Diploma in

[Robotics & Mechatronics]

Full Term Semestral Project Report [12 weeks]

Title:

[Development of subsystem for RoboMaster competition & Development of GUI for Badal simulator]

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Report Template

Acknowledgement

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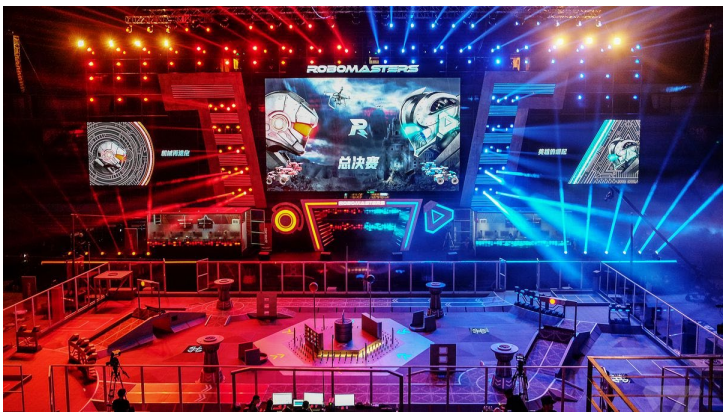


The RoboMaster Youth Championship (RMYC) was created to take existing robotic competition standards to a whole new level to inspire and engage the next generation in engineering and robotics. DJI Education builds on the success of their flagship RoboMaster University Challenge, which yearly drew over 300 teams from several prominent worldwide universities and discovered technical talent for DJI.

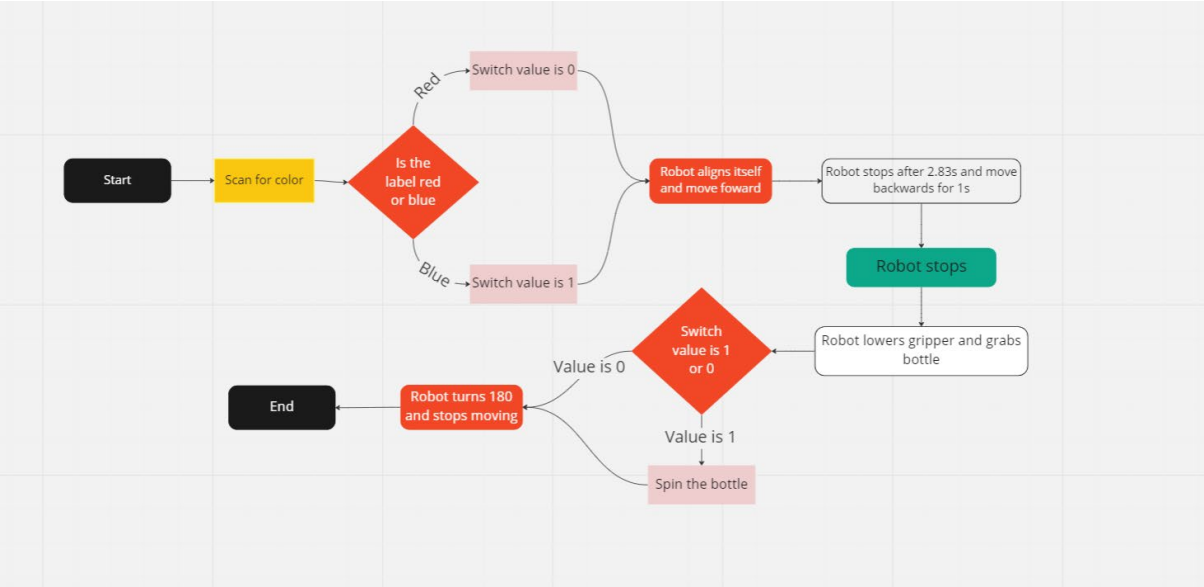
RoboMaster 2022 Youth Championship Singapore is a national level competition, as the champion, first runner-up, second runner-up, and third runner-up teams of RoboMaster 2022 Youth Championship Singapore may choose to represent Singapore at either the RoboMaster 2022 Youth Championship Final in China, where all top teams of RoboMaster 2022 Youth Championship will compete for the grand champion, or at the DJI RoboMaster International Game, where teams from other countries will compete using remote access technologies.

