abstract: In contemporary firefighting, the manual handling of hoses has remained a physically demanding and labor-intensive aspect of the profession. Firefighters find themselves grappling with exhaustion and expending substantial energy as they manually roll hoses during their duties. Recognizing this challenge, a groundbreaking solution emerges in the form of the "Hose Reel" project an innovative initiative designed to alleviate the physical strain on firefighters and enhance the efficiency of their operations.

The crux of the Hose Reel lies in its ability to revolutionize hose management. By introducing a mechanized rolling system, this project aims to significantly reduce the physical toll on firefighters, enabling them to perform their duties with increased vigor and endurance. The design of the Hose Reel is meticulously crafted to streamline the hose-rolling process, ensuring that it not only expedites the task at hand but also minimizes the need for excessive manpower.

One of the primary advantages of the Hose Reel is its potential to expedite the hose rolling procedure, thereby saving crucial time during emergency responses. Unlike traditional methods that involve manual effort and coordination among multiple individuals, this project is tailored to be efficiently managed by a single user. This not only optimizes resource utilization but also enhances the autonomy and self-sufficiency of firefighting units.

Furthermore, the Hose Reel's user-friendly design and method of operation contribute to its adaptability in various fire stations. Its ease of use ensures that firefighters can swiftly integrate this innovative tool into their routine operations, making it an indispensable asset for every fire station. In essence, the Hose Reel emerges as a transformative solution, heralding a new era in firefighting technology by mitigating physical strain, optimizing time management, and promoting operational efficiency.

Keywords: Firefighters, Hose management, Hose Reel, Physical strain, Efficiency, Mechanized rolling system, Endurance, Time-saving, Manpower optimization, User-friendly design, Autonomy, Self-sufficiency, Innovative technology, Emergency response, Fire station.

1. Introduction

The introduction of the product, providing an elaborate overview. The discussion encompasses the overall perspective of the product, its background, problem statements, objectives, scopes, importance, and functions of the project.

1.1 Background

Up until the mid-19th century, firefighting primarily relied on transporting water to the scene using buckets. The original hand pumpers discharged water through a small pipe or monitor atop the pump tub. Hoses only became widely accessible in the late 1860s, facilitating the easier conveyance of water from hand pumps, and later steam pumps, to fires. With the advent of the vulcanization process, enabling the curing of raw soft rubber into a more durable product, the fire service transitioned from bulky and unreliable leather hoses to unlined linen hoses. This evolution continued to multi-layer, rubber-lined, and coated hoses with interior fabric reinforcement. While the resulting rubber hoses retained some bulk and stiffness, they were less prone to leaking and more durable than their predecessors. Their wrapped construction mirrors hoses employed in various industries today, such as fuel delivery hoses for servicing airliners.

Firefighting, acknowledged as strenuous and perilous, involves tasks like rolling and re-decking fire hoses, which can be both challenging and hazardous during non-emergency situations. The imperative for firefighters is to efficiently and safely manage fire hoses, conserving energy and physical well-being for the demanding task of suppressing fires. Firefighters face the risk of lower back strains and injuries during hose management.

1.2 Problem Statement

The Development of An Ergonomic Hose Reel for A Firefighter was created because there are some problems faced by the users. There are some problems such as they wanted exposed to water roll cloth quickly absorbs water and will be heavy to roll and now, they use rubber canvas for a better hose. Furthermore, they have to roll with hands because there are no tools and just have only one tools but there is ample space to roll the hoses. Besides that, it is difficult to roll in hilly, small and narrow area and that come many obstacles. Finally, time to roll is long and they have to roll it neatly down so that it does not break down. Ergonomic Issues, Firefighters are at risk for a number of ergonomic injuries such as back pain, shoulder pain, and knee pain. One of the most common causes of these injuries is rolling hoses. When firefighters roll hoses, they often have to lift and carry heavy hoses, which can put a strain on their muscles and joints. In addition, firefighters often have to twist and bend their bodies in awkward positions when rolling hoses, which can also lead to injuries. Operational Efficiency, The rolling of fire hoses is a critical task for firefighters. It is essential that hoses be rolled in a way that is

both efficient and safe. However, the current methods of rolling hoses are often inefficient and time-consuming. This can lead to delays in responding to fires, and can also increase the risk of injury to firefighters. Maintenance and Durability, Firefighters face a number of challenges when it comes to rolling hoses. Hoses can be heavy and bulky, making them difficult to roll and carry. They can also be damaged by sharp objects or rough surfaces. In addition, hoses can become dirty and contaminated with chemicals, which can make them difficult to clean and maintain.

1.3 Objectives

The objective of this project are:

- i. To develop the operation of water hose
- ii. To determine the hose reel can work faster
- iii. To compare the time taken with hose reel and without hose reel

1.4 Scope

The Scope of this project are:

- i. This Development of An Ergonomic Hose Reel for A Firefighter is a small lightweight, collapsible unit suitable for coiling hoses to roll.
- ii. 76mm diameter and max length 20 meters.
- iii. The unit can be easily reduced in size for storage by positioning the handle further down the shaft of the body
- iv. There are 3 main parts to this tool such as body, swing or handle and clamping unit

1.5 Importance of Project

The importance of the product is:

- i. To fulfil task given about hose reel
- ii. To study about the hose
- iii. Design the hose reel

1.6 Function of Project

There are several that required this project:

- i. Roll the hose
- ii. Make hose easier to roll
- iii. Save time

2. Materials and Methods

All of the explanation mentioned is focused on the project development according to the chart to make sure the step and procedures of this project are implemented properly in appropriate time which had been planned before. The methodology starts by gain information that relates with the title of the project. All the information has been identified from the distributed questionnaire and makes the analysis from the input. After that, the analysis will be continued for the detail design. The different between materials also to study that make sure the product is better than existing product in market.

2.1 Project Flow

There are some very important processes to follow in order to create and produce a product. The flow chart created shows the steps and procedures to follow throughout the project. This is a diagram that represents an algorithm or process, showing a step symbol. The meaning of the symbol is explained in table 2.1. The symbol is associated with an arrow, indicating the flow must be followed to create the product.

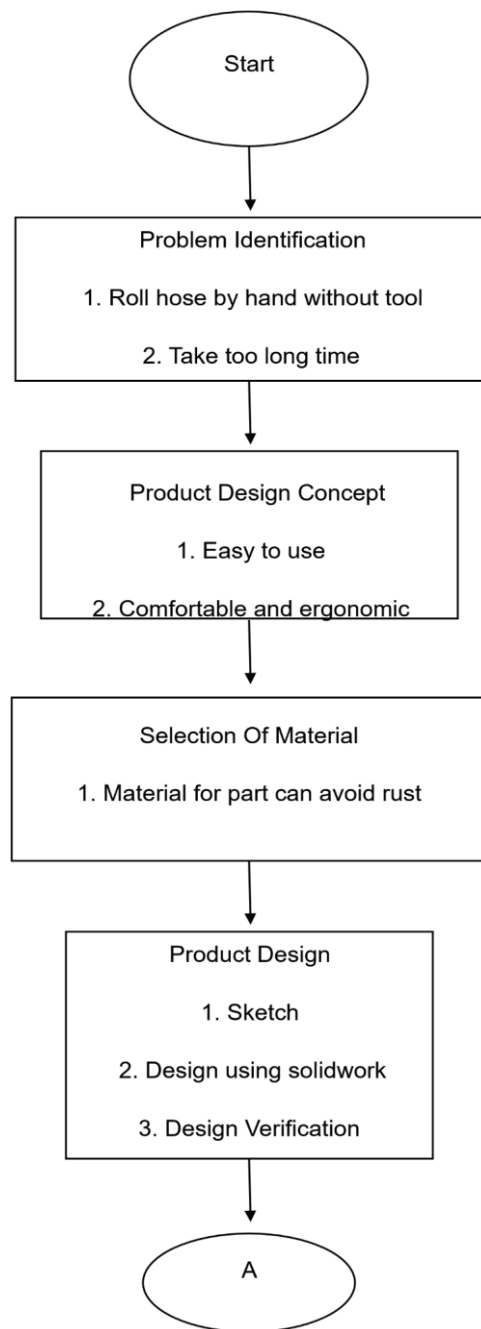


Table 2.1: Flow Chart

2.2 Questionnaire

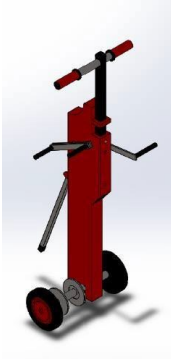
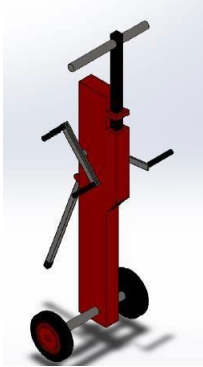
A questionnaire instrument functions as a research tool, incorporating a series of questions and prompts designed to gather information from participants. Although these instruments are often tailored for the statistical analysis of responses, this isn't always the primary objective. Questionnaire are commonly employed in quantitative marketing research and social research, serving as a valuable method for gathering a wide array of information from a sizable group of individuals, commonly known as respondents

No	Question	Answer
1	Which features are most valuable to you?	Design of the product
2	Will you buy the product for your own?	Yes, company use
3	How the product look?	Easy to use
4	How would you compare the products to other competitors?	Had improvement compare ro others
5	Do you prefer this product auto or manual?	Auto but for now still use manual
6	This product can save user time?	Yes, work faster
7	This product is portable to use?	Exactly, just had to roll the hose
8	This product can help the user?	Ofcourse because just can push the hose reel

9	Where the other place could find the product useful?	School
10	How likely are you to recommend this product to others?	Everyday in daily life for firefighters

Table 2.2: Questionnaire

2.3 Concept development

Concept	Describe	Picture
A	The design more perfect and comfortable for the firefighter use with the evaluation gain and the clamp	
B	The design doesn't have evaluation gain so the consumer can get back pain	

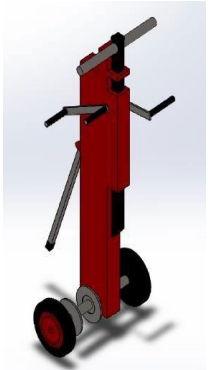
C	The design too doesn't have evaluation gain but have clamp that can straighten the hose	
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Table 2.3: Concept design

2.4 Material Selection

Choosing materials is a pivotal phase in the design of any tangible entity. Within the realm of product design, the primary objective of material selection is to optimize cost while achieving the specified product performance objectives. The methodical process of selecting the most suitable material for a particular application commences with a thorough examination of the properties and costs associated with potential materials. The effectiveness of material selection is frequently enhanced by employing a material index or performance index that aligns with the sought-after material properties.



Figure 2.1: Hollow steel

A hollow structural section (HSS) refers to a metal profile characterized by a hollow cross-section. This term is primarily utilized in the United States or in countries that adopt US construction or engineering terminology.

HSS elements come in circular, square, or rectangular configurations, although alternative shapes like elliptical are also accessible. As per the code, HSS exclusively consists of structural steel.

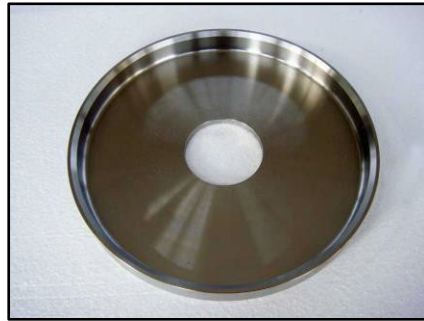


Figure 2.2: Plate

Upon forging high manganese steel, effective control over casting defects such as loose texture, shrinkage cavities, and coarse grain is achieved. As cutting technology and cutter materials advance continuously, and with ongoing enhancements in welding processes and materials, the challenges associated with cutting and welding high manganese steel can be gradually addressed.



Figure 2.3: Screw

A screw and a bolt (refer to the differentiation between bolt and screw below) are akin types of fasteners commonly crafted from metal. They are distinguished by a helical ridge, identified as a male thread (external thread). Utilized for fastening materials, screws and bolts engage with a corresponding female thread (internal thread) in the mating part.

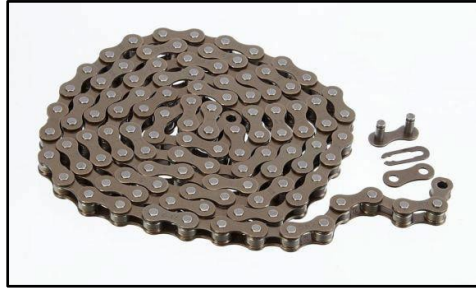


Figure 2.4: Chain

A bicycle chain, constituting a roller chain, serves the purpose of transferring power from the pedals to the drive-wheel of a bicycle, propelling it forward. The majority of bicycle chains are constructed from plain carbon or alloy steel, although certain variants are nickel-plated to inhibit rust or purely for aesthetic reasons.



Figure 2.5: Bearing

A bearing is a component within a machine that limits relative motion to the desired trajectory, effectively minimizing friction between moving parts. The bearing's design may allow for unrestricted linear movement of the mobile component, permit free rotation around a fixed axis, or impede specific motions by managing the vectors of normal forces acting on the moving parts. Primarily, bearings facilitate the desired motion by reducing friction. The classification of bearings is generally based on the mode of operation, the permissible motions, or the orientations of the loads (forces) applied to the components.



Figure 2.6 Pin Spring

A spring pin, also known as a tension pin or roll pin, is a mechanical fastener employed to secure the relative position of two or more parts within a machine. These pins feature a body diameter larger than the hole diameter, accompanied by a chamfer on one or both ends to ease the initiation of the pin into the hole. The spring-like property of the pin enables compression as it adapts to the hole's diameter. The force exerted by the pin against the hole wall keeps it securely in place, classifying a spring pin as a self-retaining fastener.



Figure 2.7: Sprocket

A sprocket, also referred to as a sprocket-wheel or chainwheel, is a wheel characterized by profiled teeth or cogs that engage with a chain, track, or another perforated or indented material. The term 'sprocket' is generally used for any wheel where radial projections interact with a chain passing over it. It differs from a gear as sprockets do not directly mesh with each other, and it distinguishes itself from a pulley by having teeth; in contrast, pulleys are smooth, except for timing pulleys used with toothed belts.

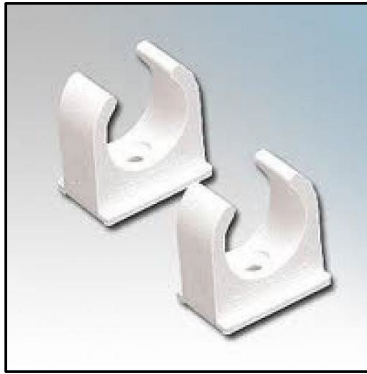


Figure 2.8: Clip

A clip is constructed from a strip of resilient sheet metal, typically steel, shaped into a specific profile. It features a flat base with a hole, allowing the clip to be semi-permanently attached to a surface through screws. Extending from each end of the base are curved sides that rise to cradle and secure a cylindrical object. These sides then expand to create guides, facilitating the imprecise insertion of objects into the clip.





Figure 2.9: Tyre




A tire (American English) or tyre (British English) is a circular component encircling a wheel's rim. Its primary function is to transfer a vehicle's load from the axle through the wheel to the ground, ensuring traction on the surface over which the wheel moves. The majority of tires, such as those designed for automobiles and bicycles, are structures inflated with air, offering a flexible cushion that absorbs shocks when the tire encounters uneven features on the surface. Tires create a contact patch, often referred to as a footprint, designed to align the vehicle's weight with the bearing strength of the surface. This ensures a bearing pressure that avoids excessive deformation of the surface.

3. Results and Discussion

These projects need to test the product when want get the result. After that, need to make the testing in the product and take the reading for time to to roll the hose by this product. The tetsing in the product and take the reading for time to roll the hose by this product and without tools. The testing must be taken in some of reading. This project also can make the result for the product that had attach on customer and technical requirements table and QFD.

3.1 Results of Hose Reel Testing

	<p>Step 1</p> <p>Adjust the position of the hose</p>
	<p>Step 2</p> <p>Tighten the hose using a padle so that it does not move</p>

	<p>Step 3</p> <p>Roll the hose and raise the handle with ease</p>
	<p>Step 4</p> <p>Drop the hose and the spindle cover will fall together</p>
	<p>Step 5</p> <p>Uphold the stand so that the easy roller stands on its own without having to hold it</p>


	<p>Step 6</p> <p>Pull the spindle cover pin and place it back in place</p>
---	--

Table 3.1: Step To Roll the Hose

3.2 Details Solution and Experiment Results

	Weight	Durable	Size	Design	Movable
Speed and Timelessness	□	□	○		△
Ergonomic	△		△	□	△
Long Term Use	△	○		○	○
Cost	○		△	○	○
Easy to fix		○	○		△
Easy to hold	○		○	△	○
Easy to use		○			△
Easy to move	○		○	□	
Safe	△	○			○

Table 3.2: Customer and Technical Requirements Table

Base on the given data on Table 3.2 which consists of the Technical Requirements (TR) in the columns and the Customer Requirements (CR) in the Rows. Its show they are compared according to the relationship between them and values are given to them ranging from 1 to 9 where 9 is the strongest relationship and 1 is the weakest. Figures (circle, triangle, and square) are used in place of values. Circle = 1, Triangle= 3, Square = 9.

Customers' Requirements	Importance	Plan	Points
Speed and Timelessness	2	8	1.5
Ergonomic	3	6	1.2
Long Term Use	5	5	1.3
Cost	3	9	1.2
Easy to fix	4	8	1.3
Easy to hold	5	7	1.4
Easy to use	4	5	1.4
Easy to move	3	6	1.5
Safe	2	5	1.2

Table 3.3: Prioritizing Customer Needs

Table 3.3 describes the Analytical Hierarchy Process plan matrix. It consists the customer requirements in both rows and columns. It can also be said as the Input Data matrix of order equal to the number of customer requirements which is 10 here. In this, the comparison is done between each cell head. The value rated here extends from 1 to 9. The corresponding diagonal cell is filled with the reciprocal of that value.

3.4 Capturing the Voice of the Customer

It is important to remember that there is no one monolithic voice of the customer. Customer voices are diverse. In consumer markets, there are a variety of different needs. Even within one buying unit, there are multiple customer voices (e.g., children versus parents). This applies to industrial and government markets as well. There are even multiple customer voices within a single organization: the voice of the procuring organization, the voice of the user, and the voice of the supporting or maintenance organization. These diverse voices must be considered, reconciled and balanced to develop a truly successful product. One technique to accomplish this is to use multiple columns for different priority ratings associated with each customer voice in the product planning matrix.

Quality Function Deployment requires that basic customer needs are identified. Frequently, customers will try to express their needs in terms of “how” the need can be satisfied and not in terms of “what” the need is. This limits consideration of development alternatives. Development and marketing personnel should ask “why” until they truly understand what the root need is. Breakdown general requirements into more specific requirements by probing what is needed.

Once customer needs are gathered, they then have to be organized. The mass of interview notes, requirements documents, market research, and customer data needs to be distilled into a handful of statements that express key customer needs. Affinity diagramming is a useful tool to assist with this effort. Brief statements which capture key customer requirements are transcribed onto cards. A data dictionary which describes these statements of need are prepared to avoid any misinterpretation. These cards are organized into logical groupings or related needs. This will make it easier to identify any redundancy and serves as a basis for organizing the customer needs for the first QFD matrix.

		Desired direction of improvement (↑,0,↓)					
		Functional Requirements (How's) →					
1: low, 5: high	Customer importance rating	Customer Requirements - (What's) ↓	Weight	Durable	Size	Design	Movable
1	2	Speed and Timelessness	9	9	1		3
2	3	Ergonomic	3		3	9	3
3	5	Long term use	3	1		1	1
4	3	Cost	1		3	1	1
5	4	Easy to fix		1	1		3
6	5	Easy to hold	1		1	3	1
7	4	Easy to use		1			3
8	3	Easy to move	1		1	9	
9	2	Safe	3	1		1	1
Technical importance score			59	33	32	79	54
Importance %			23%	13%	12%	31%	21%
Priorities rank			2	4	5	1	3

Table 3.4: QFD

Table 3.4 which consist of the Customer requirements, Functional requirements, Customer importance rating, Technical importance score, Percentage and Priorities rank whose calculation procedure has been described previously. It also contains the values which are the product of Customer Requirements Weight and Technical Requirements Tables. The figure above it is the House of Quality Matrix in which the values are written ranging from 1 to 9 which depicts the interrelations between each technical attributes with the others.

From this case study, it was concluded that the most important technical requirements to be looked upon for meeting the customer requirements optimally is “Design” (31%). It was preceded by “Durable” (13%) and followed by “Size” (12%). It was also concluded that the most important customer requirement among all of the 7 is “Design” (31%), followed by, “Movable” (21%) and “Weight” (23%). So, throughout the study, I have found out at last that to achieve the most important customer requirement i.e. “Ergonomic” optimally the “Design” should be perfect and should be taken care of with maximum priority.

QFD is designed to help planners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs. The technique yields charts and matrices. QFD helps transform customer needs (the voice of the customer) into engineering characteristics (and appropriate test methods) for a product or service, prioritizing each product or service characteristic while simultaneously setting development targets for product or service.

4. Conclusion

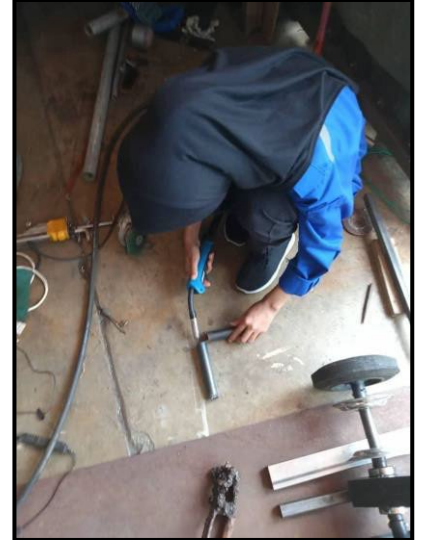
In conclusion, the objective has been successfully achieved without problems. The comfort of the project holder makes the user feel comfortable and easy to carry to roll up the hose. Besides that, the time taken is shorter and firefighters are not too tired to do work for a long time.

