

IIUM RESEARCH INITIATIVE GRANT SCHEME

**ASSESSING THE POTENTIAL OF AUGMENTED REALITY
(AR) AS ATTRIBUTES OF SUCCESSFUL LEARNING OF
HERITAGE ARCHITECTURE**

**RESEARCH PROJECT NUMBER
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ABSTRACT

The usage of Augmented Reality (AR) in architecture field is considered in an infant stage as compared to other disciplines such as medical science and entertainment. Thus, this research explores possibilities of using AR to enhancing architectural representation of heritage buildings. The objectives of the research are to identify potential and challenge of AR in enhancing architectural representation of heritage buildings in Malaysia; to explore the processes of producing architectural virtual modellings of 13 types of the Malay traditional houses, and their AR prototypes; and to recommend how implementation of AR could be used in teaching and learning architecture, specifically in relation to timber construction class and heritage architecture class. This research will be conducted using qualitative approach, with substance of exploratory action research. It is anticipated that this research will contribute in providing clear knowledge on the advancement of Augmented Reality in Architecture; regulating the ranges of process involved in the development and application of Augmented Reality (AR) in architecture; and recommending ranges of possibility of applying AR technology in Architectural learning. The findings of the research may implicate the ways advanced technology is used in architecture, to the extent that visualization of projects could be simulated in a clearer manner prior to construction.

Keywords: Augmented Reality, Virtual Reality, Active Learning, Architectural Education, Blended Learning, Traditional Houses.

1: INTRODUCTION

1.1 BACKGROUND

The usage of Augmented Reality (AR) in architecture field is considered in an infant stage as compared to other disciplines such as medical science and entertainment. Thus, this research explores possibilities of using AR to enhancing architectural representation of heritage buildings. This research has the proposition that learning heritage architecture could be enhanced by using Augmented Reality (AR), despite the challenges of skill deficiency and limited technology availability.

1.2 PROBLEM STATEMENT

The usage of Augmented Reality (AR) in architecture field is considered in an infant stage as compared to other disciplines such as medical science and entertainment. Both architectural education and architectural practice thus far have not explored the huge potential of AR to produce spectacular architectural representation. The majority of Architects and academicians in architectural education are still not aware of AR potential in teaching and learning architecture. Thus, this research explores into answering what are the potential and challenge of AR in enhancing architectural representation of heritage buildings, in relation to history of architecture and timber construction classes. This will provide an analysis and perspective on the use of AR technology, generally in architectural education and specifically in understanding and appreciation of heritage buildings among students and the public.

1.3 RESEARCH QUESTIONS

The following are the research questions:

1. What are the potential and challenge of AR in enhancing architectural representation of heritage buildings in Malaysia?
2. What and how the processes are to be explored in producing architectural virtual modelling of 13 types of Malay traditional houses, and their AR prototypes?
3. How AR could be implemented in teaching and learning architecture, specifically in relation to timber construction class and Heritage architecture class?

1.4 RESEARCH OBJECTIVES

The objectives are as the followings:

1. to identify potential and challenge of AR in enhancing architectural representation of heritage buildings in Malaysia.
2. to explore the processes of producing architectural virtual modellings of 13 types of Malay traditional houses, and their AR prototypes.
3. to recommend how implementation of AR could be used in teaching and learning architecture, specifically in relation to timber construction class and heritage architecture class.

1.5 RESEARCH METHODOLOGY

This research is conducted using qualitative approach, with substance of exploratory action research, where researchers involve in the experience of testing the potential and effectiveness of using AR in dissemination of knowledge. Secondary data is obtained by literature review, whilst primary data is obtained by developing the VR modelling and AR prototypes. This research revolves around achieving the objectives.

Objective 1 would be achieved by examining the issues linked with current Augmented Reality (AR) and Virtual Reality (VR) technologies relevant to architectural education. Thorough literature and case studies on AR technology would be examined and consequently, literature review on research background and methods implemented would be concurrently written.

Objective 2 will be achieved by conducting research via exploration of virtual modellings of 13 types of Malay traditional houses, which later will lead to the production of AR prototypes of those heritage buildings. First, study of the form and structure of heritage buildings will be done prior to focusing on development of computer generated modellings of the chosen traditional Malay houses. Exploration will come in term of looking for the best methods to model heritage buildings and to produce AR prototypes. Upon completing the processes of developing VR models and AR prototypes, the prototypes will be tested by letting experts and novices to experiencing the interface environment (AR and real-time environments). Markers of AR prototypes could be placed on physical site model, or in the form of pages in a book.