Objective of project

The objective of this project originally for me was to program and train an AI for the engineer robot, to get it to perform certain tasks autonomously. However, due to the AI module only arriving in during Week 6, the objective changed to programming a subsystem for the engineer robot.

Scope

Major Deliverable



For this example, the blue teams engineer robot will scan for either red or blue, and depending on what it senses, a switch value will become 0 or 1. The robot will than align itself and move forward for 2.83 seconds, before moving back for 1 second. The robot will stop, move its arm 120 mm forwards and 70 mm downwards. The robot will wait 2 seconds, close its gripper than wait another 2 seconds. If the switch value is 0, the robot will spin the bottle such that the blue label it is facing inwards else the robot will simply pick up the bottle. Afterwards, the robot will turn 180 around and the program will stop.

This subsystem can be paired for line tracing and a AI module to ensure that the engineer robot fulfils the conditions for the competition, where during the first minute of the round, the engineer robot has to autonomously move to the resource island, pick up the projectile container and return to its base by tracing the lines that are laid from the engineer base to the resource island that leads to the resource island.

Implementation

Issues Faced

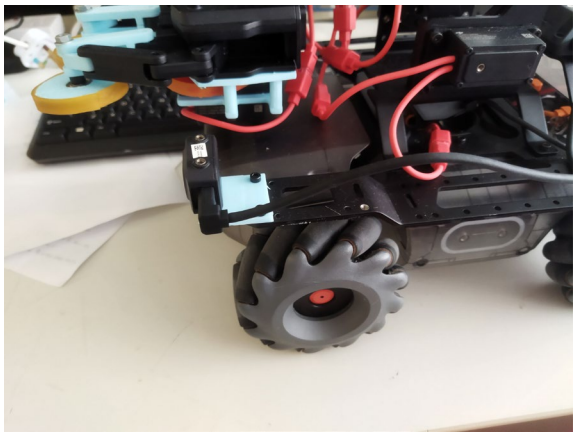
The camera is unable to detect the labels on the bottle if it’s not at the same level at times due to the lighting in the environment. The robot will also sometimes collide

with the place holder for the projectile container and the wheels on the gripper will lock in place due to friction.

Solutions

For the problems stated above, there are solutions available to help solve them.

- By relocating the camera to the front of the chassis, the camera can detect the labels around 26 cm away from the bottle. The camera can detect from further distance if the magnification is changed to x3, however x2 magnification will be the baseline.



- I programmed the robot to move back after moving forward, such that even if the robot was to collide, the robot will still move back far enough that the robot arm can extend and grab the bottle with a small margin of error.

- The axles that the wheels were mounted on was changed to screws, which reduces the surface rubbing against the wheel. Washers were also added in between the wheels and the other parts to reduce the friction.

Development of GUI for Badal simulator

Introduction

Project Background

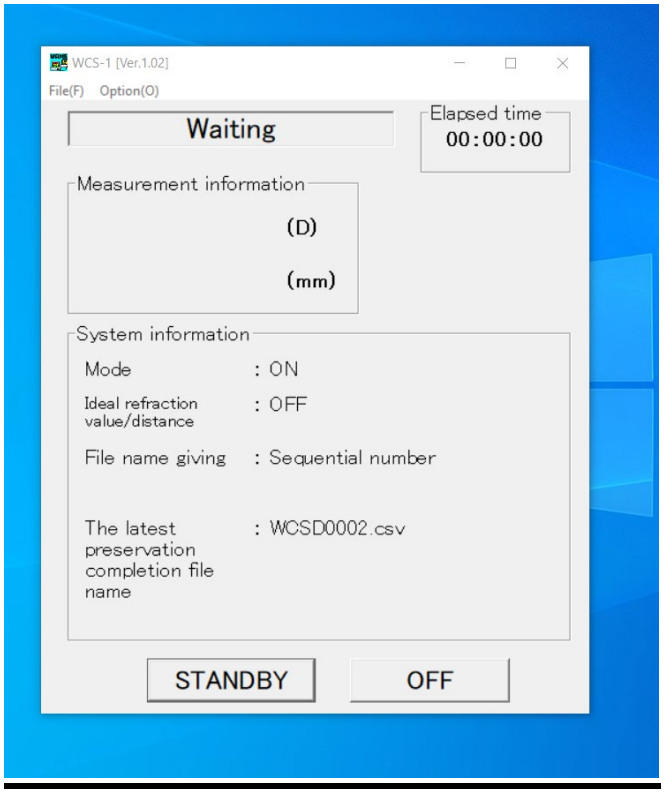
A picture of the Grand Seiko WAM 5500 Binocular Autorefractor/ Keratometer