Conclusion from this project can achieve the targeted objectives for planning hose reel design. To meet the need by testing the product to see if the project is working or not. When this project will also learn to use the software effectively and be able to improve the skills of using this software it will have many applications that can be used in this software and try it.

After that, this project will also be able to use the PDD method in writing this report to get the best result from this project. This project has done a similar survey to get customer's views on this project. When this project is done, it can solve the problems of customers facing. Then, the design is also selected according to the criteria. Selection criteria that need to be done to see and choose the appropriate design for the product.

Finally, based on the test results, this project can save time for fire fighter to do work. Later, in developing hose reel, some limitations were determined. This project was developed for how hose reel work, as this product has limited size for hose. At the same time this product can make work faster. This product is also easy to use and can be used at fire station and other that use hose.

APPENDIX



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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Feasibility Study and LCoE Analysis of Geothermal Energy Production from Depleted Oil Fields in Sarawak

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Abstract: The idea of repurposing depleted hydrocarbon fields into geothermal fields is found to be feasible based on the researchers. Other than reducing the high upfront cost needed for exploration and drilling, it is also an effort to move towards energy transition to mitigate global climate change. To date, there is no geothermal power plant yet to be fully implemented in Malaysia while Malaysia has rich experience in the oil and gas industry. The research objectives are to evaluate the simulated enthalpy production from the produced geothermal fluid, perform sensitivity analysis to understand the effect of different parameters, and estimate the ultimate enthalpy recovery. The main scope of the study is to estimate the electrical energy generated from the two depleted oil fields, one is a sandstone reservoir while the another is a tight carbonate reservoir. However, only limited field data is accessible in which assumptions were made to build the simulation model. The simulation software used is CMG-STARs, which is a thermal reservoir simulator. The parameters selected for the sensitivity analysis include the reservoir fluid flow properties, rock properties, injection properties, well spacing, and geothermal gradient. Geothermal gradient and reservoir permeability are found to be the two most affecting parameters on the cumulative enthalpy production of both fields. The annual electricity generated per well estimated was more than the targeted value of 2 MW. Levelised cost of energy (LCoE), which will show the economic viability of the project for the two fields was also calculated to be USD 0.075/kWh and USD 0.080/kWh, which are comparable with other renewable energy options in Malaysia. Hence, with the assumptions made in this study, the two depleted oil fields in Sarawak are feasible for geothermal energy production and it was recommended to consider the minimum and maximum cases for LCoE calculation in future work.

Keywords: simulation, geothermal energy, LCoE, depleted oil fields

1. Introduction

Geothermal energy is a type of renewable energy in which the extracted heat energy from the Earth core can be exploited for electricity generation or direct-use application such as building heating and cooling. Binary cycle plants are more efficient for low temperature geothermal temperature resources (107°C to 180°C), as compared to dry steam and flash steam plants, that is more efficient for medium to high temperature geothermal resources (180°C to 350°C) [1]. Developing geothermal energy requires

high capital cost due to high drilling and exploration cost [2]. Abandoned wells in depleting hydrocarbon fields are good candidates to be repurposed into geothermal wells. This in turn contributes to Sustainable Development Goals in terms of energy transition into clean energy from conventional fossil fuels resources to meet global energy demand as well as tackle climate crisis.

Levelised cost of energy (LCoE) is a fundamental metric that is important to determine the viability of a project by measuring the lifetime costs of the power plant divided by the total electricity generated over its assumed lifetime [3]. The capacity factor and installed cost of geothermal power plant are highly affected by the reservoir quality, especially its permeability, temperature and flow rates [4]. The assumed plant operation lifetime in this study is 20 years as most of the binary geothermal plant lifetime are planned at 20 years [5].

There is no geothermal power plant yet to be fully implemented in Malaysia but there are two geothermal resources potential discovered, which are 67 MW in Tawau, Sabah, and also 162 MW in Ulu Slim, Perak [6]. The current key action for geothermal energy development is to perform feasibility study and economic assessment [6]. Therefore, the first objective of this study is to evaluate the simulated heat production rate and field enthalpy of the produced geothermal fluid. The second objective is to perform sensitivity analysis to understand the effect of the parameters including permeability, porosity, rock thermal conductivity, rock heat capacity, injection flow rate, injection temperature, well spacing and geothermal gradient. The third objective is to estimate the ultimate recovery of the geothermal field and lastly is to conduct LCoE calculation and compare it with other existing renewable energy options.

2. Methodology

2.1 Simulation Software

The simulation software used in this study is CMG-STARs, which is a thermal reservoir simulator developed by Computer Modelling Group (CMG).

2.2 Box Model Building

Two box models were built for Field A and B. The reservoir grid was designed to be 25×25×16 in the cartesian coordinate system of i, j, and k. The dimension of each grid block, which is a cube, is 100×100×100. The array input for reservoir properties of Field A (sandstone reservoir) and Field B (tight carbonate reservoir) are shown in **Table 2.1**. The initial water-oil contact depth (DWOC) and gas-oil contact depth (DFOC) were assumed to be 7000 ft for Field A and 10000 ft for Field B to ensure water is the only component in the box model.

Table 2.1: Reservoir Properties of Field A and Field B

Field	Field A (sandstone)	Field B (carbonate)
Grid Top (Layer 1), ft	7630	11820
Porosity, %	19	5
Permeability I, mD	15	5
Temperature, °F	302	338

2.3 Sensitivity Analysis of Field B Simulation Cases

Base case, minimum case and maximum case were simulated for the values of the parameters shown in **Table 2.2** to understand the effect of the parameters on the enthalpy production based on the simulated enthalpy production rate. The well spacing indicates the distance between the injector and producer.

Table 2.2: Values of Changing Parameters for Each Simulation Case

Field B	Minimum Case	Base Case	Maximum Case
Permeability I, mD	2	5	8
Porosity, %	1	5	9
Well Spacing, ft	300	600	900
Injection Flow Rate, bbl/d	800	1000	1200
Rock Thermal Conductivity, Btu/(ft·day·°F)	21.68	24.09	26.50
Rock Heat Capacity, Btu/(ft ³ ·°F)	32.23	35.81	39.39
	Base Case	Case 2	Case 3
Injection Temperature, °F	77	85	90

2.4 Changing Well Spacing

To determine the optimum well spacing, the distance between the injector and producer was changed with every increment of 100 ft for each simulation case starting from well spacing of 100 ft. The optimum well spacing can be determined when no significant changes are shown on the simulated result for the subsequent well spacing. By using the optimum well spacing, two five-spot models were built with two producers at production rate of 1200 bbl/d and six injectors at injection rate of 400 bbl/d.

2.5 Using CMOST for Sensitivity Analysis Study

To create the box models that resemble to the real reservoir for the sensitivity analysis study, the porosity and permeability across depth were calculated using the available correlations that were proposed based on the studies made on nearby region within Sarawak, which is **Eq. 2.1** for Field A and **Eq. 2.2** for Field B [7][8]. The typical geothermal gradient value of 15°F/1000 ft was used to calculate the temperature across the depth.

$$y = 1.3886x - 5.521, R^2 = 0.75 \quad \text{Eq. 2.1}$$

$$y = 0.7067x - 2.0298, R^2 = 0.5817 \quad \text{Eq. 2.2}$$

The parameters for the sensitivity analysis for both Field A and Field B using CMOST are porosity, permeability, geothermal gradient, rock heat capacity, rock thermal conductivity, and injection fluid temperature. The upper and lower limit of the parameters were set to default at ±25% except for geothermal gradient was set to be ±10°F/1000 ft.

2.6 Ultimate Enthalpy Recovery Estimation

The production duration in the simulation was extended to be longer until the point where the average reservoir temperature reached the minimum feasible operation condition of binary plant at 248°F, which is the point indicates the ultimate enthalpy production of the field.

2.7 LCoE Calculation

The formula used to calculate LCoE in this project is shown in **Eq. 2.3** and **Eq. 2.4** as proposed by National Renewable Energy Laboratory which includes the capital recovery factor [9]. In this calculation, the discount rate, r is assumed to be 7.5%, economic lifetime, n is assumed to be 20, fixed and variable operating and maintenance are assumed to be USD 154.3/kW/year and USD 0.017/kWh respectively whereas the capital cost for Field A and Field B are assumed to be USD 2600 and USD 2945 respectively, which excluded 35% of the capital cost accounts for the cost for exploration, drilling and field development. The capacity factor is assumed to be 80%.

$$LCoE = \frac{\text{Capital cost} \left[\frac{\$}{kW} \right] \times \text{Capital Recovery Factor (CRF)} + \text{Fixed O\&M} \left[\frac{\$}{kW \text{ year}} \right]}{8760 \times \text{Capacity Factor}} + \left(\text{Fuel Cost} \left[\frac{\$}{MMBtu} \right] \times \text{Heat Rate} \left[\frac{Btu}{kWh} \right] \right) + \text{Variable O\&M} \left(\frac{\$}{kWh} \right) \quad \text{Eq. 2.3}$$

$$\text{Capital Recovery Factor (CRF)} = \frac{r(r+1)^n}{(r+1)^n - 1} \quad \text{Eq. 2.4}$$

3. Results and Discussion

3.1 Field B Sensitivity Analysis

Based on the simulation cases conducted on Field B with the result presented in **Figure 3.1**, the cases that have higher enthalpy production rate than the base case scenario are when the reservoir porosity is higher at 9%, the well spacing is larger at 900 ft, the rock thermal conductivity is smaller at 21.68 Btu/(ft·day·°F), the rock heat capacity is higher at 39.39 Btu/(ft³·day), the injection flow rate is lower at 800 bbl/day and the injection temperature is higher at 90°F. The most important parameter in Field B is found to be well spacing as it has shown significant effect on the enthalpy production rate, followed by reservoir porosity, injection flow rate, rock heat capacity, rock thermal conductivity, injection temperature and lastly reservoir permeability. Due to small permeability values are used as Field B is a tight carbonate formation, no significant difference was found on the enthalpy production rate for three different cases. On the other hand, larger well spacing allows more complete heat transfer between the water and the rock matrix. However, it is also noted that optimum well spacing should be determined as when the well spacing is too large the connectivity between the injector and producer will be lost.

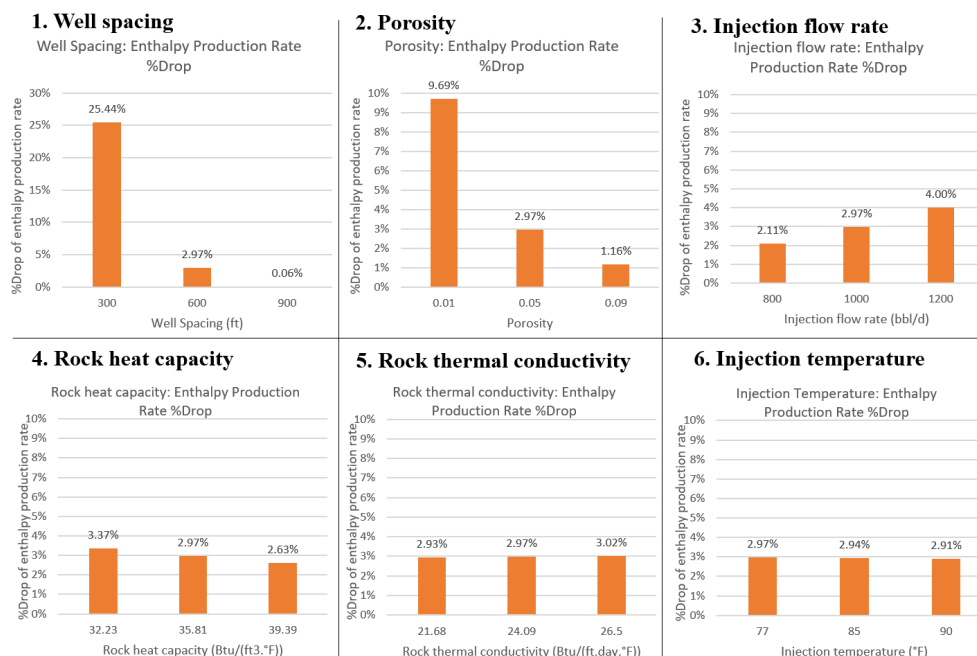


Figure 3.1: Comparison of effect of parameters on enthalpy production rate in Field B

3.2 Optimum Well Spacing

Based on **Figure 3.2**, the optimum well spacing found for both fields were found to be 600 ft as the increasing trend for the subsequent well spacings becomes insignificant.

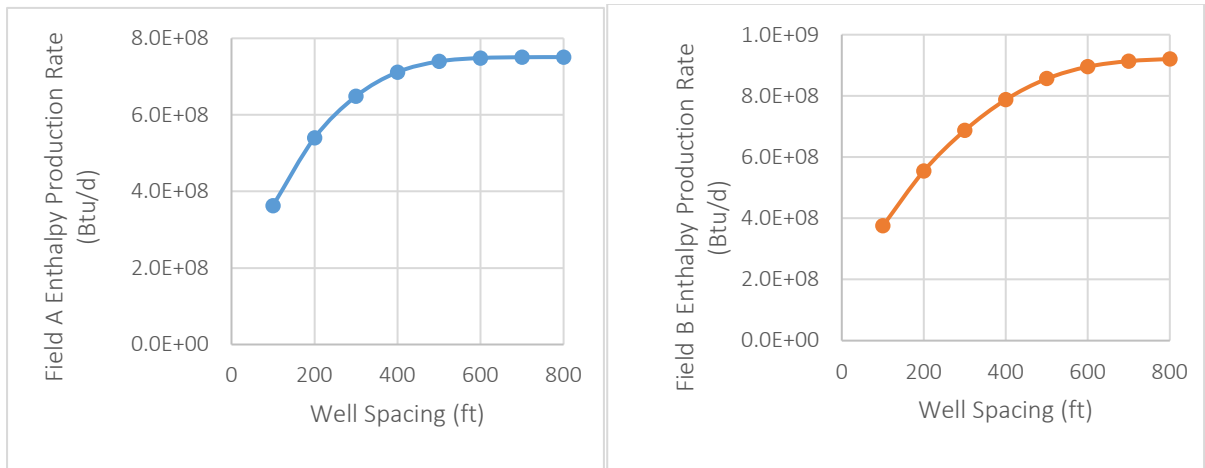


Figure 3.2: Well spacing determination for Field A (left) and Field B (right)

3.3 Field A and Field B Sensitivity Analysis using CMOST

Based on **Figure 3.3** and **Figure 3.4**, the most affecting parameters on the cumulative enthalpy production of Field A is permeability while for Field B is geothermal gradient. Reservoir permeability determines the ability of the fluid flow through the rock and it is a critical parameter to ensure good transport passage for the fluid to be heated up with minimum heat loss and produced through the producer. Geothermal gradient will directly impact on the reservoir temperature across the reservoir layer that will determine the maximum possible heat that can extracted for enthalpy production. This has proven that permeability and reservoir temperature are the two of the dominant parameters on enthalpy production that will eventually affect the viability of the project.

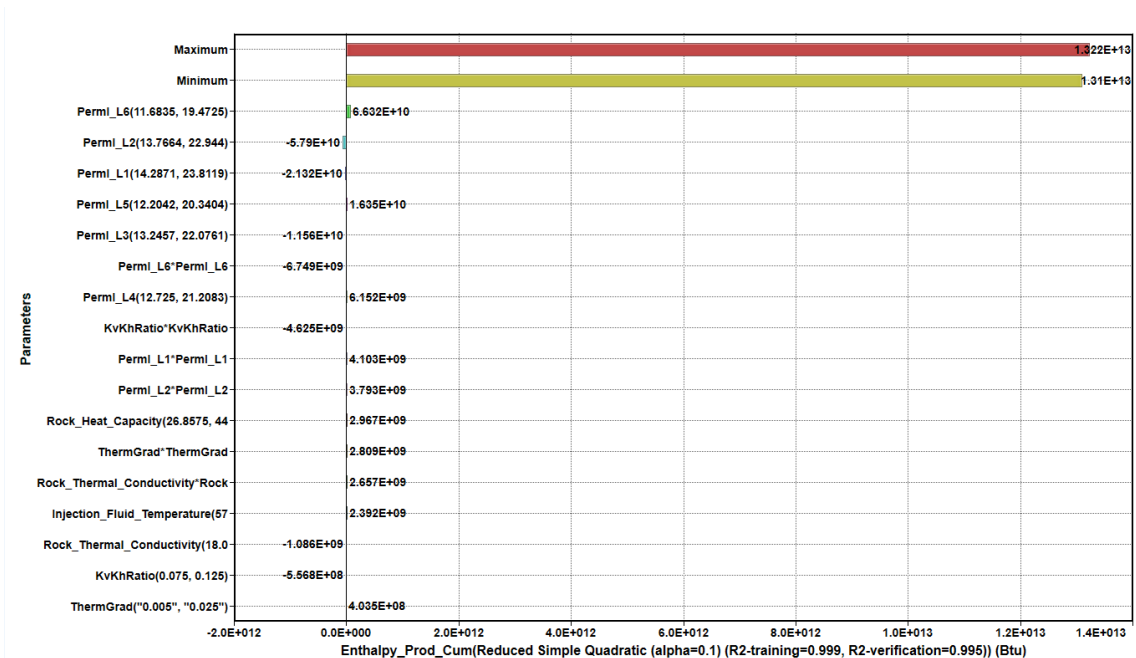


Figure 3.3: Contributions of parameters affecting the minimum and maximum cumulative enthalpy production of Field A

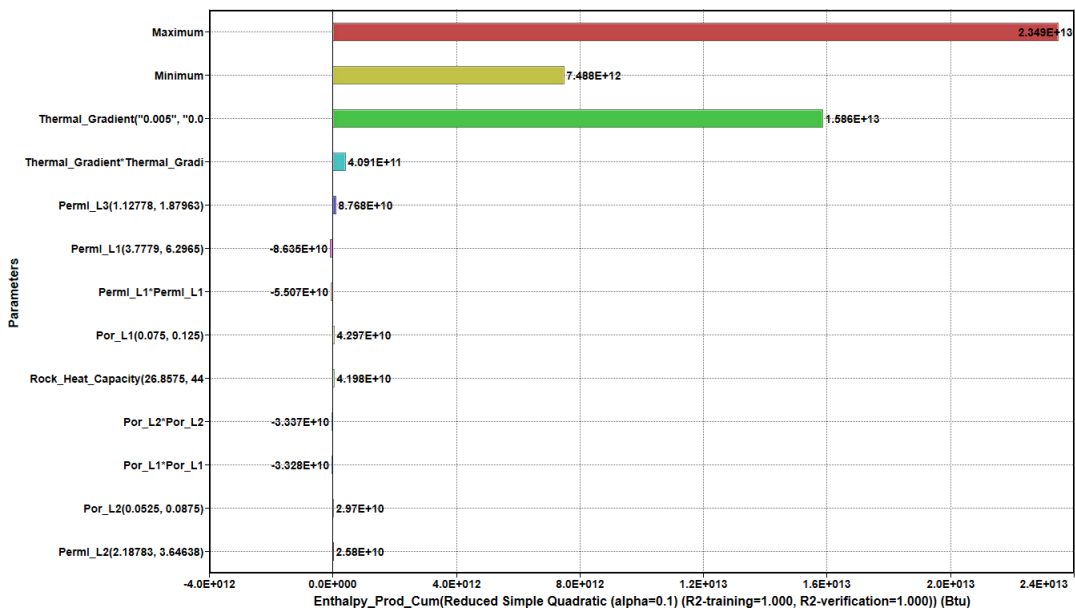


Figure 3.4: Contributions of parameters affecting the minimum and maximum cumulative production of Field B

3.4 Ultimate Enthalpy Recovery

Based on **Figure 3.5**, when the average reservoir temperature reaches the minimum feasible operation condition of binary plant at 248°F, Field A and B achieve ultimate enthalpy recovery on year 2121, which is 98 years of production, and year 2139, which is 116 years of production, respectively. From the graph trend, it was found out that the Field B, which has poorer reservoir fluid properties but with higher reservoir temperature, has different declining trend with Field A.

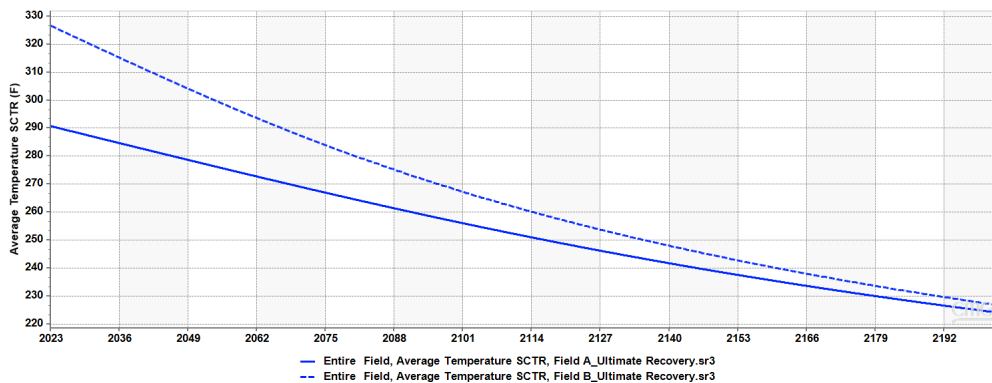


Figure 3.5: Simulation results of average reservoir temperature for 200 years of production

3.5 Electricity Power Generation

By taking the average enthalpy production from the simulation result for 20 years of production for Field A at 1,801,915,214 Btu/d and Field B at 2,087,676,595 Btu/d, and considering power capacity of 80%, the electricity generated per well for Field A and B are 8.8 MW and 10.2 MW respectively. Both exceed the target electricity generation target of 2 MW per well.

