MALAYSIA-JAPAN INTERNATIONAL INSTITUTE OF TECHNOLOGY

ESE DEPARTMENT

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SMJE3303 INTEGRATED DESIGN PROJECT

COVID19 SELF HANDLING UV LIGHT SANITIZER ROBOT

(SHULF)

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Abstract

This report defines a device consisting of a disinfectant UV light for the surfaces and objects that human expects to touch. This device can be powered automatically by the movement of the user's hand. It disinfects the surface of the walls and the objects in front of them using an ultraviolet (UV) lamp. Control and monitoring can be done automatically or manually, which assure ample and effective disinfection. In addition, it has an infrared detection system that turns off the system when triggered. The device has a futuristic, elegant, and practical shape. The total cost to make this device is below RM 500 and it is easily customizable which different respect to proprietary commercial devices actually available is. This device signifies an open source, secure, fast and automatized equipment for space disinfecting. The prototype will be built completely next semester .We believe this sanitizing device can be an effective tool in the fight against the current COVID-19 pandemic and, in general, help to address the health challenges related to hygiene and disease prevention.

Keywords: UV light, IOT, Covid-19, disinfect

Contents

CHAPTER 1: INTRODUCTION

1.1 OVERVIEW

This chapter describes the idea and motivation to develop a portable UV light sanitizer or which will be known as SHULS-BOT. It also includes problem statement, objectives, project significance, project scope and distribution of workload. The problem statement summarises the motivation and the problems leads to the development of this product while the solution for the problems are stated in objectives. Besides, the project significance discusses on need, approach, benefits and competition (NABC) of this product. The project scope covered about the functionalities provided by this product.

Rest of the report is organised in the sequence of Chapter 2 Literature Review, Chapter 3 Methodology, Chapter 4 Results and Discussion and Chapter 5 Conclusion and Recommendations, followed by References and Appendixes of this project. Chapter 2 discusses on the background of project and available commercial product in the market while Chapter 3 discusses on project development and cost estimation. Chapter 4 covered about the design of prototype, survey and simulation results and discussion on the results obtained. Lastly, Chapter 5 concludes the report with some future recommendations that can be implemented to the product.

1.2 PROBLEM STATEMENT

Because of the COVID-19 global health issue, sanitizers and disinfectants have become widely used. These items are likely to be at the top of people's grocery lists anytime they go shopping for necessities. However, while these household treatments keep us clean and prevent the spread of the virus, they can be hazardous if used excessively.

When the coronavirus first emerged, individuals were encouraged to wash their hands thoroughly and frequently in order to eliminate germs and prevent the virus from spreading. Alcohol-based hand sanitizers with at least 60% alcohol concentration are a fantastic alternative when people can't use soap, especially when running errands. Even yet, consuming too much alcohol can harm your skin and body. Furthermore, sanitising spray or chemical sanitizers do not provide complete disinfection of germs and viruses. When sprayed, the virus

and bacteria are not entirely killed since the spray does not completely cover the air space and the surface.

UV disinfection is ecologically friendly, chemical-free, and extremely effective, which has led to its widespread use. For wastewater disinfection, chlorine gas is most commonly utilised, and sodium hypochlorite is a diluted form of chlorine. Chlorine gas is an extremely poisonous chemical that is also quite cheap. It requires extraordinary attention to store, handle, and transport from one location to another. In comparison to chemicals, UV inactivates germs in water or on any other surface quickly and effectively. UV disinfects microorganisms in a matter of seconds, however chemicals like Clorox 4 in 1 disinfectant spray require longer to disinfect.

If we employ the old way of sanitising with chemicals, we will require more labour because more effort is necessary, such as wiping and spraying. In contrast to UV light disinfection, chemical sanitizers do not work in the food and beverage industry since they can have adverse effects. Traditional disinfection is a chemical procedure that is hazardous, unfriendly to the environment, and, of course, difficult to manage. It also has a high maintenance cost, is difficult to use, and has a higher operational cost, whereas UV light is a one-time investment.

1.3 OBJECTIVES

This section includes the description of specific objectives of developing a portable UV light sanitizer, namely SHULS-BOT.

There were three primary objectives for this project:

i. To develop a portable device that uses line tracking system and have different sanitization checkpoints to sanitize certain area effectively

ii. To build an effective Ultra Violet (UV) sanitizer. UV light disinfection, unlike previous disinfection procedures, is a physical technique of destroying bacteria and viruses

iii. To design a device that can alert and shut down automatically people that pass by SHULS-BOT using PIR sensors.

1.4 PROBLEM STATEMENT

Most of the UV light sanitizer available in market are designed to be run using wall socket. Moreover, the machine tend to have quick power draining. Furthermore, the usage of a GPS tracker is quite rare because it is inconvenient to bring it along everywhere. Hence, it is essential to have an portable device which has large power storage with a GPS tracker.

This device's sanitising process impacts a wide spectrum of germs and has a number of advantages over chemical-based sanitising procedures. With this initiative, we will be able to create a more environmentally friendly machine and a greener environment. Aside from that, investing once in UV light disinfection technology can save you time and money for years. Furthermore, because the robot is an IoT device, it is capable of self-handling. It does not require any manual handling. There's also no need for constant monitoring because the robot is equipped with a camera that can be viewed from a smartphone. It also has a tilting feature that aids in covering the surface area of objects in its path.

The machine will be beneficial in various aspects. It is portable device that can be used by everyone regardless time and place with only one touch. Other than that, it has security system to avoid exposing UV lights to humans using PIR sensors .

1.5 PROJECT SCOPE

Our UV light sanitizer is designed for public areas including malls, supermarkets, and factories. To accomplish this, the IOT - UV system for surface sanitization is highlighted. Because UV rays can have long-term negative consequences, the deployment of IoT will be beneficial. Because there is no need to manually turn on the button, it can be turned on using a mobile phone connected to a Wi-Fi network. We do not need to move the machine because it will move based on our instructions in the programme. This will be used in conjunction with the Internet of Things (IoT). Most of the disinfection machine in the market need to move by human or not portable.

1.6 DISTRIBUTION OF WORK LOAD

This part discusses about the distribution of workload. Task allocation is used to let each team members know their responsibility and do the tasks listed so that this project can be completed on time. For the completion of the whole project, summary of the activities carried out by team members was shown as Table 1. 1.

TASK	SYAHMI	HANIF	PRAVIN	AFRA
RESEARCH ON PROJECT TOPICS				
MAIN IDEA FOR THE PROJECT				
COMPARISON OF PRODUCTS				
TEAM DISCUSSION				
SOFTWARE				
HARDWARE				
SLIDE PREPARATION				
PRESENTATION				

VIDEO PREPARATION				
POSTER PREPARATION				
REPORT				

CHAPTER 2: LITERATURE REVIEW

2.1 BACKGROUND

COVID-19 is a disease caused by the SARS-CoV-2 virus, which was found in Wuhan, China, in December 2019. It is highly contagious and has spread rapidly over the world. SARS-CoV-2 is the virus that causes COVID-19. It's a member of the coronavirus family, which contains viruses that leads to the simplest illness such as head or chest colds to more serious (but less common) illnesses like severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). Coronaviruses, like many other respiratory viruses, spread fast via droplets that are expelled from yourmouth or nose when you exhale, cough, sneeze, or talk.[1]

Despite tremendous efforts to control the transmission of the disease, over 5.3 million cases are confirmed and over 340,000 deaths are confirmed to have been reported as of May 25, 20201. SARS-CoV-2, the beta coronavirus that causes COVID-19, is thought to transmit via both direct contact andairborne routes, and tests of SARS-CoV-2 survivability in aerosols have demonstrated viability for atleast 3 hours. Given the disease's rapid spread, which includes asymptomatic carriers, it's critical to investigate viable mitigation technologies that can inactivate the virus in public places and thereby reduce airborne transmission. [1]

The global community's focus has been distracted from the emergence of other infectious illnesses because to the COVID-19 pandemic. The Malaysian government has, however, never given up fighting other contagious illnesses. Despite the epidemic, efforts are still being made in Malaysia to stop and restrict the spread of infectious illnesses, according to Health Minister Dr. Adham Baba. In order to better coordinate the steps, it was taking to stop the spread of other infectious illnesses in Malaysia as well as the COVID-19 pandemic, the government modified The Prevention and Control of Infectious Diseases (Measures within the Infected Local Areas) Regulations as of March 2020. Here are details on three infectious illnesses that affect Malaysia and how the nation is addressing them. [2]

First is the dengue fever. Since the first reports of dengue fever in Malaysia appeared in 1902, the disease has been around. Dengue fever is carried through the bite of contagious mosquitoes, which is why it affects a significant portion of Malaysia's population. People who live in underdeveloped regions are most impacted since these locations have a lot of stagnant water bodies that are perfect for Aedes mosquito reproduction. [2]

Surprisingly, however, the Malaysian government only recorded a total of 16,565 dengue cases

from January to August 2021 as opposed to 63,988 cases in 2020. The government is optimistic about committing to and continuing the current effective measures, maintaining general hygienic conditions in residential areas as well as public areas with frequent mosquito fogging operations. With an approximate 94 percent decrease in total count of dengue cases across the country. [2]

The next contagious disease is tuberculosis. The lungs are affected by the airborne illness known as tuberculosis (TB). Similar to dengue, it is amongst the most widespread infectious illnesses in Malaysia, particularly affecting the poor. In low-cost apartments all around Malaysia, TB is made easier by living spaces that are too congested and improperly aired. The average number of cases reported across the country has fluctuated and changed in its trend, but as of 2019, about 92 out of every 100,000 persons in Malaysia had received a diagnosis. [2]

UV light exposure is a direct antibacterial strategy that has long been proven effective against many types of airborne viruses. A low-pressure mercury-vapor arc lamp, generating about 254 nm, isthe most often utilized form of UV light for germicidal purposes; more recently, xenon lamptechnology, providing a broad UV spectrum, has been used. While these lamps may be used to disinfectempty places, they cannot be utilized to treat occupied public spaces since direct exposure togermicidal UV light wavelengths can be harmful to the skin and eyes. [1]

