IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

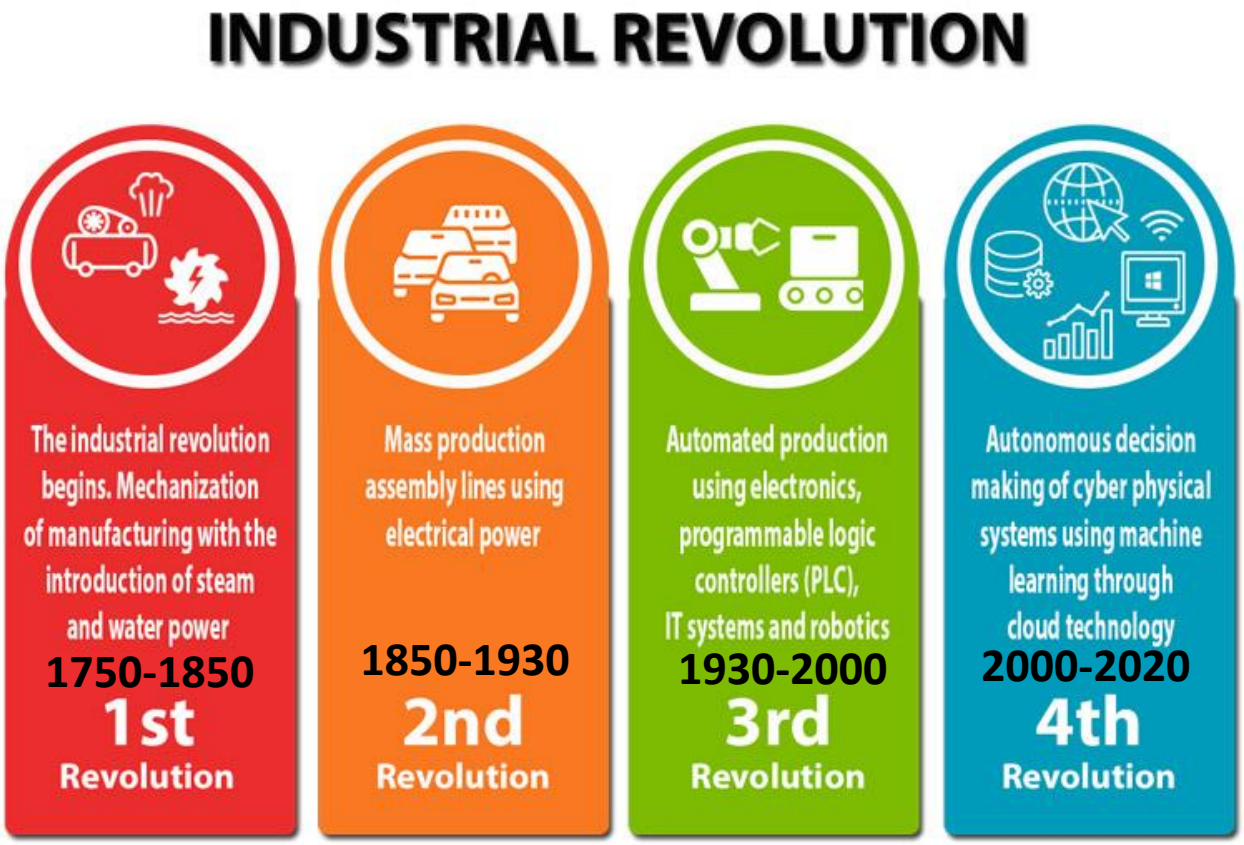
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Implementation of IR 4.0 and IIoT in various research and TnL activities at IIUM

By

Ir. Dr. Tanveer Saleh

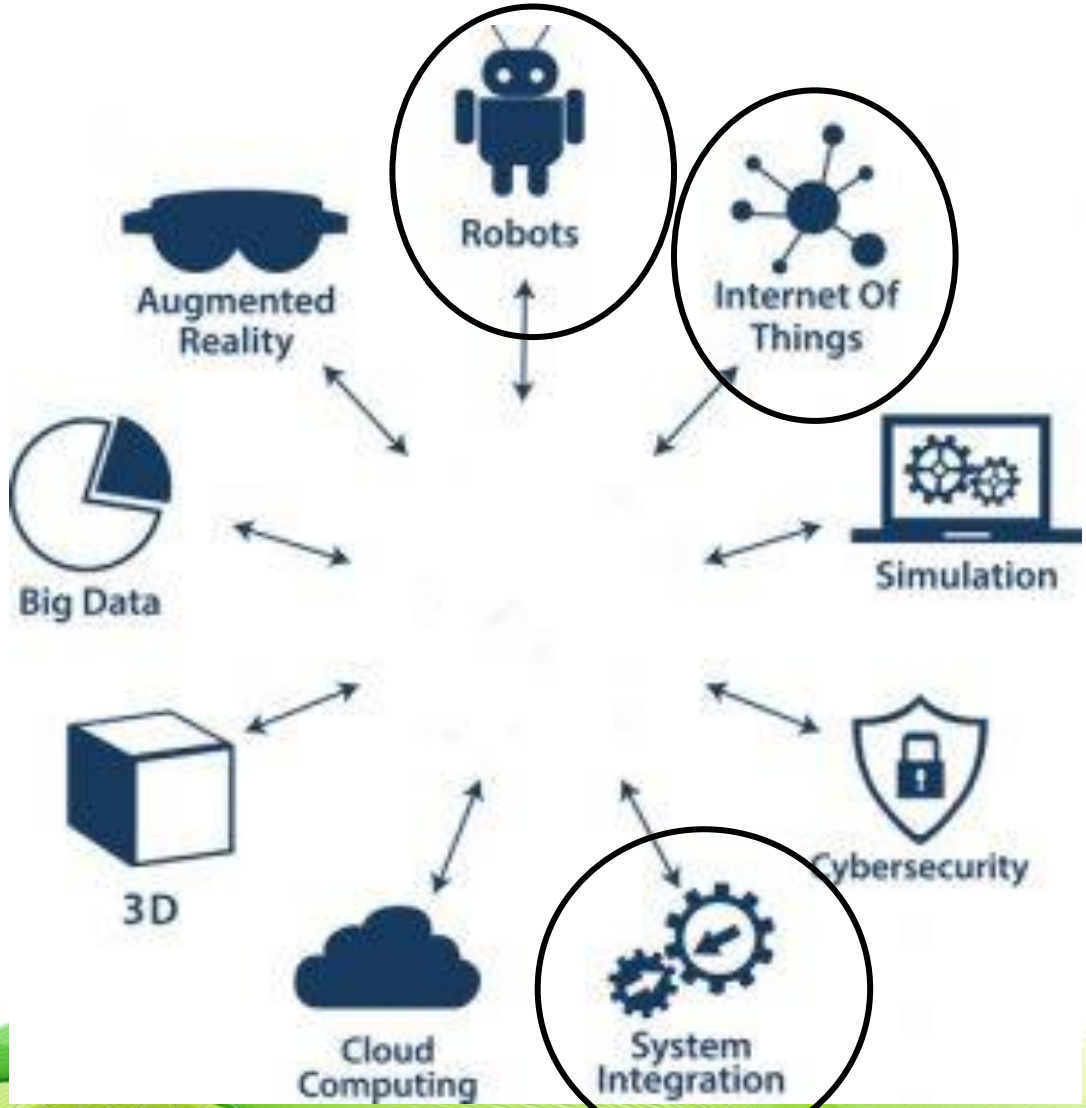
Background about phases of Industrial Revolutions



Next phase: IR 5.0 Collaborative Robotics, Mass customization by the synergy of technologies like 3-d Printing, AR/VR and 6G communication

Widely circulated picture to describe phases of IRs

Aspects of IR 4.0



Todays talk will broadly cover our T&L and research activities related to the three aspects of IR 4.0

Picture source Internet

IEEE RAS MALAYSIA CHAPTER

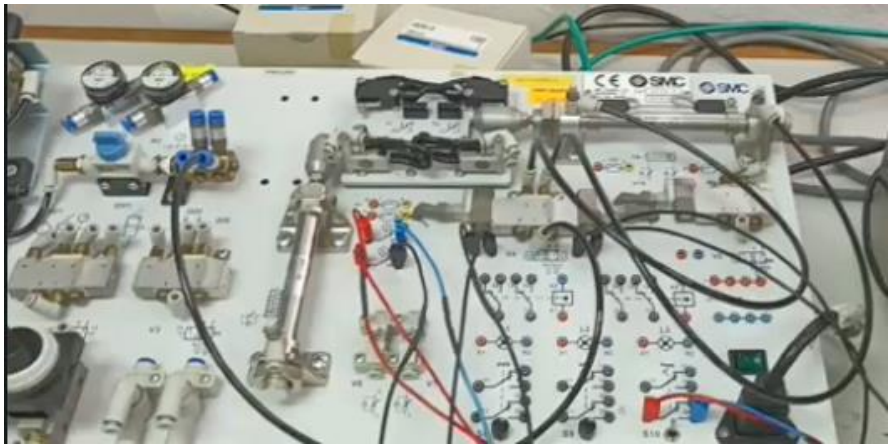
AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Implementation of IoT based SCADA System for T&L purposes at IIUM

by
Ir. Dr. Tanveer Saleh & Mohammed Banawair

Existing PLC and Pneumatic system

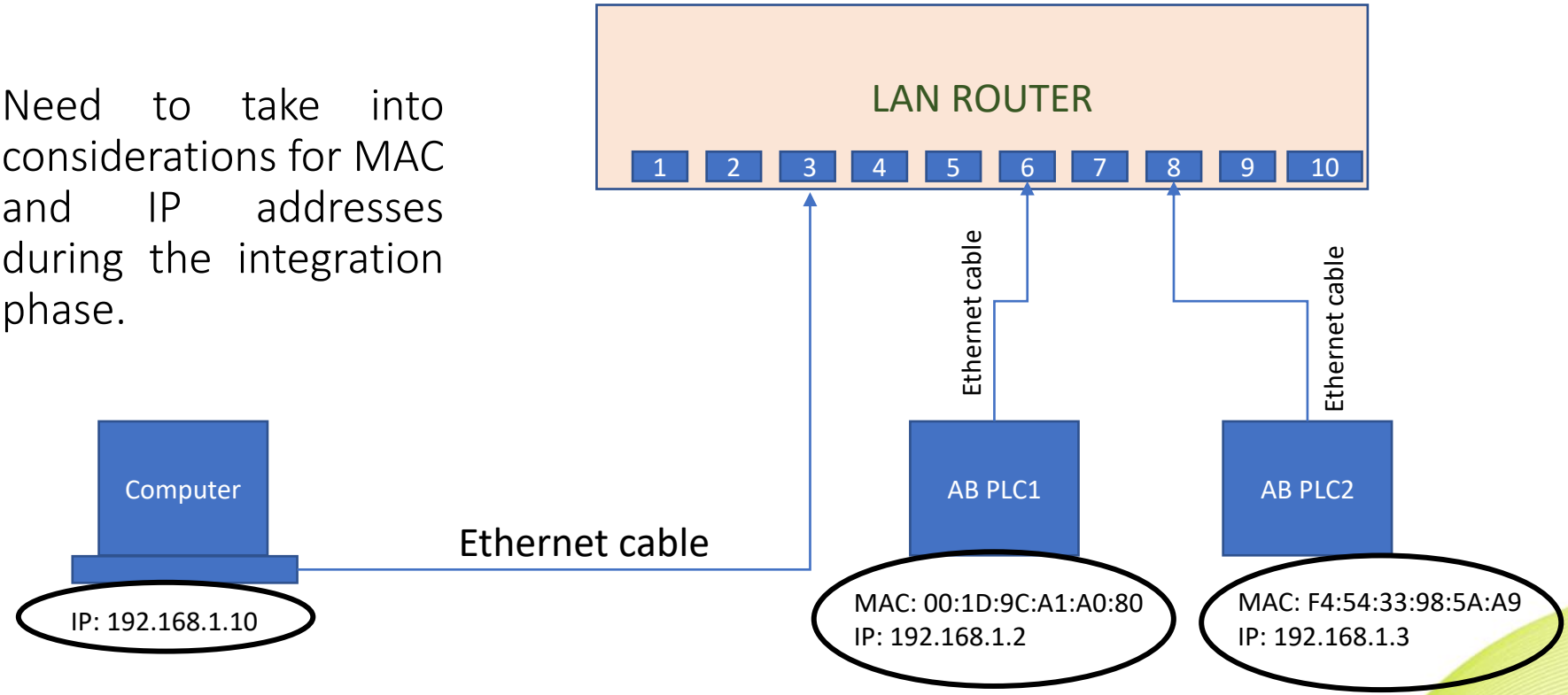


Pneumatic system with cylinder actuator and various types of solenoid valves

PLC controller to program and drive the pneumatic system. PLC is AB from Rockwell automation

Proposed integration between the two PLC field stations

Need to take into considerations for MAC and IP addresses during the integration phase.