The Grand Seiko Auto Refractometer is used by opticians to measure the refractive index of a person's eye, to check for conditions such as myopia, hyperopia, and astigmatism. This project that I am working on is part of the research and development of the Badal simulator requested by Essilor.

Essilor is the world leader in the ophthalmic industry. They are committed to providing solutions to correct and protect the visual health of the people around the world. They have put their expertise at the service of good vision in designing, manufacturing, and distributing quality products and services through business models, as well as providing products and services to meet the needs of everyone, everywhere.

Objective of project

A picture of the GUI that came with the Grand Seiko Auto Refractometer

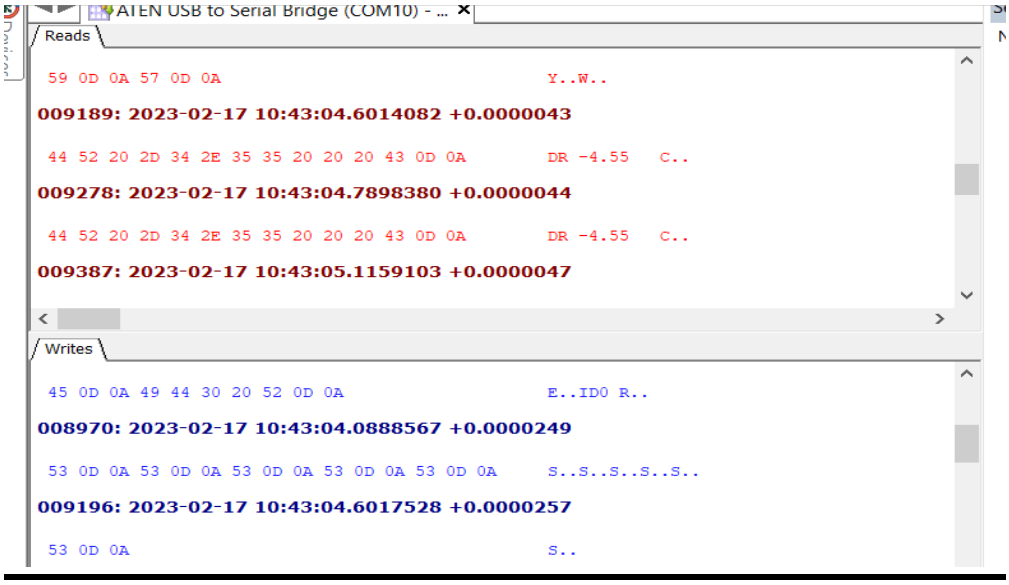


The objective of my part of this project is to develop a software application that is able to control the Grand Seiko Auto Refractometer. The software application has to come in the form of a GUI (Graphical User Interface) that can control the machine, able to decode the communication protocol that occurs between the machine and the PC. Furthermore, it has to come with functions that makes it an improvement to the software that came with the Grand Seiko Auto Refractometer.