Objective 3 will be achieved by observing people's experience of using AR, and analyzing written feedback given by participants during the testing process. Narration of feedback on the experience will be qualitatively analyzed via content analysis, using Nvivo software.

In addition, social media could also be used to gain the public's insights of AR building prototypes. Upon analyzing students', academicians', experts' and the general public's feedback, recommendation of how implementation of AR could be used in teaching and learning architecture, especially in relation to history of architecture and construction classes will be established.

1.6 FINDINGS AND RESEARCH ORGANISATION

The findings of this research report is presented in published papers format, rather than in mini-thesis form. Hence, the published papers would be listed in section 2.

1.7 CONCLUSIVE REMARKS

This research is relevant to the advancement of technology where learning takes place by doing, engaging students to be more active in controlling their learning. This research also respond to the university's campaign that learners and teachers should use the element of Problem based learning (PBL) in class, where in architecture, students could learn better by doing. This research has answered to government call that, at least 20% of teaching and learning practice in tertiary educational institution is to be conducted by using ICT, including via e-learning mechanism.

2.0 LITERATURE REVIEW

2.1 DEFINATION OF AR

Augmented Technology offers a new way of delivering knowledge, where visualization of virtual object could be interfaced with situated real world in real time. However, the usage of Augmented Reality (AR) in architecture field is considered in an infant stage as compared to other disciplines. It is claimed that lack of interest into exploring the potential of AR is due to human limited skill on technology usage, and equipment shortage. Therefore, exploration of AR application should be done by researchers, to take advantage of the available advanced method of teaching and learning using Information and Communications Technologies (ICT).

This research aims to assess the possible application of AR in dissemination of knowledge of heritage architecture. The objectives of the research are as the followings: to identify potential and challenge of AR in enhancing architectural representation of heritage buildings in Malaysia; to explore the processes of producing architectural virtual modelling, and AR prototypes of heritage architecture; and to recommend how implementation of AR could be used in teaching and learning heritage architecture, especially in relation to history of architecture and construction classes.

AR is defined as the “emerging technology that allows the real time blending of the digital information processed by a computer with information coming from the real world by means of suitable computer interfaces” (AR-media, 2015). AR is believed to improve the way information is delivered and received, specifically using the context of media of ICT. In architecture, AR could be used to interfacing the real and virtual

environment as it is a system “that overlays, or augments, the real world with digital information that seemingly co-exists (Abboud, 2014). This new system “can overlay a real site with a virtual design at full-scale” (Abboud, 2014). In this regard, Thomas, Piekarski, and Gunther (1999) have tested integration of Augmented and Outdoor environment in the process of modifying building design and adding extension to an existing building relative to its physical surroundings.

In contrast with Virtual Reality (VR), AR does not allow user to immerse in a virtual environment created using computer. In fact, AR lets “virtual elements to be overlaid and integrated into the real physical space” (AR-media, 2015). Four elements are needed to build an augmented reality environment; a computer with the required software, which serves as the rendering unit; a tracking system which locates the position of the user; a recording device in form of a camera; and a display (Broschart & Zeila, 2014). For example, a mobile device could be used to view an AR virtual object, by pointing the device screen to a printed marker that is placed on a physical site model. The projection of an additional virtual content into the reality signifies the so called “human-machine-interaction methods” (Zeile, 2011).

The use of digital media to disseminate knowledge in AR will be the gist of the near future. Current movement has seen the shift of printed book to digital book for basic dissemination of knowledge. Yet the near future offers “ever increasing digital version of content” (AR-media,2015), which has begun to manage resources comparable to the print counterpart, in fact more and better in many cases. Perey (2011) illustrates the vision of future is where printed materials like a poster and a book will have additional digital content that could be viewed or read by using an “algorithm” that recognizes the

content of the page. In promoting this new way of knowledge dissemination, Perey (2011) also highlights the weakness of printed media, such as “un-directionality and linearity of communication; static contents; poor or no interactivity; closed and un-contextual information; passive enjoyment; high degree of opacity of contents, and mono-media.” By converting media of learning from printed format, to digital format, and then to digital interactive format that combines virtuality and reality in real time, the new generation will have splendid way of learning, relevant to post-modern era. In fact, “integrating the emerging Augmented Reality technology into the product design process may offer a viable solution for working in the globalized, data driven design environment” (Shin & Jennings, 2013).