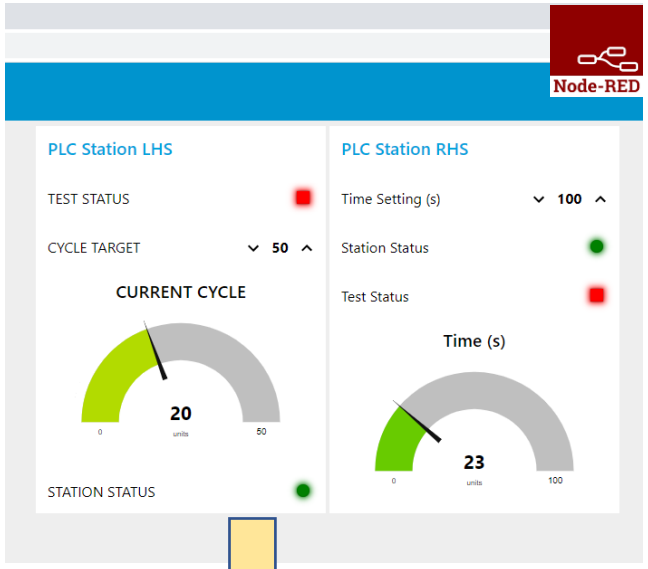


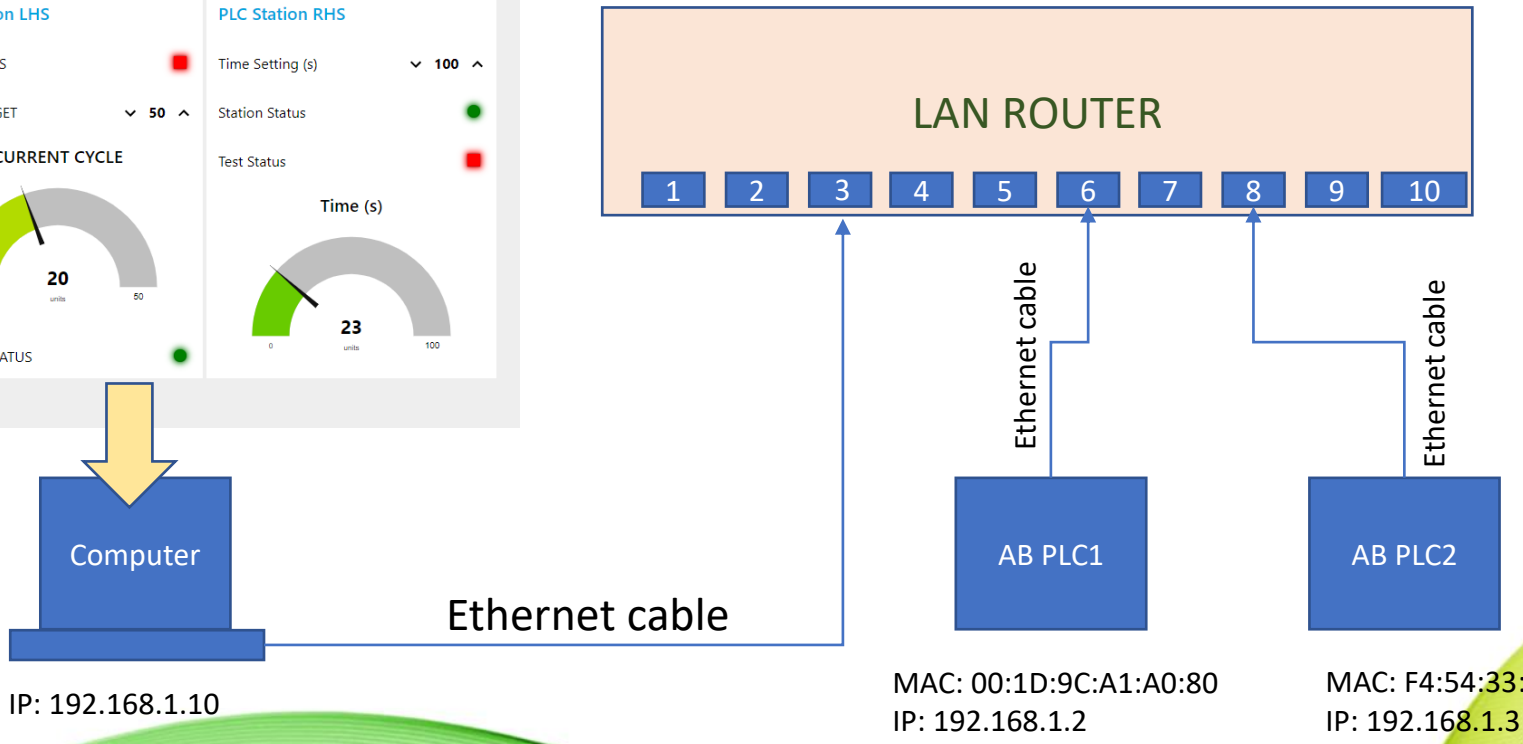
Recliner chair testing simulation

Picture source
Internet

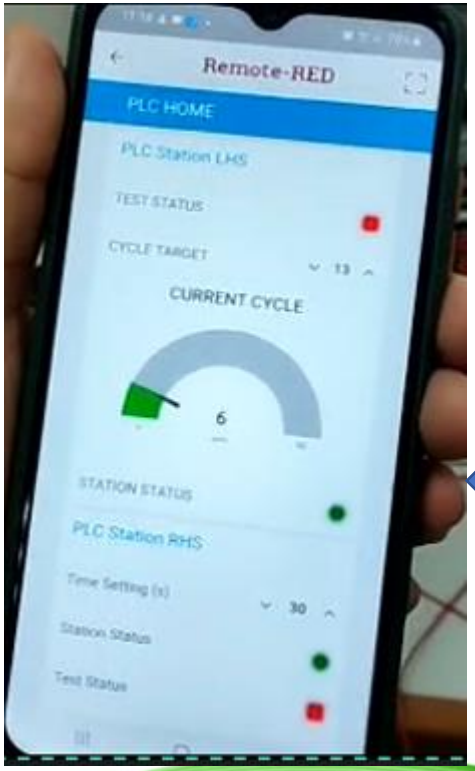
- A reciprocating pneumatic cylinder is used to test the backrest of the chair.
- One of the stations tests based on number of cycle.
- Other station tests based on duration of the reciprocation.

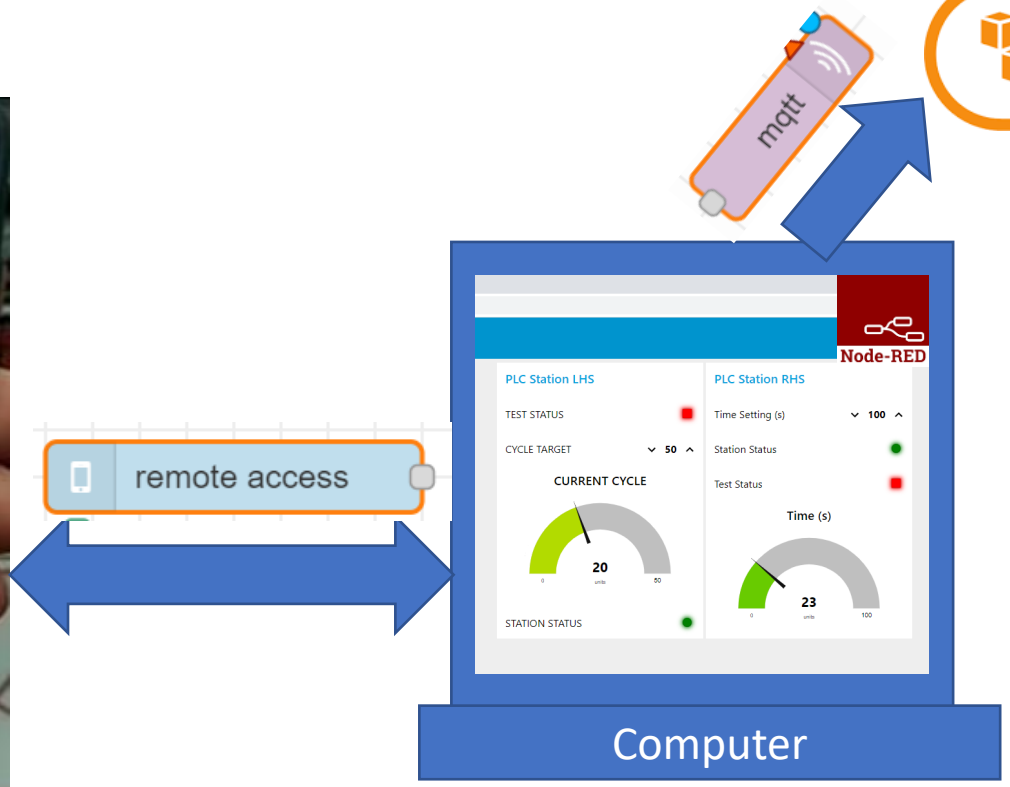
Implementation of Node-Red based WEB SCADA system





IIoT integration of the system through Remote access and AWS





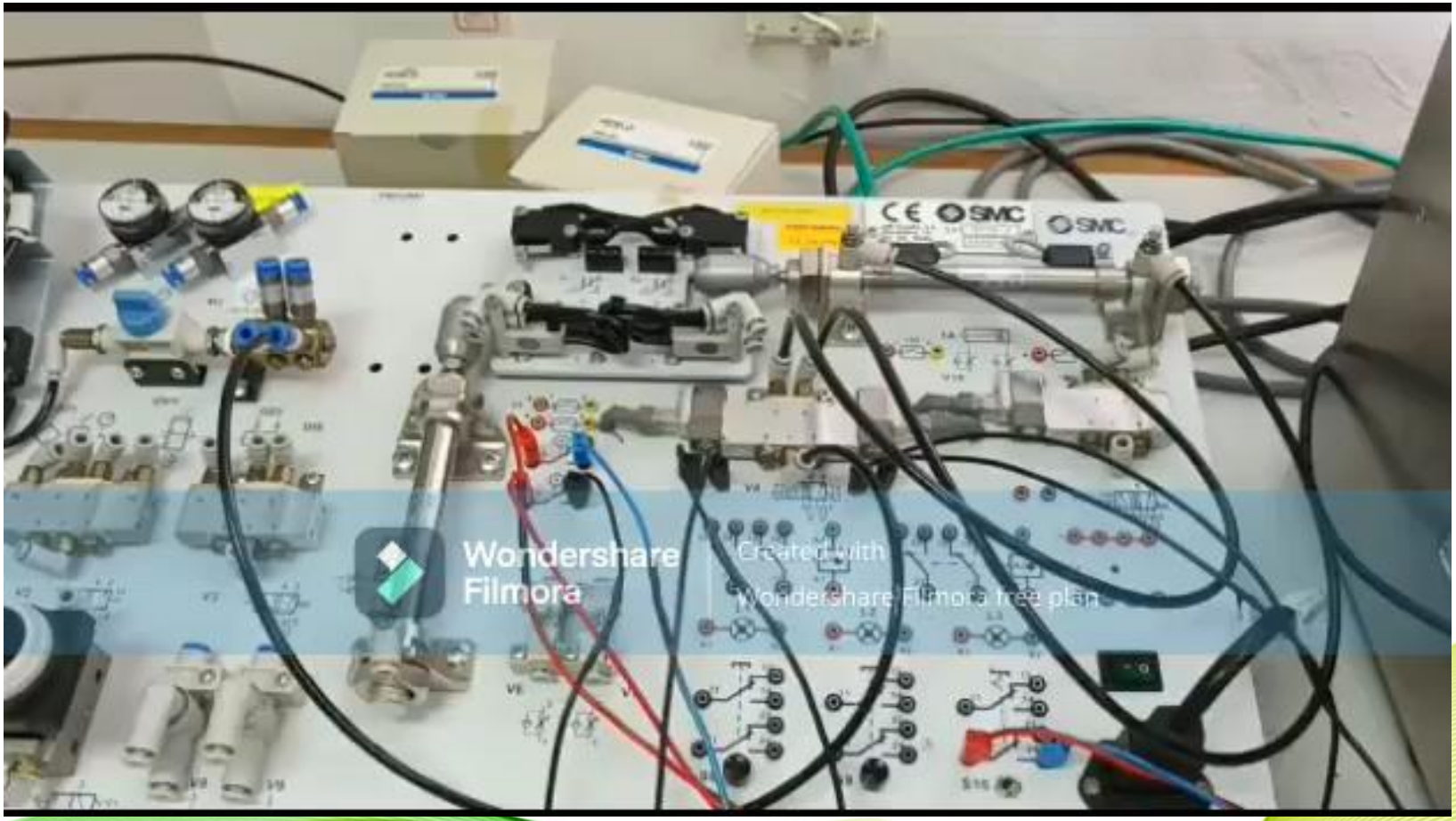
IP: 192.168.1.10

IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Short Demonstration Video



IEEE RAS
MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS
RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

UPGRADING AND VALUE ADDITION TO AN EXISTING 3-AXIS CNC MACHINE FOR TEACHING AND LEARNING

by
Dakhel Abdulrahman & Ir. Dr. Tanveer Saleh

Background

- Programmable CNC machines was one of the key components **of IR 3.0**.It is widely used for various industries ranging from woodworking to automotive and aerospace.
- In the era of IR 4.0 and IR 5.0 CNC machines are becoming **smart (thanks to data driven technology)** and **IoT compatible.**

Research Problem and Objective

- In many higher learning and vocational institutes we may find many CNC machines are sitting idle because some major elements are spoiled such as **the controller or the motors**. Hence, the machine ends up **occupying space and being a waste of resources.** However, the machine's structure is still intact and in a good condition.

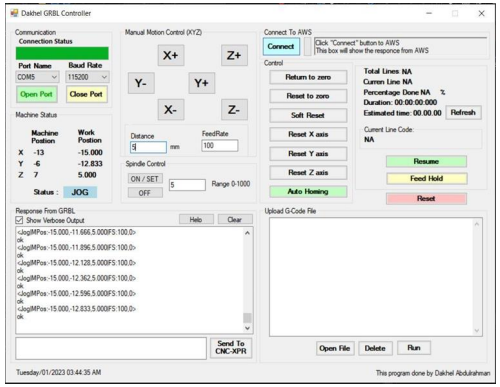
- Hence we aimed to develop a generic GUI software that may help to refurbish **stepper motor driven CNC machine** with some **value addition.**

IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Overview of the project and its significance



Modular Controller

GUI

MECHANICAL MODIFICATION

Innovation and Infrastructure: Increase Efficiency and Productivity

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Sustainable Cities and Communities: Reduce Resource Needs.

11 SUSTAINABLE CITIES AND COMMUNITIES

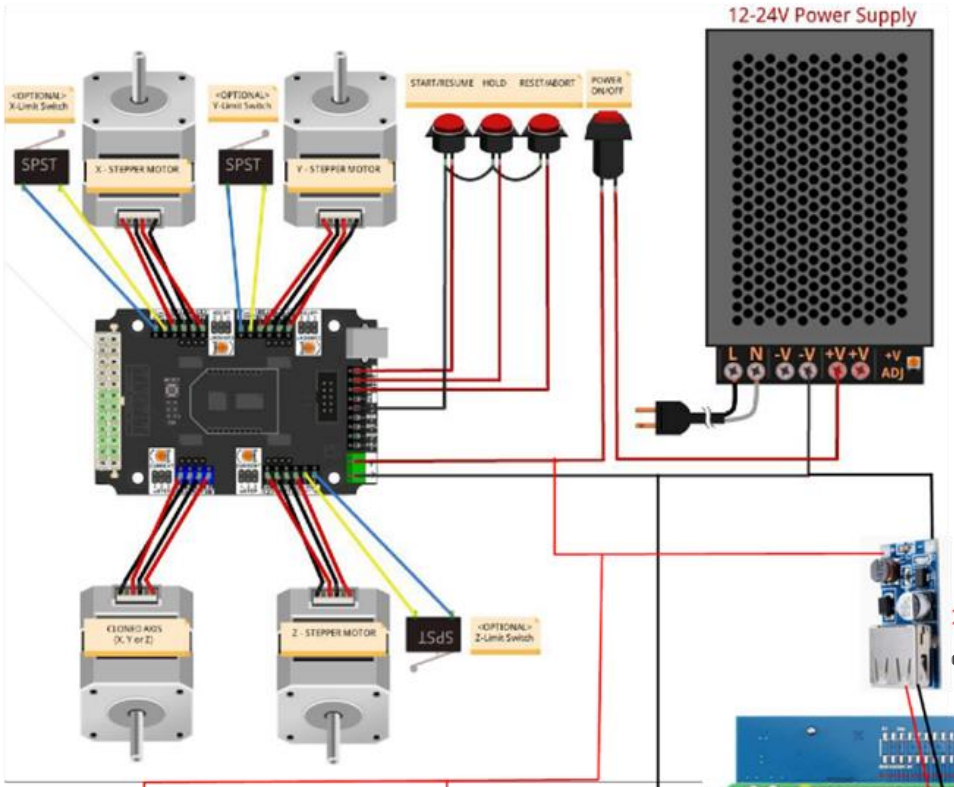
IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

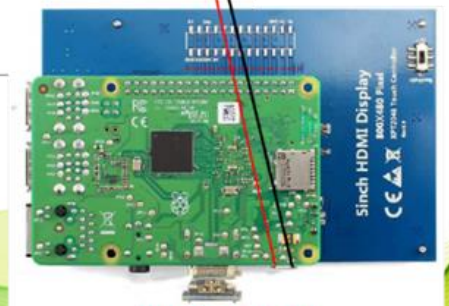
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Circuit Design

Powering with 12 - 24V (DC) supply:



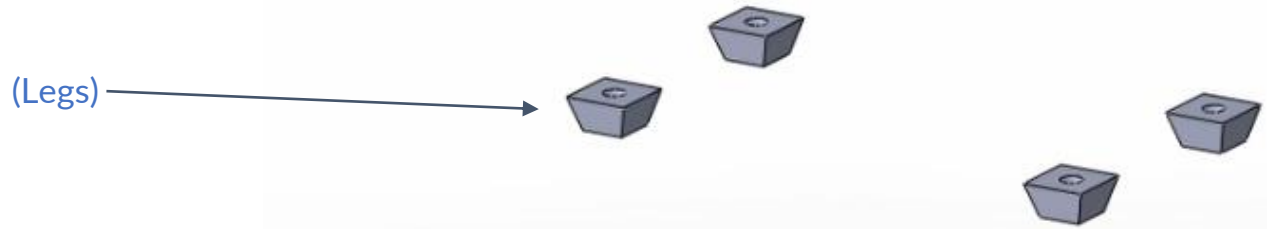
DC-DC step down
24 v to 5 v converter



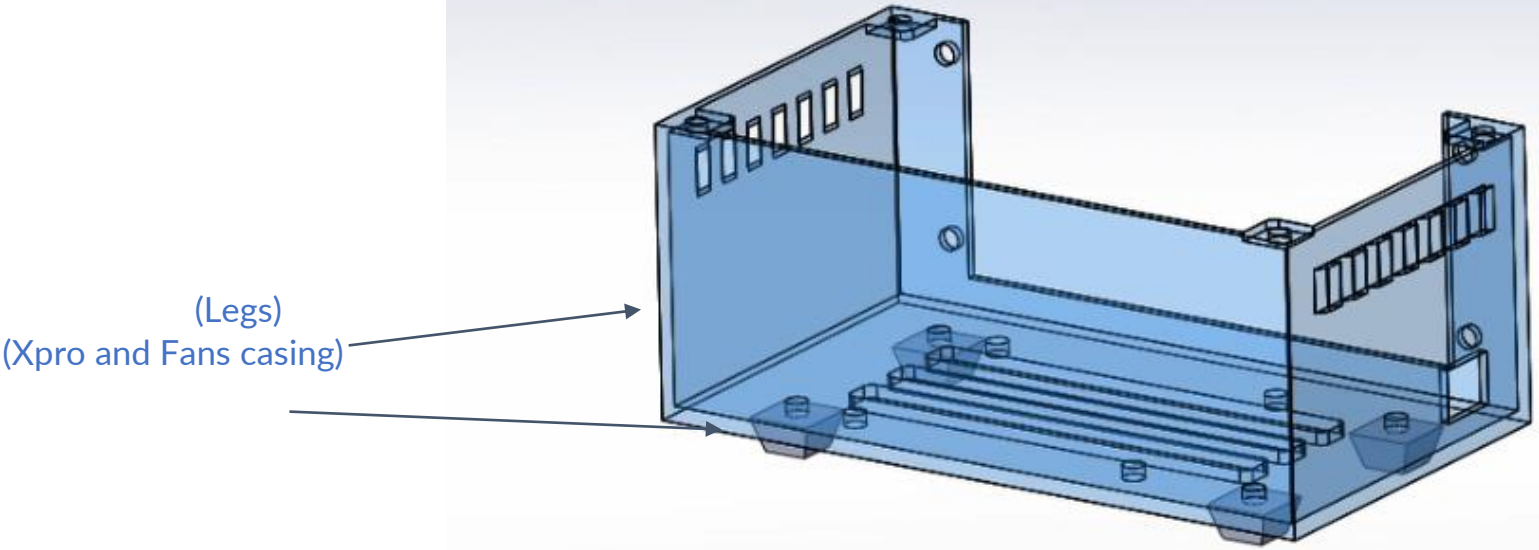
Raspberry Pi

24 v Cooling Fans

CAD Controller Case Design



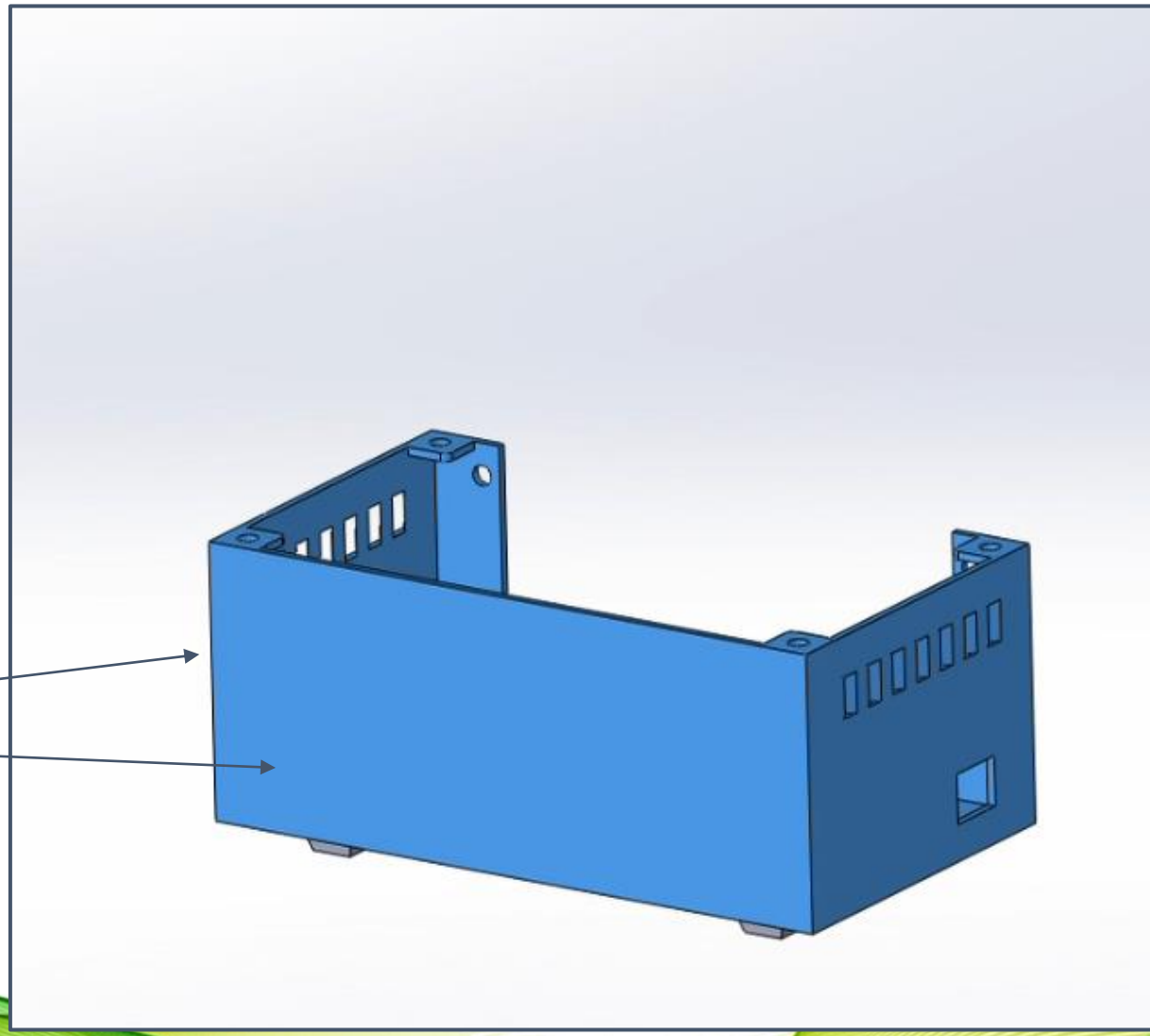
CAD Controller Case Design



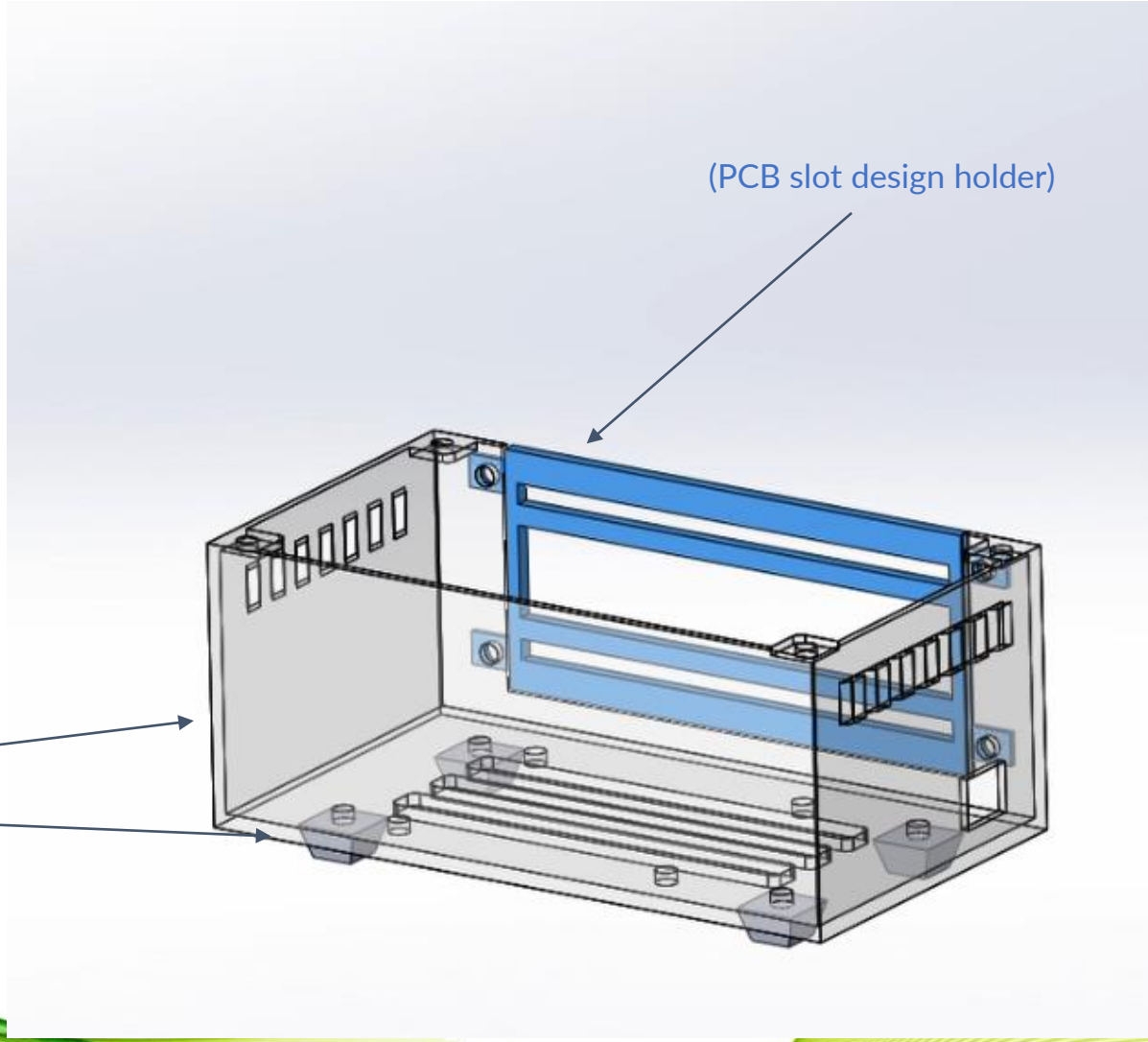
CAD Controller Case Design

(Xpro and Fans casing)

(Legs)

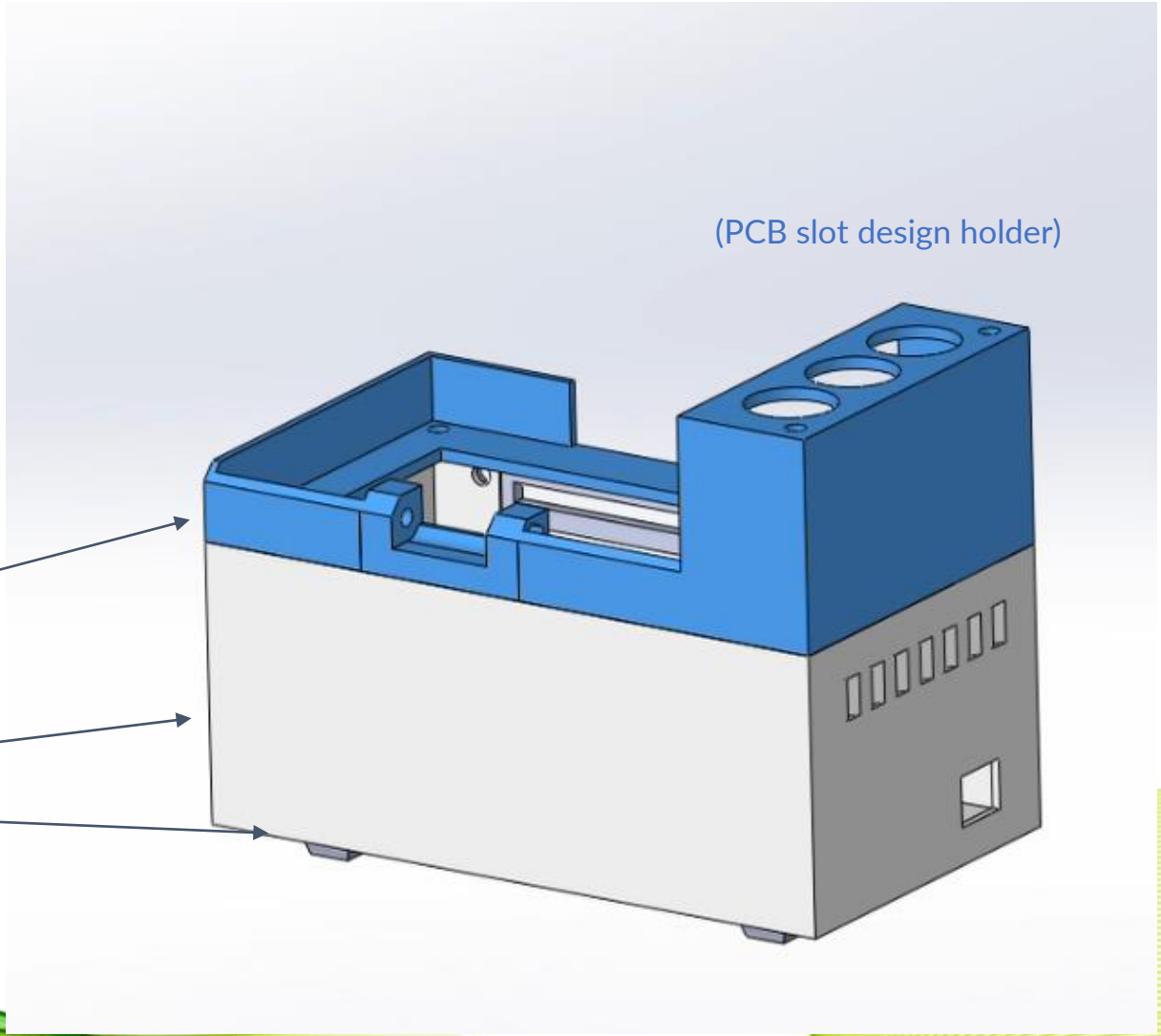


CAD Controller Case Design



CAD Controller Case Design

(PCB slot design holder)