Scope

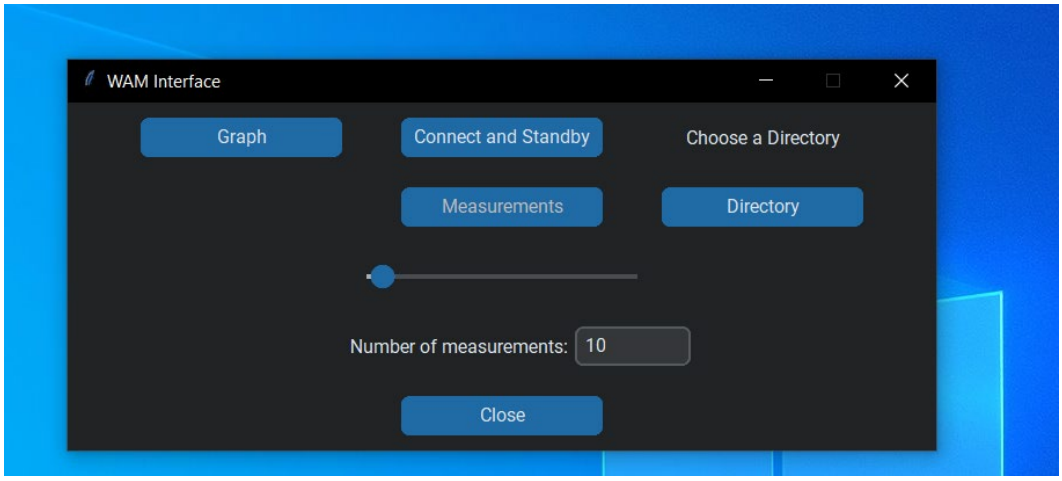
Major Deliverable

A picture of the communication protocol between the refractor and PC



The communication protocol taken from the communication between the refractor and the provided GUI using a third-party software, shows the hex code that is transmitted in between both during the measurement process. The process is complete manual as it requires the user to press the button on the joystick located on the refractor. By determining the codes that start, measure, and stop the measurements, they process can be replicated and made autonomous in the GUI that I create.

A picture of the GUI (Graphical User Interface) I created.

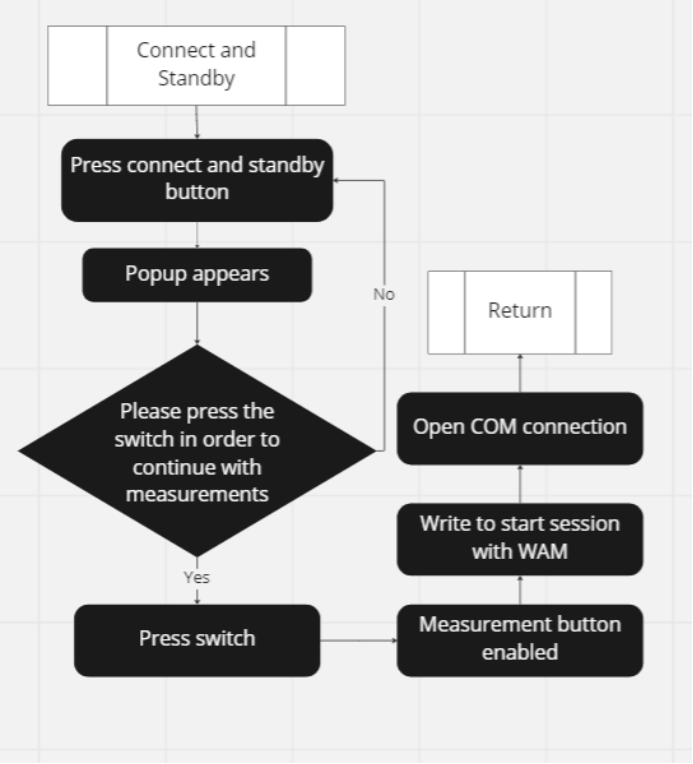


The GUI has multiple functions such as connecting to the refractor from the PC, selecting the number measurements and measuring them, saving the measurements into a Excel file, selecting the pathway to the saved file and graphing it out. This can

be broken down into four main functionalities, which are Connect and Standby, Slider/ entry box and Measurements & Save, Directory & Graph and a Close function.