The use of far-UVC radiation to destroy two kinds of human coronaviruses in the air was investigated in research published in the journal Scientific Reports. 229E and OC43 are two coronaviruses that can cause the common cold in humans. [3]

Based on their findings with these viruses, researchers calculated that far-UVC light could kill 99.9% of airborne coronaviruses in roughly 25 minutes if used according to existing regulatory requirements. These findings, they believe, would also apply to SARS-CoV-2. [3]

2.2 Available Commercial Product

There are quite a few UVC light sanitizer robot present in the market. The need for a clean and sanitized surrounding is very much prioritized in this day and age, especially after the emergence of COVID-19. [4]

Product	Description
ADDVERB  ***Figure 1***: S. User, "AGV and Amr Robot Home," *AGV ROBOT HOME*. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• The UV disinfectant mobile robot, also known as the decimator, is intended for use inside. • Decimator emits radiation in all directions, assuring a 99.99 percent disinfection rate. [5]
ATHEON  ***Figure 2:*** S. User, "AGV and Amr Robot Home," *AGV ROBOT HOME*. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• Second on the list is AITHEON. • Breaks down the DNA structure of infectious illnesses, bacteria, viruses, and other forms of hazardous organic germs • AITHEON has created Yezhik UVD, which is used as part of a regular cleaning cycle to prevent and reduce their spread. [6]
ALTOROS  ***Figure 3:*** S. User, "AGV and Amr Robot Home," *AGV ROBOT HOME*. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• Made in the USA. • Has built-in ultraviolet (UV) lamps, disinfects rooms and surfaces in a semiautomatic mode. • Uses motion sensors to identify individuals from other visual objects, preventing harm to human health. The COVID-19 disease is caused by dangerous germs, which are efficiently destroyed by the robot. [7]

UVNinja  ***Figure 3:*** S. User, "AGV and Amr Robot Home," AGV ROBOT HOME. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• Made in the USA, • A self-contained UVC disinfection robot that can treat both air and work surfaces. • It employs established UV technology found in hospitals to eliminate health dangers in indoor public places in a silent and autonomous manner. • Follows a schedule, on demand, or via the cloud. • It has an 8-hour disinfecting time and a 5-mile range between charges. • It is ecologically friendly, as it disinfects without the use of chemicals, is completely electric, and produces no waste. [8]
ASTI  ***Figure 4:*** User, "AGV and Amr Robot Home," AGV ROBOT HOME. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• Made in Spain. • A mobile disinfection robot against COVID19 created by ASTI Mobile Robotics and BOOS Technical Lighting • Employs ultraviolet (UV- C) light to kill germs and pathogens in the air, on surfaces, and on objects. • The radiation released by the robot, which can roam about the cleaned areas, achieves a 99.99 percent reduction in virus and bacterial load. [9]
DF Automation & Robotics Sdn Bhd  ***Figure 5:*** S. User, "AGV and Amr Robot Home," AGV ROBOT HOME. [Online]. Available: https://www.agvnetwork.com/uvc-disinfection-mobile-robot#addverb. [Accessed: 14-Jul-2022].	• Made in Malaysian by a tech firm that investigates the field of automation and robotics in order to fulfill worldwide demand and supply growth. • They specialize in the design, manufacture, marketing, and continuous improvement of Autonomous Mobile Robot (AMR) systems for a variety of industrial and commercial applications.[10]

2.3 ADVANTAGES AND DISADVANTAGES

Aspect	Advantages	Disadvantages
Software	• Can control all the functionalities of the robot easily using the IoT feature. • User-friendly	• Too many features at one place make the Network Analyser App makes it to lag
Hardware	• Can disinfect 99.9% germs using UVC lamp. • Has a buzzer feature that turns on when people are detected. • versatility of the machine (can be used anywhere) •	• Unable to stop the robot when human passes by or when one is in close range.
Surface Area and sites	• Able to disinfect the surface area of most of the objects and obstacles in a public space. • can be used for domestically and public sites such as malls, airports, railway station, banks and etc.	• Unable to cover the hidden surface area of objects such as under the table and so on.

Chapter 3: Methodology

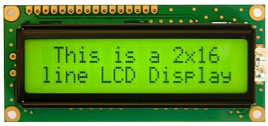
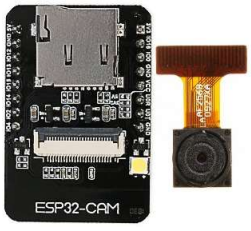
3.1 Project development (components, schematic & prototype design)

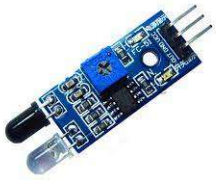
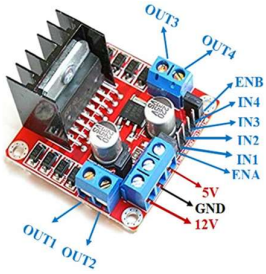
Our project development consists of three part which are component, schematic design and project design.

3.1.1 Modern tool usage (list of components)

The following Table 3.1 shows the list of components and its features.

Table 3.1: List of components and the features

Component	Description
Arduino uno 	The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller
WIFI ESP32 	The ESP32 is a very versatile System On a Chip (SoC) that can be used as a general purpose microcontroller with quite an extensive set of peripherals including WiFi and Bluetooth wireless capabilities.
LCD 2x16 	A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.
ESP32-Cam 	The ESP32-CAM has a very competitive small-size camera module that can operate independently. ESP-32CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications
Infrared Sensor	IR Line Tracking Module consists of a IR reflex sensor, it is a sensor with optoelectronic transmitter and receiver in a package.

	This module enables a robot to autonomously navigate a line-marked path
NEO-6M GPS module 	The NEO-6M GPS module is a well-performing complete GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna, which provides a strong satellite search capability. With the power and signal indicators, you can monitor the status of the module
HC-SR501 PIR Sensor 	PIR sensor is specially designed to detect such levels of infrared radiation. It basically consists of two main parts: A Pyroelectric Sensor and A special lens called Fresnel lens which focuses the infrared signals onto the pyroelectric sensor. HC-SR501 PIR sensors are a great choice. They are low power and low cost, pretty rugged, have a wide lens range, easy to interface with
Piezo Buzzer 	Piezo Buzzers are simple devices that can generate basic beeps and tones. They work by using a piezo crystal, a special material that changes shape when voltage is applied to it. If the crystal pushes against a diaphragm, like a tiny speaker cone, it can generate a pressure wave which the human ear picks up as sound.
Obstacles Avoidance 	HC-SR04 Ultrasonic Distance Sensor can report the range of objects up to 13 feet away. HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signal into 40KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses
L298N motor driver 	This L298N Motor Driver Module is a high-power motor driver module for driving DC and Stepper Motors. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control
'TT' motors	Plastic Gearbox Motors (also known as 'TT' motors) are an easy, low-cost way to get our projects moving.

	
Relay 	The 4 Way relay can trigger high voltage, high current load such as Motor, Lamps, AC load. It can control by microcontroller such as PIC, Arduino, Raspberry Pi, Node-MCU and more.

3.1.2 Schematic design

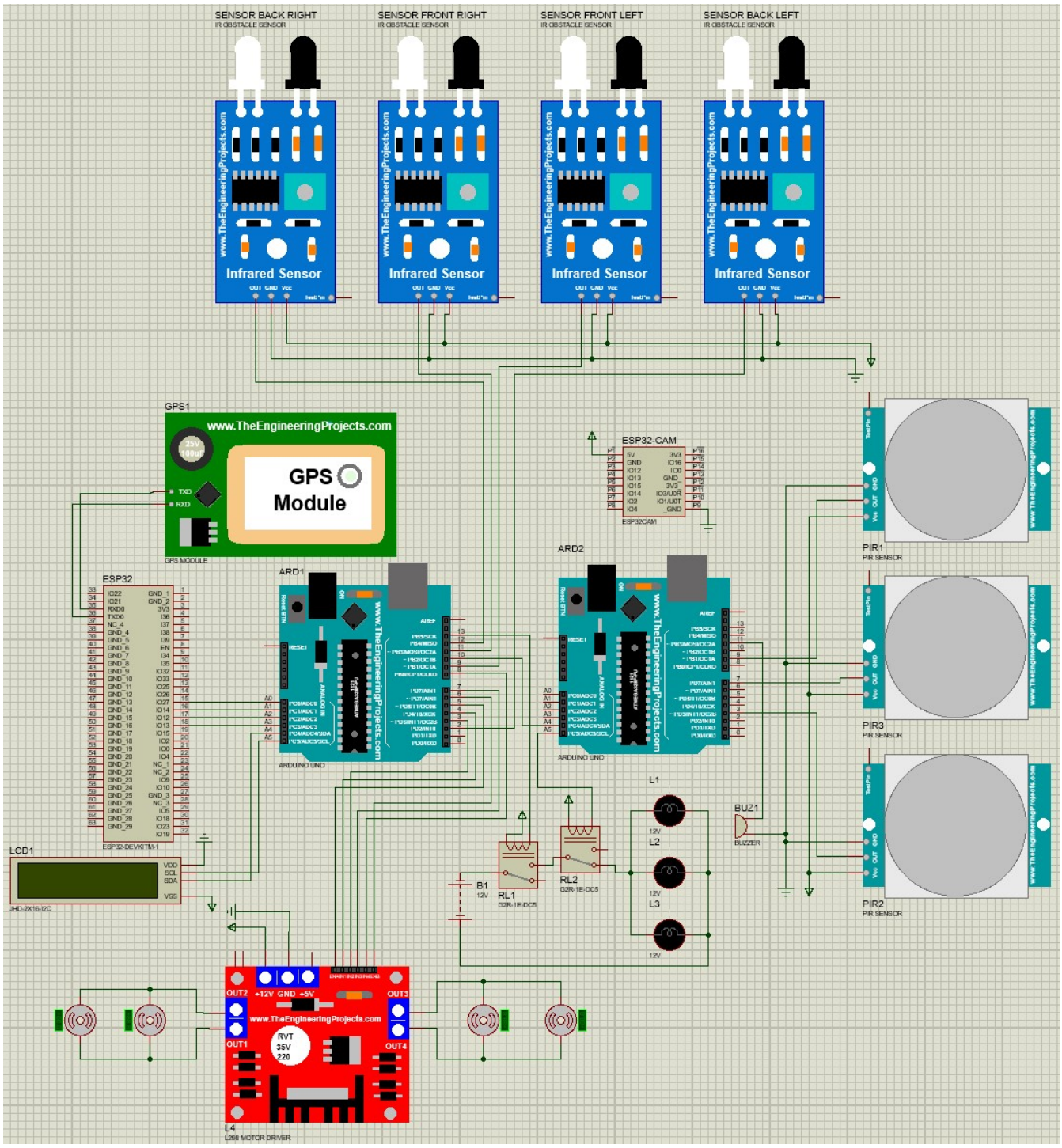


Figure 3.1.2: Schematic diagram for all connections.