3.6 LCoE Analysis

By applying all the assumptions on the capital cost and discount rate, the calculated LCoE for Field A and Field B are USD 0.075/kWh and USD 0.080/kWh respectively, which are lower than the cost of conventional energy generation by Tenaga Nasional Berhad of Malaysia at USD 0.095/kWh. Based on the LCoE of energy generation in Malaysia predicted by Accenture Strategy & Consulting, the calculated LCoE values is still slightly more expensive than the utility photo-voltaic and hydro energy.

4. Conclusion

It is important to determine the optimum well spacing to obtain optimum enthalpy production. Based on the assumptions used with the optimum well spacing found at 600 ft, Field A and Field B are feasible for geothermal energy production as they can produce electricity generated per well of more than the target of 2 MW. The LCoE estimated at USD 0.075/kWh and USD 0.080/kWh are also comparable with the other dominant renewable energy options in Malaysia which are solar and hydro energy. By referring to the sensitivity analysis conducted on CMOST, geothermal gradient and the reservoir permeability are the most affecting parameters that have significant impact on the enthalpy production. Besides, Field A and Field B allows 98 years and 116 years of enthalpy production before they reach the minimum feasible operating condition of 248°F for binary geothermal plant. Further study can be conducted to estimate the minimum and maximum cases for LCoE calculation to provide a possible range of LCoE for the investor and operator.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Flexible Sensor Based for Simultaneous Robotic Hand Controller using 3D Printed Acrylonitrile Butadiene Styrene (ABS)

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Abstract: Robotic hand can be used in a number of applications by changing the program of the controller and the structure is designed in such a way that it is capable of lifting light loads but also medium loads. The benefit includes reducing the risk of direct contact with chemical substances, saving by minimizing potential liabilities, and enhancing quality through the improvement of the working environment. This invention are presenting a robotic hand that mimics the motion of a human hand wearing a control glove, an opening and closing of each individual finger of the human hand is duplicated by the robotic hand with the individual servo controlling each robotic finger. The invention can use a 3D printed robotic hand, a custom circuit board had to be built, and the controller microcontroller had to be programmed using the Arduino. The servos can be connected to the robotic finger with a fishing line. The control glove was connected to the control board with the wires. The mechanical hand is usually programmable consist the similar function of to the human hand. The connected joints allow rotational motion. The kinematic chain of manipulators is called effectors and it is analogous to the human hand. The design effectors can be performed by any desired task such as gripping, or spinning depending on the function of the application based on the objective stated. It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The application of the invention is crucial across diverse fields such as chemical handling, medical surgery, management of radioactive materials, and ensuring the safety of disabled persons, especially children.

Keywords: Flexible, Hand, Robotic, Microcontroller, Arduino, Human

1. Introduction

There are several problem statements related to this invention that need to be addressed. Firstly, workers or employees involved in the chemical and mechanical industries face heightened hazards, such as the necessity for chemists to wear gloves when testing chemical solutions in fume chambers. Secondly, some individuals experience impaired finger functionality, limiting them to only being able to move three fingers. Thirdly, there are cases where hands cannot adequately grasp or hold light objects. In medicine, a prosthesis addition, application, attachment is an artificial device that replaces a missing body part, which may be lost through trauma, disease, or congenital conditions. Prosthetic amputee rehabilitation is primarily coordinated by a prosthetics and an inter-disciplinary team of health care professionals including psychiatrists, surgeons, physical therapists, and occupational therapists. Furthermore, individuals working with radioactive materials are also at risk. Lastly, special attention must be given to disabled persons, including children, to ensure their safety and well-being in various environments.

Nowadays, the increasing need to create artificial hand for different in human situation where human interaction is difficult or impossible. Robotic hand can be used in number of application by changing the program of controller and the structure is designed in such a way that it is capable to lift light loads but also lift medium loads. [1] designed a robotic hand that is basically sensors with high degrees of repeatability, precision, and reliability. [2] explained the method of interfacing the robotic arm stepper motors with the programmed 8051-based micro-controller which are used to control the robot operations.

We present a robotic hand mimicking human hand motion controlled by a glove, where each finger movement is replicated by individual servos. The controller, driven by flex sensors, comprises the hand, servos, Arduino, glove, and flex sensors. Flex sensors act as variable resistors, detecting finger movements and triggering proportional servo responses. 3D printed robotic hand components, custom circuitry, and Arduino programming enable functionality. Servos connect to fingers via fishing line, while the glove interfaces with the control board via wires. The manipulator, akin to the human hand, offers programmable joint movement for various tasks, such as gripping or spinning, based on defined objectives.

Materials and Methods

2.1 Materials

Poly Lactic Acid (PLA), Servo control (MG90), Flexion sensors, Glove, Cable Tie, Hot Glue Gun, Transformer 12V 2A, Rectifier (DC IN1007), Capacitor (0.1 uf & 2200 uf), Arduino (Uno R3), Microcontroller (LM 7812 & LM 7805), Breadboard, Transistor (LM7812 & LM7805)

2.2 Project Fabrication

For project fabrication, we divided our progress into 4 steps which are stated on Table 3.3 for servo motor, wiring board and flex sensor for step 1. Then, we precede our progress as shown that is 3D printed hand (PLA) for step 2. After that, glove section for step 3. And finally, we proceed to step 4 which is the Finishing step.

2.3 Mapping the Servos with Flex Sensor Analog Reading

We have to generate the analog value which is can be determined as the resistance value from the resistor which is each of the sensor print out different reading analog value. We used this analog value to give the servo motor position to rotate from its 0 degrees angle position to 180 degrees angle position. The value of the analog read from flex sensor was determined by minimum value reading to maximum value reading which is it consider as steady position of human finger to maximum bend of human finger. By using those maximum and minimum analog read value, we can map the position of

servo motor to rotate fully 180 degrees angle position from 0 degrees angle position. The value of resistance will be the range of the servo to rotate. For instance, we take the finger 1 to demonstrate this function. The value of analog read for finger 1 is 320 to 375 analog values. So, this value will set as the parameter for the servo to rotate. If the analog value gives below 320, servo will not rotate either if the analog value gives more than 375; the servo will stop rotate when the rotation reaches 180 degrees angle position. This method was used for all servo motor and flex sensor.

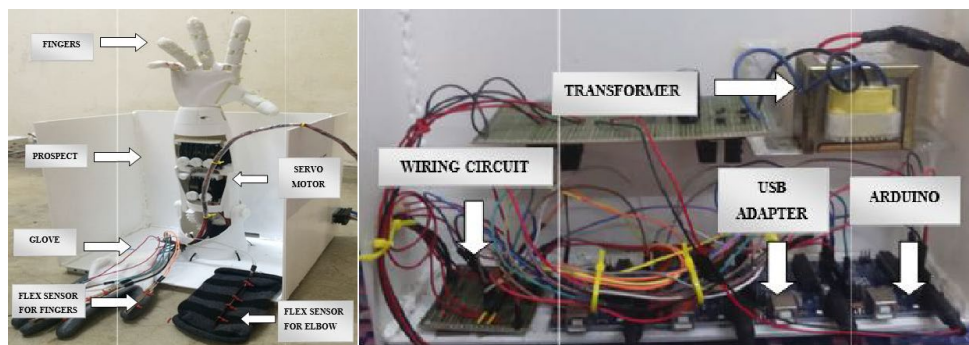
2.4 Programming Script

We could use the information from Section 2.3 to create our programming script. The robotic and programming script was created using Arduino IDE and we have uploaded the script to the Arduino board via USB connection.

2. Results and Discussion

3.1 Results

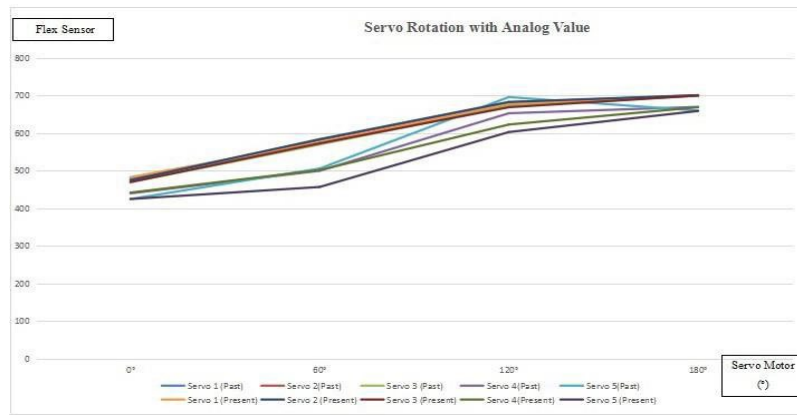
The method of movement for our robotic fingers is based on the rotation of the servo motor shaft. Each robotic finger is connected to the edge of the servo motor's shaft with fishing thread, resembling the ligaments of a human finger. Servo motors act as actuators, pulling the thread to move the fingers. The core components of this project are Arduino and flex sensors. Flex sensors provide variable resistance when bent, allowing for control similar to human fingers.



Graph 3.1 : Fabricated robotic arm with their controller system

3.2 Servo Rotation with Flex Sensor Analog Values

Based on the Graph 3.2, as the overview of servo motor rotation and flex sensor analog values widely. As conclusion, the analog values from flex sensor were varying to each other but the ranges of sensors value are slightly consistent through the range. It has proved the consistency reading of analog value from flex sensor. Based on the graph, there we can two data from past project and compared with this present data that our flex sensor analog values were consistently running according to our programming script and the result had showed our flex sensors were operated well during operation of our robotic hand project. By that, our data on servo motor and flex sensor with the past data are almost the same.



Graph 3.2: Servo rotation with analog values

Based on Table 3.1, we can see the overall analog value range that we mapped to the servo motor for it to rotate from 0° to 180° distance. All five flex sensors show different analog values to each other. This condition occurs because each finger consists of a different range of bending, and the different length of each finger also affects the analog value readings.

Table 3.1: Analog value range from 0° to 180° for servo motor for past and present data

Servo motor	Flex sensor value at 0°(Past)	Flex sensor value at 0°(Present)	Flex sensor value at 180°(Past)	Flex sensor value at 180°(Present)
1	480	483	700	701
2	475	475	700	701
3	470	470	700	700
4	440	442	670	669
5	425	425	660	659

3. Conclusion

We connected flex sensors and servo motors to the Arduino for programming. Arduino acts as the brain, processing analog and digital signals and controlling the servo motors based on input from flex sensors. We completed the circuit connection before programming, enabling the flex sensors to control the robotic fingers via Arduino. Our robotic hand can move all five fingers simultaneously using flex sensors. We have designed this hand from finger to elbow using PLA to minimize manpower exposure to hazards. The novelty of this innovation lies in the fact that a stretchable glove is used to handle the artificial hand, which is made of ABS and 3D printed to form its structure. The robotic hand reduces the need for manpower to handle explosive and radioactive chemicals in fume chambers, minimizing health and environmental risks associated with exposure. Companies can decrease liability for compensation and other costs by using robotic hands instead of direct human handling, improving production quality and safety.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

DEVELOPMENT OF NET ZERO ENERGY BUILDING MODELLING TO ESTIMATE THE ENERGY SAVING FOR EXISTING BUILDINGS AT UNIKL BMI

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Abstract: This paper introduces a net zero energy building model at UniKL BMI, utilizing IESVE and Sketchup Pro to reduce energy consumption while ensuring occupant comfort and air quality. Through a detailed analysis of HVAC and lighting efficiency measures, the study contributes to sustainable building practices and emphasizes energy conservation in educational institutions, specifically at UniKL BMI. The need for this research arises from the pressing issues at UniKL BMI, where higher emissions of greenhouse gases are directly linked to elevated energy consumption due to the absence of an effective energy-saving strategy. The main buildings at UniKL BMI face a challenge due to low energy conservation awareness, leading to increased energy usage and higher power bills. To tackle these challenges, the research focused on developing a net-zero energy building model using IESVE software for energy savings calculation and estimation. This research aimed to reduce energy consumption and emissions, emphasizing building information modeling techniques, especially in managing electricity demand within the main building. Additionally, the research aimed to achieve future energy efficiency by integrating efficient technologies and optimizing occupant behavior, contributing to a sustainable and environmentally conscious approach for UniKL BMI. The project achieved a 55% energy saving by optimizing HVAC and lighting systems, decreasing monthly consumption from RM 61,799 to RM 27,790. The addition of a solar PV system further reduced costs and minimized overall energy consumption by 45%, making the PV generated daily electricity at 2,535 kWh, transforming the existing UniKL BMI building into a Net-Zero Energy building model with an ROI payback period of less than 10 years. Future improvements will expand the project's scope, considering additional saving measures and applying them to the entire building. In summary, this research is vital in promoting sustainable energy practices and fostering a culture of energy conservation at UniKL BMI's main campus building.

Keywords: NZEB, IESVE, Unikl BMI, Energy efficiency, Lighting efficiency, HVAC, Sketchup Pro, Sustainable, Energy saving.

1. Introduction

Consumption of electricity and environmental conservation are increasingly worldwide goals since pollution from energy consumption influence significantly to climate change. As a result, there is a tremendous need to conserve energy in many parts of our lives. Buildings, in particular, utilize a significant amount of energy, accounting for around 40% of total energy usage [1]. As a result, building energy simulation programs from different parts of the world are becoming more advanced. With the increasing need for energy and the growing recognition of the environmental effects of construction, it is crucial to prioritize sustainability during the design stage. This project focuses on the development of net zero energy building modeling to estimate the energy saving for existing buildings at Universiti Kuala Lumpur British Malaysian Institute (UniKL BMI) where building energy simulation software is used. The development was motivated by the fact that the majority of building occupants are unaware of their facility's electrical power usage that has been used up where it has led to waste of energy. It is a major concern for the university to cut back on energy use and electricity bills since the energy expenditure for a university is extremely high and expensive where the university may have difficulty paying them. Hence, having this building modeling simulation could help determine the energy saving and combat energy waste and cost-cutting measures.

The phrase "net zero energy" is frequently utilized to describe the yearly power consumption of a grid-dependent building, although it excludes the supply of energy needed to provide the facility and its elements [2]. Despite the fact that this system was designed to cut the use of energy on the academic campus, the comfort of occupants and the quality of the indoor air will stay unchanged because this study includes benefits for conservation of energy too. Enhancing the cost-effective system at UniKL BMI is one method for boosting the occupant knowledge and participation in the development of net zero energy building modelling by utilizing engineering tools which is the IESVE software [3].

This project advanced building energy simulation software to develop net-zero energy building models. High energy expenditure is a major concern for the university, making it crucial to cut back on energy use and bills. Hence, improving energy efficiency for the HVAC system and lighting quality control can save a significant amount of money on power bills. The research also explores effective strategies for minimizing electricity consumption and enhancing resource efficiency, considering local climate conditions and using the IESVE simulation program to determine Energy Use Intensity (EUI). Overall, the project contributes to global sustainability goals by addressing energy consumption and conservation in building

2. Materials and Methods

The project involves a three-step process, commencing with SketchUp Pro, followed by exporting to IESVE software, and culminating in result generation.

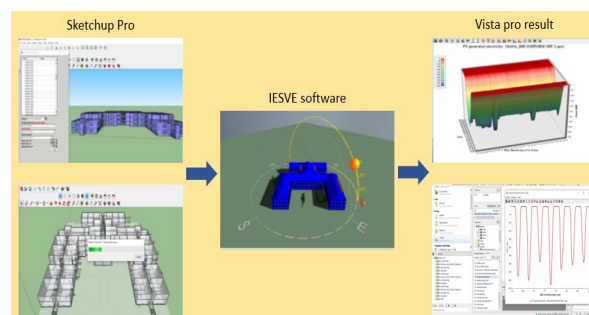


Figure 1: Block diagram of three-step process on software implementation

In this initial phase, determining the orientation and crafting a detailed floor plan with floor area of 10,300m² are imperative. Following this, the project advances to room selection, and upon completion of the 3D model, the groundwork is laid for transitioning to the IESVE software. The suncast module within the software is then employed for simulation purposes. The final leg of the project involves the generation of results using Vista Pro, after undergoing various processes within the module. This comprehensive approach ensures a meticulous and effective workflow, incorporating key design elements and simulation tools to achieve optimal outcomes.

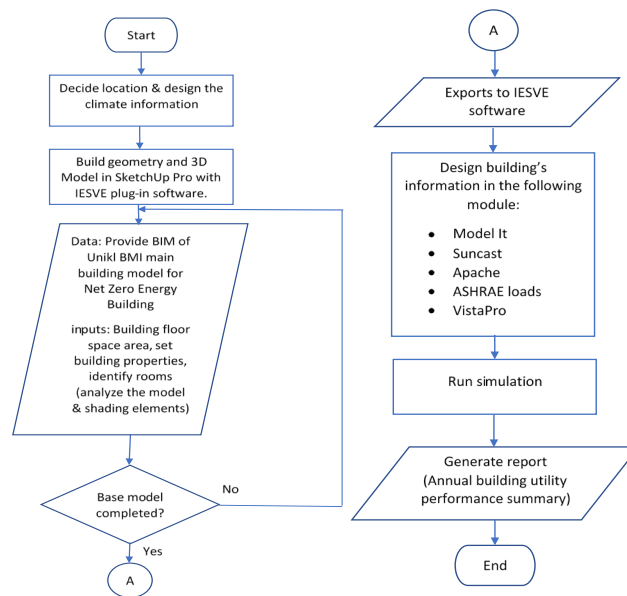


Figure 2: Flowchart of the project

It starts with the decision on the building's location and the design of climate information, which helps in understanding the environmental conditions. Next, the building geometry is constructed using SketchUp Pro then 3D building is produced. Once the base model is completed, it is exported to IESVE software for simulation. The subsequent stage involves designing the Building Information Model (BIM) of the Unkl BMI main building, considering inputs such as location site data, sufficient building construction, lighting system and HVAC operation. The simulation evaluates the building's energy performance. The resulting information is then delivered, and an annual building utility performance summary report is generated, highlighting the building's energy consumption and potential improvements. The process concludes at the end. Overall, this flowchart provides a structured approach to designing and assessing an NZEB, ensuring energy efficiency and sustainability.

3. Results and Discussion

3.1 Lighting result

3.1.1 Lighting baseline

Below is the measured calculation energy consumption of light loads using T8 Fluorescents light 4x2ft casing before lighting retrofit is applied.

Table 1: Lighting baseline

Area	Operating hours	Rated power	Total quantity	Consumption/day (kWh)	Tariff electricity bills (0.365)
Classroom	8	32	996	254.976	93.06624
Lab	8	32	1044	267.264	97.55136
Seminar room	8	32	294	75.264	27.47136
Corridor	5	21	270	28.35	10.34775
Lift	9	21	24	4.536	1.65564
Main toilet	4	32	27	3.456	1.26144
Staff room	8	32	102	26.112	9.53088
Stairs	4	21	9	0.756	0.27594
Multipurpose room	4	32	96	12.288	4.48512
Store room	2	32	120	7.68	2.8032
TOTAL PER DAY			3030	680.682	248.4489
TOTAL PER MONTH				20420.46	7453.468

The total daily consumption for all areas is 680.682 kWh, resulting in a monthly consumption of 20,420.46 kWh and corresponding electricity bills totaling RM 7,453.468.

3.1.2 Lighting retrofit

The provided table illustrates the post-retrofit energy consumption data of light loads using 4ft T8 LED replacement after lighting retrofit is applied.

Table 2: Lighting after retrofit

Area	Operating hours	Rated power	Total quantity	Consumption/day (kWh)	Tariff electricity bills (0.365)
Classroom	8	15	996	119.52	43.6248
Lab	8	15	1044	125.28	45.7272
Seminar room	8	15	294	35.28	12.8772
Corridor	5	10	270	13.5	4.9275
Lift	9	10	24	2.16	0.7884
Main toilet	4	15	27	1.62	0.5913
Staff room	8	15	102	12.24	4.4676
Stairs	4	10	9	0.36	0.1314
Multipurpose room	4	15	96	5.76	2.1024
Store room	2	15	120	3.6	1.314
TOTAL PER DAY			2982	319.32	116.5518
TOTAL PER MONTH				9579.6	3496.554

Comparing this post-retrofit data with the previous table, it is evident that the energy consumption has significantly decreased. The retrofit, specifically the change in lighting systems, has led to lower daily and monthly consumption figures, resulting in reduced electricity bills. This outcome underscores the effectiveness of the retrofit in achieving energy efficiency goals and highlights the importance of targeted measures for sustainable resource usage.

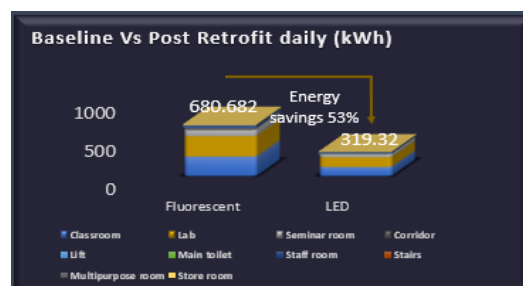


Figure 3: Fluorescent vs LED lighting

The depicted graph also reveals that transitioning from fluorescent lighting to modern LED lighting can result in energy savings of up to 53%. It is important to emphasize that this percentage represents the comparative energy savings achieved through the replacement of old lighting with new LED technology. Detailed results are available below.

Table 3: Baseline vs post retrofit

Area	Baseline		Post-retrofit		
	Consumption/day (kWh)	Tariff electricity bills (0.365)	Consumption/day (kWh)	Tariff electricity bills (0.365)	
Classroom	254.976	93.06624	119.52	43.6248	
Lab	267.264	97.55136	125.28	45.7272	
Seminar room	75.264	27.47136	35.28	12.8772	
Corridor	28.35	10.34775	13.5	4.9275	
Lift	4.536	1.65564	2.16	0.7884	
Main toilet	3.456	1.26144	1.62	0.5913	
Staff room	26.112	9.53088	12.24	4.4676	
Stairs	0.756	0.27594	0.36	0.1314	
Multipurpose room	12.288	4.48512	5.76	2.1024	
Store room	7.68	2.8032	3.6	1.314	
TOTAL PER DAY		680.682	248.44893	319.32	116.5518
TOTAL PER MONTH		20420.46	7453.4679	9579.6	3496.554

The baseline energy consumption for each area is generally higher, contributing to a total daily consumption of 680.682 kWh and a monthly consumption of 20,420.46 kWh. After the retrofit, there is a notable reduction in energy consumption across all areas, resulting in a total daily consumption of 319.32 kWh and a monthly consumption of 9,579.6 kWh. Hence, it can be said that the retrofit has led to a significant decrease in daily and monthly energy consumption, indicating the success of the changes made, particularly in the lighting systems.

