FACULTY OF ENGINEERING (FKJ)

ELECTRONIC ENGINEERING (COMPUTER)

UH6523002/HK20

KS32702 DESIGN PROJECT II

SEMESTER I SESSION 2021/2022

GROUP 2

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ABSTRACT

Due to the recent COVID-19 pandemic, the World Health Organization (WHO) and the Ministry of Health in Malaysia advise the general public to perform social distancing as one of the effective methods to curb the spread of COVID-19. This method works but is not normally practiced in the community due to the Asian culture or stubbornness of society; the public rarely performs social distancing. To teach the young school children about social distancing, develop a social distancing band for kindergarten level or Primary 1 to Primary 3 to strictly adhere to social distancing. In addition, this band also can be used for Home Surveillance Order (HSO) for the public that has been infected by the COVID-19 disease. This report proposed a newly upgraded device than the usual smartwatch out on the market. Social distancing bands can be produced using methods such as embedding the programming into the microcontroller and developing applications to trace the distance between each band or track the user's exact location on the map. The methods involving in several steps, for example, to make the hardware function on several requirements for its function properly, we need to identify which pins on the microcontroller need to be used and write a program on any suitable compiler software to write the function of the hardware and embed it using any suitable software such as Arduino. While developing an application, we need to select which convenient gadgets that need to be used to monitor our daily track which is usually nowadays which will be developed on smartphones. After that, we need to make the user interface convenient for the user and make any recommended functions to be included such as quarantine status, location on maps, profile, etc. Lastly, after all the user interfaces are developed we need to make it in real apps which use any programming software such as Android Studio to make the apps function in real-life daily users. For instance, the social distancing band is very useful for our daily life, especially the children who are always hard to control their movement. By this social distancing band, the children in kindergarten can be aware every time they break the social distancing SOP and can also create a better environment that follows the rules on SOP by using this social distancing band.

CHAPTER 1

INTRODUCTION

1.1 Project Overview

Social Distancing has been advised as one of the methods to curb the spread of COVID-19 during the pandemic by the World Health Organization (WHO) and the Ministry of Health in Malaysia. This is a measure that works but is not normally practiced in the community causing the spread of COVID-19. Due to our Asian culture or human close relations, we tend to forget about this advice.

1.2 Problem Statement

As inventors, you have been approached by the Ministry of Education in Malaysia to help develop a social distancing band that can be worn by younger school-going children at the kindergarten level or Primary 1 to Primary 3 to strictly adhere to social distancing. Also, this band can be extended to be used as a band for Home Surveillance Order (HSO) for COVID-19 positive persons as requested by the Ministry of Health in Malaysia.

1.3 Project Purpose

The purpose of this project is to build a Social Distancing Band to meet the requirements of the Ministry of Education in Malaysia. Here are the following requirements:

- The band should be light, The band cannot be tampered with unless authorized to be opened by authority, The band can be used to indicate adherence to the social distancing of 1 meter from each other and an alert sound is to be triggered in non-compliance cases, This value of 1 meter can be adjusted via an app, An app is to be developed for interface purposes with the band, The band shall have a function for the band to recognize the other band user and thus, calculate the distance from each other, Accuracy of the distance measurement should be within +/- 5% (ie. 5 cm for 1 m distance) of the distance stated, The band can be used to alert the authorities should the person undergoing HSO leave his/her home, Data safety of the user should be given high priority.

1.4 Literature Review

Although there are not many publicly available social distancing bands in the market, there are a few proposals or concepts that are made by companies or institutions. There are a few companies that made this product.

Table 1.1 List of the products available on the market as in January 2022.

No.	Model	Battery Life	Distance detection	Additional features
1	KKM Social Distancing Alarm Contact Tracing Wearable K59	10~14 days	1~3 meters	-IP67 waterproof -Work with or without a smartphone or App.
2	Ultimaxx Electronic Social Distancing Wristband	7 days	6 feet (1.8 meters)	-Use With Or Without The App -Customizable Functions and Data Through The App
3	VTap Smart Social Distancing Bracelet	NA	less than 2 meters	- With motion sensor

Table 1.2 List of the Proposal Product that Made by other Institution

No.	Journal	Author	Outcome
1	Smart Social Distancing Band	Evani Sai Krishna Karthik, Potu Teja, Vaggu Sridhar and B. Priyanka	A widely available component that has been used such as Arduino UNO and pulse sensor. This report presents a way to maintain social distance by alerting the person by detecting close contact of people around by using a PIR sensor and

			sending feedback through a buzzer.
2	Social distancing using IoT approach	Mayuri Diwakar Kulkarni, Khalid Alfatmi & Nikhil Sunil Deshmukh	Proposed using commonly available hardware with custom design to fit the whole housing. The Grove PIR motion sensor measures the distance with response speed 0.3 s to 25 s. This will measure a distance maximum of 3–6 m. This sensor will detect the object with an angle of 120 degrees. Suitable for school use since it does not require a smartphone connection to connect.
3	Social Distance Monitoring Approach Using Wearable Smart Tags	Tareq Alhmiedat and Majed Aborokbah	They are using various types of sensors to make a wearable tag. From the result obtained, they found out that the band was comfortable to use and it has high accuracy to detect other people. SD-Tag offers an efficient social distancing method for maintaining social distances between people in public places, with an average accuracy of 1.69 m, and achieves minimum power consumption; the tag can work for the whole day with one charge.