The proteus 8 professional software is used in our schematic design project for covid-19 self-handling UV light sanitizer. Refer to the schematic diagram, we can see that all the components are connected to Arduino Uno and ESP-32, but only ESP32-CAM that have separate connection because it can stand alone doing wireless Wi-Fi monitoring task. ESP-32 are act as main controller and will communicate with other two Arduino Uno via connection pin between of them.

3.1.3 Project design

Figure 3.1.2 and Figure 3.1.3 below shows our prototype design for the 1st phase. Our design was divided into 3 parts which is mobile base, UVC base and the connection between those two bases. But in our final product design, we decide to increase the gap between each of UVC lamp to enhance the efficiency by wider the coverage of UVC exposure like Figure 3.1.4 as our final project design.

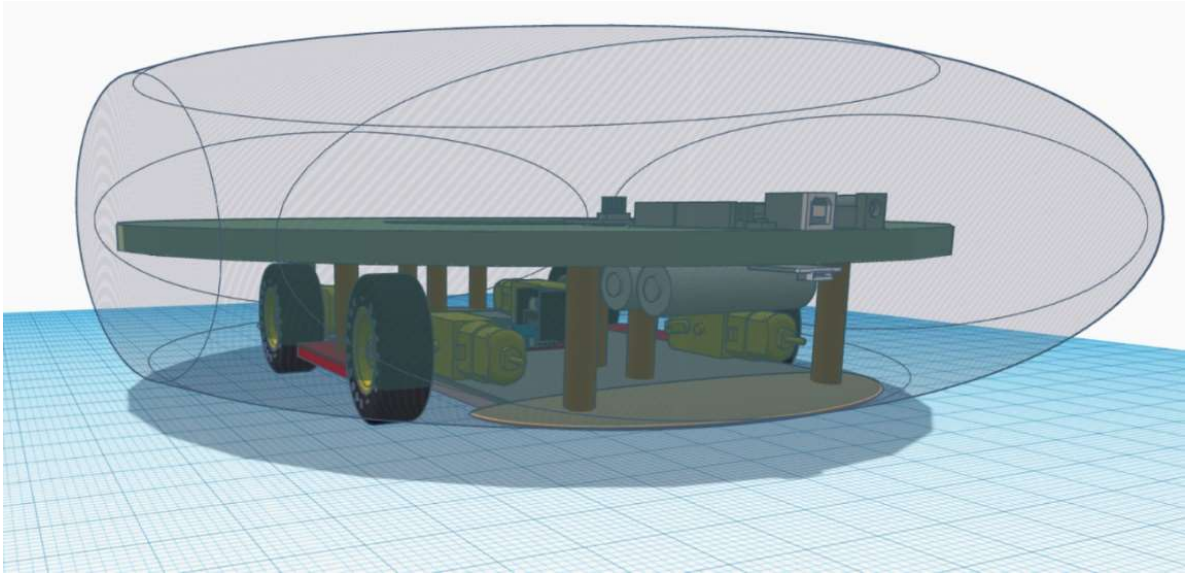


Figure 1.1.2: Mobile base side view.

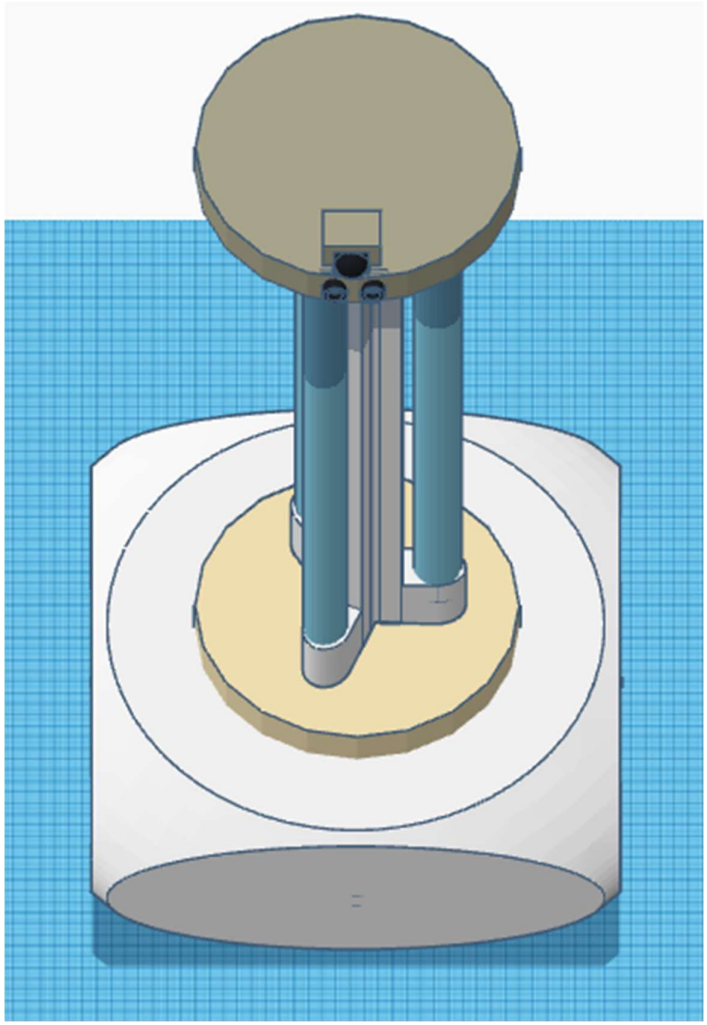


Figure 3.1.3: 3D prototype 1st design (side view).

Figure 3.1.4: Final project design

3.1.3 Project Block diagram & Flowchart

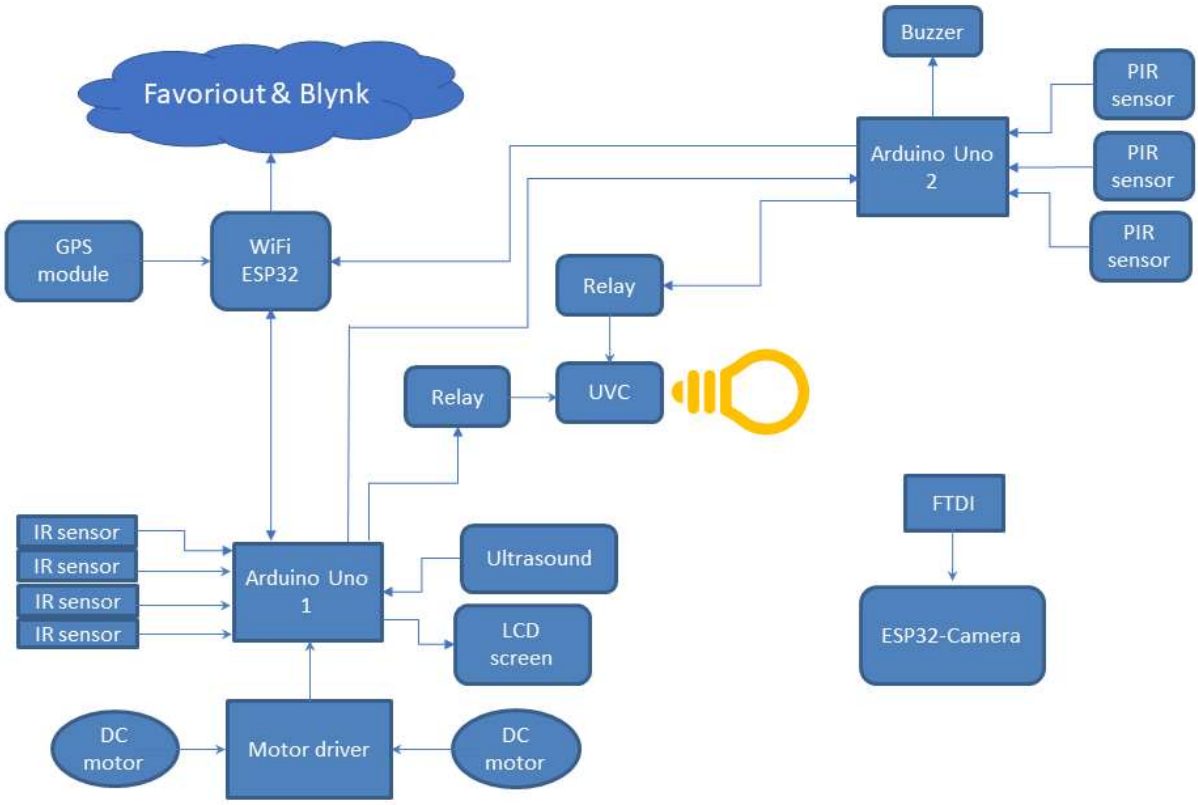


Figure 3.1.5: Block diagram of Covid-19 self-handling UV light sanitizer

The block diagram above shows the mechanism of covid-19 self-handling UV light sanitizer. As we can see, there are some of module have bidirectional and unidirectional connection to main brain of this project which is ESP-32. This project contributed 4 types of sensors which is ultrasound module as obstacle avoidance, PIR sensor as the detector movement of living things, IR sensor as the line tracker and GPS module as tracer for our device. As you can see, our UVC and is connected by two relay switch which is from Arduino Uno1 and Arduino Uno2. Relay is a switch that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. Those are for to turn on our UVC when arrive check-point and turn off when our device senses some movement object approach. Another component that we use is a buzzer as alarm to alert for someone approaching our device during sanitizing process.