3.1.3 Payback period of lighting retrofit

Table 4: Payback period of lighting retrofit

Light fittings	RM/unit	Quantity	Total RM	Saving per year	Saving per year
4ft T8 LED Replacement	30	2682	80460	47482	84960/47482
2ft T8 LED Replacement	15	300	4500		
Total		2982	84960		1.79 years

The recommended brightness level for the classroom area falls within the optimal range of 300 to 500 lux. To enhance energy efficiency, it is suggested to reduce the number of tubes from 2 to 1. Additionally, replacing the current fluorescent tube with a more energy-efficient 10W-15W LED type is advised. The estimated unit price for the replacement light tube includes both labor and material costs. The total investment in light fittings, considering 4ft T8 LED replacements at RM 30 per unit and 2ft T8 LED replacements at RM 15 per unit, amounts to RM 84,960 for 2,982 units. This investment is anticipated to result in significant annual savings, with an estimated payback period of 1.8 years. The detailed breakdown of savings includes RM 47,482 per year from 4ft T8 LED replacements and an additional RM 4,500 from 2ft T8 LED replacements, contributing to a substantial reduction in energy expenses.

3.2 HVAC result

3.2.1 HVAC baseline

Table 5: HVAC baseline

Area	Before			
	Operating hours (8a.m - 5p.m) fully utilized	Active air conditioning unit at 18-20°C	Energy consumption/day (kWh)	Tariff electricity bills (0.365)
Classroom	9	60	1890	689.85
Lab	9	56	1764	643.86
Seminar room	9	14	441	160.965
Staff room	9	10	315	114.975
Multipurpose room	9	17	535.5	195.4575
TOTAL PER DAY			4945.5	1805.1075
TOTAL PER MONTH			148365	54153.225
TOTAL PER YEAR			1780380	649838.7

The provided data outlines the energy consumption for different areas within the facility during operational hours (8 a.m. to 5 p.m.). The classroom, with 9 hours of utilization, maintains an active air conditioning unit at 18-20°C and consumes 1890 kWh of energy per day, resulting in a daily electricity cost of 689.85. Extrapolating to monthly and yearly periods, the facility's total energy consumption amounts to 148365 kWh and 1780380 kWh, incurring electricity costs of 54153.225 and 649838.7, respectively. The baseline energy consumption is notably higher, primarily due to the continuous operation of air conditioning units and their preset temperature range. To enhance energy efficiency and reduce costs, it is recommended to install thermistor sensors. These sensors will enable real-time monitoring of the temperature in each area, allowing for more precise control over the air conditioning systems.

3.2.2 HVAC retrofit

The updated data provides insights into energy consumption after implementing a thermistor sensor system to maintain a setpoint temperature of 24-26°C, compared to the previous scenario where the air conditioning units were operated continuously at 18-20°C.

Table 6: HVAC retrofit

Area	After				
	Active air conditioning unit at 24-26°C	Thermistor sensor to maintain the setpoint temperature	Energy saving /day (kWh), 5% saving per degree celcius, 20% (5%*4°C)	Energy consumption/day (kWh)	Tariff electricity bills (0.365)
Classroom	42	24	205.8	823.2	300.468
Lab	39	24	191.1	764.4	279.006
Seminar room	9	24	44.1	176.4	64.386
Staff room	7	24	34.3	137.2	50.078
Multipurpose room	11	24	53.9	215.6	78.694
TOTAL PER DAY			529.2	2116.8	772.632
TOTAL PER MONTH			15876	63504	23178.96
TOTAL PER YEAR				762048	278147.52

The implementation of thermistor sensors has proven effective in optimizing energy usage, leading to substantial cost savings. This has resulted in significant energy savings, calculated at 5% per degree Celsius, equivalent to a 20% reduction (5% * 4°C).

3.2.3 HVAC setpoint temperature

Table 7: HVAC setpoint temperature

Area	Energy consumption/ day at setpoint temperature (kWh)				
	at 20'c	at 21'	at 22'	at 23'	at 24'
Classroom	1890	977.55	926.1	874.65	823.2
Lab	1764	907.725	859.95	812.175	764.4
Seminar room	441	209.475	198.45	187.425	176.4
Staff room	315	162.925	154.35	145.775	137.2
Multipurpose room	535.5	256.025	242.55	229.075	215.6
Total	4945.5	2513.7	2381.4	2249.1	2116.8

The data indicates a clear correlation between setpoint temperatures and energy consumption. In the "Before" scenario (18-20°C), the facility's daily energy usage was 4945.5 kWh, whereas implementing thermistor sensors for a 24-26°C setpoint temperature in the "After" scenario reduced it to 2116.8 kWh. Analyzing energy consumption at various setpoint temperatures (20°C to 24°C) for each area reveals a consistent trend: higher setpoint temperatures correspond to lower energy consumption. This suggests a hypothesis that maintaining a slightly higher temperature can significantly reduce overall energy usage without compromising comfort or functionality.

3.2.4 After (Implementation of Changes - Thermistor Sensors)

The data below presents a before-and-after comparison of energy consumption in various areas of the facility,

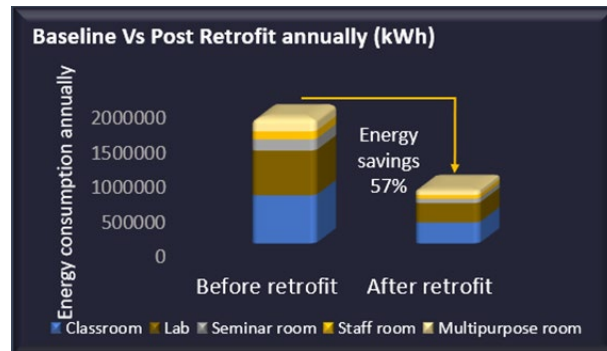


Figure 4: Energy consumption with thermistor vs without thermistor

The total daily energy consumption significantly decreased to 2116.8 kWh, indicating a substantial reduction. Monthly and yearly totals also decreased to 63504 kWh and 762048 kWh, resulting in lower electricity bills of 23178.96 and 278147.52. By adjusting the setpoint temperature to 24-26°C, as indicated in the "After" data, the system likely achieved energy savings by reducing the load on the air conditioning units during operational hours. The total daily energy consumption decreased by approximately 57% after the implementation of changes. The HVAC system experienced a savings of 37.5%, suggesting enhanced efficiency in temperature control and air circulation. Additionally, other loads contribute substantial savings of 62.5%. Hence, the comparison underscores the importance of adopting smart control technologies, such as thermistor sensors, to optimize energy efficiency and reduce operational costs in a facility.

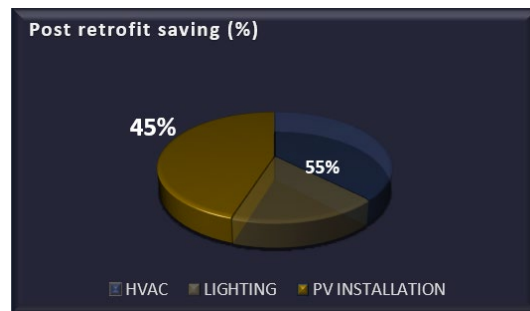


Figure 5: Percentage breakdown of energy savings

The presented data outline the percentage breakdown of energy savings post-retrofit across different categories. The HVAC and lighting systems combined achieved a 55% savings. To achieve a net-zero energy building (NZEB), an additional 45% in energy savings is required. This underscores the necessity for a secondary power source which is PV system installation.

3.3 PV system installation

3.3.1 Before and after PV system installation

The total consumption for the PV system is recorded at RM 27,790, indicating the overall energy expenditure within the system. Importantly, a series of saving measures have been implemented to optimize energy efficiency, contributing to the overall strategy for sustainable energy consumption. The summary of the provided information is as follows.

Table 8: PV system's efficiency

Total consumption for PV system	Saving measures	PV installations
RM 27,790	✓	x
507kWp installed capacity	✓	✓
2,535kWh	✓	✓

The data paints a comprehensive picture of the PV system's efficiency, emphasizing the successful implementation of saving measures and the impactful contribution of the 507kWp installed capacity to achieve substantial energy savings in the amount of 2,535kWh.

To determine the required solar panel capacity for achieving a monthly energy savings goal of 76,139.52 kWh, several considerations and calculations are employed. Firstly, it is imperative to establish that the solar PV panels must contribute an additional 45% energy savings for the building. Concurrently, to accommodate the power demand of the LED lighting system, it is crucial to ensure that the Monocrystalline PV panel selected possesses a minimum capacity of 300W. Local solar conditions and panel orientation are taken into account to optimize energy generation efficiency. The calculation of the total number of PV panels required is carried out using following formula.

Table 9: Calculation on required solar panel capacity

Step 1: Calculate Annual Savings	Step 2: Determine Initial Investment	Step 3: Calculate Paybac Period
Annual Savings	Installed Capacity (kWp)	Initial Investment/Annu Savings
Monthly Electricity Bill Reduction ×12	76139.52/(30*5)	4.566362001
RM27,790×12	507.5968	
RM333,480.00	Hence, Initial Investment = RM1,522,790.40	Hence, payback period 4.5 years

In summary, the calculation involves assessing the annual savings, determining the installed capacity, evaluating the initial investment, and calculating the payback period. This analysis provides a financial perspective on the feasibility and return on investment for the project, indicating that the initial investment is expected to be recovered within a period of 4.5 years through the generated annual savings.

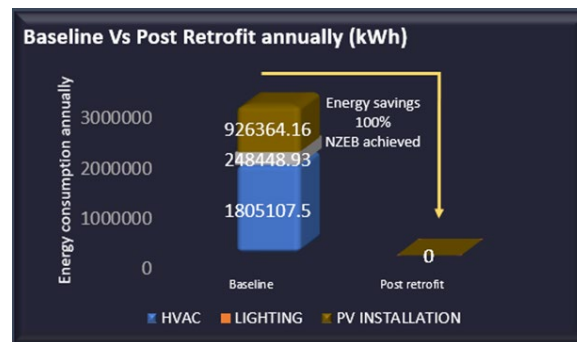


Figure 6: Baseline vs post retrofit

The presented data illustrates a significant reduction in energy consumption after a retrofit across different categories. The achievement of zero energy consumption suggests a transition to renewable energy sources, energy-efficient technologies, or a combination of both. In summary, the data highlights a remarkable outcome of the retrofitting process, resulting in a complete elimination of energy consumption for HVAC, lighting, and PV installation categories. This transformation underscores the effectiveness of the retrofit measures in promoting energy efficiency and potentially adopting sustainable practices, leading to a net-zero energy consumption state in the post-retrofit scenario.

3.3.2 Payback period after PV system installation

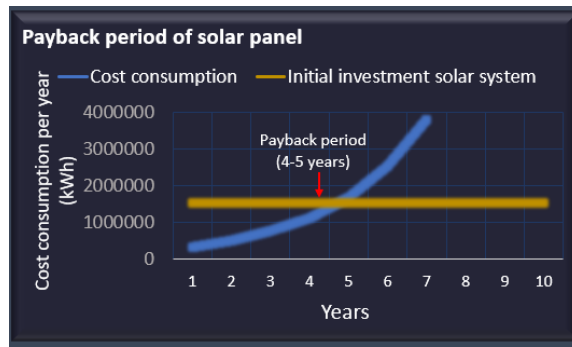


Figure 7: Payback period of solar PV system

In this case, the initial investment is recovered in the 4.5 year, as the cumulative cost consumption reaches RM1,522,790.40. Beyond this point, the subsequent years show a positive net gain, indicating a return on the initial investment. In summary, the payback period is achieved in the 4.5 years, and from that point onward, the investment in the solar system starts generating a net positive return, emphasizing the financial viability and sustainability of the solar project over the 10-year period.

3.3.3 PV generated electricity

The provided data represents the electricity generation from a photovoltaic (PV) system at UniKL BMI, with hourly values recorded over a 24-hour period.

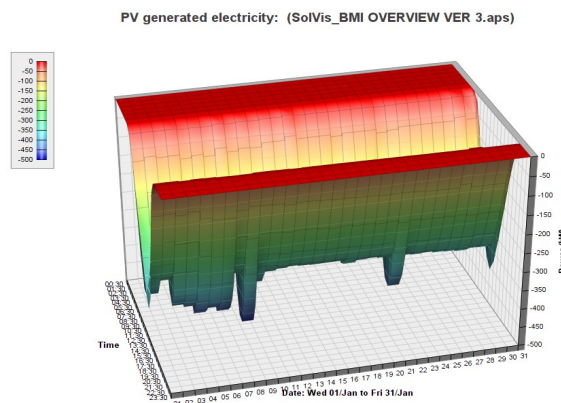


Figure 8: PV generated electricity graph

From 8:30 am to 5:30 pm (8 hours), the PV system exhibits negative values, indicating a net consumption rather than generation. This suggests that during these hours, the PV system is not producing surplus electricity but rather drawing from another source.

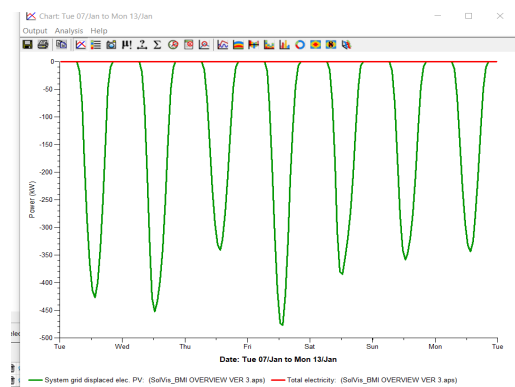


Figure 9: PV generated electricity and total electricity

In the context of energy simulation software like IESVE, negative values for PV-generated electricity are a correct representation and hold significance in accurately portraying the energy dynamics. The peak electricity generation from the solar PV system occurred at 1:30 pm, reaching its highest value of 405.9016 kWh.

3.4 Simulation vs measured calculation

The provided data represents incident solar power on an external surface with an external ceiling over a 24-hour period. Incident solar power is similar to solar irradiance and refers to the amount of solar energy that strikes a surface per unit area.

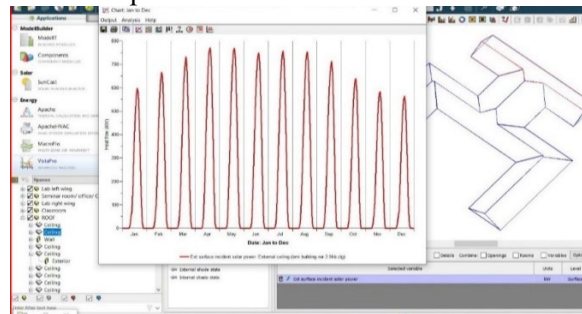


Figure 10: Incident solar power northern-western-facing

Starting from 7:30 am, the incident solar power begins to rise, reaching a peak at 1:30 pm with a value of 260.23 kW. This peak represents the highest amount of solar energy striking the external surface during the recorded period. Subsequently, the incident solar power gradually decreases in the afternoon and evening hours, approaching zero again by 20:30 and remaining at zero during the nighttime. From the presented data, it is evident that the northern-western-facing side of the roof receives the highest amount of sunlight, making it the most efficient and optimal location for installing PV panels.

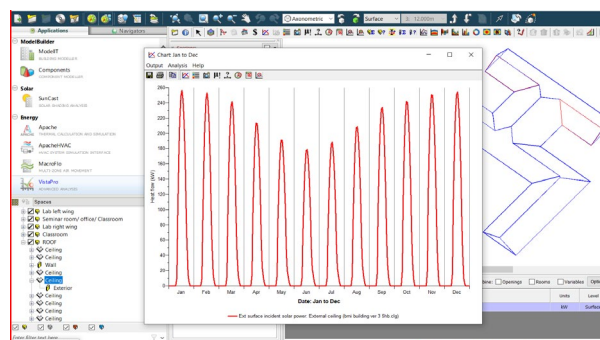


Figure 11: Incident solar power eastern facing

Conversely, the east-facing roof receives the least incident solar power, indicating a reduced amount of sunlight in comparison. This suggests that installing PV panels on this side may not be as efficient or suitable as the north-west-facing roof, which receives a higher amount of solar energy.

Table 10: Comparison between calculated and simulated values

Type	Calculation	Simulation	Percentage Similarity
Total electricity per day	2537.98kWh	2474.16kWh	97.50%
Solar irradiance/ external surface incident power per day	4.4kWh/m2	4kWh/m2	90%
PV generated electricity per day	2537.984kWh	2566.63kWh	98.80%

The comparison between calculated and simulated values for various key metrics related to electricity generation and solar irradiance reveals insightful findings. In the image analysis model viewer, the solar irradiance for one year is 1462.11 kWh/m² make it equates to an average of approximately 4 kWh/m² per day when this annual value is divided by 365 days. On the other hand, the comparison of PV-generated electricity per day yields a highly favorable result, with a calculated value of 2537.984 kWh closely aligned with the simulated value of 2566.63 kWh, resulting in an impressive 98.80% similarity.



Figure 12: PV generated electricity and baseline total electricity

Based on above figure, the blue graph represents total electricity meanwhile the red graph indicates PV generated electricity. The cumulative electricity consumption registers as zero on Saturdays and Sundays due to project limitations, as no measurements were taken for energy usage during weekends. These findings collectively contribute to a comprehensive understanding of the reliability and precision of the simulation models employed in predicting energy-related outcomes.

3.5 Total energy consumption

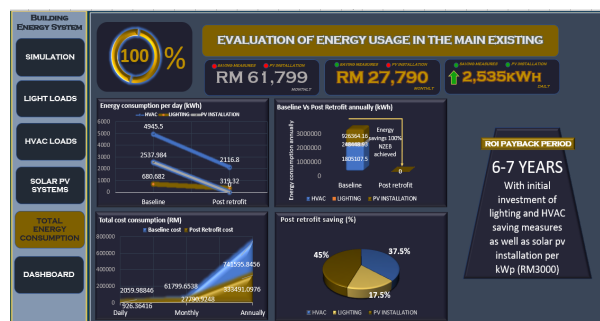


Figure 13: Total energy consumption dashboard

For the first scenario with a monthly consumption of RM 61,799, no saving measures or PV installations have been applied. In the second scenario with a monthly consumption of RM 27,790, saving measures have been applied, while PV installations have not. In the third scenario with a PV generated daily electricity of 2,535 kWh, both saving measures and PV installations have been applied.

The applied saving measures and PV installations, demonstrates a step towards making the UniKL BMI academic building closer to achieving Net Zero Energy Building (NZEB) status. This project is anticipated to achieve a payback period within the range of 6 to 7 years, considering the initial investment made in the implementation of lighting retrofit and HVAC saving measures, alongside the installation of solar PV systems at a rate of RM 3000 per kilowatt power (kWp).

4. Conclusion

Having achieved a significant 55% energy saving through HVAC and lighting optimization and additional 45% cost reduction through solar PV system integration has resulting in positioning the UniKL BMI building as a Net-Zero Energy structure with an ROI payback period of less than 10 years. Future recommendations involve expanding the project to cover the entire building, implementing additional saving measures, adopting advanced technologies, and exploring innovative solutions. The projected payback period of 6 to 7 years reaffirms the financial viability of the project, emphasizing its sustainability and cost-effectiveness. Overall, this project underscores the importance of promoting sustainable energy practices and fostering a culture of energy conservation at UniKL BMI's main campus building.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Microstructural Characterization of Ceramic Coatings for High Temperature Application

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Abstract: Ceramic coatings used in high-temperature applications as thermal barrier coatings (TBCs), focusing on their behaviour under thermal stress and ability to resist oxidation. This project aims to understand how these coatings can prevent cracks caused by oxidation on the thermally grown oxide (TGO) layer. Tests were conducted on ceramic-coated samples exposed to high temperature oxidation at 600°C and subsequent cooling. The two types of samples which single ceramic layer (YSZ) and double ceramic layer (LZ/YSZ) TBC were used. The oxidation behavior of single ceramic layer and double ceramic layer was evaluated in terms of weight changes and TGO growth thickness. The outcomes of this study will contribute to the development of ceramic coatings with enhanced resistance to oxidation, particularly in high-temperature environments. The findings provide insights into the factors influencing TGO layer thickness and contribute to the prevention of cracks caused by oxidation. This research holds practical implications for industries relying on high-temperature applications. It establishes a foundation for further advancements in ceramic coatings, with the objective of improving material performance and extending the lifespan of components operating in extreme conditions

Keywords: ceramic coatings, thermal stress, oxidation resistance, thermally grown oxide (TGO) layer, high-temperature applications.

1. Introduction

In recent years, there has been a great demand for the development of materials used for ceramic coatings' pivotal role in high-temperature applications such as gas turbines, where their microstructure significantly influences properties and performance. The study emphasizes the use of ceramic coatings, LZ and YSZ, on Inconel 625 to enhance its durability and resistance to oxidation. Recognizing the challenges faced by turbine blades in harsh conditions, the research aims to characterize the microstructure of Single Ceramic Layer (YSZ) and Double Ceramic Layer (LZ/YSZ) coatings, shedding light on their structural integrity and resistance to high-temperature degradation. The problem statement underscores concern about TBC degradation, prompting the need for innovative coating materials and designs to improve gas turbine engine durability and safety [1][2].