Connect and Standby function

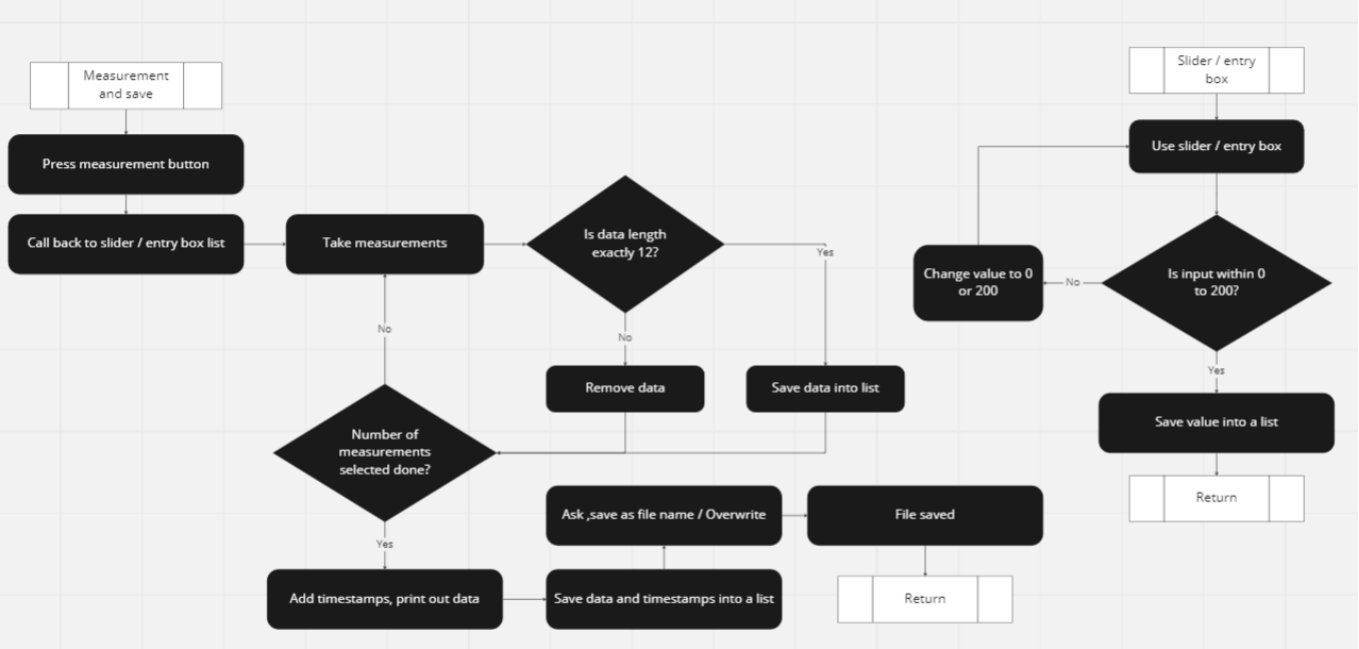
A flowchart of the Connect and Standby function's code



This flowchart shows how the Connect and Standby function works. The user will press the Connect and Standby button, which will trigger a popup to inform the user to press the button on the joystick. The user will either select yes to continue with the connection process or press no to close the popup. If they pressed yes, the measurement button is enabled, the hex code to enable Hi-speed mode is written to the refractor and the communication port connection is established.

Slider/ entry box & Measurement and save functions

A flowchart of the Slider/ entry box & Measurement and save function's code.



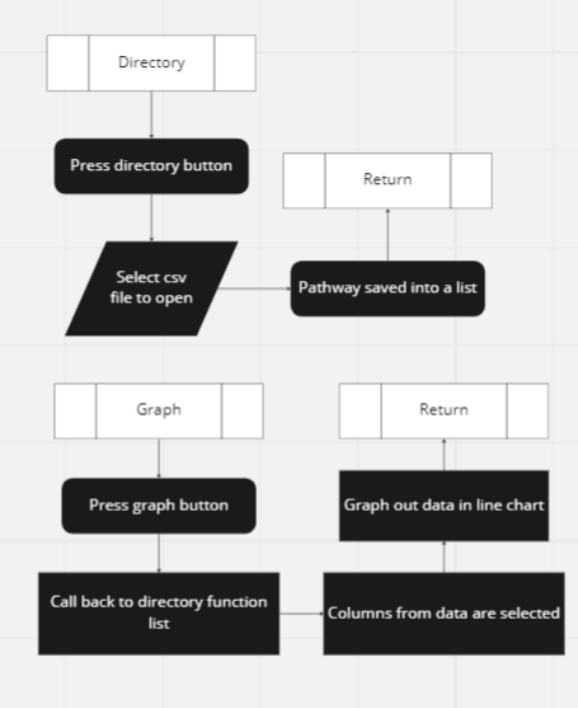
The user will select how many measurements they want, using the slider or entry box. If the user attempts to type in a value in the negative range or outside 200 measurements, the function will correct it to either 0 or 200 measurements. Once the user selects a value they want, the value is saved into a list.