All the data process are collected and being executed in ESP-32 microcontroller as a main controller. Output collected will be transmit to the targeted sub microcontroller like Arduino Uno1 and Arduino Uno2 to run the functionalities. ESP32-Camera will be standalone microcontroller and just communicate through cloud by gain it IP address as communication

address. The IR sensor, ultrasound sensor, moto driver, LCD screen and relay are connected with Arduino Uno1. Arduino Uno1 also is connected to Arduino Uno2 for communication purpose. From Arduino Uno2, PIR sensor, buzzer and relay are connected. Arduino Uno2 also make a communication with ESP-32. All-important data collected will be send to cloud by ESP-32, such as location tracer and sanitize process via Favoriot platform, and online control via Blynk platform such as manual control or see live stream camera.

As example, when process sanitizing happens, the Arduino Uno1 will turn on the UVC by switch on the relay and communicate with Arduino2 to active the PIR sensor to senses any movement object that existence during sanitizing process. the Arduino Uno2 will receive a signal from PIR sensor if any kind of movement object are detected. The signal received will translate by giving the buzzer a signal to create alarm for people who approaching to noticed and turn off the UVC by switch off the relay. Other example, when ultrasound sensor give a signal to Arduino Uno1 that there is object blocking our device, Arduino Uno1 will force to stop the sanitizing process and communicate with ESP-32 to trace the location via GPS module and stream the location coordinated to Favoriot platform. All the process are depending by set of instruction that we have code on all of our microcontroller and the data signal receive. We will discuss more about this on the flowchart.

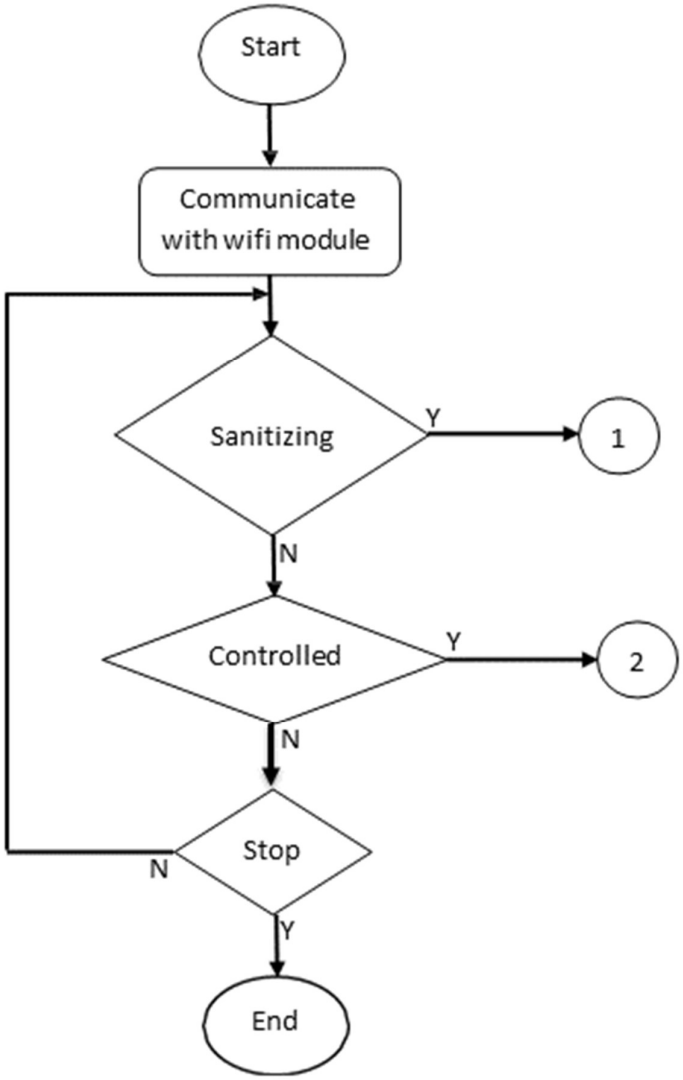


Figure 2.1.6 Main flowchart

Figure 3.2.2 shows that the flowchart of the main program of our covid-19 self-handling UV light sanitizer (SHULS-BOT) device. From the start we can see that our device will communicate via internet Wi-Fi first. The purpose is to linked sensors, features and other components connected to the internet of things (IoT) that can be remotely monitored, controlled or accessed and provide services that respond to the needs of the users. After that, user must decide on what type of mode that they want to use in sanitizing process either automated sanitizing or manual controlled. Lastly if they do not want to do any process, they can choose 'stop' to end setup. This cycle between line tracking, controlled and stop will continuously until the user made decision.

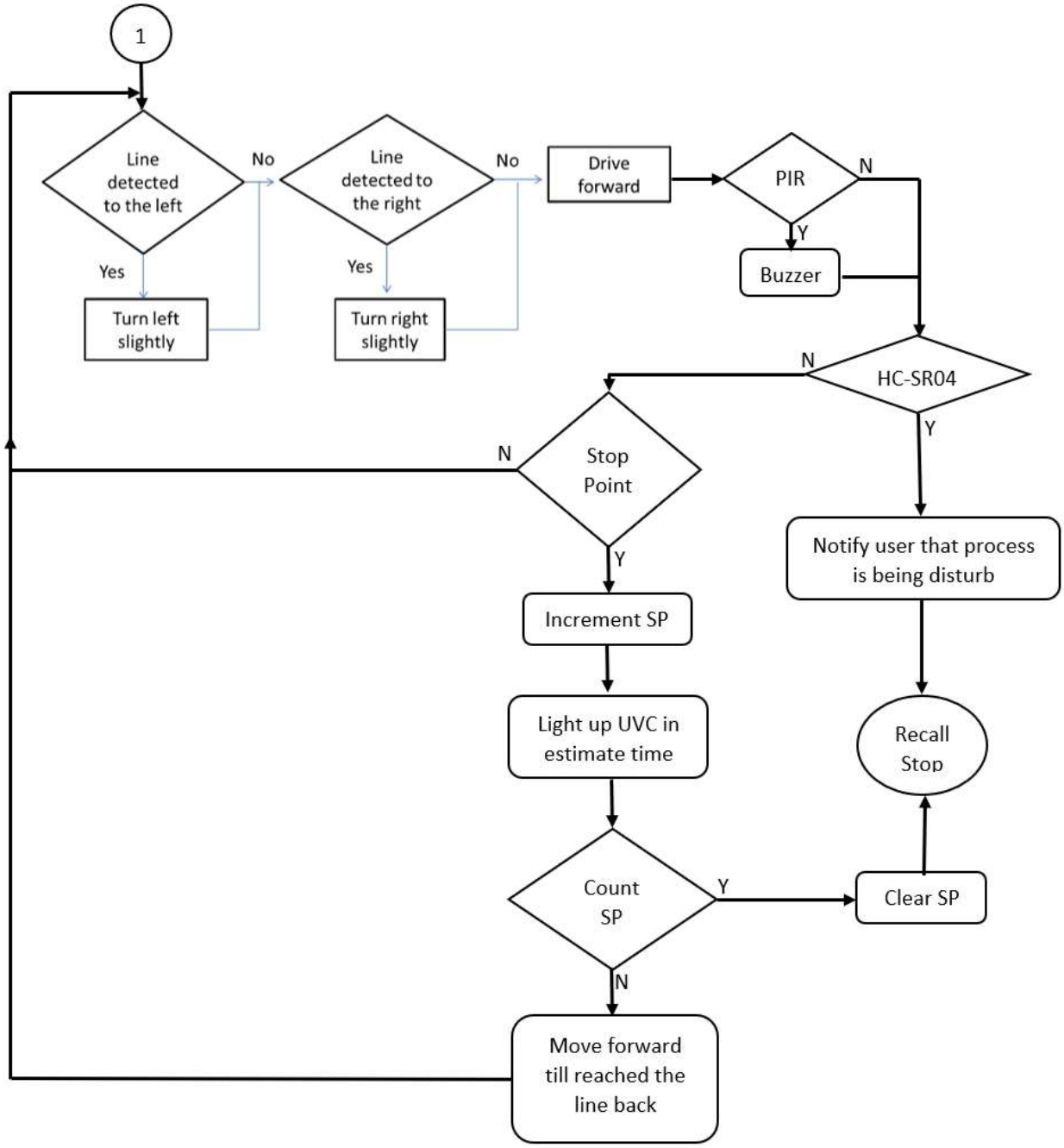


Figure 3.1.7: Sanitizing flowchart

In Figure 3.2.3, it shows the flowchart for sanitizing mode. First, it will determine the path for which way it must to go either left, right or forward. After that the device will check PIR sensor if it senses there is any human existence during the process begin. If the signal is 'yes', it will send a signal to buzzer to make an alarm sound to alert for those who approaching the area and turn off the UVC as long the object is inside the hazard range distance. If the signal is 'no', it will continue by check ultrasound (HC-SR04) sensor if there have any obstacle that block the

line tracking. If ‘yes’ it will notify the user that the process is being disturb and will recall the ‘stop’ at main programs, if ‘no’ it will continue execute next instruction. Next is determine either the device currently at stop point or not. If ‘no’ it will return again to determine the path for which way it must go. If ‘yes’ it will increment the ‘SP’. ‘SP’ is actually the value of stop point that our device must stop and run the process of sanitize by turn ON the UVC. After increment the ‘SP’, the process will continue by turn ON the UVC in estimated time and automatically turn OFF after that period.