The research objectives encompass microstructural characterization, evaluation of thermally grown oxide (TGO) growth, and assessment of high-temperature oxidation behavior [3]. The expected outcomes include insights into oxidation prevention, the effectiveness of double-layer coatings, and the protective role of TGO [4], contributing to the optimization of ceramic coatings for high-temperature applications [5].

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2. Materials and Methods

2.1 Materials Details

The Inconel 625 substrates, sized at 15 x 15 x 6 mm, underwent a sandblasting process with 24–50 mesh alumina grit to enhance surface area and promote better adhesion between the coating and substrate. The resulting surface roughness, measured at 6–8 μm using a Mitutoyo surface roughness tester, was achieved after sandblasting. Following this, the roughened surfaces were cleaned in an ultrasonic bath machine with acetone for 15 minutes to eliminate any remaining contaminants. Subsequently, the specimens were washed and preheated in an oven at 70–100 $^{\circ}\text{C}$ [6].

The bond coat powders, composed of NiCoCrAlYTa ($\text{Ni}_{20}\text{Co}_{18}\text{Cr}_6\text{-Al}_{0.3}\text{Y}_2\%\text{Ta}$ -Amdry 997) from Sulzer Metco, with an average particle size of 5–37 μm , were applied through high-velocity oxy-fuel (HVOF) using the DJ 2600 system. The bond coating achieved a thickness of 150 μm . For the top coat, commercial $\text{La}_2\text{Zr}_2\text{O}_7$ powders from Trans-Tech Inc, Adamstown, MD, were used as the third layer, and Metco 204 NS-G YSZ powders ($\text{ZrO}_2\text{-8 wt}\%\text{Y}_2\text{O}_3$) served as the intermediate layer. The double ceramic layer (DCL) LZ/YSZ coating system was created using atmospheric plasma spray (APS) deposition equipment from Sulzer Metco equipped with a 3 MB gun. The spraying parameters for APS are detailed in Table 1. The LZ layer had a thickness ranging from 80–100 μm , while the YSZ layer measured 200–250 μm [6].

Table 1 Air plasma spray parameters.

Parameters	YSZ	LZ
Current (A)	600	600
Voltage (V)	70	70
Primary gas, Ar (l/min)	38	35
Secondary gas, H_2 (l/min)	3	8
Powder feed rate (g/min)	35	34
Spray distance (cm)	12	10

2.2 Experimental Setup

In designing a furnace setup for the high-temperature oxidation test, several crucial components and specifications must be considered [7]. Firstly, the dimensions of the furnace need to accommodate the test specimen, ensuring uniform heating and cooling. These dimensions are selected based on the specific requirements of the test setting. Secondly, high-temperature insulation materials, such as ceramic fibre or refractory bricks, are essential to minimize heat loss and maintain a stable environment within the furnace. This insulation ensures efficient heating during the test. Thirdly, the furnace is equipped with suitable heating elements, typically resistance heating elements like Kanthal or Nichrome, capable of achieving and sustaining the target temperature of 600 $^{\circ}\text{C}$.

Additionally, a robust temperature control system, employing sensors and feedback mechanisms, ensures precise temperature control throughout the test, which involves heating to 600 $^{\circ}\text{C}$ for 5 hours and subsequent cooling for 24 hours. The heating and cooling rates are determined by the time required to reach and maintain the desired temperature during each phase, providing a controlled environment for accurate assessment of materials' performance under cyclic high-temperature stress.



Figure 1: Carbolite AAF 11/18 Furnace

2.3 Sample Preparation

The Inconel 625, cut into dimensions of 15mm x 15mm x 6mm, served as the substrate in this study. A bond coat comprising NiCoCrAlYTa ($\text{Ni}_{20}\text{Co}_{18}\text{Cr}_6\text{Al}_{0.3}\text{Y}_2\%\text{Ta}$ -Amdry 997) from Sulzer Metco, with an average particle size ranging from 5-37 μm , was applied to the substrate using a high-velocity oxy-fuel (HVOF) system, specifically the DJ 2600 model from Sulzer Metco. Commercial $\text{La}_2\text{Zr}_2\text{O}_7$ powders from Trans-Tech Inc, Adamstown, MD, were chosen as the third layer top coat, while Metco 204 NS-G YSZ powders (ZrO_2 -8 wt% Y_2O_3) were utilized as the intermediate layer top coat. The double ceramic layer (DCL) LZ/YSZ coating system was crafted through the use of atmospheric plasma spray (APS) deposition equipment from Sulzer Metco, featuring a 3 MB gun. The LZ layer had a thickness ranging from 80–100 μm , and the YSZ layer measured 200-250 μm [6].



Figure 2: Specimen size: 15mm x 15mm x 6mm.

2.4 Test Procedure

2.4.1 Pre-oxidation Process

In this initial step of the high-temperature oxidation test, specimens are placed within the furnace for a predetermined duration, typically 12 hours, at an elevated temperature, 1000°C. The purpose of this pre-oxidation process is to establish a consistent oxide layer on the specimen surfaces. This oxide layer plays a crucial role in influencing the subsequent behavior of the specimens during the main high-temperature oxidation test.

2.4.2 Specimen Preparation

Before entering the test phase, meticulous attention is given to the preparation of specimens. This involves ensuring the specimens are thoroughly cleaned, free from contaminants, and undergo any necessary surface treatment steps. Common preparatory actions include deburring, coating application, or adjustments to surface roughness to facilitate accurate and reliable testing conditions.

2.4.3 Furnace Setup

The furnace setup is a critical component of the testing procedure. It involves configuring the furnace according to specifications, considering dimensions, insulation, and heating elements. Additionally, the temperature control system is calibrated to ensure precise and reliable operation throughout the test. This step ensures a controlled environment for accurate evaluation [8].

2.4.4 Specimen Placement

Once the furnace is ready, the prepared specimens are carefully positioned within it. Proper spacing is ensured to facilitate uniform heating and cooling. The correct placement of specimens within the furnace is vital for obtaining reliable and representative test results, as it influences the heat distribution and overall performance.

2.4.5 Heating Cycle

The actual test begins with the initiation of the heating cycle. The temperature is gradually increased from ambient conditions to the desired maximum temperature. The heating rate is adjusted according to the specific test requirements, for instance, setting it at 8 degrees Celsius per minute. This phase aims to simulate the conditions of elevated temperature exposure.

2.4.6 Cooling Cycle

Following the heating cycle, the cooling cycle is implemented. The temperature is gradually reduced from the maximum level back to ambient conditions. The cooling rate is adjusted as per the test requirements, such as 8°C per minute. This phase simulates realistic thermal stress conditions, allowing researchers to observe the specimens' response to temperature variations.

2.4.7 Repeat Cycles

To replicate real-world scenarios and enhance the reliability of the test, multiple heating and cooling cycles are conducted. The number of cycles is determined based on the material's anticipated operating conditions and the specific objectives of the test. This step ensures a comprehensive evaluation of the specimens' performance under cyclic thermal stress.

2.4.8 Test Monitoring and Data Collection

Throughout the cyclic thermal test, researchers diligently monitor and systematically record relevant parameters. These parameters include temperature, time, and any observations or measurements of the specimens' response to thermal stress. This meticulous data collection is crucial for evaluating the specimens' performance and behaviour under cyclic thermal conditions, providing valuable insights into their high-temperature oxidation resistance.

2.4.9 Heating and Cooling Cycles

Specific time durations and temperature levels are determined for the heating and cooling cycles based on testing requirements and the material being evaluated. For instance, the heating cycle involves increasing the temperature to 600°C and maintaining it for 5 hours. The subsequent cooling cycle entails reducing the temperature from 600°C back to ambient conditions over a 24-hour period.

2.4.10 Dwell Periods and Hold Times

While the provided information does not explicitly detail specific dwell periods or hold times at temperatures, researchers may strategically introduce optional dwell periods during the heating or cooling cycles. These intervals, if included, serve purposes such as stabilization or observation at specific temperatures, providing a more nuanced understanding of the specimens' behaviour under prolonged exposure to specific conditions. The decision to include dwell periods is contingent upon

testing requirements, material properties, and the specific insights sought from the cyclic thermal test, offering adaptability to unique material characteristics and testing objectives.

2.5 Microstructural characterization

Scanning electron microscopy (SEM) (Hitachi, SN3800) and field emission scanning electron microscopy (FESEM) (Hitachi S-4160) equipped with energy dispersive spectrometer (EDS) were utilized to investigate the microstructural characterization.

3. Results and Discussion

3.1 Microstructural characterization

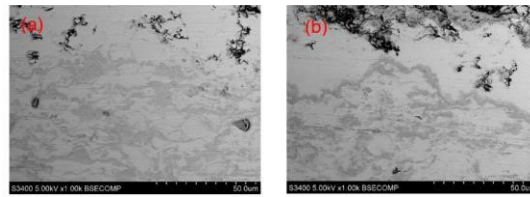


Figure 3: Microstructure of sample (a) Lanthanum Zirconia/ Yittria Stabilized Zirconate (b) Yttria Stabilized Zirconate.

The analysis of the figure 3 sheds light on the oxidation behavior of dual-layer (DCL) and single-layer (SLC) coatings after undergoing a 90-hour high-temperature oxidation test. Notably, the DCL coating exhibits superior oxidation resistance compared to the SLC, evident from the absence of a black area representing the Thermally Grown Oxide (TGO) layer. However, within the DCL coating, a grey area indicates the presence of mixed oxides, including chromia, spinel, and nickel oxides (CSN), suggesting a complex but effective defense against oxidation. In contrast, the single-layer YSZ coating shows a clear TGO line after 90 hours, indicating a less robust oxidation resistance compared to DCL. The cross-sectional morphology of the YSZ coating reveals a continuous Al_2O_3 scale (black area), distinct from DCL, and lacks the mixed oxides seen in the grey area of the DCL coating. This distinction underscores the unique oxidation characteristics of the YSZ coating during high-temperature oxidation testing, emphasizing the influential role of layer thickness ratios in determining the overall oxidation resistance of the coatings.

3.2 EDX analysis

3.2.1 10 Hours

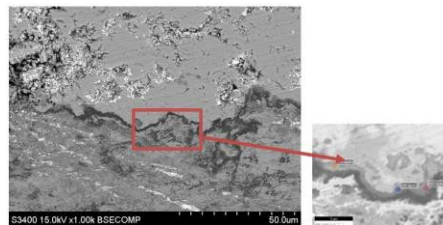


Figure 4: High magnification of TGO layer for YSZ.

Table 2: Data of Elements in TGO layer YSZ

Coloured	Element	%Atomic
Dark Area	Al_2	20.42

	O ₃	42.68
Gray Area	Cr	17.92
	Co	8.36
	Ni	10.62

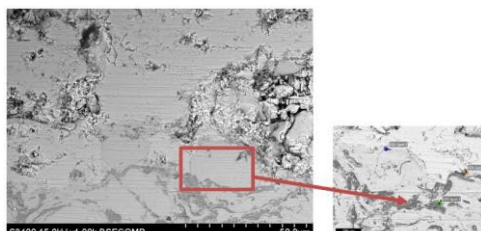


Figure 5: High magnification of TGO layer for LZ/YSZ

Table 3: Data of elements in TGO layer LZ/YSZ

Coloured	Element	%Atomic
Dark Area	Al ₂	30.5
	O ₃	28.98
Gray Area	Cr	14.55
	Co	14.66
	Ni	11.31

3.2.2 90 Hours

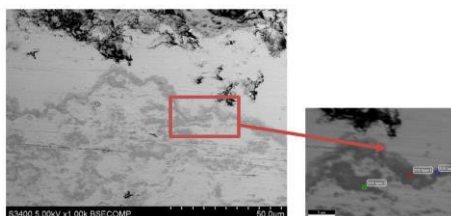


Figure 6: High magnification of TGO layer YSZ.

Table 4: Data of Elements in TGO layer of YSZ

Coloured	Element	%Atomic
Dark Area	Al ₂	18.77
	O ₃	31.98
Gray Area	Cr	19.01
	Co	14.3
	Ni	15.94

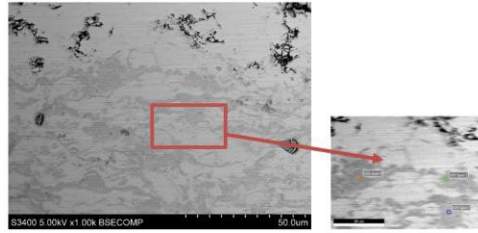


Figure 7: High magnification of TGO layer for LZ/YSZ

Table 5: Data of elements in TGO layer of LZ/YSZ

Coloured	Element	%Atomic
Dark Area	Al ₂	20.55
	O ₃	30.28
Gray Area	Cr	16.55
	Co	14.84
	Ni	17.78

The elemental composition analysis of the coated sample at 10 and 90 hours reveals notable changes in both the dark and grey areas, offering insights into material transformation over time. In the dark area, representing the primary coating, there is a decrease in the percentage of Al₂O₃ from 20.42% to 18.77%, and O₃ from 42.68% to 31.98% between 10 and 90 hours. This suggests a reduction in Al₂O₃ content and potential alterations in the oxide composition, indicating ongoing oxidation processes.

In the grey area, encompassing mixed oxides like Cr, Co, and Ni, significant changes are observed. The percentage of Cr increased from 17.92% to 19.01%, Co from 8.36% to 14.3%, and Ni from 10.62% to 15.94% over the same period. These variations indicate a dynamic evolution in the composition of mixed oxides, likely due to oxidation and transformation processes during extended heat treatment.

The increased percentages of Cr, Co, and Ni underscore the importance of these elements in the evolving composition of the grey area. In summary, this elemental composition analysis provides valuable insights into material changes during high-temperature oxidation testing, enhancing our understanding of the coating's behaviour over time.

3.3 Weigh Gain



Figure 8: Graph represent Weight Gain and Lost of Sample

Figure illustrates the weight changes over a 90-hour period for LZ and YSZ samples. The y-axis depicts weight in a narrow range from -0.003 to 0.003, while the x-axis represents time in hours (10 to 90). Peaks and troughs in the graph indicate variations in weight gain and loss, potentially associated with

oxidation processes. Peaks suggest points of interest, likely indicating thickness increase during specific cycles, while weight loss at certain hours may signify processes resulting in reduced weight. The data implies that these specific hours are crucial for assessing sample performance. LZ, with a double coating layer (LZ/YSZ), outperforms YSZ with a single layer, indicating more stable weight changes over the 90-hour period during high-temperature oxidation testing.

3.4 TGO Thickness

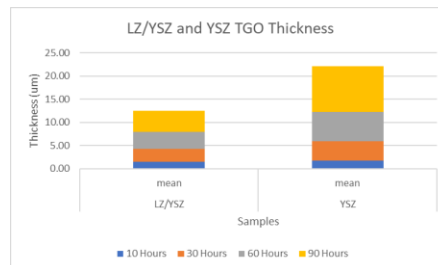


Figure 9: Comparative Analysis of LZ/YSZ and YSZ Samples by Layer Thickness in Micrometres (µm) with Mean Values

The provided graph is a stacked bar chart comparing the thickness of thermal grown oxide (TGO) layers in two samples: LZ/YSZ and YSZ. The thickness of the TGO layers is presented as a mean value in micrometres (µm), segmented into four time-based categories represented by different colours: blue for 10 hours, orange for 30 hours, grey for 60 hours, and yellow for 90 hours. This indicates that the measurements were taken after these specific durations of oxidation. The graph shows that the TGO layer thickness increases with time for both samples, which is consistent with the expected behaviour of TGO layers growing because of oxidation at elevated temperatures.

Analysing the graph, it is evident that the YSZ sample has a significantly greater mean thickness across all time intervals compared to the LZ/YSZ sample. Specifically, after 90 hours of oxidation (the yellow segment), the YSZ sample shows the greatest increase in thickness. This suggests that the YSZ material undergoes more substantial oxidation over time, which could imply a faster oxide growth rate, or a different oxidation mechanism compared to the LZ/YSZ sample. Such data is crucial in high-temperature oxidation testing, as the growth rate of TGO can impact the performance and lifespan of protective coatings in turbines, engines, and other thermal barrier systems.

4. Conclusion

This study aimed to investigate key aspects related to the microstructure, Thermally Grown Oxide (TGO) growth, and the influence of heat treatment on different ceramic coating configurations, specifically comparing single-layer YSZ (Yttria-Stabilized Zirconia) coatings with double-layer LZ/YSZ (Lanthanum Zirconate/Yttria-Stabilized Zirconia) coatings. The results obtained shed light on the distinctive characteristics and performance of these coatings under high-temperature oxidation testing conditions.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

NanoPso: Novel formulation for topical psoriasis treatment

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Abstract: Topical therapy is a primary treatment for psoriasis, offering significant advantages over systemic administration such as reduced toxicity effects. However, the delivery of cyclosporine (CsA) through topical means faces limitations due to its high molecular weight and low water solubility. To address this, nanoemulsion technology is utilized to enhance CsA delivery and the effectiveness of psoriasis topical treatment. Nanoemulsion-based drug delivery systems have emerged as potential carriers for improving the solubility, stability and bioavailability of hydrophobic drugs. The oil-in-water nanoemulsion (NE 1 and NE 2) were prepared using a high shear homogenization technique and was further analyzed to stability studies evaluation with respect to its particle size, polydispersity index, and zeta potential as well as the rheological analysis. The permeation potential of CsA was assessed using a Franz diffusion cell, while the kinetic behaviour of the formulated nanoemulsion was evaluated based on five kinetic models. Stability studies revealed that the formulated nanoemulsion maintained its physicochemical characteristics under different settings of storage conditions. Moreover, the nanoemulsions demonstrated non-Newtonian and pseudoplastic flow characteristics, indicates highly suitable for topical administration. Experimental data also showed that NE 1 exhibits the highest CsA permeation within 24 hrs at 88.19% followed by NE 2 and the control carrier, which achieved cumulative permeations of 72.52% and 50.16%, respectively. Furthermore, the Korsmeyer-Peppas model best describes the release behaviour of both formulated nanoemulsions. This novel nanoemulsion as a carrier for CsA was formulated with nutmeg oil and virgin coconut oil as the oil phase and aimed to be effective in moisturizing the dry skin of psoriasis patient. This information allows furthers research in providing a safer alternative treatment of psoriasis using CsA by preventing adverse effects caused by systemic therapy.

Keywords: Cyclosporine, Nanoemulsion, Topical, Psoriasis, Stability, Permeation

1. Introduction

Psoriasis, affecting 2 to 5% of the global population [1], involves accelerated epidermal cell production in patients, leading to the rapid development of thick, itchy, red, and dry skin patches [2]. Topical therapy, the primary treatment for psoriasis, offers advantages such as user convenience and patient-directed application, minimizing exposure to non-target organs and reducing toxicity [3].

However, challenges arise in topical delivery of cyclosporine due to its large molecular weight and low water solubility [4,5]. The application of nanotechnology, specifically nanoemulsion formulation, and the topical administration of the cyclosporine is promising in enhancing the efficacy of psoriasis therapy.

This research aims to develop cyclosporine-loaded nanoemulsions for treating psoriasis topically. The study focuses on assessing the stability of the formulated nanoemulsions and investigation on its release ability as well as kinetic behavior mechanism. The investigations involves evaluation for its physicochemical and rheological behavior, thermodynamic stability and permeation analysis using Franz diffusion cells (*in-vitro*).

2. Materials and Methods

2.1 Materials

Cyclosporine, virgin coconut oil, nutmeg oil, Tween 80, xanthan gum, phenonip, purified water, acetonitrile, phosphate buffer saline and synthetic skin membrane.

2.2 Methods

A cyclosporine-loaded nanoemulsion (NE) was formulated following the method outlined by Musa *et al.* [6]. Two different formulations of nanoemulsion were developed by adjusting emulsification parameters, as detailed in **Table 1**.

Table 1: Emulsification parameters of cyclosporine-loaded nanoemulsion

Formulation	Emulsification parameters		
	High shear intensity (rpm)	Homogenization time (min)	Temperature (°C)
NE 1	11,000	30	40
NE 2	13,000	30	40

2.2.1 Stability test

For the overnight incubation test, formulated NEs were stored at three different temperatures for 24 hrs. The freeze-thaw cycle involved storing NEs at two extreme temperatures alternately for 24 hrs. The analysis, conducted for 6 cycles in triplicate.

2.2.2 Rheological test

Rheometer was utilized to determine the rheological behaviour of the formulated nanoemulsions. The viscosity and k-value of the formulated emulsions were determined using the power law model.

2.2.3 Particle size, polydispersity index, and zeta-potential

The particle size, polydispersity index, and zeta-potential of the formulated nanoemulsion were measured using dynamic light scattering. All measurements were carried out in triplicate.

2.2.4 HPLC analysis

An isocratic elution chromatography method was employed using a 70:30 (v/v) ACN-water mixture as the mobile phase. The HPLC system, set at room temperature with a flow rate of 1.0 mL/min, column temperature of 50°C, and injection volume of 20 µL, was used to analyze the cyclosporine peak at 210 nm wavelength. The procedure was conducted in triplicate, and a calibration curve was generated.

2.2.5 Permeation analysis, *in-vitro*

The Franz diffusion cell evaluated cyclosporine permeation through a synthetic skin membrane. HPLC analysis were carried out at 210 nm wavelength, detecting cyclosporine in the samples collected from the receptor compartment.

2.2.6 Kinetic behaviour analysis

For each formulation, graphs were plotted following the equation of zero order, first order, Higuchi model, Korsmeyer-Peppas model and Hixson-Crowell model [7]. R^2 value derived from the graph was used to evaluate the model that resulted the most effective release potential of cyclosporine.

3. Results and Discussion

Figure 2 compares the pH values of NE 1 and NE 2 under various storage temperature conditions (4 and 25°C, 25 and 40°C, 4 and 40°C, -20 and 4°C). Freeze-thaw analysis is crucial for evaluating the stability of nanoemulsions, as it reveals physical and chemical changes during freezing and thawing. Both NE 1 and NE 2 demonstrated excellent physical stability where the pH values remained within the range of pH 4 to 5, aligning with the skin's pH. The presence of xanthan gum in the nanoemulsion system contributed to stability by reducing interfacial tension and promoting the formation of a cohesive interfacial film around emulsion droplets [8].