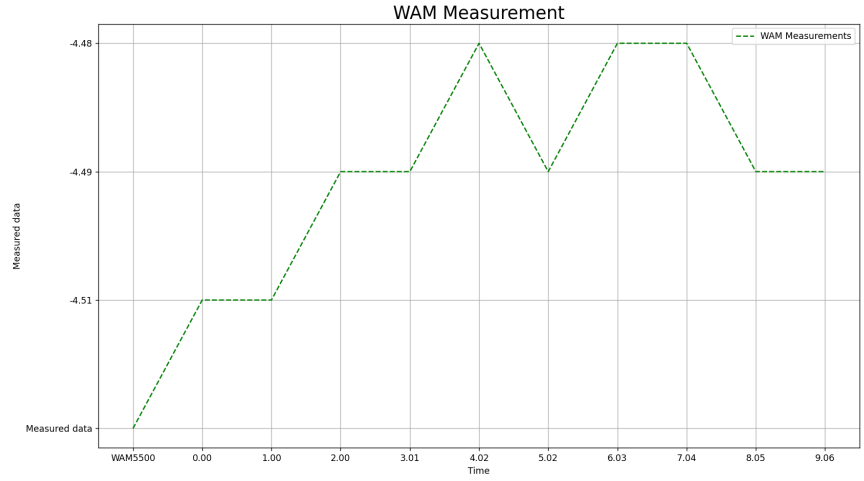
When they user presses the measurement button, the value saved in the list under the slider/ entry box function is called back to, the measurements are taken by writing the hex code to the refractor. If the measurement taken is exactly 12 characters long, the data is saved, else it is removed.

This process is repeated until the number of measurements selected by the user has been taken. The measurements are saved into a list with their individual timestamps, the user is prompted to save the file by either naming and saving it into a new file or overwriting an existing csv file.

Directory and Graph functions

A flowchart of the Directory and Graph function's code.





The user will press the directory button, which will select the pathway to the file of their choosing. Once they have selected it, it is saved into a list. The user will then press the graph button, which will call back to the list containing the pathway and select the data from the columns that are selected in the function, and it is graphed out in a line chart.

Close functions

A flowchart of the Close function's code.

When the close button is pressed, a hex code to end the session is written to the refractor, the communication port is closed and the GUI window is destroyed, exiting the user from the application.

Issues Faced

Some issues faced during this project was my lack of knowledge with Python, the refractor had its own internal program that is connected to the button which is impossible to obtain the program that is connected to the button without disassembling the machine, which is not what the company wants.

Furthermore, if the user were to take measurements outside of the model eye's location, the measurements that come back are sometimes empty but considered 12 characters.

For the problems stated above, there are solutions available to help solve them.

- I had to compromise with including the pressing of the button in my code to take measurements.

- I watched YouTube videos on Python, as well as consulted my friends and supervisor to assist me if do not understand a certain line of code in my program.
- The measurement code has a function that selects the first and third column of each measurement, if either column is empty, the measurement is rejected.

Conclusion

Reflection and acknowledgements

The 3 months I spent working on two different projects was an interesting time. I have a more comprehensive understanding of Python and its useful applications, as well as having the knowledge to build a GUI from scratch and the functions that go with it.

I also got a better understanding of creating a block-coded subsystem for an engineering robot. I can use the abilities and information I've learnt from this experience and apply them to problems in the real world, which will help my future job in this field.

I am thankful for the FYP supervisor, Mr Edwin Foo, for guiding and teaching me when I have questions about some parts of my code.

Appendices

Appendix A

Robomaster competition picture:

https://www.theverge.com/2016/9/27/13059144/dji-robomasters-robot-drone-battle-video-frank-wang-interview