The program will continue by count the ‘SP’. If ‘SP’ and the value determine is not equal, it will return to determine the path for which way it must go. This cycle will repeat until the value of ‘SP’ is equal. When the value ‘SP’ is equal, it mean that our device is completely sanitize all the stop point that we have been marked and will clear the ‘SP’ before recall ‘stop’ at main program.

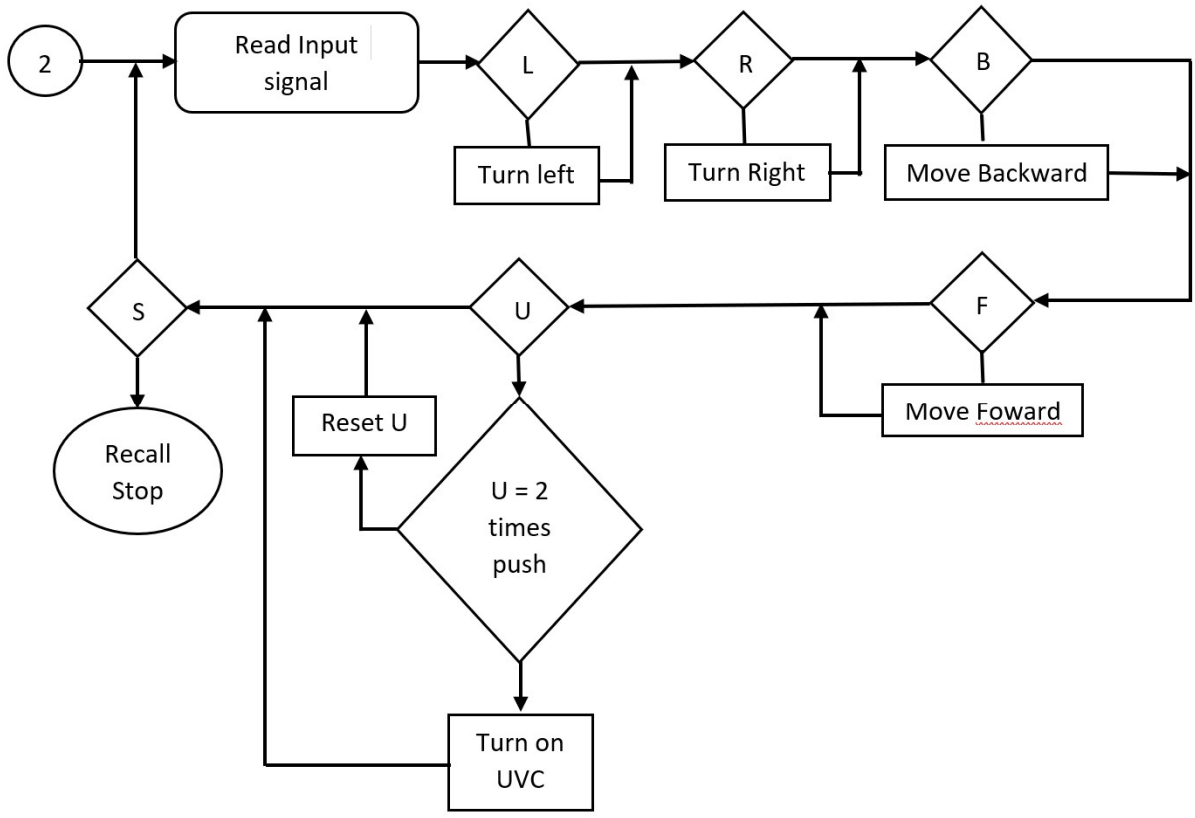


Figure 3.1.8: Controller flowchart

Based on Figure 3.2.4, it shows the cycle of every choice that user want to decide. 'L' for turn left, 'R' for turn right, 'B' for move backward, 'F' for move forward, 'U' for ON-OFF of UVC and 'S' for recall 'stop' at main programs.

3.3 Cost estimation

No.	Items	Quantity & price/unit (RM)	Cost (RM)	Date/Method of payment
1	IR sensor mobile	4 units x 6.00	24.00	22/04/2022 (Cash)
2	PIR sensor	1-unit x 10.00	10.00	22/04/2022 (Cash)
3	Arduino UNO R3 with USB cable	1-unit x 55.00	55.00	22/04/2022 (Cash)
4	DC motor (yellow)	4 units x 5.00	20.00	24/05/2022 (Debit card)
5	Motor driver L298N	1-unit x 12.00	12.00	24/05/2022 (Debit card)
6	Wheel	4 units x 6.00	24.00	24/05/2022 (Debit card)
7	Battery 18650	3 units x 8.00	24.00	24/05/2022 (Debit card)
8	Battery holder 18650X3	1-unit x 4.50	4.50	24/05/2022 (Debit card)
9	USB to TTL module CP2102	1-unit x 18.00	18.00	26/05/2022 (Debit card)
10	Breadboard 400Hole 8.3*5.5cm	1-unit x 4.50	4.50	26/05/2022 (Debit card)
11	GL-12 Breadboard 840Hole 17.4*6.6cm	1-unit x 6.50	6.50	26/05/2022 (Debit card)
12	Strip board 2.5*6 inch	2 units x 2.00	4.00	26/05/2022 (Debit card)
13	WIFI + Bluetooth module	1-unit x 35.00	35.00	26/05/2022 (Debit card)
14	Jumper wire mix 20cm 40P	1-unit x 8.00	8.00	26/05/2022 (Debit card)
15	Adaptor 12V 1A	1-unit x 15.00	15.00	29/05/2022 (Debit card)
16	Relay module 12V(1CH)	1-unit x 6.00	6.00	29/05/2022 (Debit card)
17	Acrylic board 2.0mmX400mmX300mm	2 units x 15.00	30.00	14/06/2022 (Fund transfer)
18	18650/Li-ION Battery 3.7V 4800MaH (Red)	6 units x 7.50	45.00	18/06/2022 (Debit card)
19	LEMAX DC 12V LED T5	3 units x 16.00	48.00	18/06/2022 (Debit card)
20	KB 1360X766X3MM Strawboard 10904657	1-unit x 20.00	20.00	25/06/2022 (Debit card)

21	IR sensor module	2 units x 5.00	10.00	2/07/2022 (Cash)
22	HC-SR501 PIR sensor module	1-unit x 7.80	7.80	2/07/2022 (Cash)
23	NXRC-JW-MF40 jumper wire (10cm)	1-unit x 4.00	4.00	2/07/2022 (Cash)
24	NXRC-JW-FF40 jumper wire (20cm)	1-unit x 6.00	6.00	2/07/2022 (Cash)
25	Input:3.3V~5V Output: High/Low (No)	2 units x 4.00	8.00	2/07/2022 (Cash)
26	PIR sensor HC-SR501 module	2 units x 6.00	12.00	2/07/2022 (Cash)
27	Breadboard 400hole 8.3*5.5cm	2 units x 4.50	9.00	2/07/2022 (Cash)
28	Jumper wire mix 12cm 40P	1-unit x 7.00	7.00	2/07/2022 (Cash)
29	Relay board 4pcs 5V/12V/24V High/Low triggle	1-unit x 18.00	18.00	4/07/2022 (Cash)
30	Relay board 4pcs 5V/12V/24V low triggle	1-unit x 14.00	14.00	4/07/2022 (Cash)
31	Battery holder 18650X3	2 units x 4.50	9.00	4/07/2022 (Cash)
32	Rocket switch 2pin round	2 units x 1.50	3.00	4/07/2022 (Cash)
33	Header pin 1X40	1-units x 0.80	0.80	4/07/2022 (Cash)
34	Female header 1X40	1-unit x 1.80	1.80	4/07/2022 (Cash)
35	Matte paper A1 presentation banner	1-unit x 25.00	25.00	4/07/2022 (Cash)
36	GP 9V Battery (Heavy duty)	1-unit x 3.50	3.50	5/07/2022 (Cash)
37	18650 rechargeable battery 4800mAh 3.7V	3 units x 8.00	24.00	5/07/2022 (Cash)
38	Battery holder 18650*3	1-unit x 3.50	3.50	5/07/2022 (Cash)
TOTAL EXPENSES (RM)			579.90	

CHAPTER 4: RESULTS

4.1 PROJECT ANALYSIS

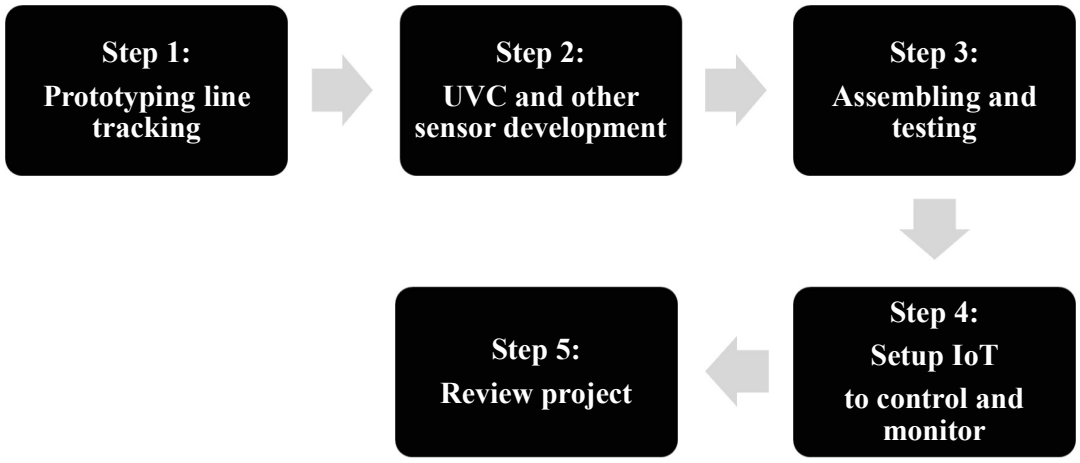


Figure 3.2.1: Project workflow

Creating a covid-19 self-handling UV light sanitize smart automated "SHULS-BOT" device are our project goal. This project also applying many sensors to ensure that our device is safe to use. On the other hand, we also determine to made our product have its durability on standard requirement. We also applied several communications system to make it user friendly. This project implementing GPS module to trace our robot and specific UVC spectrum to make our sanitizing process fully capable to completely kill the virus and bacteria at all surface and surrounding efficiently.