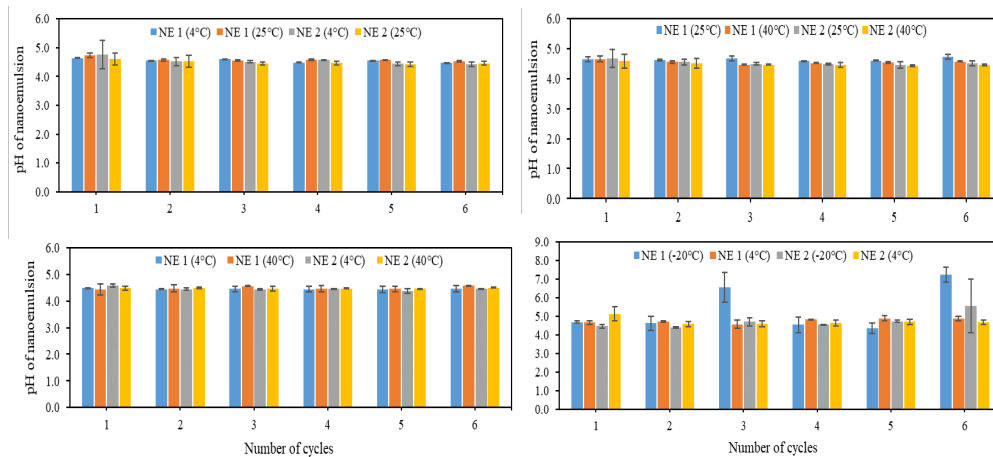
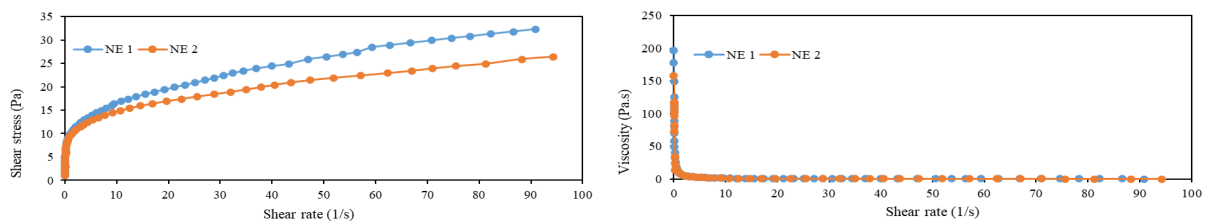


Figure 2: pH values for NE 1 and NE 2 after the freeze-thaw cycle at different temperature settings; (i) 4°C and 25°C., (ii) 25°C and 40°C, (iii) 4°C and 40°C and (iv) -20°C and 4°C

Figure 3 showcase the rheological properties of NE 1 and NE 2, assessing flow attributes and viscosity. Both nanoemulsions exhibit non-Newtonian behavior, illustrated by the gradual increase in shear stress with rising shear rate. Pseudoplastic behavior, observed in both NE 1 and NE 2, enhances easy and even skin spread, facilitating application and absorption [9]. Shear-thinning behavior advantageous for effective skin coverage and improved cyclosporine penetration. This property is desirable for topical formulations, improving their effectiveness [10,11].

Figure 3: Flow behaviour and viscosity of NE 1 and NE 2.

Table 2 summarizes the particle size, PDI, and zeta potential assessments of NE 1 and NE 2 after freeze-thaw cycles. Both formulations experienced a decrease in particle size across various storage temperatures, except for NE 1, which exhibited a notable increase at 4°C and 40°C. Zeta potential offers



insights into inter-droplet interactions in colloidal systems, forming a high-energy barrier to prevent nanoemulsion coalescence and flocculation [12]. While high zeta potential is typically crucial for

stability, this study used a non-ionic surfactant (Tween 80) relying on steric repulsion, not strong electrical charges, for stability.

Table 2. Particle size, pdi and zeta-potential analysis after freeze-thaw cycle

Nanoemulsion storage	Particle size (nm)	PDI	Zeta potential (mV)	
NE 1	FT (i)	224.27 ± 2.75	0.313 ± 0.020	-24.83 ± 1.10
	FT (ii)	228.98 ± 1.19	0.316 ± 0.002	-25.10 ± 0.35
	FT (iii)	243.01 ± 11.84	0.304 ± 0.013	-29.00 ± 1.25
	FT (iv)	202.52 ± 2.88	0.297 ± 0.010	-18.80 ± 0.17
NE 2	FT (i)	213.98 ± 1.21	0.316 ± 0.020	-25.10 ± 0.55
	FT (ii)	227.93 ± 3.17	0.318 ± 0.006	-19.10 ± 0.35
	FT (iii)	221.61 ± 4.52	0.342 ± 0.003	20.70 ± 0.87
	FT (iv)	202.21 ± 8.19	0.292 ± 0.016	-11.37 ± 0.87

* FT= freeze-thaw, (i) 4°C and 25°C., (ii) 25°C and 40°C, (iii) 4°C and 40°C and (iv) -20°C and 4°C.

Figure 4 displays the cumulative permeation of cyclosporine through a cellulose acetate membrane over 24 hours. NE 1 achieved 88.19% permeation, NE 2 reached 72.52%, and the control carrier had 50.16% after 24 hrs. Initially, both NE 1 and NE 2 exhibited similar drug permeation rates in the first two hours, but NE 1 showed rapid permeation thereafter, while NE 2 had slower permeation. The faster drug permeation in NE 1 and NE 2, starting from the third hour, was attributed to reduced particle size achieved through longer and stronger mixing forces [13]. NE 2 with higher shear intensity, showed slower permeation due to the 'overprocessing' phenomenon during emulsification, resulting in larger particle sizes.

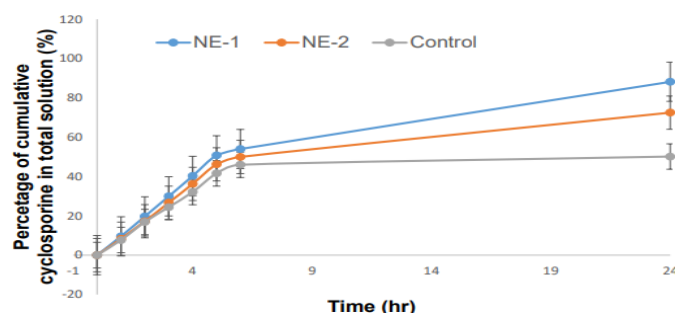


Figure 4: Cyclosporine permeated through cellulose acetate membrane from NE 1 and NE 2 over 24 hrs.

Table 3 displays the correlation coefficients (R^2) for various kinetic models studied, showing a linear relationship. NE 1 and NE 2 predominantly followed the Korsmeyer-Peppas model, exhibiting high R^2 values of 0.9777 and 0.9626, respectively. The Korsmeyer-Peppas model describes drug release through diffusion and swelling phenomena [14].

Table 3. Correlation coefficients corresponding to different kinetic release models.

Kinetic Model	Correlation coefficient (R^2)	
	NE 1	NE 2
Zero order	0.7853	0.7051
First order	0.9706	0.8582
Higuchi	0.9469	0.9000
Korsmeyer-Peppas	0.9777	0.9626
Hixson-Crowell	0.5847	0.4977

Conclusion

In this study, stable nanoemulsions containing cyclosporine, named NE 1 and NE 2, were successfully formulated using high shear homogenization using optimum emulsification parameters. Both formulations demonstrated excellent physical stability, with no observed phase separation or instability. The pH values, after incubation and heating-cooling cycle tests, were suitable for skin

application. However, NE 1 showed pH instability during freeze-thaw cycles at -20°C. Particle size and PDI results met the intended criteria (200-250 nm, PDI <0.35). Rheological properties exhibited non-Newtonian and pseudoplastic flow behavior, suitable for topical administration. The permeation potential of cyclosporine-loaded nanoemulsion was studied under various emulsification parameters, revealing that NE 1 exhibited the highest permeation (88.19%), outperforming NE-2 (72.52%) and the control carrier (50.16%). High shear intensity influenced permeation potential, with excessive speeds leading to 'overprocessing' and reduced permeation. Both NE 1 and NE 2 best fit the Korsmeyer-Peppas model, indicating anomalous transport. NE 2 demonstrated better formulation stability with consistent pH data, making it a promising approach for stable topical treatments for psoriasis.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Remotely Control Safety Warning Triangle For Roadside Car Breakdown

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Abstract: A greater amount of current research on the effectiveness and benefits of a safety warning triangle for road users has been conducted. However, the risk of users walking along the roadside to install the safety warning triangle has received little attention. This study addresses this critical gap by proposing the design of an innovative, remote-controlled safety warning triangle aimed at reducing the potential risks of secondary accidents among users. The questionnaire was used in the study, and the participants were chosen randomly from the private and commercial vehicle users in Malaysia. The data revealed that most respondents had difficulty placing the safety warning triangle and agreed to make some changes to the method of installation. Therefore, several design methods were applied to develop a new safety warning triangle by applying remote-controlled mechanisms. In order to ensure customer satisfaction, the remote-controlled safety warning triangle's design integrates user feedback from an online survey of Malaysian car drivers. A thorough concept integrates both customer needs from user feedback and engineering elements from the designer. Moreover, usage of prism retro-reflective material significantly increase reflectivity, enhancing the warning capability of the safety warning triangle. The addition of orange fluorescent material further amplifies visibility during daylight hours, optimizing road users' sight. This two-material approach provides better performance in both daytime and low-light situations, enhancing overall safety by optimizing the warning triangle's visibility to oncoming cars and pedestrians. The design was analyzed using Finite Element Analysis (FEA), and a few tests were carried out. The study's findings could drive manufacturers and designers to create an innovative safety warning triangle that reduces the risk of secondary accidents involving individuals and vehicles.

Keywords: safety warning triangle, remote-controlled, secondary accidents, prism retro-reflective material, orange fluorescent material, finite element analysis.

1. Introduction

The safety warning triangle is an important component of any vehicle's safety equipment. Safety warning triangle is a form of warning sign that alerts other drivers to an impending danger and is one of the supplies found in car emergency kits. It has been widely utilized in many developed countries around the world, with numerous European countries making safety warning triangle mandatory for all vehicle types. In Malaysia, the usage of the safety warning triangle is only compulsory for the

commercial vehicles such as lorries, trailers, vans, taxis, and buses as specified in the Motor Vehicle Rules 1959. However, private automobiles are undoubtedly involved in accidents involving a rear-end collision with a parked vehicle[1].

The safety warning triangle needs to be placed at a certain distance to reduce the risk of other road users crashing the parked vehicles in front and give more time for them to react to avoid any secondary accident happens. To place it, the user needs to risk their life by walking on the roadside that might be dangerous especially at night. According to Directorate General of Traffic (DGT) director, Pere Navarro: there were 16 fatal cases on the roads in Spain after they gotten out the vehicle to set up the safety warning triangle[2]. Apart from that, users need to struggle to set up the safety warning triangle in any weather conditions such as in heavy rain. This inclement weather will endanger the users' health and safety. Heavy rainfall will limit the driver's sight and tire traction that increases the probability of an accident [3]. Furthermore, the safety warning triangle was difficult for users to balance properly on roads with such conditions, and it was found to be less than ergonomic.

1.1 Project Overview

The research questions focus on how to enhance awareness of parked vehicles on the roadside and reduce the risk of secondary accidents through the development of a remote-controlled safety warning triangle. The problem statement addresses the current limitations of traditional safety warning triangles and the need for an improved design to meet customer demands effectively. The objectives of the study include creating a prototype that aligns with United Nations and SIRIM standards, simplifying installation and storage for users, and ultimately enhancing safety measures for parked vehicles. The expected outcome of the research is a feasible and functional prototype that addresses user preferences and contributes to minimizing the occurrence of secondary accidents through increased visibility and awareness.

1.2 Significance of the Project

The usage of safety warning triangle is vital in order to reduce the number of accidents among vehicles or persons. Therefore, the aim of this study is to research the best material for increasing the visibility of the safety warning triangle. Aside from that, this project intends to lessen the possibility of a driver setting up a safety warning triangle when their vehicle breaks down thus ensuring they are forced to park on the side of the road.

2. Materials and Methods

In this study approach, quantitative methodologies were applied to obtain more accurate and reliable data. These ways will assist in achieving the objectives, producing a better result, and producing an appropriate design for the safety warning triangle.

2.1 Materials

- Online survey
- Experiment
- Product analysis

2.2 Methods

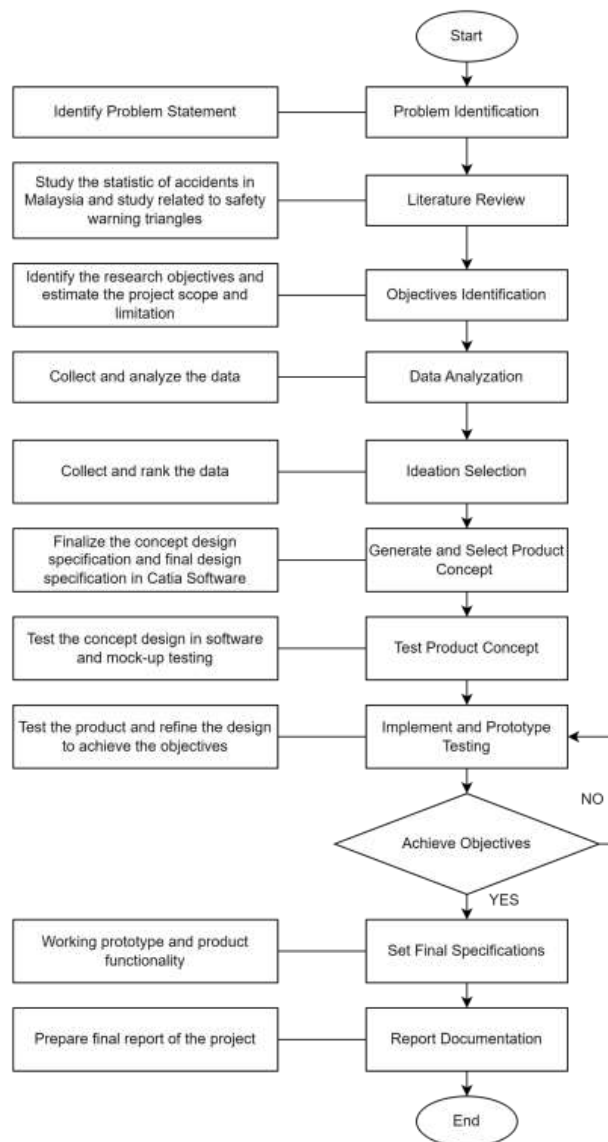


Figure 1: Project Methodology Flowchart

2.3 Project Limitation

The project on remotely controlled safety warning triangles for roadside car breakdowns has specific boundaries and constraints. These include difficulties in studying different road types across Malaysia due to their varying locations, using only available materials and components, focusing solely on private car applications, limiting the device's range to 40 meters, and requiring manual control without distance-detecting sensors. These limitations shape the project's scope and guide its objectives and outcomes.

3. Results and Discussion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

3.1 Reflectivity Results

Table 1 : Reflectivity Results

Light condition	Result
Daytime	The retro-reflective material seems to be brighter than PMMA material in the daylight. Then, the red-fluorescent material increases the visibility of the product.
Night with bright illumination	The retro-reflective material reflects more uniform under bright light night compared to the PMMA material.
Dark night	The retro-reflective material reflects more uniform under dark night compared to the PMMA material.

3.2 Velocity Results

Table 2 : Velocity Results

Testing	Distance travelled (meter)	Time Taken (second)	Velocity (m/s)
1.	20	20	1.00
2.	20	18	1.11
3.	20	17	1.18
Average velocity			1.10

4. Conclusion

In conclusion, the development of the remote-controlled safety warning triangle for roadside car breakdowns has shown promising results in enhancing visibility and reducing the risks of secondary accidents among users. Through a comprehensive design process that incorporated user feedback and engineering principles, a practical and user-friendly solution was achieved. The integration of prism retro-reflective technology has significantly improved the effectiveness of the safety warning triangle, ensuring better visibility in various lighting conditions. The prototype testing and user validation have demonstrated the functionality and usability of the remote-controlled safety warning triangle, highlighting its potential to enhance road safety. Overall, this project has successfully addressed the need for a more efficient and reliable warning system for drivers in distress situations.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Soft Hydrothermal Pre-Treatment of Organic Waste for Elucidation of Physical and Chemical Properties

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Abstract: Municipal solid waste, categorized by inorganic and organic matter, is a significant challenge to control, 70% of global waste ends up in dumps and landfills, which contribute to environmental and health impacts. The solid waste management industry is predicted to increase by 2.6 billion tonnes by 2050 due to leachate generation and greenhouse gas emissions leakage. Malaysia faces challenges in municipal solid waste management due to rapid urbanization and industrialization, leading to increased waste generation. Although landfills account for 80% of waste disposal, however they are expected to drop to 65% by 2020. The government struggles to provide alternate methods for waste disposal as existing landfill space shrinks and construction costs rise. Minimizing food waste could result in significant financial savings and reduce environmental impact. Hence, this research focuses on treating uncooked organic waste using soft hydrothermal pre-treatment, a safe and effective approach to resource utilization, transforming organic carbon and nutrients into energy resources and goods with added value. This approach reduces landfill waste, protects the environment, and lowers greenhouse gas emissions. The study compares the physical and chemical properties of uncooked organic waste generated in UniKL MICET by varying the treatment's heating time as the parameter. Comparisons between untreated and treated organic waste will be investigated and the results will be compared with previous studies to determine the treatment method's efficiency.

Keywords: Organic waste, Landfill, Treatment, Soft hydrothermal

1. Introduction

Malaysia's population reaching up to 32.8 million in 2021 generates a significant amount of solid waste, with landfills receiving 82.5% of the disposal. By 2022, municipal solid waste is expected to reach 14 million metric tonnes, equivalent to filling the Petronas Twin Towers seven times [3] and food is the largest contributor to municipal solid waste. It is primarily caused by natural decomposition, apprehension about food safety, misreading "best-before" dates, inadequate food preparation, improper storage, and ignorance of the negative environmental effects of food waste on consumers [11]. Food waste, which includes leftovers from cooking and uneaten food, is a significant concern for landfill

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management due to its high biodegradability [1]. Seasonal variations, cultural customs, and lifestyle shifts affect the composition of food waste. Composting, landfilling and mixing food waste with municipal solid waste before burning are the best waste management strategies [4]. Food waste has negative effects on the environment and economy, causing significant financial burdens for individuals and national economies.

Currently, the most common methods of treating food waste include landfilling, incineration, anaerobic digestion, and composting. Traditional approach of using a landfill requires vast amounts of land, emitting significant greenhouse gases and leachate problems. However, other methods has a low processing capacity, a high running cost, a complex process due to its irregular process cycle and time consuming [12]. Hydrothermal treatment, a novel approach can reduce waste quantity in landfills, sustain the environment and reduce greenhouse gas emissions [6] . This new treatment technology has special implications due to its high moisture and high organic content of food waste [14] which is beneficial for organic treatments in the waste-to-energy conversion process. It has no restrictions on water content and beneficial for treating food waste due to its ability to process energy-dense fuels and valuable compounds [12] . It also has bactericidal effects. Hence, the soft hydrothermal pre-treatment is an efficient way of utilizing resources. This research aims to measure food waste generated in UniKL MICET, to treat uncooked food waste using soft hydrothermal pre-treatment and to compare the physical and chemical properties of untreated and treated organic waste.

2. Materials and Methods

The uncooked food waste were collected in UniKL MICET's student café and categorized into two categories which are chicken and vegetable. The food waste was treated at 121°C at heating time of 10 mins and 15 mins. The soft hydrothermal pre-treatment was performed in an autoclave with 20g of ground sample in a 50ml Erlenmeyer flask with the pressure of 1 bar. Physical and chemical analyses were conducted on both untreated and treated samples which are analyses of moisture content (MC), total solid (TS), volatile solid (VS), fat content (FaC), and fibre content (FiC).

The moisture content was calculated based on Equation 1 where the process involved heating at 100°C for 24 hours. Total solid is the amount of dry matter remaining after the moisture removal. The percentage of TS was calculated based on Equation 2. The volatile solid was measured by burnt the sample in a furnace for 5 hours at 550°C. The percentage of the VS was calculated using Equation 3. Fat content was analysed using Soxhlet extractor where 60ml of ethanol was added into the solvent beaker for the extraction process. Equation 4 was used to measure the fat wet basis. A total of 3g of residue from the fat content analysis was used for the measurement of fibre content. The crude fibre was calculated based on Equation 5.

$$MC (\%) = \frac{(weight\ of\ sample+crucible)-(weight\ of\ dried\ sample+crucible)}{weight\ of\ sample} \times 100 \quad \text{Eq. 1}$$

$$TS (\%) = \frac{(Weight\ of\ dried\ sample+crucible)-(Weight\ of\ crucible)}{(Weight\ of\ sample+crucible)-(Weight\ of\ crucible)} \times 100 \quad \text{Eq. 2}$$

$$VS (\%) = \frac{(Weight\ of\ dried\ sample+crucible)-(Weight\ of\ ash\ sample+crucible)}{(Weight\ of\ dried\ sample+crucible)-(Weight\ of\ crucible)} \times 100 \quad \text{Eq.3}$$

$$fat\ wet\ basis (\%) = \frac{(beaker+fat)-beaker}{original\ sample\ weight} \times 100 \quad \text{Eq.4}$$

$$Crude\ fibre (\%) = \frac{Weight\ loss}{Weight\ of\ sample} \times 100 \quad \text{Eq.5}$$

3. Results and Discussion

Figure 1 illustrated the comparison between the physical and chemical properties of the uncooked organic waste before and after the soft hydrothermal pre-treatment. The percentage of the MC after the treatment was clearly 50% to 70% lower than untreated organic waste. Additionally, the MC of the treated uncooked organic waste for the vegetable samples were still higher than the chicken samples due to its water-retaining characteristic as mentioned previously. The MC of the treated uncooked organic waste could have been decreased dramatically due to the influence of the temperature which also correlated with the heating time during the treatment [2] that could be concluded the heating time determine the overall yield of organic solid waste conversion of degradation in addition to the composition of the final product [7]. In any treatment methods for the organic waste, the MC is an important parameter to determine the success rate of the treatment owing to the ability of moisture content to alter the physical and chemical properties of organic waste which serves as a transport medium of nutrients for microbial growth [8].