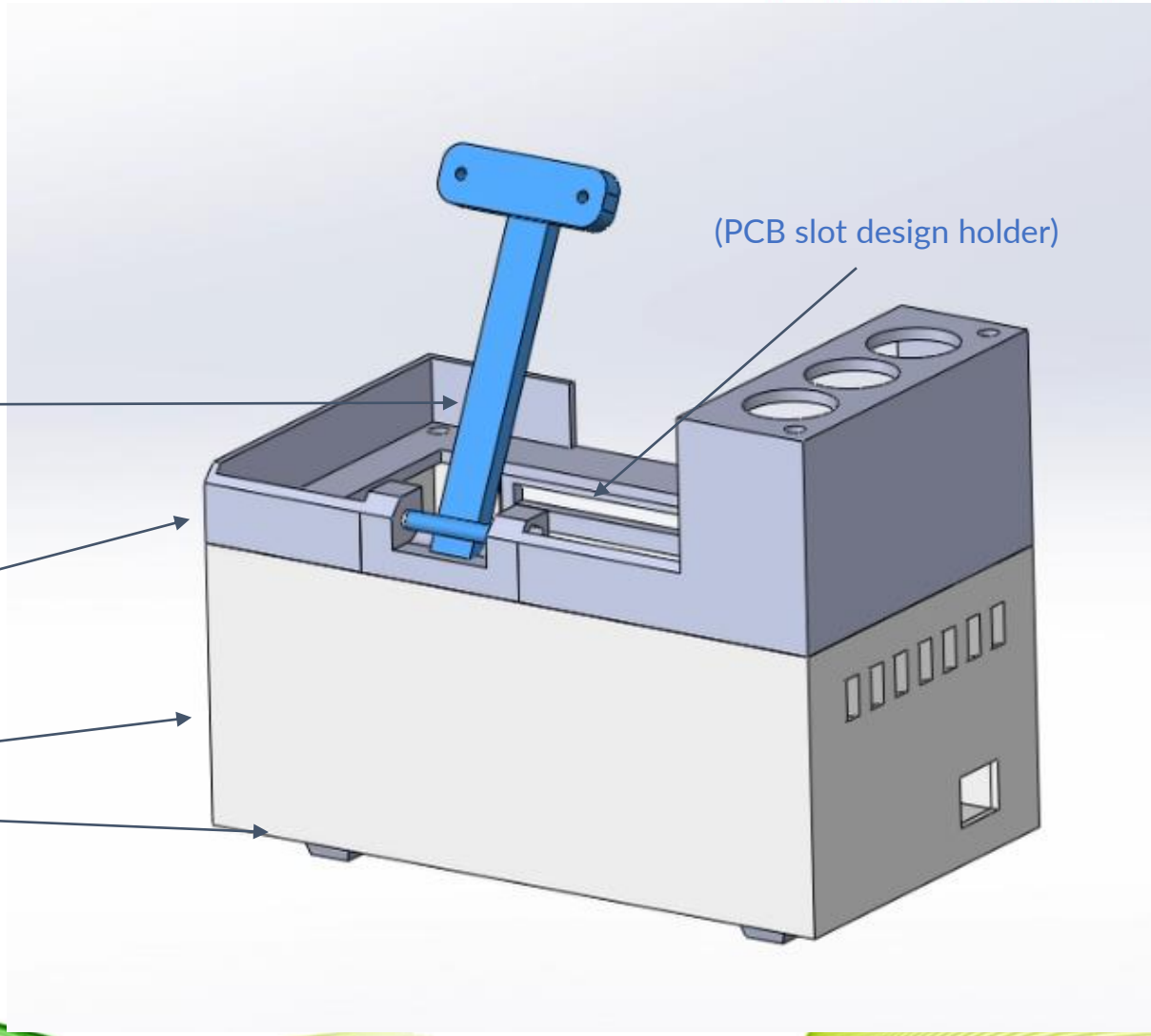


(Switches case and hinge base joint)

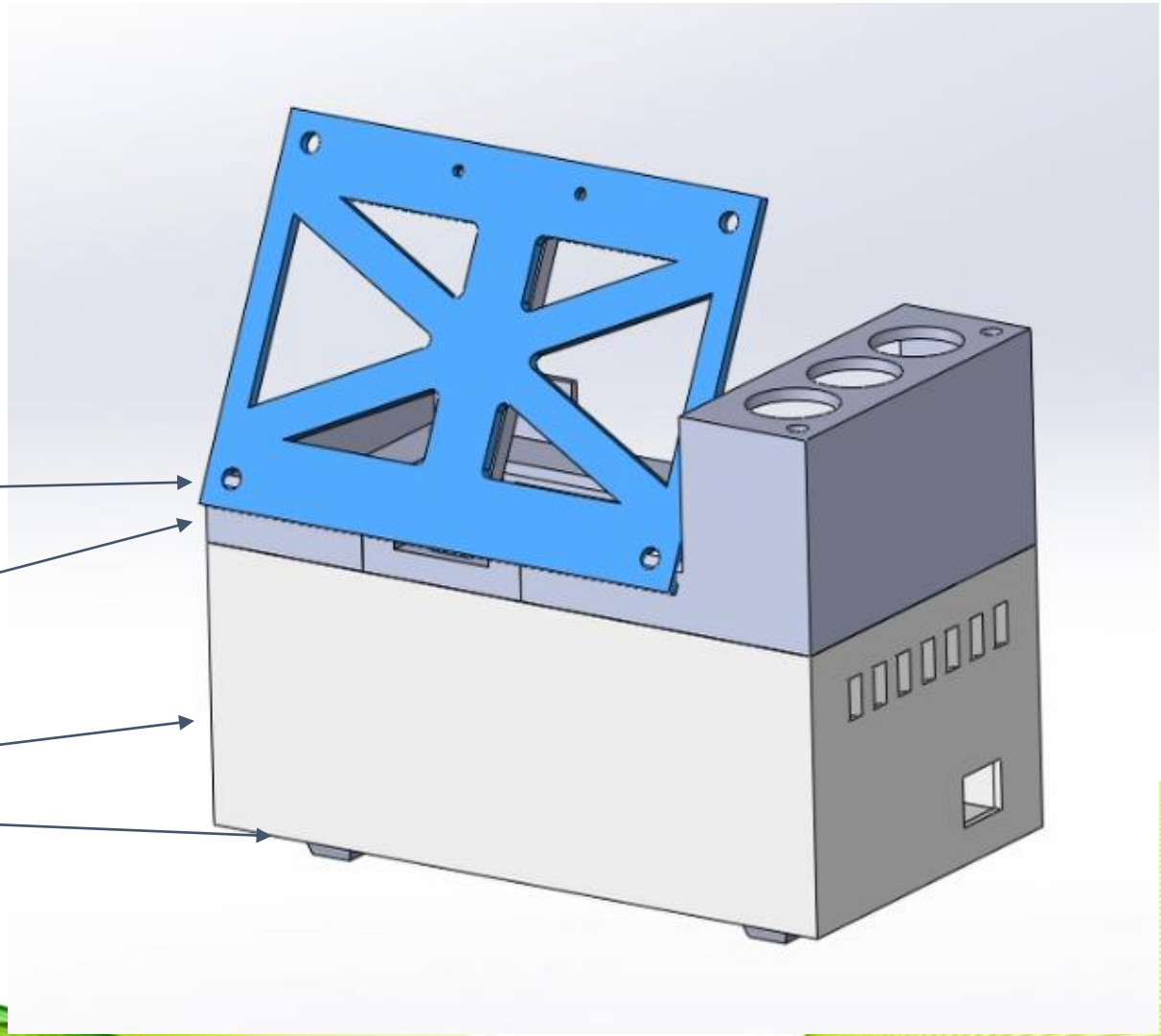
(Xpro and Fans casing)

(Legs)

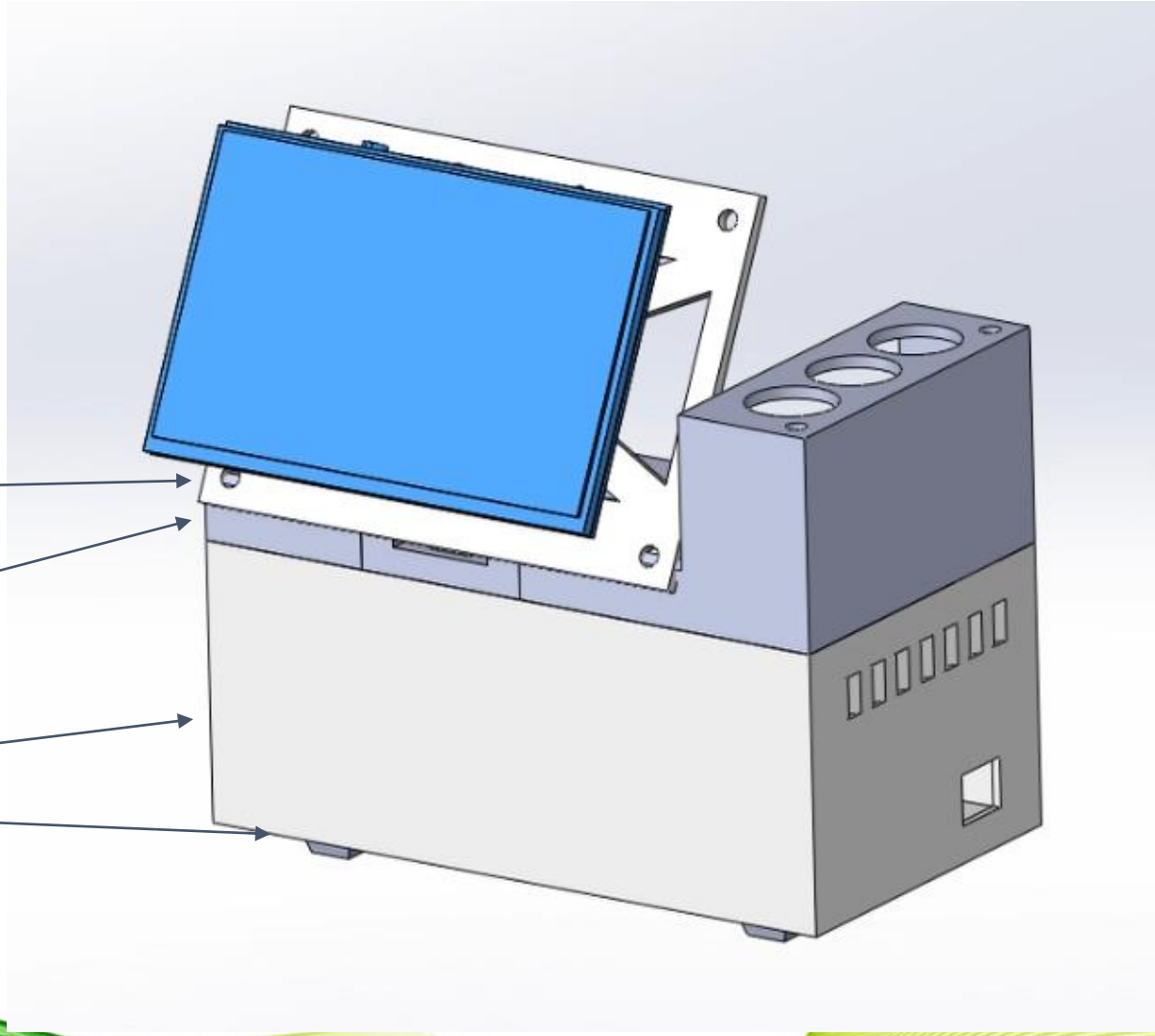
CAD Controller Case Design



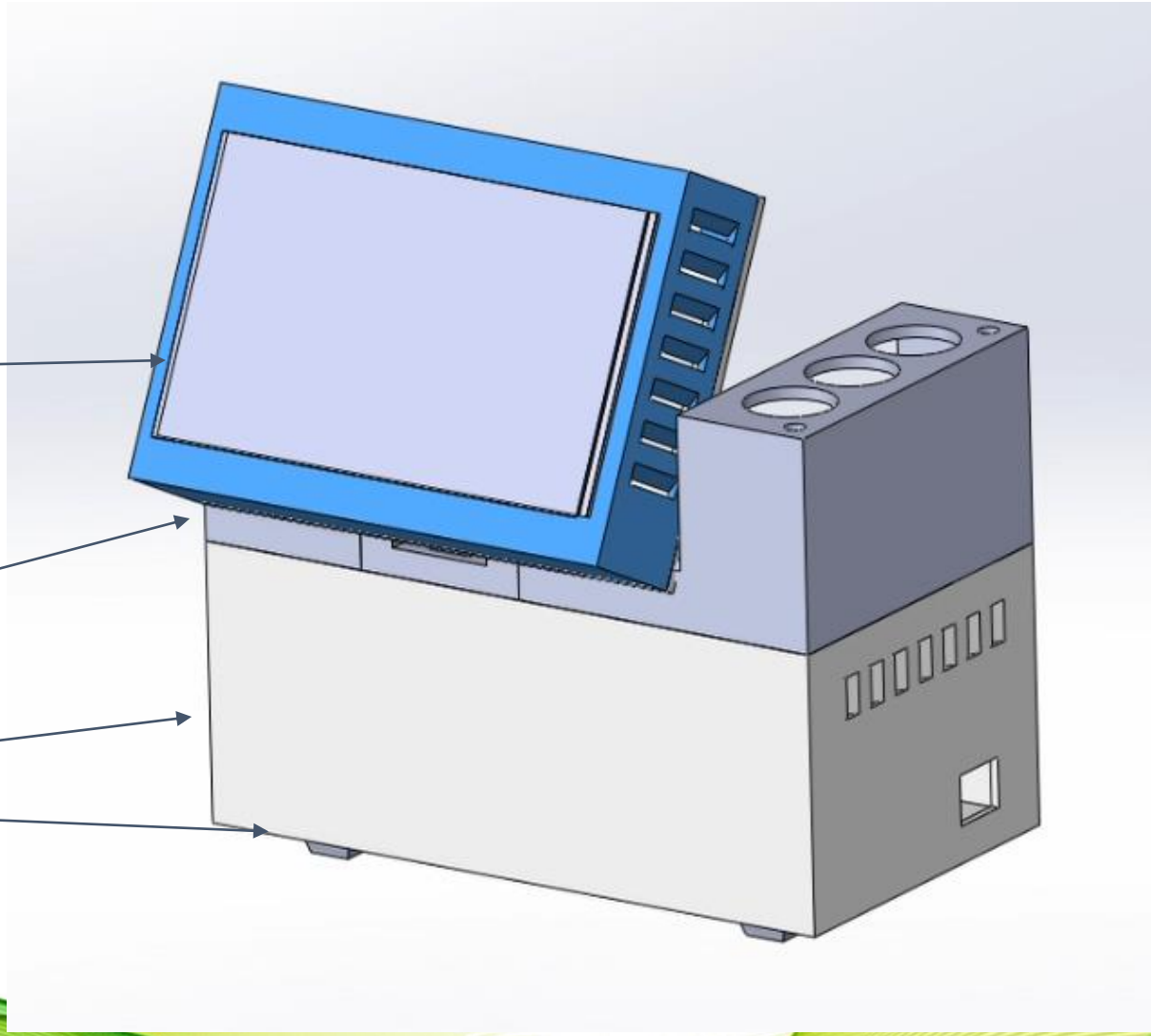
CAD Controller Case Design



CAD Controller Case Design



CAD Controller Case Design

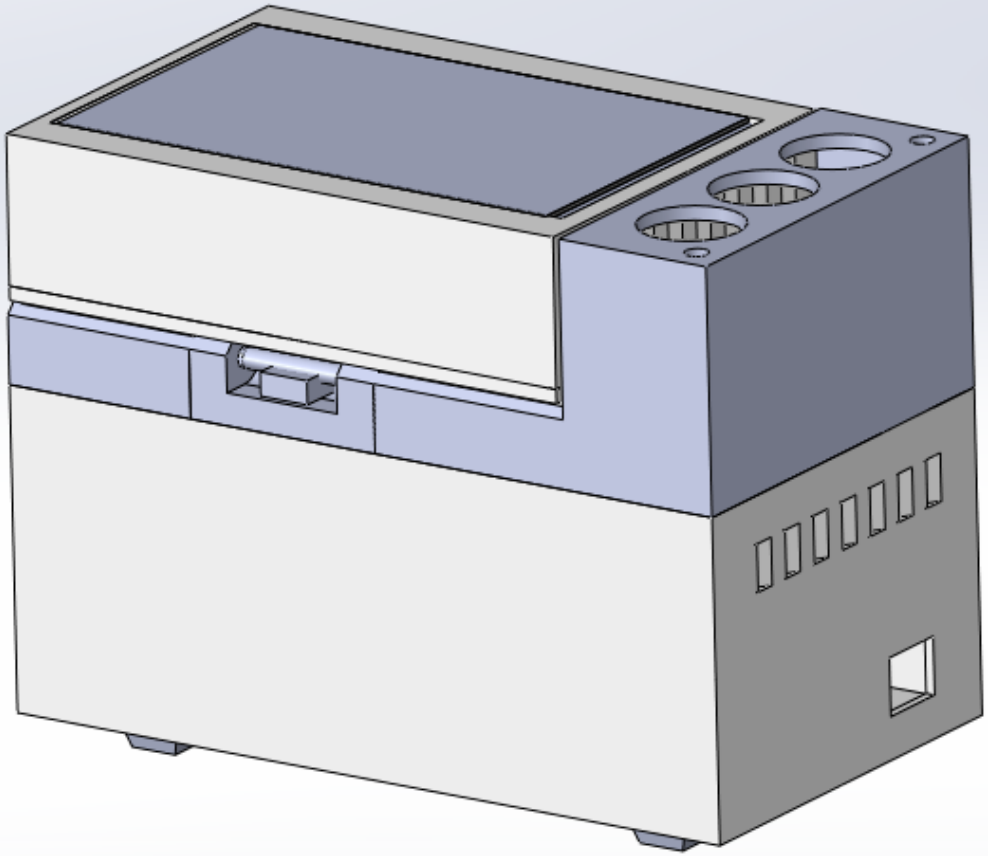


IEEE RAS
MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS
RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