Step 1: Prototyping line tracking

First thing we do is develop a line tracking system and prototyping to run the sanitizing process. The prototype is designed by using Arduino Uno as microcontroller, 4 IR sensor as driver, 4 tyre and 4 dc motor. In this part, we prototype and testing so that our line tracking system can successfully follow the rule that we organize like our flowchart for sanitizing process. We place our connection like the schematic circuit Figure 3.2.2. and our initial prototype is in Figure 3.2.3. There is 2 front IR sensor to drive our robot when sanitizing process begin. When our robot approached the check-point, the front sensor will detect all black. After several time, the back IR sensor will drive the robot until the front sensor not detect both of them are in black

track. The back sensor will pass the driving to front sensor after one of front sensor or both of front sensor detect white area.

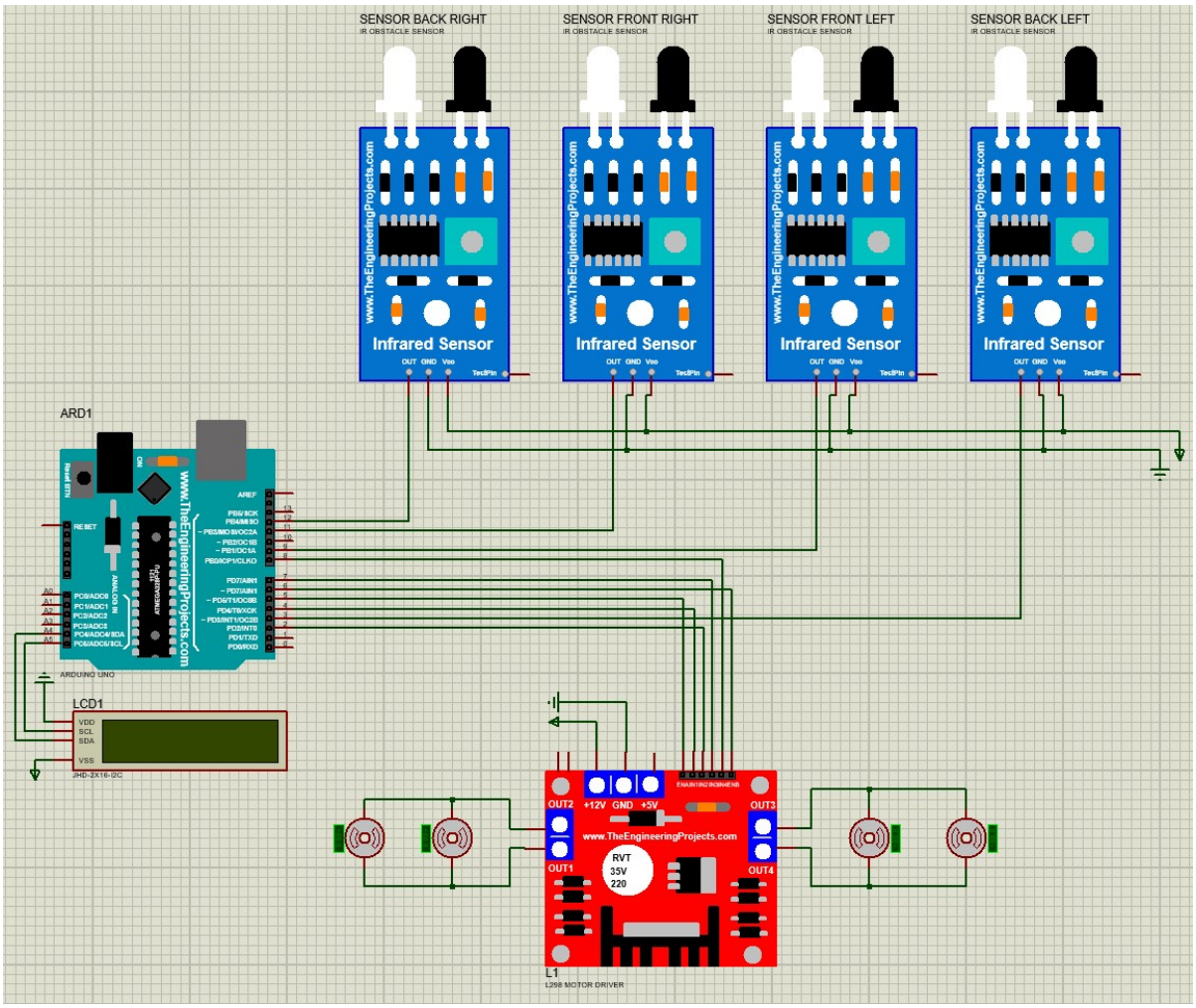


Figure 3.2.2: Schematic circuit for line tracking

Figure 3.2.3: Initial line tracking prototype

Step 2: UVC and other sensor development

After we successfully create and run the line tracking system, we proceed with develop all our sensor feature which is PIR sensor and buzzer to alert from UVC exposure hazard first. This safety also needs Arduino Uno2 (ADR2) to turn off the UVC by switch off the relay that connected with pin A5 when the PIR sense movement object approached within the hazard distance range. Then we code the ESP32-CAM to obtain the IP address for live streaming

camera. Lastly, we try to obtain real time location coordinate by GPS module via ESP-32. Figure 3.2.4 show our schematic circuit for UVC and other sensor connection.

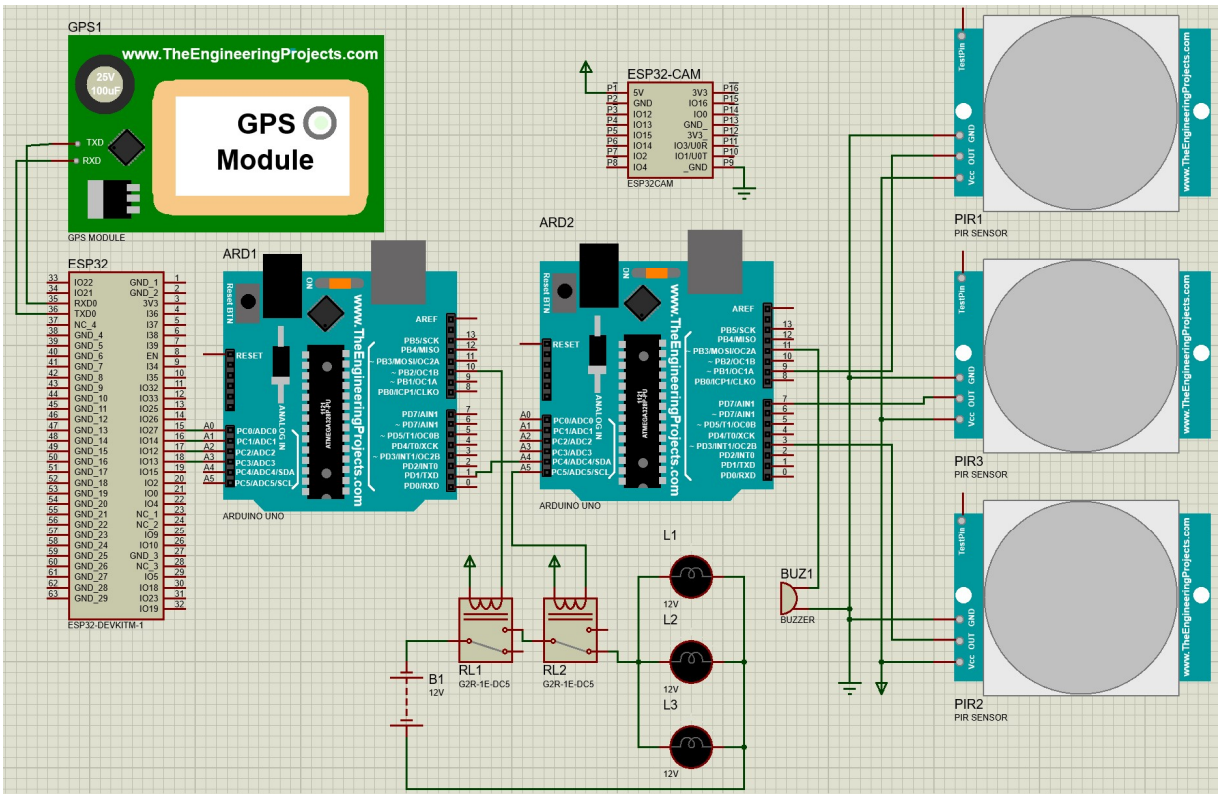


Figure 3.2.4: Schematic circuit for UVC and others sensors connections.

Step 3: Assembling and testing

After we troubleshoot and successfully operate all part separately, then we build our real project design and assembling all the connection for mobilize, UVC and all sensor exist in our project. We try to run all the function of our SHULS-BOT and troubleshoot if have error before we go to IoT development. Figure 3.2.5 and Figure 3.2.6 show our real project design development base on our 3D design in Figure 3.2.7. Figure 3.2.8 show our schematic circuit for mobilize, UVC and all sensor connection.