It had shown that the TS and VS of the treated uncooked organic waste were 64% to 87% higher than the untreated ones. The percentage of VS denoted the organic or biodegradable portion of the food waste, whereas the percentage of TS measures both suspended and dissolved solids. Consequently, the amount of degradable organic components that are accessible for use as microbe nutrition will increase with a greater percentage of VS which was a positive signed for the success rate of the soft hydrothermal treatment which also stated in the study by Ma et al., [5] and Wordofa, [13]. Theoretically, untreated organic waste that has a high volatile solid content is favourable for its utilization in organic waste treatment such as composting, anaerobic digestion and other biological processes [10].

Conversely, it could be seen that the FiC of the treated uncooked organic waste was rapidly decreasing to 8% and 6% for chicken and vegetable respectively after the treatment which was differed from the study that had been done by Perez-Pimienta et al., [9]. The study stated the soft hydrothermal pre-treatment would increase the rate of carbohydrate including crude fiber by breaking down complicated cellulose, hemicellulose, or lignin, to improve the substrate's surface area and rate of degradation. This phenomenon might happen because of no additional water that was added to the uncooked organic waste during the treatment process. Furthermore, the trend also revealed that there was no significant effect on the FaC of the treated samples with the untreated samples.

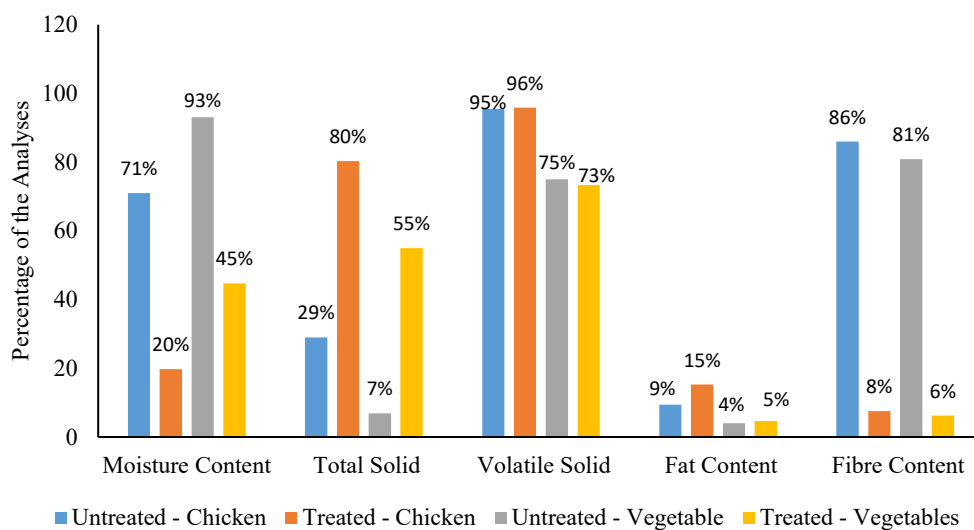


Figure 1: Characteristic of the untreated and treated organic waste

4. Conclusion

Hydrothermal treatment is beneficial for organic waste treatment in waste-to-energy conversion processes. Hence, this study proves that poultry had the lowest MC (71%), while vegetables had the greatest (93%). Since MC modifies the chemical and physical characteristics of organic waste, it is a critical factor in determining the treatment's success rate. The treated uncooked organic waste had higher TS and VS, increasing the amount of degradable organic components available for microbe nutrition. The treatment also reduced the FiC, but did not significantly affect the FaC. The fundamental information provided by the study's findings may help Malaysia create a system for valuing food waste and using it for higher-value uses.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

Tensile Analysis of Palm Oil Empty Fruit Bunch Reinforced with Chicken Feather Composite for Furniture Application

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Abstract: Environmental contamination, both natural and manmade, has risen substantially in recent years, notably in the palm oil and poultry sectors. In Malaysia, 90% of lignocellulosic materials from palm oil end up as waste, including empty fruit bunches (EFB). In addition, 10% of chicken production waste items, primarily feathers, are produced. This highlights the need for ongoing research on bio-based materials such as Empty Fruit Bunch-Chicken Feather Composite (EFBCF), which mixes epoxy, EFB, and feathers. In this investigation, four compositions are prepared: control (H: EFB: CF-80:20:0), sample 1 (H: EFB: CF-80:19:1), sample 2 (H: EFB: CF -80:18:2), and sample 3. (H: EFB: CF-80:17:3). Six specimens were made for each composition, and the three best findings were obtained. The composites without CF had the lowest average tensile strength at 5.87 MPa, according to tensile testing. Depending on the tensile strength value or elongation, the recommended ideal feather loading for chicken was between 1 and 2%. However, the composite's tensile characteristics were diminished by 3% chicken feather loading. The optical pictures of the tensile test sample at the broken site revealed the quality of bonding between EFB fibre, CF, and the polymer matrix, as well as voids and empty spaces. This describes the composite's tensile performance for each composition.

Keywords: Empty Fruit Bunch (EFB), Chicken Feathers (CF), Empty Fruit Bunch-Chicken Feather Composite (EFBCF), Tensile test

1. Introduction

Two categories of pollution affect the environment: pollution caused on by human activity, which includes radioactive contamination of the air, water, land, food, noise, and natural deterioration from phenomena like earthquakes and floods (Appannagari, 2017). Malaysia, a major palm oil producer, produces a large amount of biomass, of which only 10% is used to make oil, and the other 90% is left as lignocellulosic trash (Onoja et al., 2018). Acknowledging the environmental implications, researchers explore sustainable applications, including using Empty Fruit Bunch (EFB) fiber to create thermoplastic composites. Interest in natural fibers like EFB and chicken feathers for applications like bioplastics and biocomposites is increased by the worldwide trend towards eco-friendly goods (Asyraf et al., 2022). This research examines the mechanical qualities of EFB and chicken feathers as raw materials for biocomposites, examining the effects of blending ratios between epoxy resins and EFB-CF fiber. The study attempts to support sustainable material growth in the face of growing environmental awareness and the need for creative solutions.

2. Methodology

The materials and methods section, or methodology, describes all the information required to obtain the study's results.

2.1 Raw Materials and Equipments

a. Empty Fruit Bunch (EFB) Fibers

- Processing: EFB is washed with water multiple times and crushed into smaller fibers. After crushing EFB into smaller fibers, it is dried under the sun for a day. The fibers are then dried again in a drying oven to remove any moisture for 20 hours at 105°C.
- Percentage Used: 20% (Control), 19% (Sample 1), 18% (Sample 2), 17% (Sample 3).

b. Chicken Feathers (CF)

- Processing: Water-washed and rinsed to remove residue. After washing with detergent, CF were rinsed to remove residue. Sanitizing CF with isopropyl alcohol and hydrogen peroxide for an hour removed pathogens and made it odour-free. After draining the chemicals combination solution, CF was washed many times to eliminate chemical residue. After a day in the sun, CF was dried in a drying oven at 65°C for 30 minutes. CF then chilled to room temperature for a few minutes to remove heat.
- Percentage Used: 0% (Control), 1% (Sample 1), 2% (Sample 2), 3% (Sample 3).

c. Epoxy Resin

- Type: non- Biodegradable epoxy
- Curing Time: 24 hours
- Mixing Ratio: 3:1

d. Equipments

- a. An electronic balance (High-Precision Electronic Balance Scale 0.1G Precision).
- b. Standard sieve (Standard Screen GB/T6003.1-2012 Mesh 18-inch, 1mm sieve size, Zhang Xing screen Factory).
- c. Tensile Testing Machine (Galdabini model Quasar 100).
- d. Tensile specimen mold as per ISO 527 1B.
- e. Pulverizing Machine.
- f. Epoxy Toolkits.
- g. Drying oven

2.2 Methods

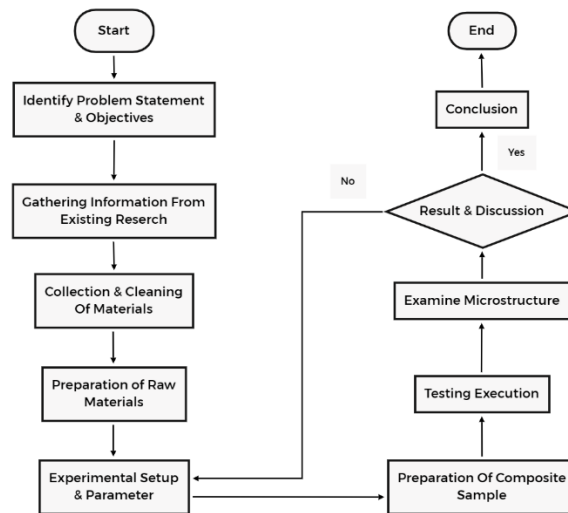


Figure 1. Flowchart.

Scope And Limitations.

1. Tensile test specimen size as per ISO D570 1B standards.
2. non-biodegradable epoxy with a mixing ratio 3:1 is used to bind all materials.
3. Mechanical properties studied in this research are Tensile strength (MPa), Modulus of Elasticity (MOE), and Elongation at break(EAB).

3. Results and Discussion

Figure 2 displays the tensile test results performed at the material laboratory. Each composition has six specimens, and only the three best results are averaged for the tensile strength (MPa), Young's Modulus (E), Elongation at break, EAB (percent), and Standard Deviation findings (sd).

No.	SAMPLE	EPOXY: HARDENER (g)	EPB (g)	CF (g)	TENSILE STRENGTH (MPa)	MOE	EAB	AVERAGE (3 BEST) with s.d.						
								TENSILE STRENGTH (MPa)	s.d.	MOE (MPa)	s.d.	EAB (%)	s.d.	
KC		8	2	0	4.65	676.19	5.12							
C1	CONTROL	8	2	0	7.39	1264.91	6.16	5.87	0.06	852.55	369.48	6.83	1.44	
C2		8	2	0	6.24	752.98	7.24							
C3		8	2	0	5.93	602.14	8.16							
C4		8	2	0	5.81	1264.45	7.04							
C5		8	2	0	5.88	691.06	5.3							
K1	SAMPLE 1	19	0.1		10.84	2209.07	5.00	17.30	0.69	1178.16	910.99	1.68	0.05	
S1A		8	19	0.1	17.84	2221.86	1.63							
S1B		8	19	0.1	12.89	1997.01	3.16							
S1C		8	19	0.1	16.52	742.46	1.70							
S1D		8	19	0.1	17.55	561.15	1.72							
S1E		8	19	0.1	12.81	730.18	3.11							
K2	SAMPLE 2	18	0.2		17.19	2573.79	1.86	17.47	0.28	1492.97	978.07	1.74	0.41	
S2A		8	18	0.2	15.68	2848.80	1.82							
S2B		8	18	0.2	17.75	668.99	2.08							
S2C		8	18	0.2	14.13	606.82	1.50							
S2D		8	18	0.2	17.46	1238.83	1.28							
S2E		8	18	0.2	17.33	730.18	1.36							
K3	SAMPLE 3	17	0.3		9.39	744.49	3.73	12.73	1.29	2410.70	962.71	0.87	1.81	
S3A		8	17	0.3	7.18	1227.13	2.21							
S3B		8	17	0.3	8.06	1798.59	2.93							
S3C		8	17	0.3	13.49	1678.52	1.02							
S3D		8	17	0.3	13.46	3801.19	0.93							
S3E		8	17	0.3	11.24	2052.40	0.67							

Figure 2. Table 3. Testing results. (Bold data is the best three results).

Tensile Strength

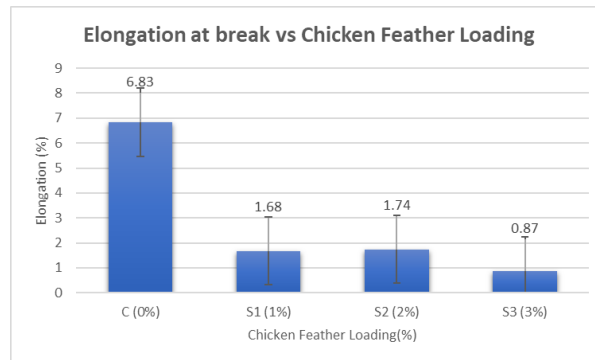


Figure 3. Elongation at break of the composite without and with chicken feathers loading at different content. (C-control, S1-sample 1, S2-sample 2, S3-sample 3).

Modulus of elasticity.

Young's Modulus can characterize and calculate a material's stiffness or elasticity. The Modulus of Elasticity measures material deformation. Figure 9, MOE vs. CF loading percentage bar chart. The maximum MOE is 2410.7 N/m² at 3% CF loading. MOE increases with Chicken Feathers loading %. The stiffest sample is Sample 3, with 3% CF loading. High MOE values indicate that the material needs more stress to deform or strain. Based on the statistics, it may indicate sample void size. Sample 3 has a lower void than others. The MOE value is higher due to reduced material vacancy sizes (Wei et al., 2020). Smaller voids reduce structural dislocation. This stiffens the material by preventing distortion. (Mihailovic, 2022) tested materials' mechanical properties that facilitate this behavior.

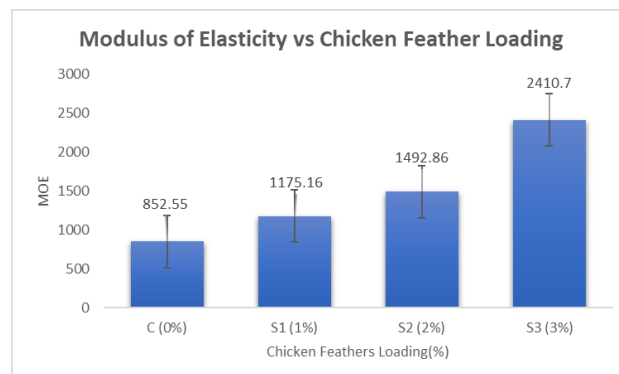


Figure 4. Modulus of elasticity of the composite without and with chicken feathers loading at different content. (C-control, S1-sample 1, S2-sample 2, S3-sample 3).

Elongation at the break.

Figure 5 displays a bar chart of Elongation at Break versus CF Loading. Control specimens with 0% CF loading showed farther elongation than those with CF loading. The control sample is more ductile than another specimen because it can endure greater and longer plastic deformation before breaking. The CF content will make the specimens brittle. Sample 2 demonstrated 1.74 percent Elongation at Break, the highest among CF-loaded specimens. Due to material structure, specimens with CF loading had minimal Elongation at the break. Chicken feathers may make a substance brittle. Galant et al., 2019, state that the material composition's atomic or molecular organization prevents plastic deformation, limiting Elongation before fracture. All CF-loaded specimens had a higher stiffness or elasticity modulus than the control sample. High-stiffness materials have low break Elongation because they resist deformation and restrict stretching space. Polymer chain cross-linking lowers Elongation upon break. Cross-linking between polymer chains limits mobility in CF-loaded specimens. Brittleness may occur from high cross-link density limiting plastic deformation.

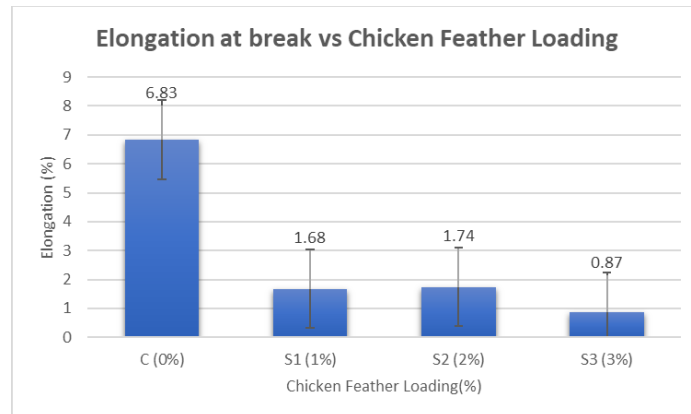


Figure 5. Elongation at break of the composite without and with chicken feathers loading at different content. (C-control, S1-sample 1, S2-sample 2, S3-sample 3).

Morphology

Wei et al. (2015) found that morphology, including void content, affects the mechanical performance of biocomposite materials. EFBCF composite voids are shown in Figures 10, 11, 12, and 13 according to their composition. Within the chicken feather control sample with 0% loading, the void content was found to be higher. It's possible that this is the result of improperly filling the mold with a mixture of materials. As seen in Figure 6, chicken feathers reduced the number of voids, and the control sample adhered very well to epoxy and EFB fiber. Samples with 1% and 2% chicken feathers had few voids, demonstrating that epoxy and chicken feather fiber interfacial reaction eliminates air and cavities. Rangappa et al. (2022) found similar results. Sample 3, with 3% chicken feathers, was fragile and fractured due to feather density. Chicken feathers should be added to biocomposites at 2% or less, not 3%.

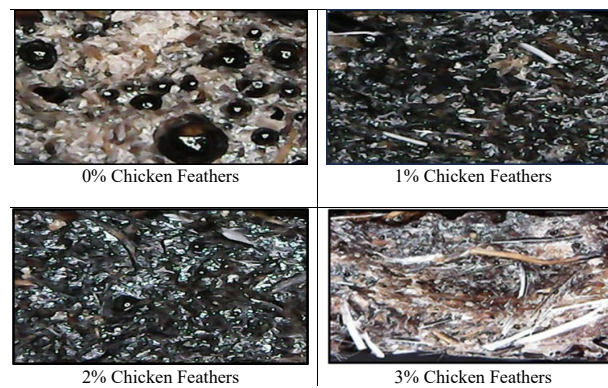


Figure 6. Optical observation.

4. Conclusion

This research paper details the development of a novel composite material, named the Empty Fruit Bunch-Chicken Feathers Composite (EFBCF), comprising epoxy, palm oil Empty Fruit Bunch (EFB), and varying chicken feather (CF) loadings. Tensile tests were conducted on samples with 0%, 1%, 2%, and 3% CF, revealing that 1% and 2% CF loading increased tensile strength, while 3% CF resulted in a decrease. Microscopic examination showed that CF effectively filled voids, enhancing the interfacial bonds between polymer matrices. However, excessive CF loading (3%) negatively impacted interfacial bonding, diminishing mechanical performance. Optimal CF loadings were identified at 1% to 2%. Conversely, Modulus of Elasticity (MOE) increased with higher CF loading, indicating enhanced rigidity. Elongation at break (EAB) decreased with increasing CF, aligning with the toughening effect of filler accumulation. Redzuan et al. (2023) state that this pattern substantiates the effect of filler accumulation in the composite matrix on toughening. The advancement of this composite material

derived from sustainable sources has expanded the minds and outlooks of researchers regarding environmental protection and combating pollution resulting from the wasteful use of the United States' vast palm oil and poultry industries. The research highlights the potential of this environmentally friendly composite derived from sustainable sources in addressing pollution and waste from palm oil and poultry industries, emphasizing its application in daily-use objects for societal and environmental benefit.

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FINAL YEAR PROJECT COMPETITION & EXHIBITION

Innovation Unleashed: Empowering the Future of Technology

The Effect Of Peanut Shell Extract As Corrosion Inhibitor On The Physical And Mechanical Properties Of AISI 1020 Steel

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Abstract: Corrosion causes significant economic losses across several sectors. The use of green corrosion inhibitors may effectively prevent corrosion while providing minimal impact on the environment. This study investigated the effect of peanut shell extract as an environmentally friendly corrosion inhibitor on the mechanical and physical properties of AISI 1020 steel. The objective of this study is to use PSE to prevent corrosion of AISI 1020 steel in a specific way. The procedure included making PSE solutions with different concentrations. AISI 1020 steel samples were immersed in both 1 molar sodium chloride solutions and 1 molar hydrochloric acid solutions with PSE and without PSE for 7 days, 14 days, 21 days, and 28 days. The corrosion rate was then established by weight loss measurements. The mechanical properties were analyzed using tensile testing and Rockwell hardness tester while the surface morphology was studied using optical microscopy to measure the effect of PSE towards AISI 1020 steel. The results showed that the use of PSE significantly decreased the corrosion rate compared to the untreated group, so proving its effectiveness as an environmentally friendly corrosion inhibitor. The level of inhibition achieved was 58.47 percent at 30 percent concentration of PSE. The use of PSE somehow managed to preserve the tensile strength and elongation of the steel. The improvement in mechanical characteristics may be related to the development of a protective coating on the steel surface by PSE, as shown by microscopy tests. As a result, PSE has shown to have potential as an environmentally friendly solution that prevents corrosion for AISI 1020 steel. Using higher PSE concentrations results in improved corrosion protection while maintaining mechanical performance. Additional experimentation could identify the specific chemical components in PSE that are responsible for inhibiting corrosion.

Keywords: Corrosion inhibitor, AISI 1020 steel, peanut shell extract, physical properties, mechanical properties

1. Introduction

Corrosion is a common issue that negatively impacts the strength and lifespan of metals, causing significant financial losses and safety risks in several sectors [1]. Corrosion is a natural process caused by the chemical or electrochemical reaction between compounds, such as metals, and their surroundings, which causes a reduction of the material's characteristics [2]. Maintaining the strength and function of metal components, especially in harsh environments where contact with corrosive

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chemicals is natural, involves the greatest care be given to the prevention and control of corrosion. Therefore, understanding the causes behind corrosion and developing effective corrosion inhibitors are essential to improve the lifespan of metals and ensure their secure application.