CAD Controller Case Design

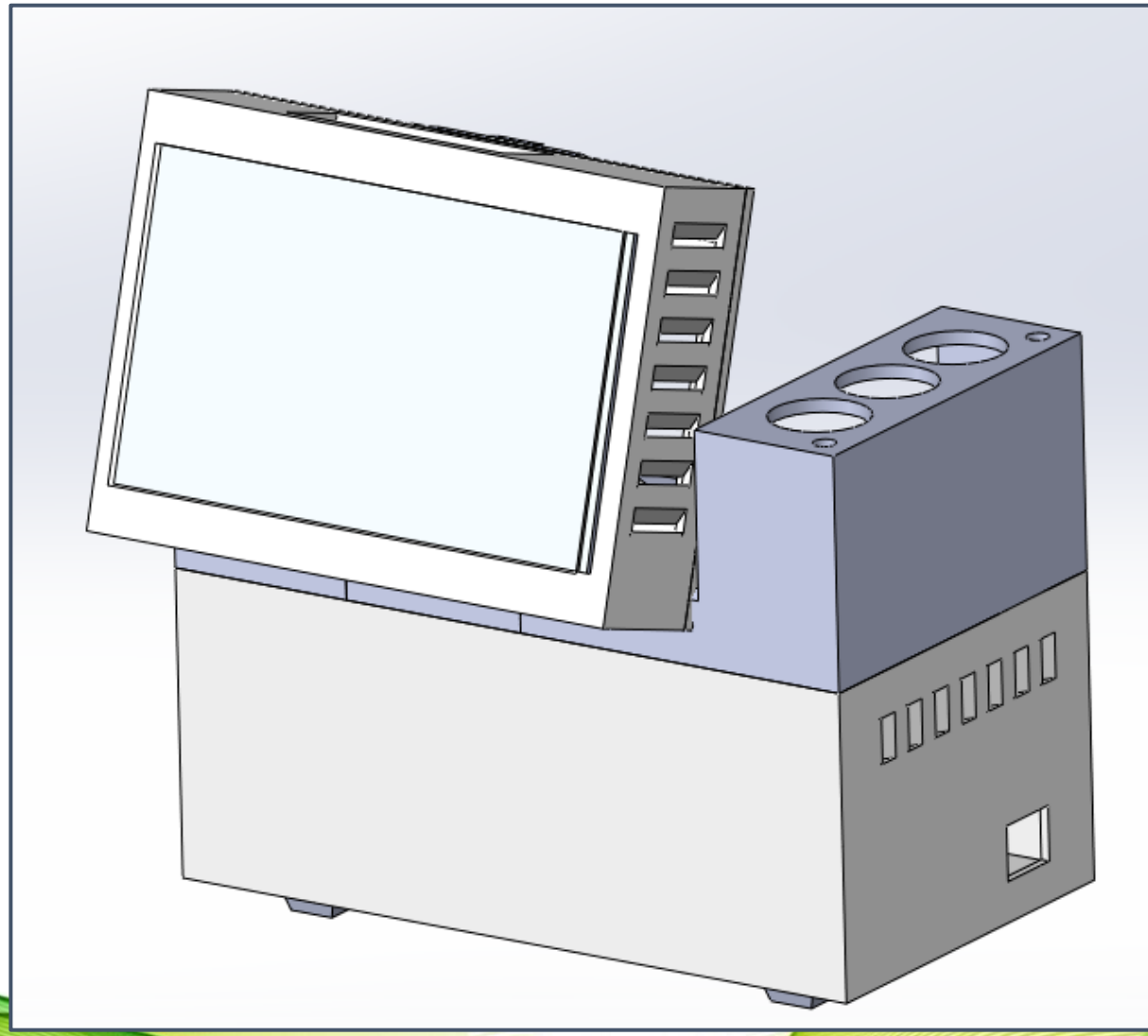


IEEE RAS
MALAYSIA CHAPTER

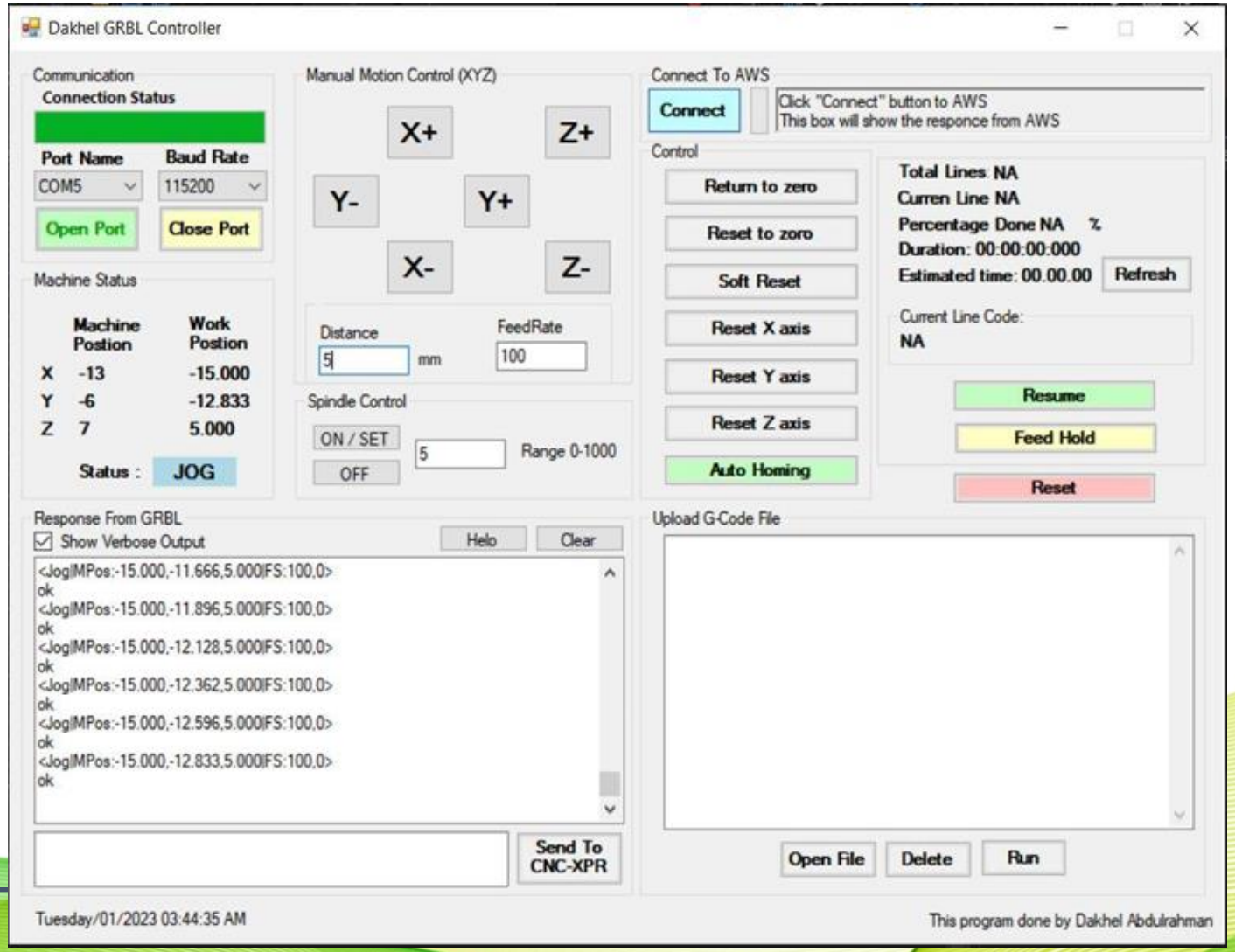
AUTONOMOUS SYSTEMS & ROBOTICS
RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

CAD Controller Case Design



GRAPHICAL USER INTERFACE (GUI)