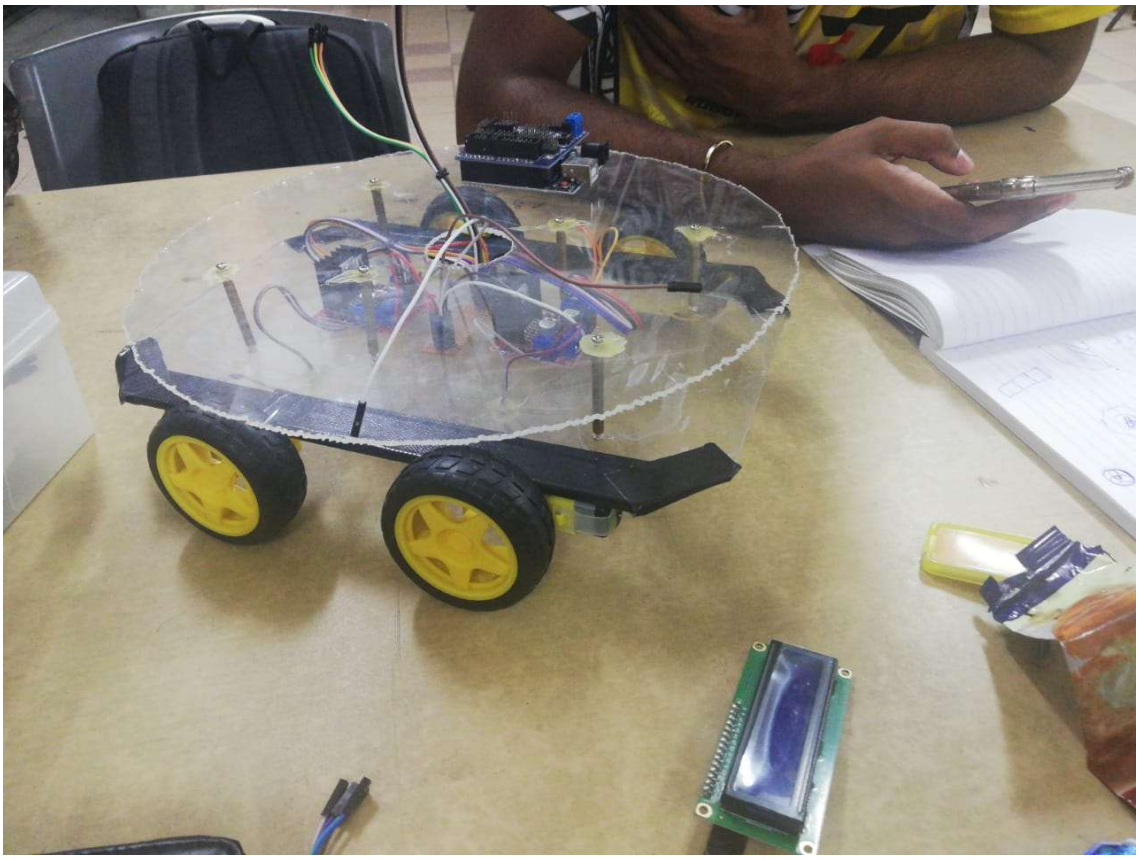


Figure 3.2.5: Mobile base development

Figure 3.2.6: Troubleshoot all SHULS-BOT function

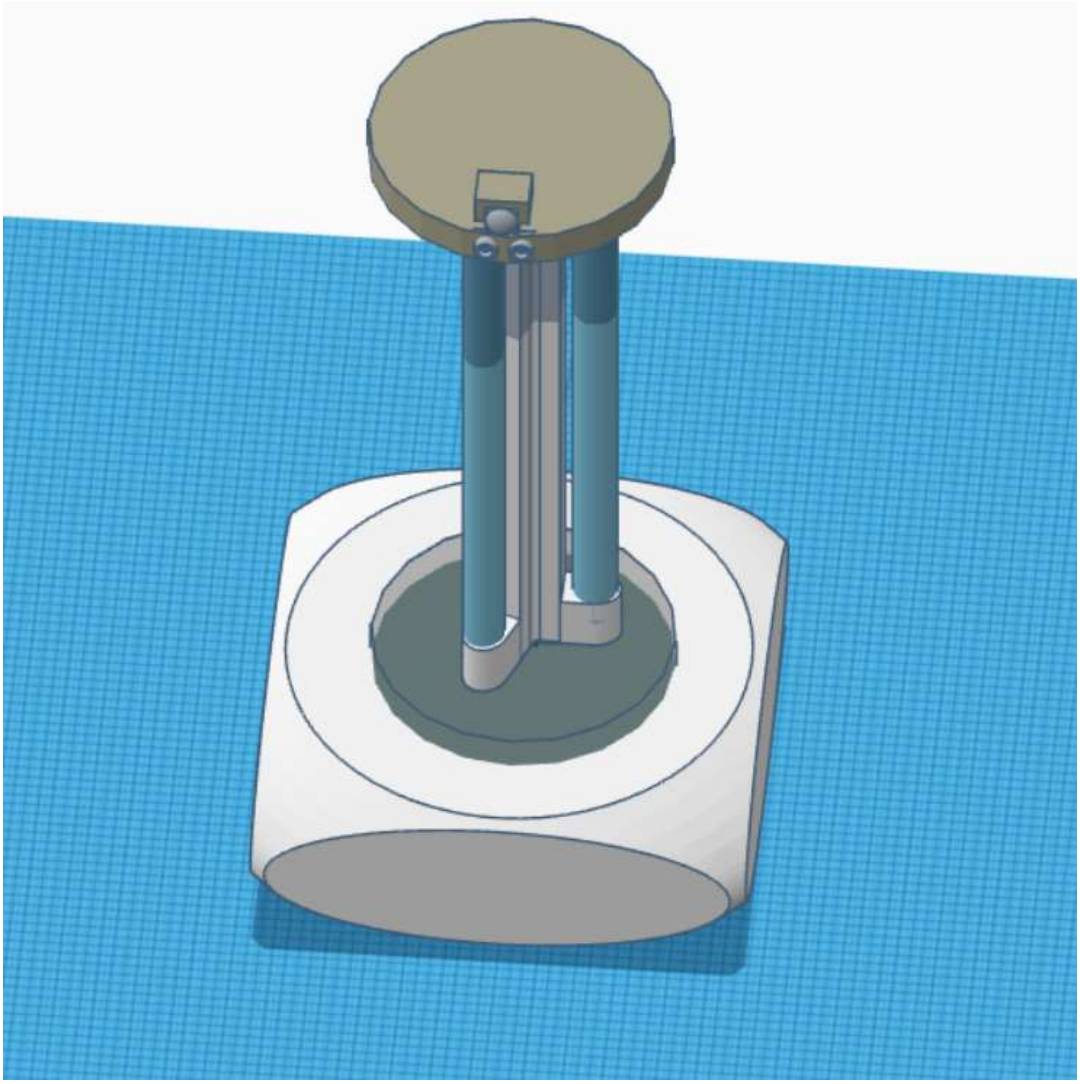


Figure 3.2.7: SHULS-BOT initial 3D design

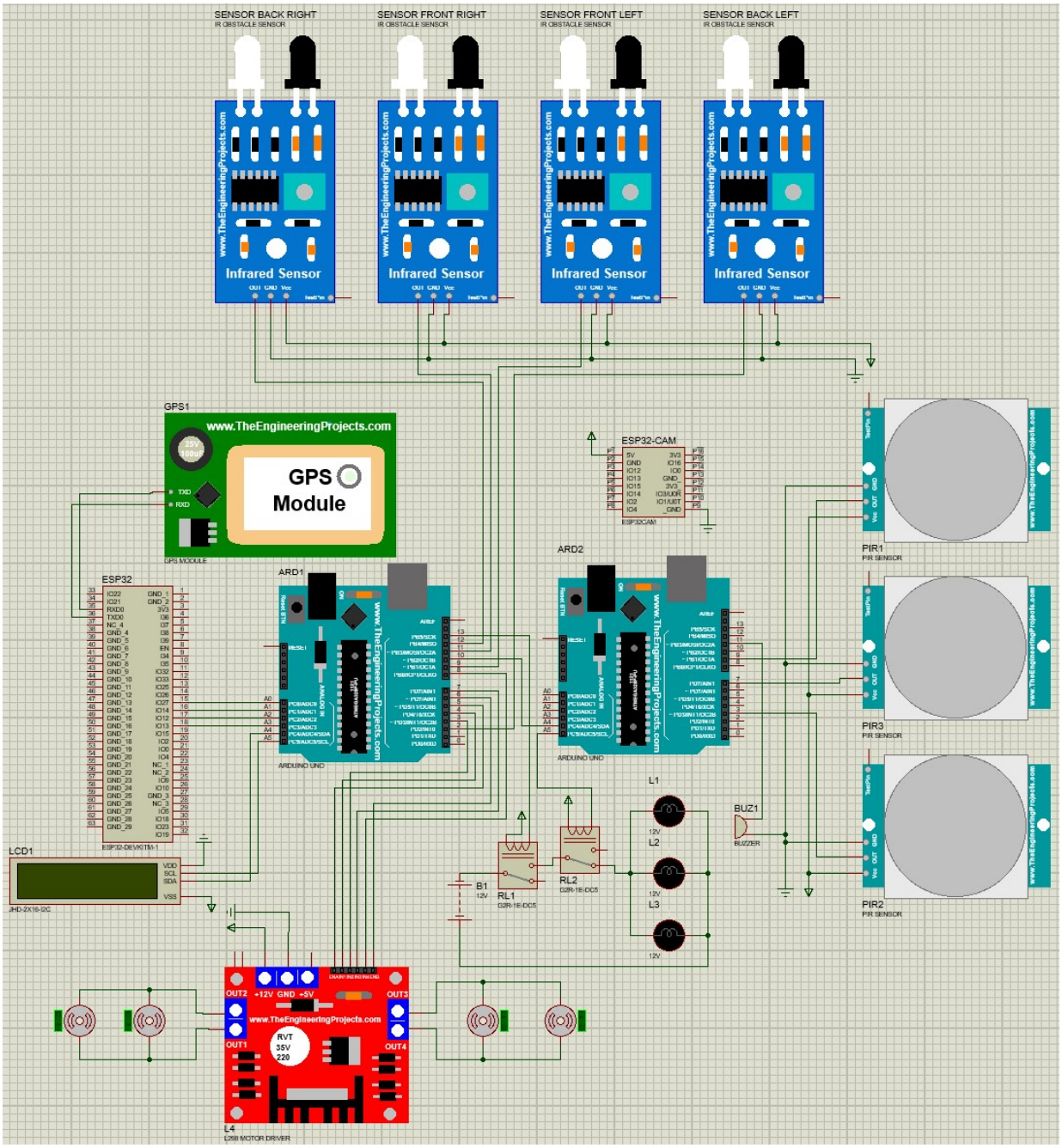


Figure 3.2.8: Schematic circuit for all component and sensor connection

Step 4: Setup IoT to monitor and control

After all the circuit connection are tested and verified, we will proceed by create IoT connection with Favoriot platform to monitoring and Blynk to remotely online control our robot. This process we need to configured what data we want to stream at Favoriot platform and what input and output we need to generate remotely online via Blynk app. Figure 3.2.9 show our device

interface using Blynk app. The above two switch from the Blynk configuration figure is set as control function for user decide. If F1 and F2 is ‘HIGH’, then it is ‘Stop’ mode. If F2 ‘HIGH and F1 ‘LOW’, then it is ‘Sanitizing’ mode. If F2 is ‘LOW’ and F1 is ‘HIGH’, then it is manual ‘Controller’ mode. In manual control mode, there are four switch below are indicate as a path of our robot which is forward, right, left and stop. Figure 3.2.10 show that we are able to stream some data to Favoriot but failed to structure the data stream properly.