AISI 1020 steel is a type of steel with a low carbon content and frequently utilized in engineering applications because of the capacity it has to be welded, and machined, and its strength [3]. However, similar to other metallic compounds, AISI 1020 steel is sensitive to corrosion, which has the potential to affect its mechanical and physical properties. Corrosion of AISI 1020 steel results in reduced strength, increased brittleness, and the possibility of severe failure when applied to stress [4]. The need to recognize and use efficient corrosion inhibitors to protect AISI 1020 steel from corrosive surroundings is crucial in improving its performance and lifespan.

The development of environmentally friendly and ecological corrosion inhibitors has been growing in popularity in recent years. Researchers have been investigating natural extracts as potential solutions for conventional synthetic inhibitors [5]. Peanut shell extract which is extracted from peanut shells, has come out as a possible alternative because of its high polyphenolic substance, known for its antioxidative characteristics [6]. Using peanut shell extract as a corrosion inhibitor provides an innovative method for preventing corrosion, creating a sustainable and eco-friendly solution.

1.2 Problem Statement

Conventional corrosion inhibitors have been widely utilized across various industries to protect metals against corrosion, a negative reaction that significantly affects the material's strength and functional efficiency. These inhibitors commonly consist of compounds that are effective in reducing corrosion rates, but they provide risks to the environment and human health because of their toxicity and lack of biodegradability [7]. The use of these synthetic inhibitors has led to issues in the possible long-term effects on the environment and human health, emphasizing the need for more secure and sustainable alternatives. The research on developing corrosion inhibitors made from natural sources to reduce the negative impacts of conventional inhibitors and still provide good corrosion protection, has become an important area of investigation.

AISI 1020 steel is known for its good weldability, machinability, and mechanical properties, and has wide use in engineering applications such as manufacturing, construction, and automotive sectors [8]. However, the sensitivity of the material to corrosion limits its use in areas where it is known to come into exposure to corrosive factors, leading to significant decreases in both materials and finances. The challenge is in finding a corrosion inhibitor that not only efficiently protects AISI 1020 steel from corrosion but also fits the increasing need for environmental sustainability. This requires an investigation into new materials that are effective in preventing corrosion and environmentally friendly, hence providing the long-term maintenance of the physical and mechanical properties of AISI 1020 steel without harming environmental and health standards.

1.3 Paper Objectives

The objectives of this paper are listed as follows:

1. To evaluate the current physical and mechanical properties of AISI 1020 steel.
2. To study the effect of the newly developed corrosion inhibitors towards the mechanical properties of AISI 1020 steel.

2. Materials and Methodologies

This section describes the materials and methods for testing the effect of peanut shell extract as corrosion inhibitor on the physical and mechanical properties of AISI 1020 steel and obtaining the project's results. The section has been divided into two separate subsections: materials and methods.

2.1 Materials

To investigate the effect of peanut shell extract as a corrosion inhibitor on AISI 1020 steels specific materials and instruments are required to ensure precise and reliable results. The following list provides an in-depth description of the specifications and characteristics of the materials and equipment used in the project:

- AISI 1020 steel samples: These are the primary materials under investigation. The steel samples are characterized by their low carbon content and are known for their good weldability and machinability.
- Peanut shell extract: The extract is obtained from the shells of peanuts and is used as the corrosion inhibitor. It contains polyphenolic compounds, which are expected to provide antioxidative properties that can prevent or reduce corrosion.
- Corrosive agents: 1 Molar of Sodium Chloride (NaCl) and 1 Molar Hydrochloric acid (HCl) are used to create a corrosive environment in the test solution.
- Weighing scale: A high-precision scale is used to measure the weight of the steel samples before and after corrosion tests to determine weight loss.
- Hardness testing machine: This equipment measures the hardness of the steel samples, providing data on the mechanical property changes due to corrosion.
- Tensile testing machine: It is used to evaluate the mechanical strength of the steel samples, including tensile strength, yield strength, and elongation at break.

2.2 Methodologies

The experiment started with the initial phase of making the test solution. The purpose of this solution is to simulate a corrosive environment and evaluate the effectiveness of peanut shell extract as a corrosion inhibitor for AISI 1020 steel. The preparation involves the dissolving of 10%, 20% and 30% of corrosives in 1Molar of HCl and 1 Molar of NaCl to provide an exact testing environment. Once the test solution was prepared, the next phase was to perform the weight loss test. During this stage, specimens of AISI 1020 steel were weighed and immersed in 100 ml of acidic and alkaline environments for the duration of 7, 14, 21 and 28 days. This experiment allowed an assessment of the steel's rate of corrosion in both treated and untreated of the peanut shell extract. After each exposure time, the steel sample was collected out, cleaned carefully to remove the corrosion layer using sandpaper paper, washed with distilled water, and then dried using acetone. The materials' visual appearance will be analyzed to identify any apparent changes or indications of degradation.

The AISI 1020 steel was re-weighed to calculate the weight loss in grams by subtracting the weight of the AISI 1020 steel before and after immersion. The weight loss was calculated by subtracting the weight of each sample before and after immersion, as shown in **Eq. 1**.

$$\Delta W = W_b - W_a \quad \text{Eq. 1}$$

Where W_b represents the weight before immersion and W_a represents the weight after immersion. The corrosion rates (mm/y) have been collected and calculated using **Eq. 2**.

$$CR = (\Delta W) / (At) \quad \text{Eq. 2}$$

The formula calculates weight loss (g) after exposure time, t (days), using the variables: ΔW for weight loss, A for specimen area (cm²), and t for exposure time in days. The inhibition efficiency was calculated using **Eq. 3**.

$$IE\% = ((W_0 - W_1) / W_0) \times 100 \quad \text{Eq. 3}$$

Where W_1 represents the weight loss in the presence of the inhibitor, and W_0 represents the weight loss in the absence of the inhibitor.

The hardness test was an valuable part of the study. The test evaluated the AISI 1020 steel's ability to withstand constant deformation after exposure to a corrosive environment. This test provided a deeper understanding of the changes in mechanical properties caused by corrosion and the possible improvement in strength resulting from the application of peanut shell extract. In addition, a tensile test was conducted to evaluate the mechanical strength of the steel samples. This test assessed the steel's maximum tensile strength, yield strength, and elongation at the point of fracture. The results showed the effect of peanut shell extract on the steel's tensile strength.

Finally, the result analysis were combined and interpreted. This investigation evaluated the mechanical properties of AISI 1020 steel both after the addition of peanut shell extract. The results showed the effectiveness of the peanut shell extract as a corrosion inhibitor and its effect on the properties of the steel. The investigation finished with an in-depth analysis of the results, leading to clear conclusions and suggestions for further investigation.

3. Results and Discussion

This section describes the results and discussion for testing the effect of peanut shell extract as corrosion inhibitor on the physical and mechanical properties of AISI 1020 steel. The section is divided into five separate subsections: macrostructure, corrosion rate, inhibitor efficiency, hardness of metal, and ultimate tensile strength.

3.1 Macrostructure

Figure 1 and Figure 2 show the macrostructure of AISI 1020 steel under different conditions. Figure 1 shows steel samples immersed in a Hydrochloric Acid solution with various concentrations of corrosion inhibitors. After exposure to an acidic environment, the steel samples showed wide chipping and spalling, resulting in apparent corrosion showing a dark grey color. Higher concentrations of corrosion inhibitors resulted in reduced appearance of corrosion. The dark gray shading changed to lighter colors of grey and silver, showing less corrosion and more surface protection. The increase of the immersion duration to 28 days increased the apparent color of the corrosion substrate, showing the growth of corrosion over time.

















Concentration of Peanut Shell	0%	10%	20%	30%
Day				
7 Days				
14 Days				
21 Days				
28 Days				

Figure 1: Macrostructure of samples in HCl Solutio

Concentration of Peanut Shell	0%	10%	20%	30%
Day				
7 Days				
14 Days				
21 Days				
28 Days				

Figure 1: Macrostructure of samples in NaCl Solution

Figure 2 shows the macrostructure of AISI 1020 steel at different concentrations of corrosion inhibitors in a NaCl solution. Corrosion pitting observation on the samples was less apparent with increased concentrations of corrosion inhibitors. Comparing samples immersed in alkaline (NaCl) and acidic (HCl) solutions showed that the AISI 1020 steel samples exposed to the alkaline solution had less corrosion. Results show that corrosion inhibitors successfully decrease corrosion and preserve the surface of AISI 1020 steel. Increasing the concentration of peanut shell extract results in improved long-term corrosion resistance. Higher concentrations of inhibitors result in improved outcomes.

3.2 Corrosion Rate

Figure 3 and Figure 4 presents the results concerning the corrosion rates of AISI 1020 samples in an alkaline and acidic environment with respect to different immersion times and concentrations of corrosion inhibitors. Specifically, as the concentration of the extract increased, the corrosion rate decreased significantly. At a concentration level of 30% peanut shell extract, the corrosion rate decreased to 0.0740 mm/year after 28 days, in contrast to 0.1781 mm/year at a concentration of 0%. These results show that peanut shell extract have significant effects towards the corrosion rate of AISI 1020 steel in acidic conditions.

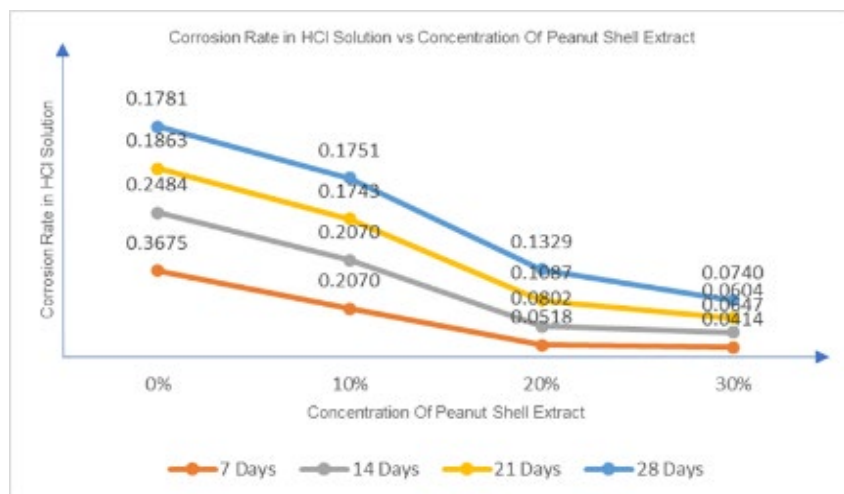


Figure 3: Corrosion Rate vs PSE Concentration in acidic environment

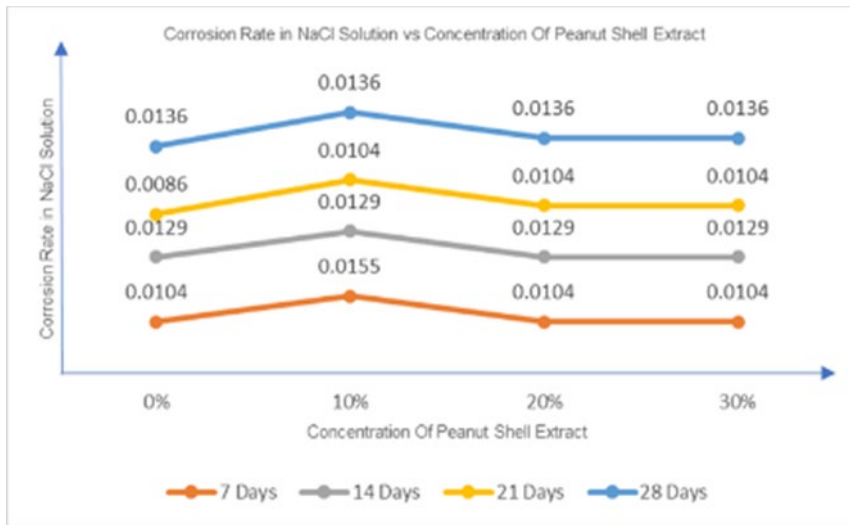


Figure 4: Corrosion Rate vs PSE Concentration in alkaline environment

In Figure 4, the correlation rate (mm/year) in NaCl solution show a direct relationship between an increase in inhibitor's concentration. The establishment of a protective layer on the steel surface is seen when the extract is present at a concentration of 20%, as shown by the stable corrosion rate during the testing period. This is consistent with the results of [9] study, which demonstrated that some metals can create protective oxide layers in alkaline environments. These oxide layers effectively inhibit the corrosion process. The findings from the investigation provide the potential for the development of affordable and environmentally friendly corrosion inhibitors produced from agricultural waste materials.

3.3 Inhibitor Efficiency

Figure 5 and Figure 6 show the corrosion inhibition effectiveness of AISI 1020 samples at different concentrations of corrosion inhibitors. The study showed that the inhibiting efficiency increases with higher concentrations of corrosion inhibitors. Higher concentrations of corrosion inhibitors improve adsorption energy, resulting in maximum inhibition efficiency.

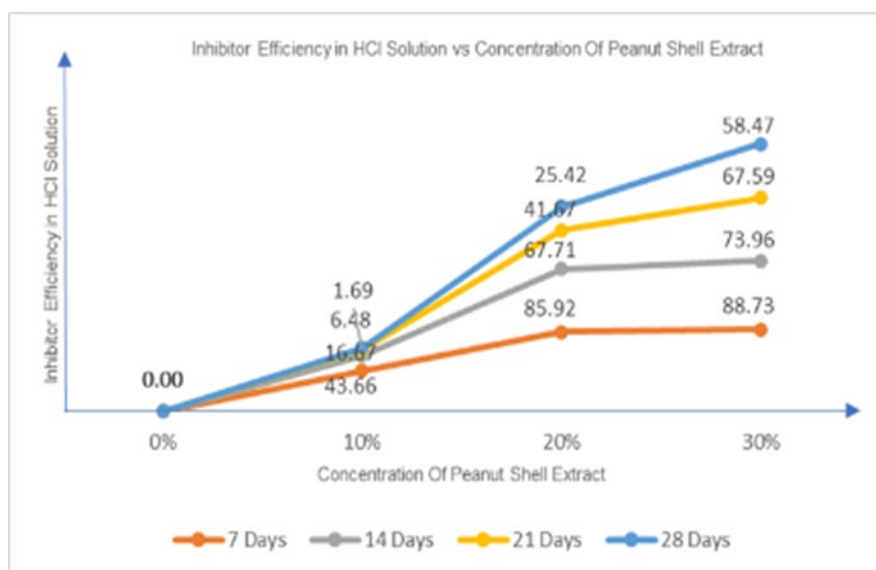


Figure 5: Inhibitor Efficiency vs PSE Concentration in acidic environment

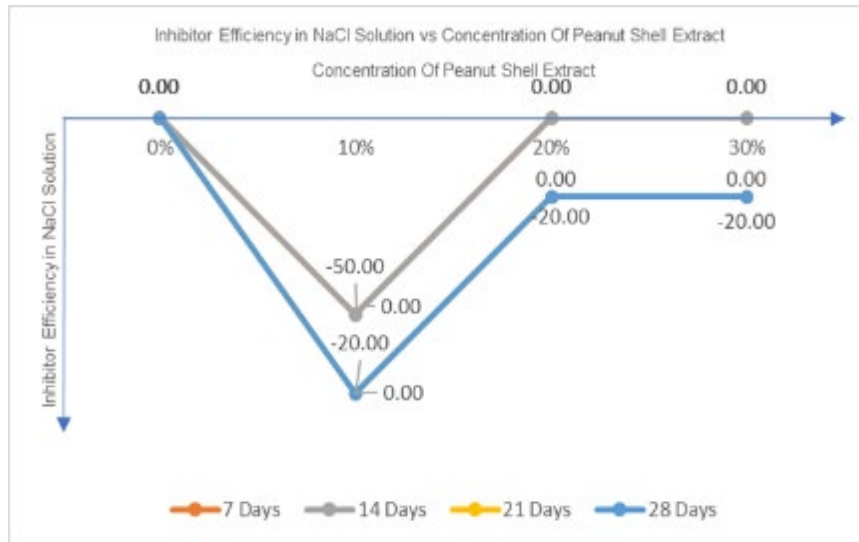


Figure 6: Inhibitor Efficiency vs PSE Concentration in alkaline environment

The sample immersed in HCL with a 30% inhibitor concentration achieved the highest inhibition efficiency of 88.73% after 7 days and 58.47% after 28 days of immersion. However, the sample immersed in NaCl with a 10% inhibitor concentration showed the lowest inhibition efficiency. As the immersion time increases, the inhibiting effectiveness of the AISI 1020 samples decreases. Cathode action decreases oxygen from the air, leading to the formation of Iron Hydroxide (FeOH). Iron Hydroxide comes and immediately oxidizes creating corrosion. This resulted in a decrease in the effectiveness of inhibition.

3.4 Hardness and Tensile Strength

Hardness and tensile strength tests were conducted on AISI 1020 steel samples after different immersion times with inhibitor concentrations ranging from 0% to 30% in acid and alkaline environments. The objective was to evaluate how different inhibitor concentrations affect the hardness and strength of the steel samples. The results shown in Table 1 show that the hardness and tensile strength of AISI 1020 steel samples showed a clear pattern about the inhibitor concentration. With the inhibitor concentration increasing from 0% to 30%, there was an overall increase in hardness. The corrosion inhibitors positively affected the hardness characteristics of the AISI 1020 steel.

The hardness trend from 7 days to 28 days immersion durations showed a decreasing pattern, which is significant. Increased exposure time affected the hardness of the steel samples, even with corrosion inhibitors present. The table shows statistical information on hardness measures and tensile strength, giving a visual evaluation of results for different inhibitor concentrations and immersion times.

The results show a positive correlation between the concentration of peanut shell extract and the strength of the steel samples in alkaline environment. This shows the extract effectively functions as a corrosion inhibitor. After being immersed for 7 days, the strength of steel was measured at 17.7380MPa in a solution with 0% extract concentration. However, when the concentration increased to 30%, the strength increased to 18.6398MPa. With an increasing concentration of peanut shell extract, the strength of the steel samples initially decreased after being immersed in a NaCl solution for 7 days. However, over 28 days, the strength showed an increase. More precisely, when the peanut shell extract was present at a concentration of 30%, the ultimate tensile strength increased from 18.6398MPa after 7 days to 18.0635 MPa after 28 days

Table 1: Hardness and Tensile Strength of metal in HCl and NaCl Solutions

Day	Peanut Shell Extract's concentration	Ultimate Tensile Strength (MPa)	Hardness of Metal (HRB)	Ultimate Tensile Strength (MPa)	Hardness of Metal (HRB)
		Acidic Environment (HCl)		Alkaline Environment (NaCl)	
7	0%	17.738	68.767	17.401	69.433
	10%	17.747	68.833	17.592	69.800
	20%	17.943	69.300	17.536	69.267
	30%	18.640	71.100	17.653	70.867
14	0%	16.791	67.933	16.884	69.433
	10%	17.176	75.133	17.868	69.733
	20%	17.332	75.133	16.968	69.233
	30%	18.015	75.400	18.075	69.967
21	0%	16.409	68.733	17.152	69.233
	10%	17.963	69.133	17.723	69.300
	20%	18.019	69.367	18.140	69.367
	30%	18.144	69.767	17.935	69.400
28	0%	16.398	62.100	17.195	67.667
	10%	16.918	62.333	17.674	67.133
	20%	17.143	70.833	17.955	67.333
	30%	18.064	73.667	18.237	68.667

Increasing the inhibitor concentration showed a positive impact on the hardness and strength of the AISI 1020 steel samples. Increased immersion durations resulted in a decrease in hardness, highlighting the need to select the right exposure period to preserve desired hardness qualities when using corrosion inhibitors.

4. Conclusion

In conclusion, two main results can be concluded about the correlation between the concentration of corrosion inhibitors and their effects on AISI 1020 steel. Increasing the concentration of the corrosion inhibitor resulted in a decrease in the corrosion rate of AISI 1020 steel. The results of the study showed that increasing the concentration of corrosion inhibitors resulted in a significant decrease in the corrosion rate of the AISI 1020 steel. When comparing the corrosion rate of samples without corrosion inhibitors to those with a 10% concentration, there was a significant drop in the corrosion rate. This pattern continued with decreased corrosion rates shown at inhibitor concentrations of 20% and 30%. Higher concentrations of corrosion inhibitors significantly slowed down the corrosion process, resulting in decreased corrosion rates in AISI 1020 steel.

According to the trend of decreasing effectiveness. When corrosion rates decreased at higher inhibitor concentrations, the inhibitory effectiveness increased as the concentration of the corrosion inhibitor increased. Inhibiting efficiency relates to the effectiveness of corrosion inhibitors in preventing or inhibiting the corrosion process. The results of the study showed that higher concentrations of corrosion inhibitors resulted in increased inhibitory efficiency. Higher inhibitor concentrations provided better corrosion protection, however, the corrosion rate decrease showed decreasing returns. Higher concentrations improved the inhibitors' effectiveness in inhibiting the corrosion process.

The study concluded that higher concentrations of corrosion inhibitors resulted in a decreased corrosion rate in AISI 1020 steel. The study showed that increased inhibitor concentrations increased the inhibitory efficacy, showing that higher concentrations of corrosion inhibitors provide greater

protection against corrosion in AISI 1020 steel. The increased corrosion resistance of AISI 1020 steel components could increase their lifespan, which decreases the need for conventional replacements and maintenance. Using this natural inhibitor could increase the longevity and reliability of steel throughout various applications. The peanut shell extract acts as an effective corrosion inhibitor, providing the benefits of eco-friendly application and efficient corrosion protection. The investigation's results indicate that peanut shell extract may function as an alternative to conventional corrosion inhibitors that are more hazardous. Further study and improvement can improve the methods and amounts of peanut shell extract application, allowing its wide usage in businesses that commonly use AISI 1020 steel.

Further research on these areas may enhance the understanding of the corrosion behavior of AISI 1020 steel and improve the application of corrosion inhibitors. This can improve corrosion prevention strategies and increase the material's durability in different environments.

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