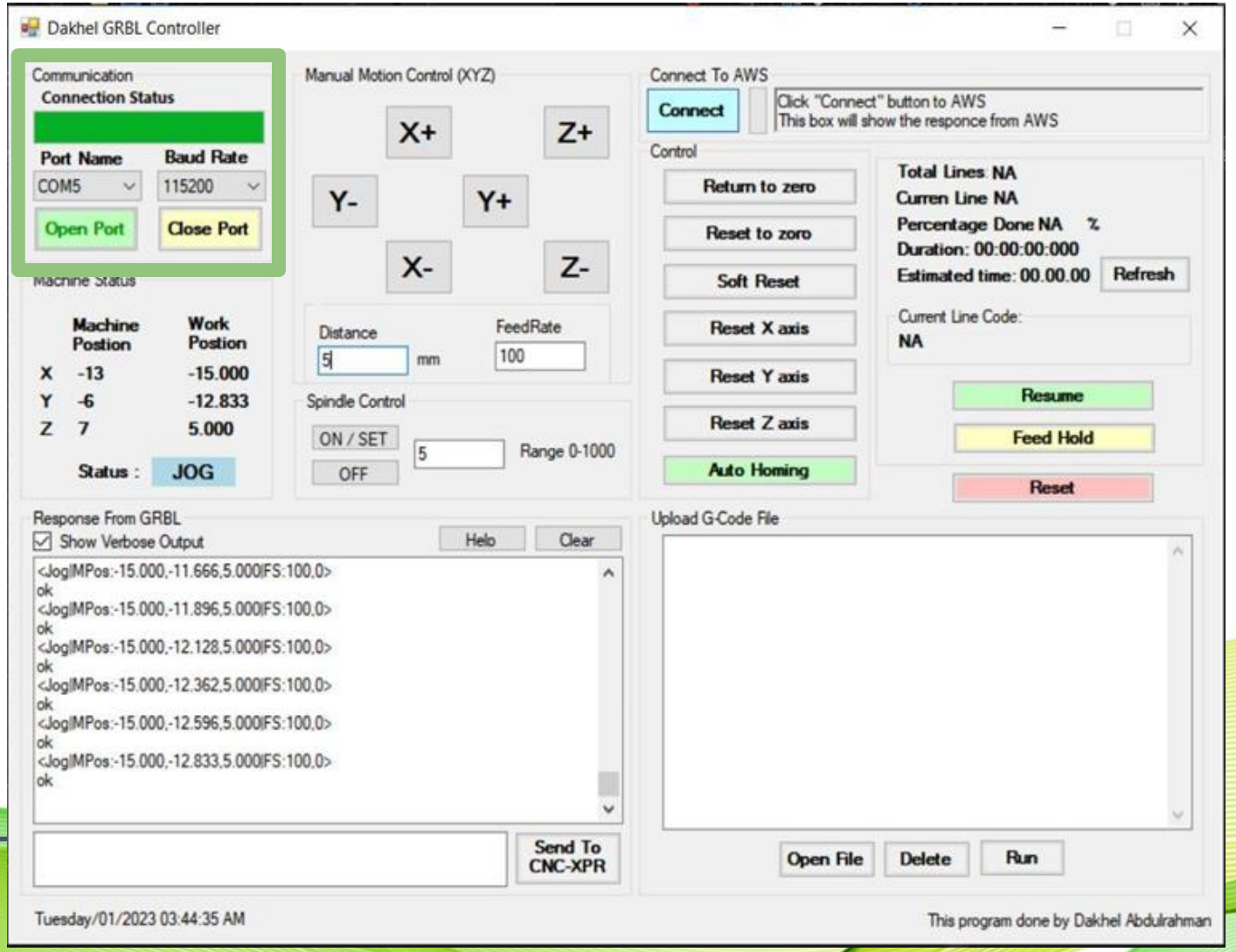


IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Connection To GRBL



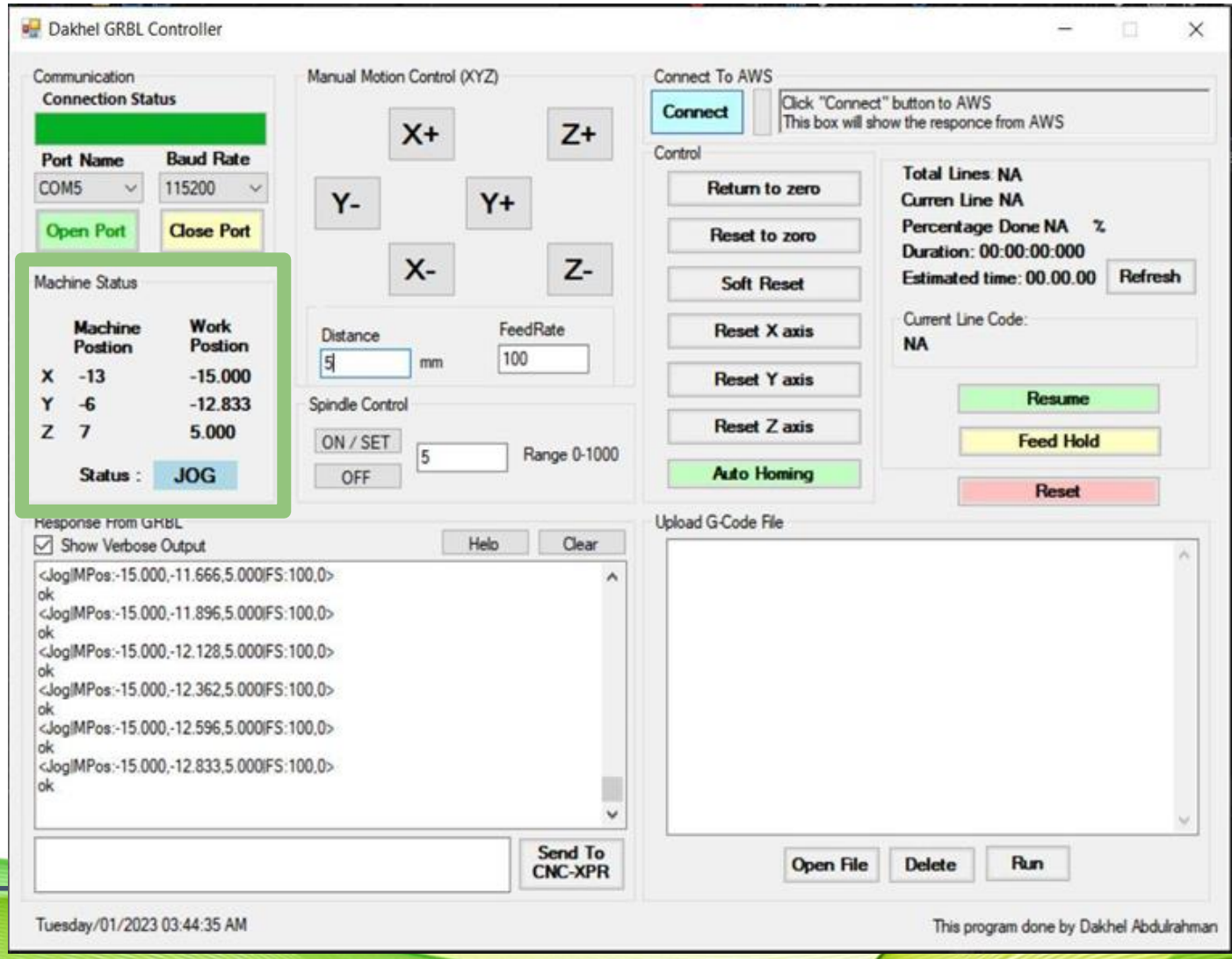
Machine Status

Status : RUN

Status : JOG

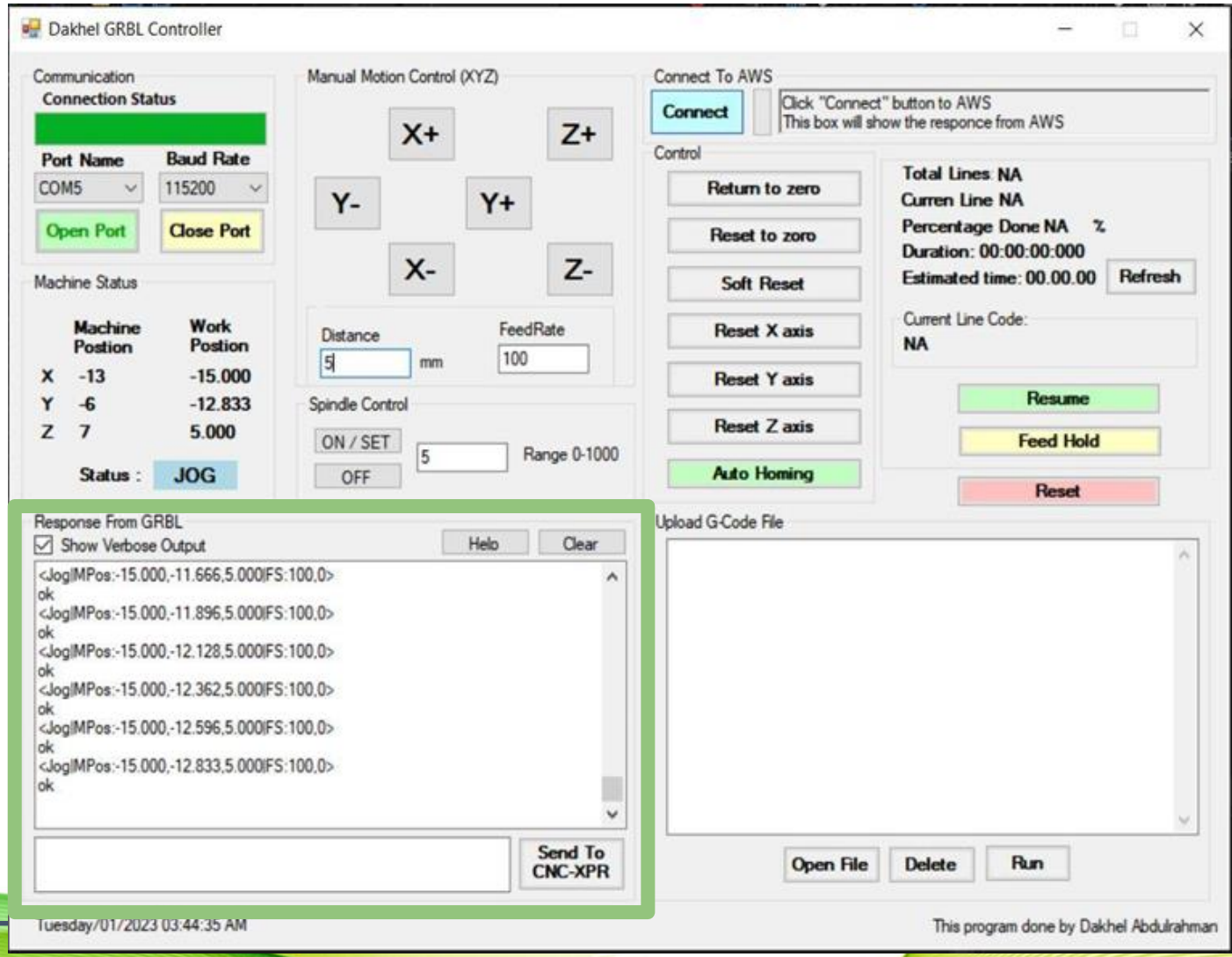
Status : IDLE

Status : Alarm



GRBL Response

- **Send Commands..**
- **Receive response.**

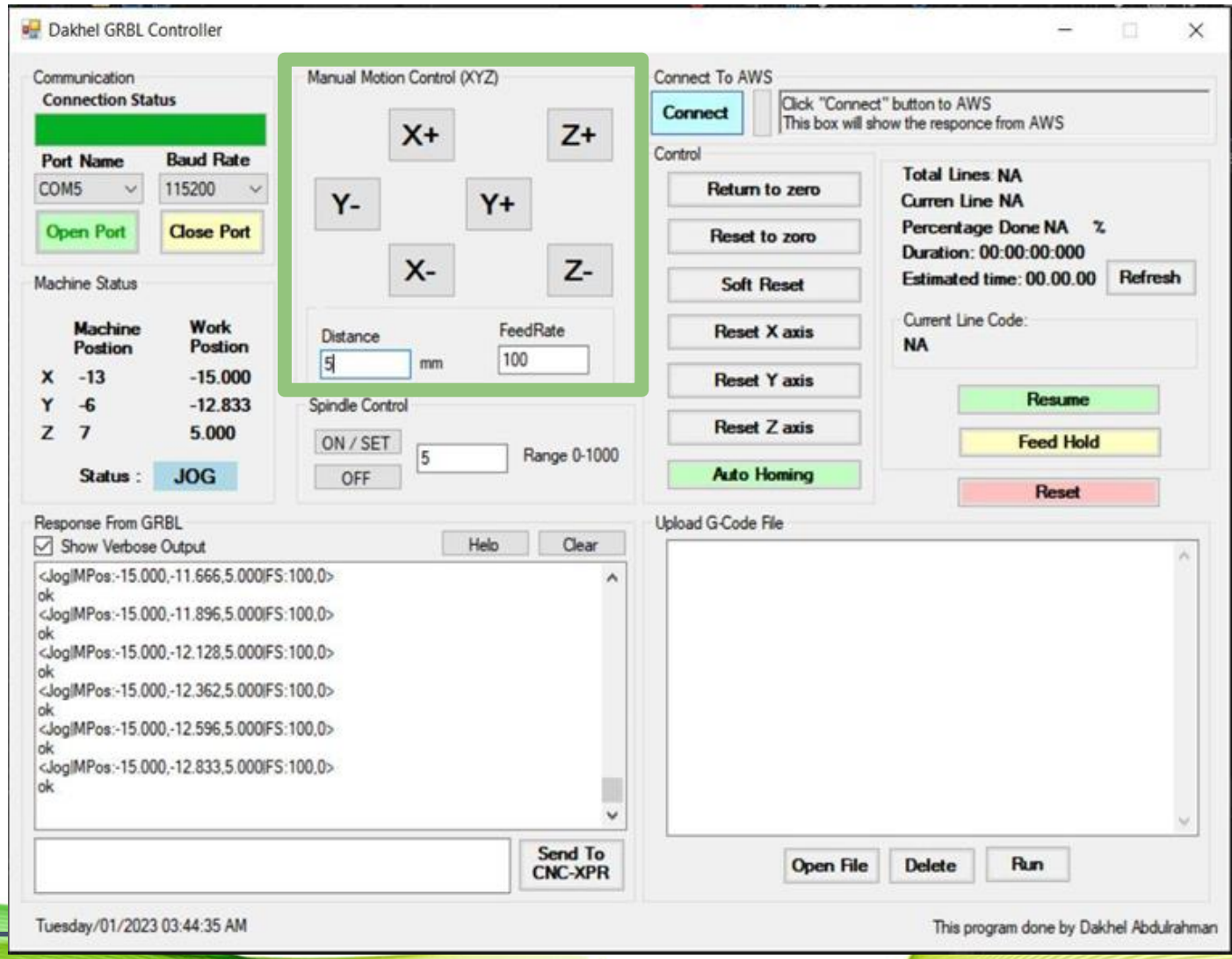


IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Manual Motion

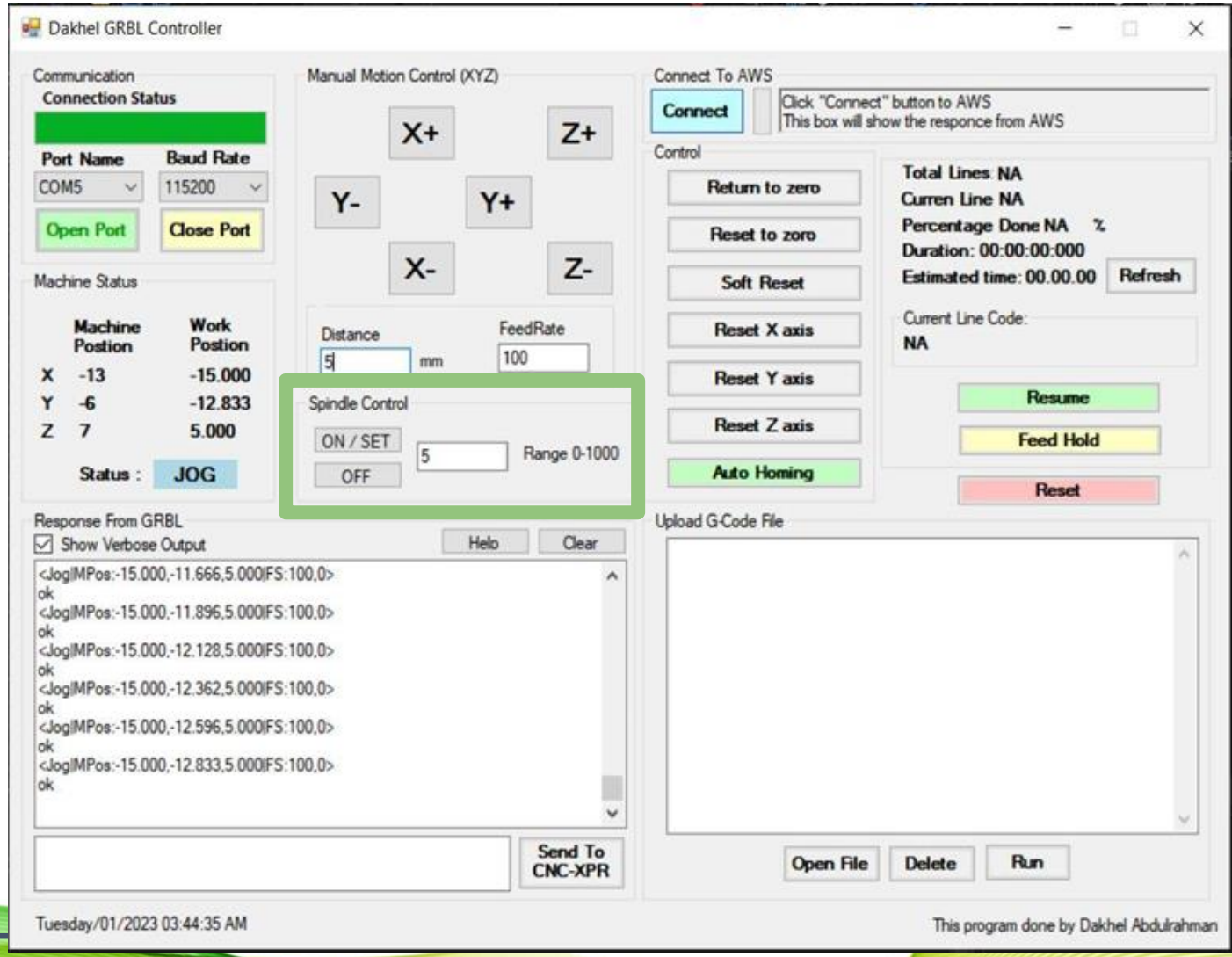


IEEE RAS MALAYSIA CHAPTER

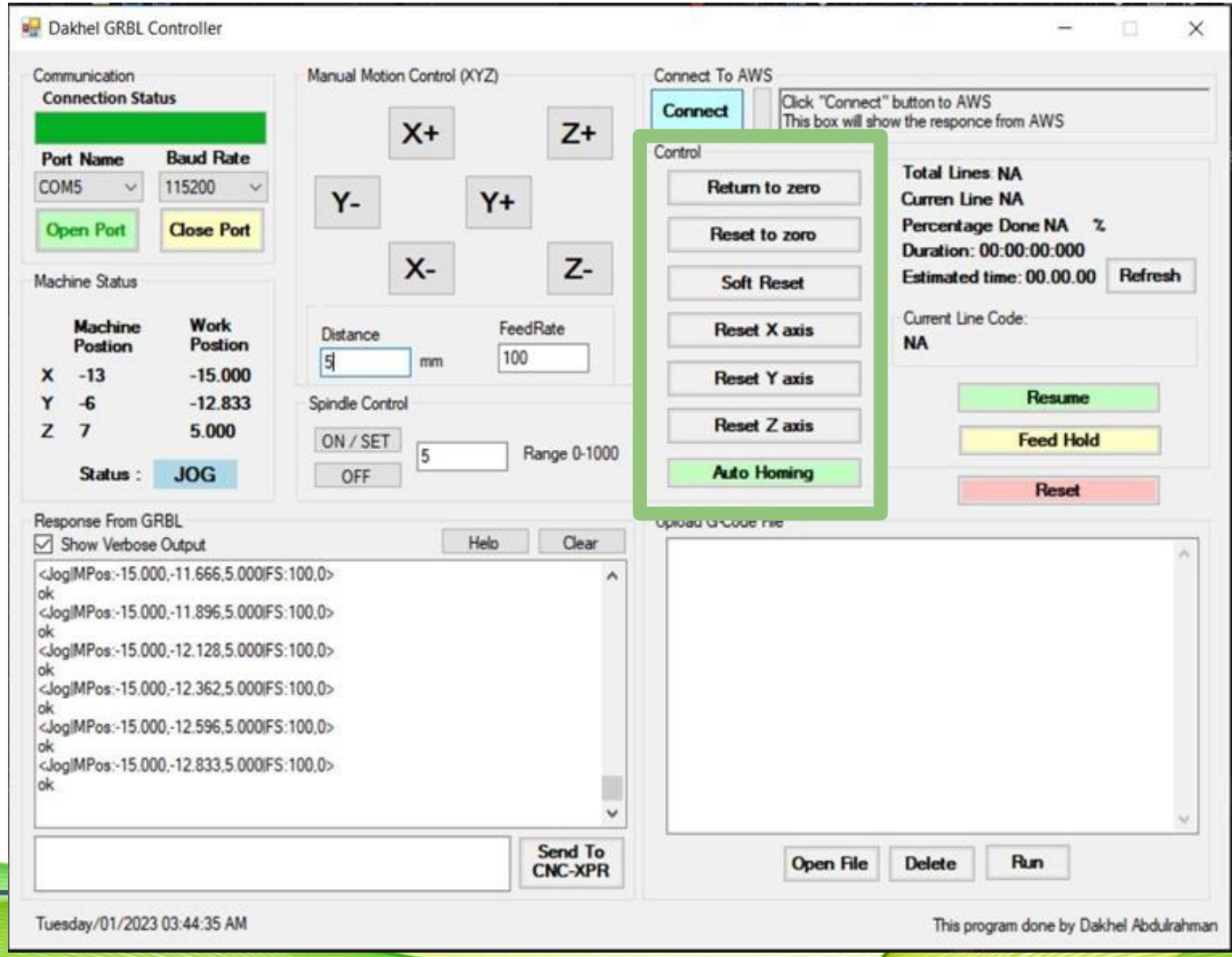
AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Spindle Control