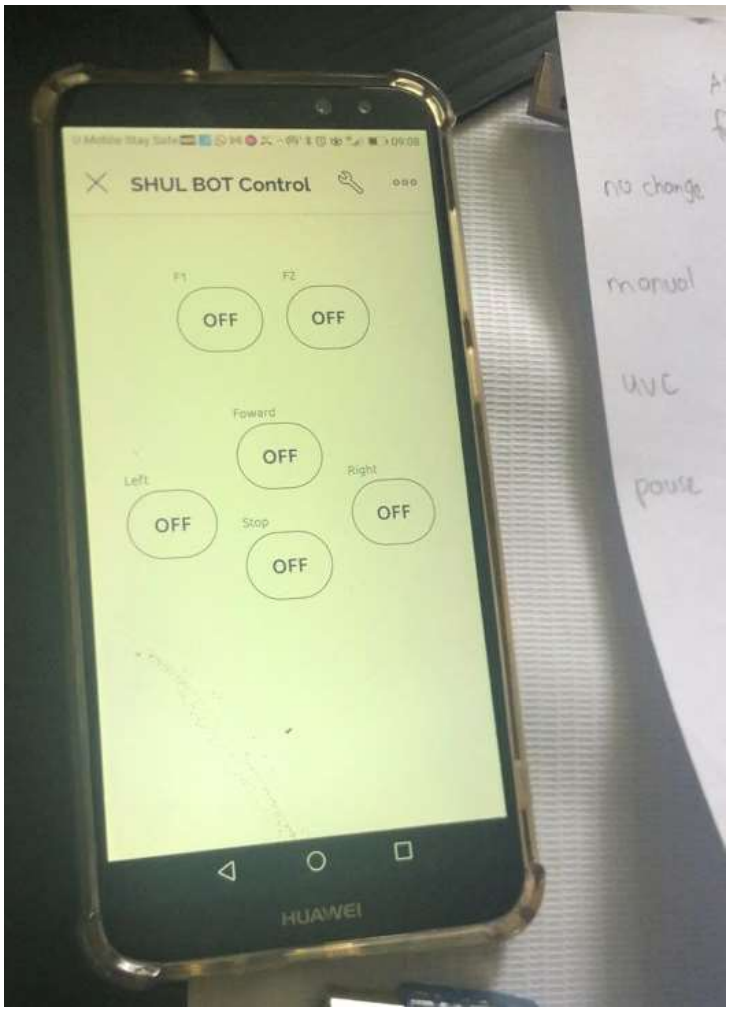


Figure 3.2.9: Blynk app configuration on user smartphone.

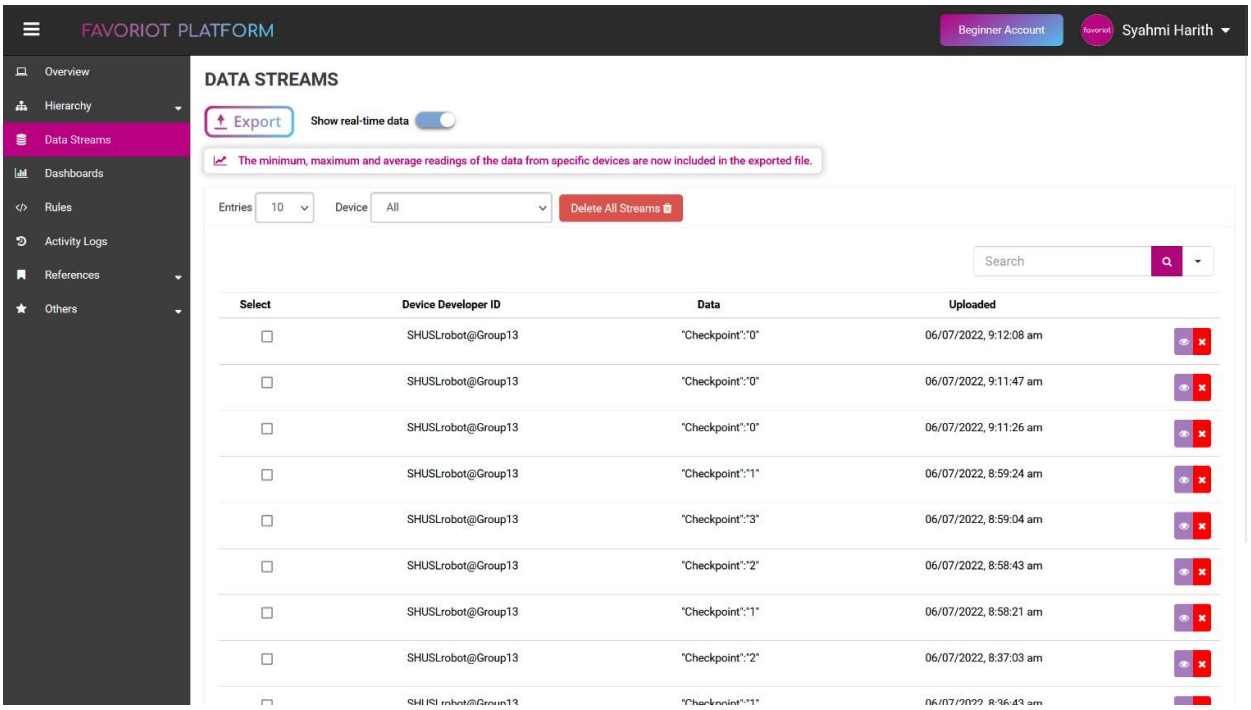


Figure 3.2.10: Data stream on Favoriot platform

Step 5: Project review

Lastly, we make project review to ensure that our robot is applied all the functionality of our project features. It needs to be fully functional and has durability to a standard requirement. Our project is finally complete and ready to be presents. We are aware that any error issues must be tackle before our product need to be present. By this, we are able to minimize our function error issues during the project showcase. Figure 3.2.11 show our final project presentation during showcase day.

Figure 3.2.11: Final project development during showcase day.

4.2 POTENTIAL CAUSE OF ERROR

This device may have some error occur when in operation. The device is equipped with many sensors and equipment to prevent any causalities such as PIR sensor to detect any human being around device before start sterilizing and buzzer to alert anyone near device. Although with these solutions, the possibilities of errors still high.

1. Device movement
   The device using line tracking system which is less movement can be made by device because the device is dependent on the line tracking. If there are some new area need to be sanitized, the line tracker needs to be added first before. Also, the line tracker needs to be maintained as it on the floor and the line will vanish after a long time. So, the cost of maintenance needs to be added.
2. Component
   The device is very heavy as many components was added like light bulb and body. As the results, the motor cannot move properly and cannot have accurate movement and checkpoint.
3. Power source
   As the bulb added into device, the power usage become high and the battery power drain faster. The power usage also high as the weight of the device added.
4. Effectiveness
   The device only can sanitize horizontal and cannot reach at higher place and vertically. This make the device less practical to some place that has higher place need to be sanitize such as table.

4.3 POTENTIAL SOLUTION

Although with these errors, it can be overcome with some innovation or function. Some of the errors

just need adjustment and take time to avoid that.

1. Usage of magnetic sensor or GPS
   Line tracking problem can be solved if the device using magnetic sensor or GPS as navigator for more accurate movement and the freedom for the device to move freely.
2. Use servo motor
   Servo motor is better than regular motor as servo motor has more accurate movement based on calculation and more powerful torque to move the device.
3. Use higher power supply
   The power supply needs higher power to make sure the device has long time to use and more convenient for user. The higher power also needed as many devices need more power to operate such as motor and bulb.
4. Use arm angle
   Arm angle more convenient to sanitize the higher place and vertical surface as it has more freedom to sanitize more places and more practical to use the device in many places. It also provides safety to human as it has specific surface to open the light and sanitize.

CHAPTER 5: CONCLUSION

This chapter discusses about the conclusions for the overall project. The conclusion of the development of the product, SHULS-BOT is concluded. Furthermore, a few recommendations for future work are discussed for any conceivable improvement on this product.

5.1 CONCLUSION

This project is developed based on the objective to provide a portable device that uses line tracking system and have different sanitization checkpoints to sanitize certain area effectively. This device will be very useful and convenient for everyone especially places that have a lot of people. In addition, this product is installed with the IOT part that able to control from our phone with one step. An enhanced sanitization device like this product will be very useful for everyone in this busy and hectic life. Thus, this project hopefully can reach the market and public so that everyone will be beneficial through this product.

5.2 FUTURE RECOMMENDATIONS

For the future recommendations, few enhancements and improvements can be made to improve the product. For the current design, this device not able to implement GPS tracker to detect location in case of lost connection. In order to overcome this limitation, it is required to use a more advanced GPS tracker so that the user able to know the exact and precise location.

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