2.2 LISTING OF PUBLISH PAPERS

Below is the list of published articles generated from this research.

1. Fadzidah Abdullah, Kassim, Mohd Hisyamuddin; Sanusi, Aliyah Nur Zafirah (2017). Go virtual: Exploring augmented reality application in representation of steel architectural construction for the enhancement of architecture education . Advanced Science Letters. 23 (2), pp. 804-808(5). DOI: <https://doi.org/10.1166/asl.2017.7464>.
2. Kassim, Mohd Hisyamuddin; Abdullah, Fadzidah; Denan, Zuraini; Arafat, Khandoker Ahmad (2017). Physical versus augmented reality model: Comparative study toward learning experiences at heritage studies gallery. Advanced Science Letters, 23 (2), pp. 890-893(4). DOI: <https://doi.org/10.1166/asl.2017.7549>
3. Aida Kesuma Azmin,, Mohd Hisyamuddin Kassim, , Fadzidah Abdullah, Aliyah Nur Zafirah Sanusi (2017). Architectural heritage restoration of rumah

datuk setia via mobile augmented reality restoration. *Planning Malaysia*, 15 (1), pp.139-150.

4. Fadzidah Abdullah, Aida Kesuma Azmin, Mohd Hisyammudin Kassim, Aliyah Nur Zafirah Sanusi (2017). Go virtual: Exploring the potential of adaptive E-learning platform for dissemination of architectural knowledge. *Advanced Science Letters*, 23 (7), pp. 6318-6321. DOI: <https://doi.org/10.1166/asl.2017.9260>
5. Fadzidah Abdullah, Brunilda Basha, Ali Raza Soomro (2017). Sustainable heritage: Analytical study on the viability of adaptive reuse with social approach, case study of asia Heritage row, Kuala Lumpur. *Advanced Science Letters*, 23 (7), pp. 6179-6183. <https://doi.org/10.1166/asl.2017.9231>

Below is the list of articles that are still in press, to be published in 2018.

1. Fadzidah Abdullah, Mohd Hisyamuddin Kassim, Aliyah Nur zafirah Sanusi, Aida Kesuma Azmin, Abhari Ahmat Tidjani (2018). Experimenting Technology Enhancement Active Learning with Support of Mobile Device, Gamification, and Augmented Reality Application. ***Paper will be presented in ICOED 2017, and will be published in 2018.***
2. Aliyah Nur Zafirah Sanusi, Fadzidah Abdullah, Mohd Hisyamuddin Kassim, Abhari Ahmat Tidjani, (2017). Architectural History Education: Students' Perception on Mobile Augmented Reality Learning Experience. ***Paper will be presented in ICOED 2017, and will be published in 2018.***
3. Mohd Hisyamuddin Kassim, Fadzidah Abdullah, Aliyah Nur Zafirah Sanusi (2017). Mobile Augmented Reality Learning: Design Exploration Toward

Student Learning Trends. *Paper will be presented in ICOED 2017, and will be published in 2018.*

4. Fadzidah Abdullah, Mohd Hisyamuddin Kassim, Mohd. Raziff Abd Razak, Aliyah Nur zafirah Sanusi (2017). Integrating Augmented Reality Visualisation in the Implementation of Blended Learning: Showcases of Two Experimentations. *Paper will be presented in ICBL 2017, in Riyadh, KSA, and will be published in 2018.*
5. Mohd Hisyamuddin Kassim, Fadzidah Abdullah, Mohd. Raziff Abd Razak (2017). Mobile Blended Learning Environment for Architectural History Education: Students' Learning Experience via Mobile Learning Platform. *Paper will be presented in ICBL 2017, in Riyadh, KSA, and will be published in 2018.*

2.3 AWARD

We won the 3rd. place for APRS (Anugerah Pemikiran dan Reka Bentuk Semula Pendidikan Tinggi Malaysia), for " Kategori Pengajaran Transformatif Syarahan Secara interaktif,." Award was given on the 20th. November 2017.