General Control

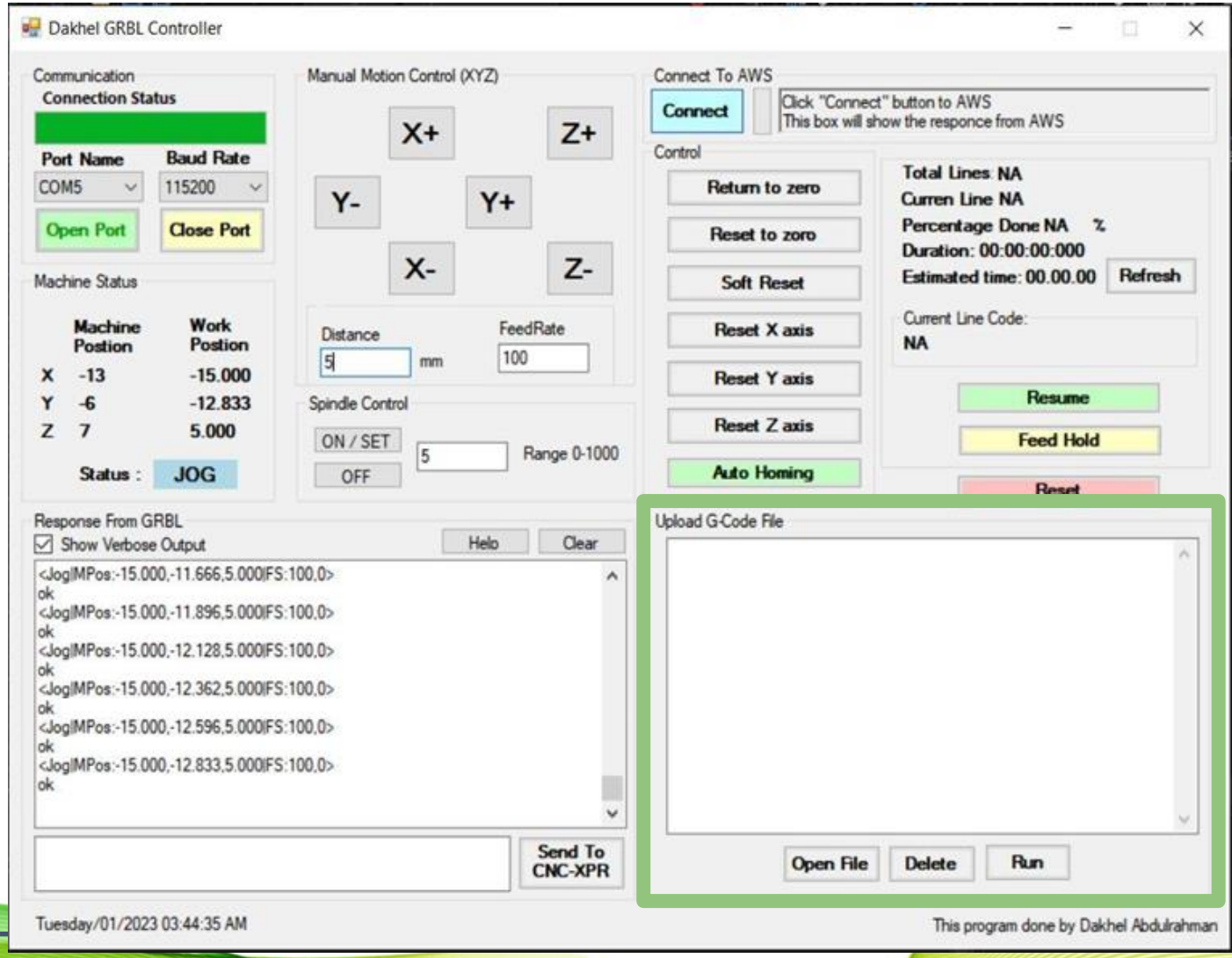


IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

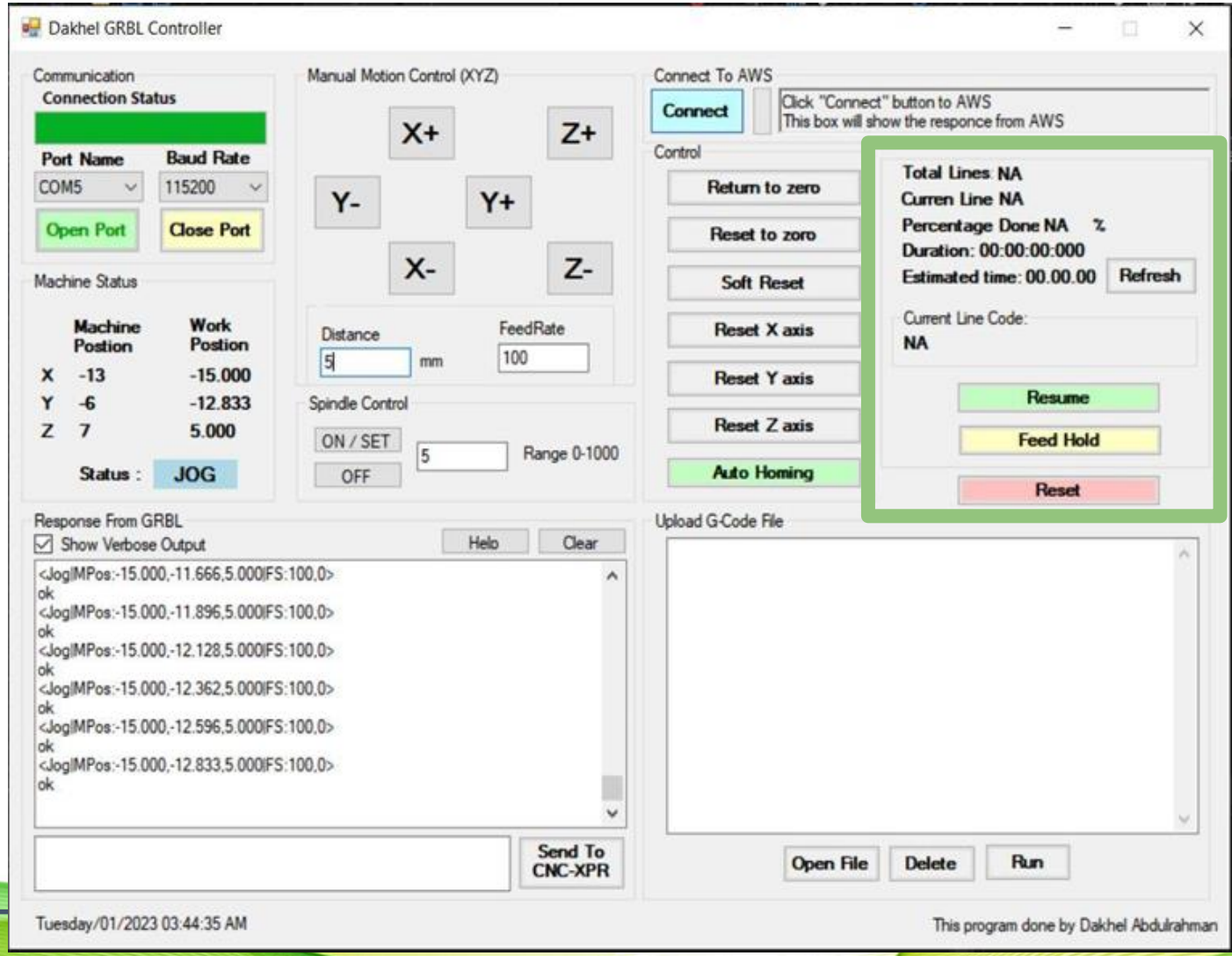
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Upload G-Code



Operation Monitor

- **Estimated Time.**
- **Current Line.**



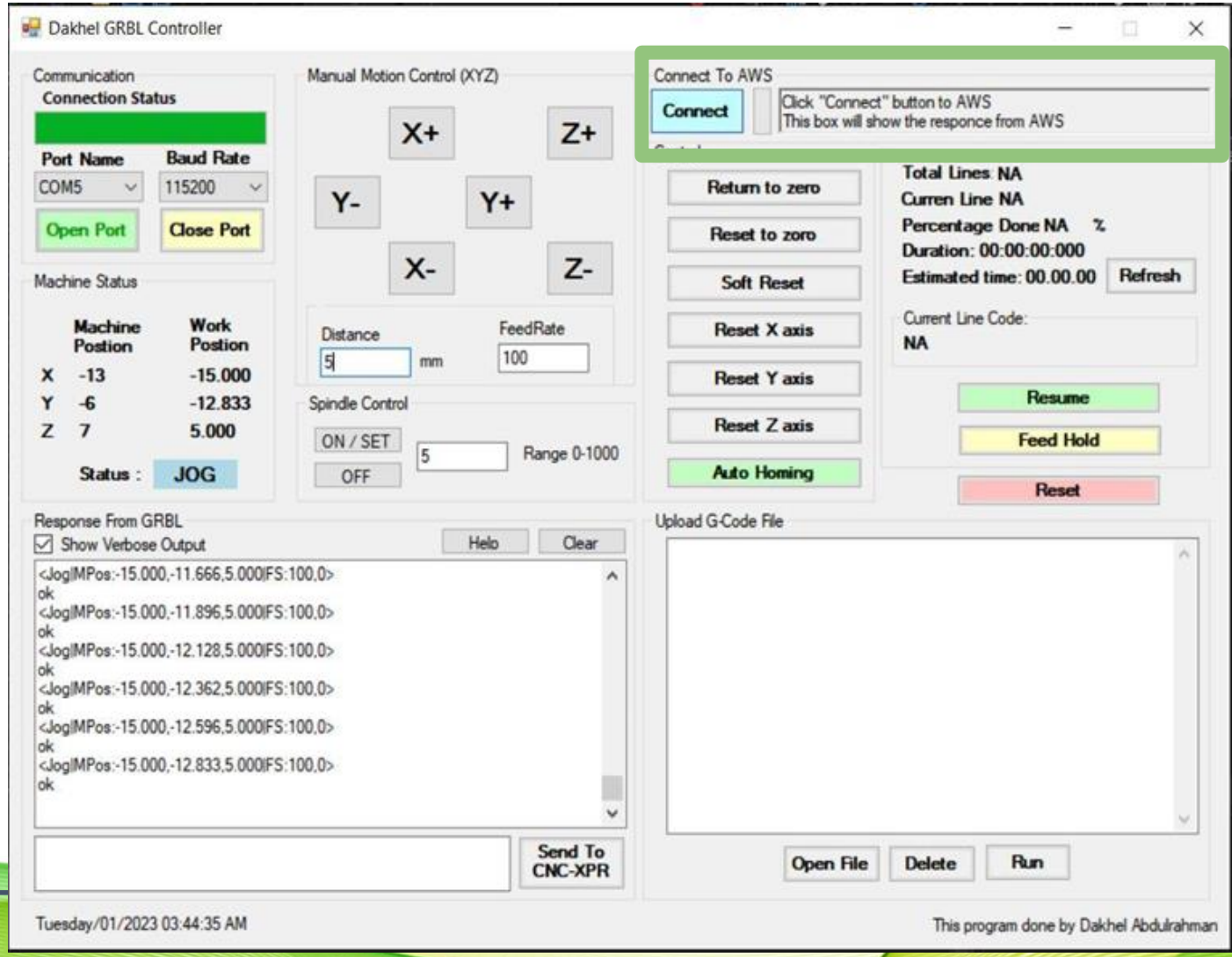
IEEE RAS MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

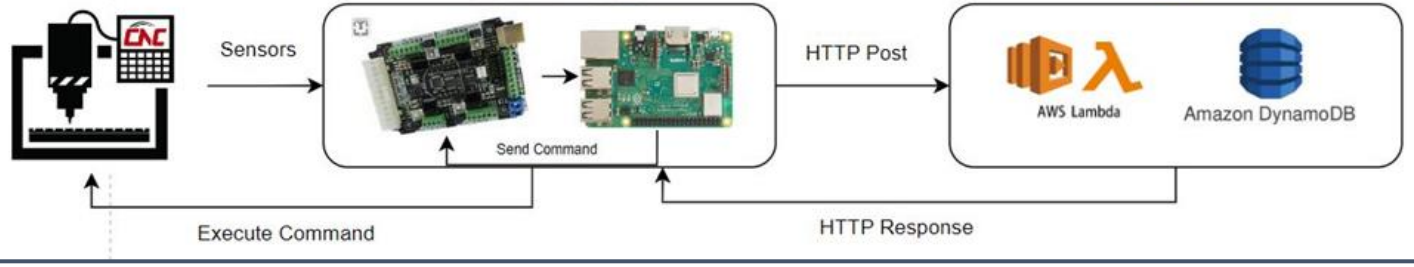
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-'ĀLAMĪN

Connect to AWS

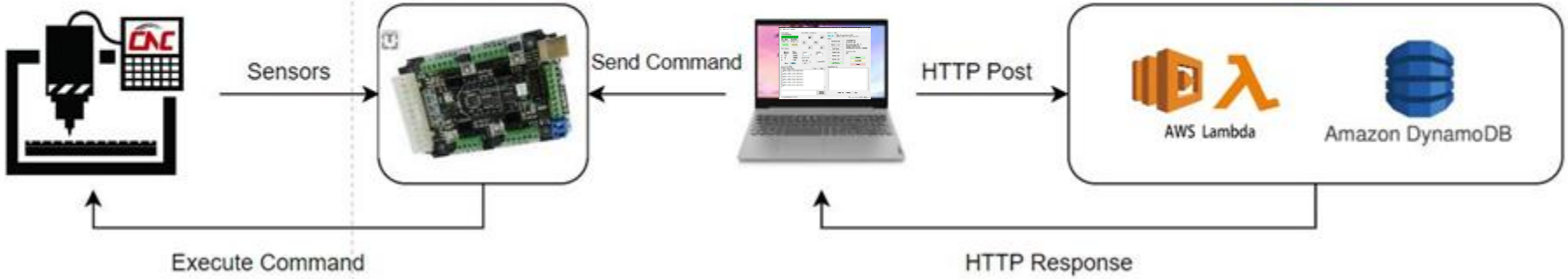
amazon web services



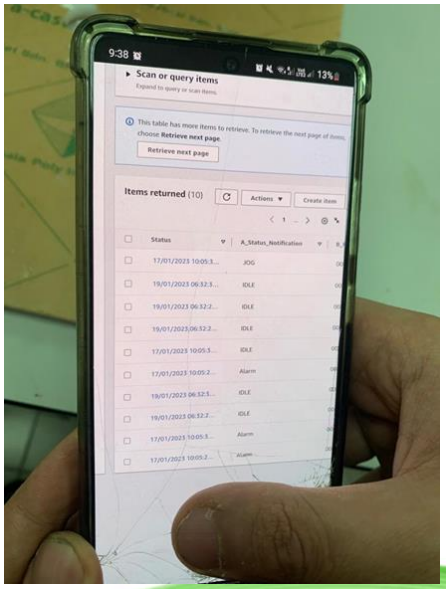
1- Onboard Interface Mode



2- Computer Connection Mode



Functionality test



Functionality test

Status	A_Status_Notification	B_Run_Ti...	C_Estimated_Time	D_Percentage_Done
17/01/2023 10:05:26 AM	Alarm	00:00:00:000	00.00.00	NA
17/01/2023 10:05:28 AM	Alarm	00:00:00:000	00.00.00	NA
17/01/2023 10:05:30 AM	Alarm	00:00:00:000	00.00.00	NA
17/01/2023 10:05:32 AM	IDLE	00:00:00:000	00.00.00	NA
17/01/2023 10:05:34 AM	JOG	00:00:00:000	00.00.00	NA

IEEE RAS
MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS
RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Gesture based movement control of industrial robots

by
Irfan Fikhri bin Iszahar & Ir. Dr. Tanveer Saleh

IEEE RAS MALAYSIA CHAPTER

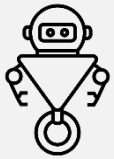
AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Target of the research

WHO 1

The Collaborative robotics industry community



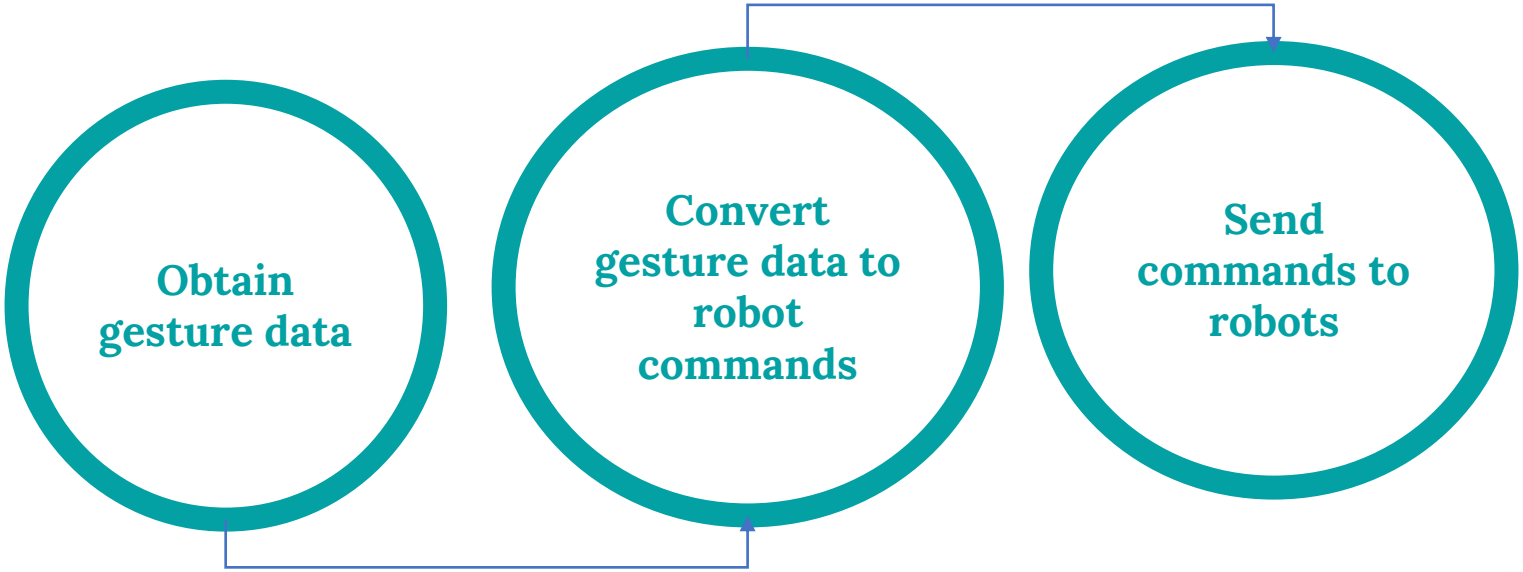
WHAT 2

Intuitive communication method

WHY 3

To allow both human operators and robots to communicate with each other in a more natural way and increase in speed and efficiency in completing a task.

System design



IEEE RAS MALAYSIA CHAPTER

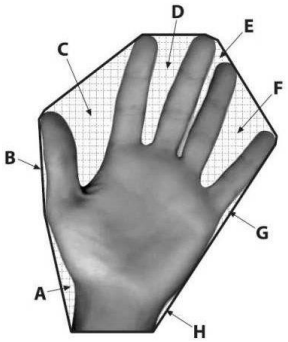
AUTONOMOUS SYSTEMS & ROBOTICS RESEARCH UNIT

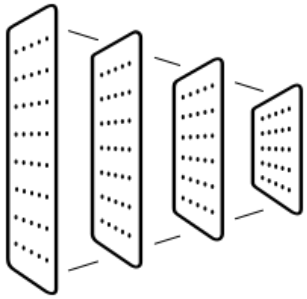
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Garden of Knowledge and Virtue

LEADING THE WAY

Gesture recognition

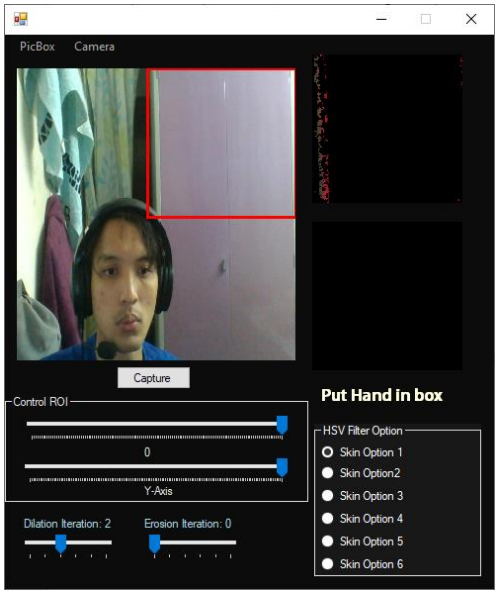


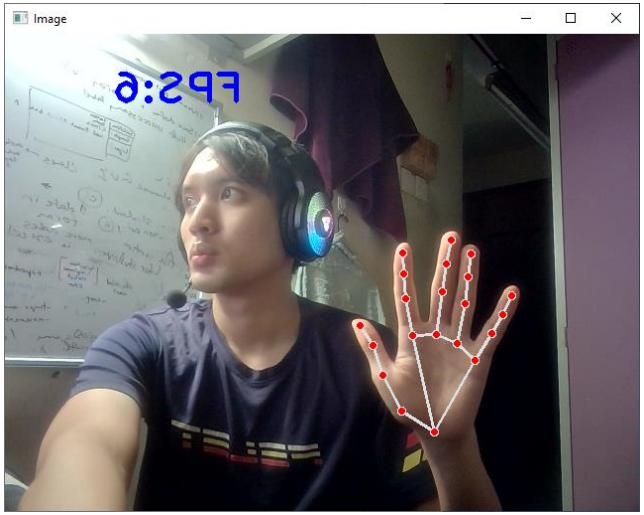


1. Convex hull algorithm

2. CNN

Interface for Gesture recognition





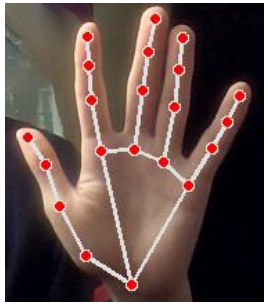
1. **Convex hull algorithm**

2. **Deep-learning framework**

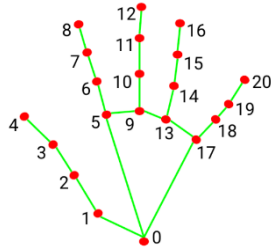
Gesture Recognition: Deep-learning framework

Developed in Python Environment

Using Mediapipe deep-learning framework

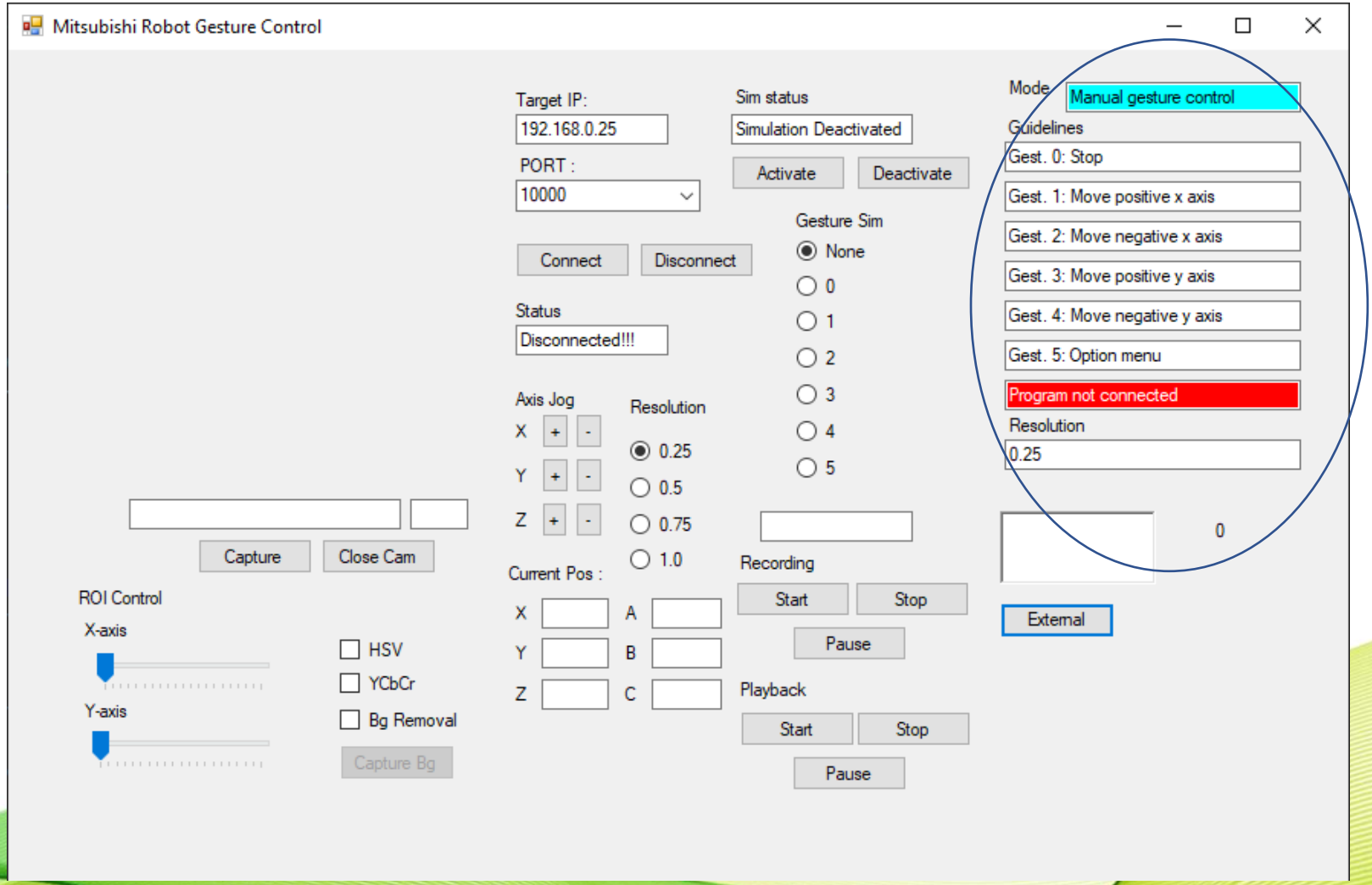


Joints detected from the framework



Joints labels

Final GUI design



Experiment 1: System consistency

- Each gestures was shown for 30 seconds.
- Correct gesture detections within 30s period were recorded.

$$Accuracy = 1 - \frac{30 - Correct\ gesture\ detection\ period(s)}{30}\ x\ 100$$

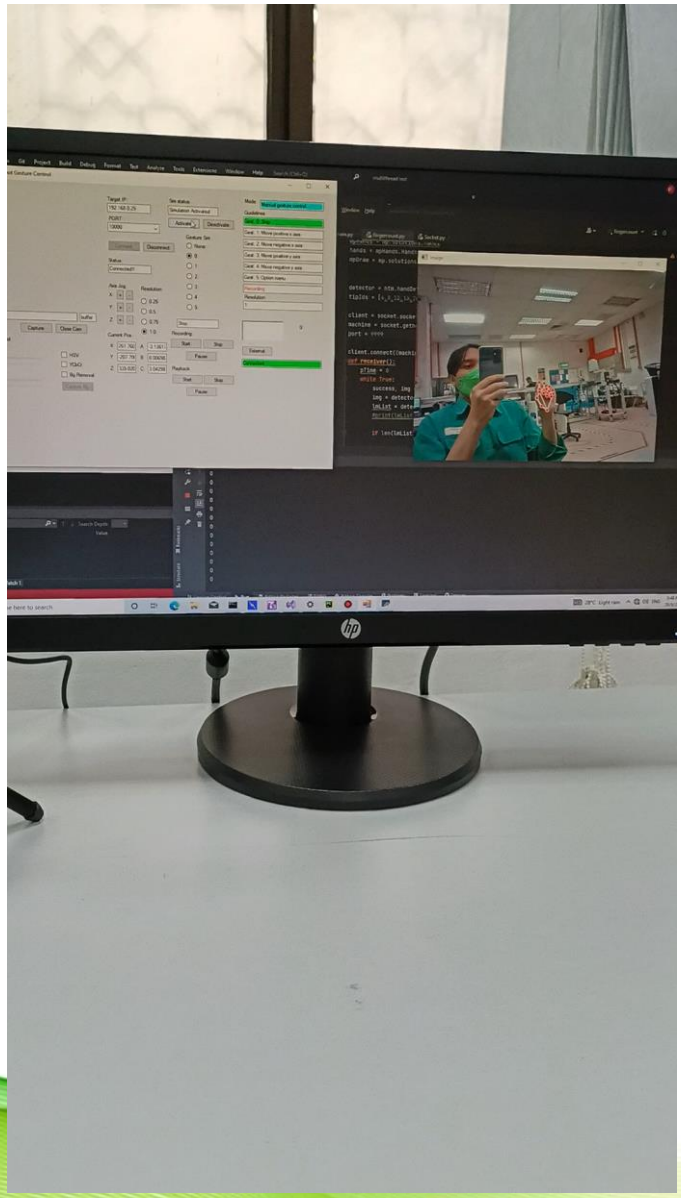
No. of fingers shown (n)	Correct gesture detection period (s)	Accuracy (%)
0	30	100.0
1	30	100.0
2	30	100.0
3	30	100.0
4	30	100.0
5	30	100.0

Experiment 2 : System reliability

- Cycle of gestures from 0 to 6 were repeated for 40 times.
- First detection were recorded.

		Predicted Gestures						
Actual Gestures		0	1	2	3	4	5
	0	40	0	0	0	0	0
	1	0	39	0	0	0	0
	2	0	1	40	2	0	0
	3	0	0	0	38	0	0
	4	0	0	0	0	40	0
	5	0	0	0	0	0	40

Experimental demonstration



IEEE RAS
MALAYSIA CHAPTER

AUTONOMOUS SYSTEMS & ROBOTICS
RESEARCH UNIT

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue
LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

Thank You.