CHAPTER 2

METHODOLOGY

2.1 Block Diagram

For this project, we will be using block diagrams as the main idea to complete the social distancing band. To make our plan clear and informative, we have decided to separate block diagrams. Below this contains a block diagram for electronic and apps/software. Each block diagram has its flow and its criterion.

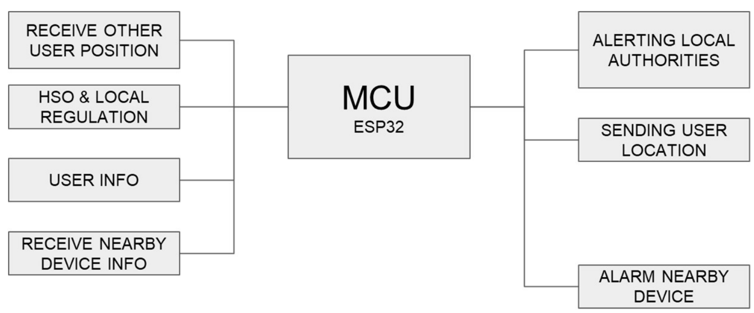


Figure 2.0 Block Diagram of the Social Distancing Band Working System

2.2 Organisation Chart

Our organisation chart is based on Work-Based System (WBS) which generally can divide into 4 which is Programming, Mechanical, Electronic and Report as stated below:

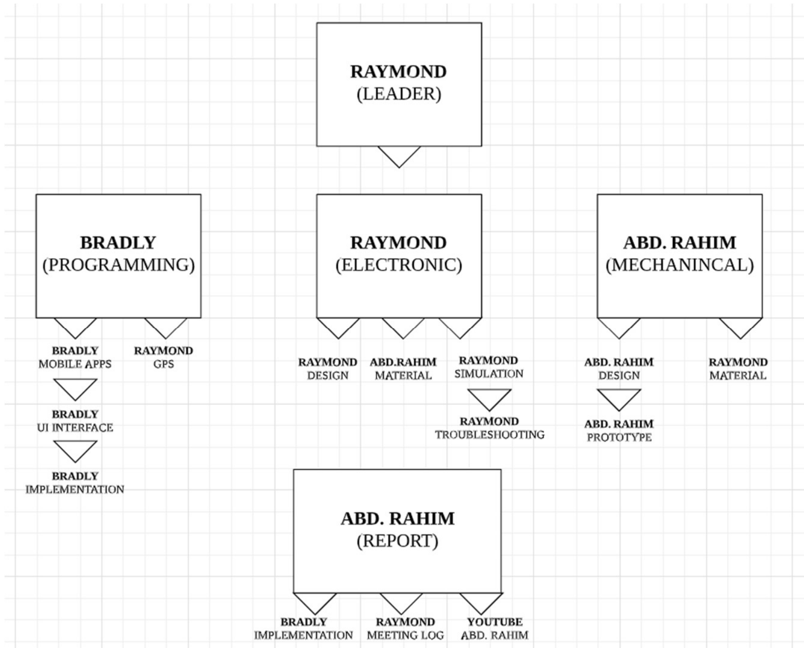


Figure 2.2 Organisation Chart

2.2.1 Project Schedule

Below this table shows the schedule to complete all tasks that we will perform within 14 weeks.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Task	Research and surveying													
			Proposal planning											
						Mechanical design and blueprint								
								Band circuit design and programming						

				Software development and programming		
					Testing,debugging and modifications	
						Report

CHAPTER 3

DETAILED DESIGN

3.1 Introduction

In this chapter, we will explain how we manage to obtain the details of our design project which will meet the requirements of the project.

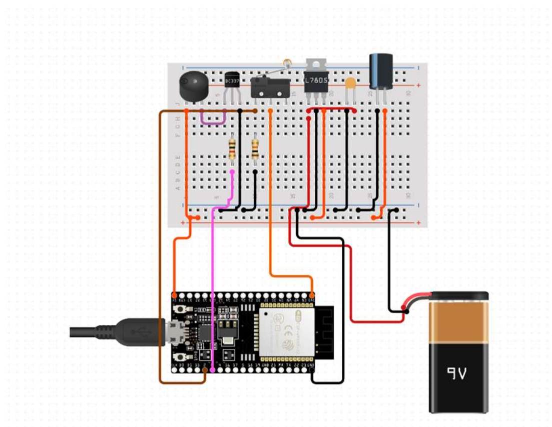


Figure 3.1 Electrical Circuit of Social Distancing Band

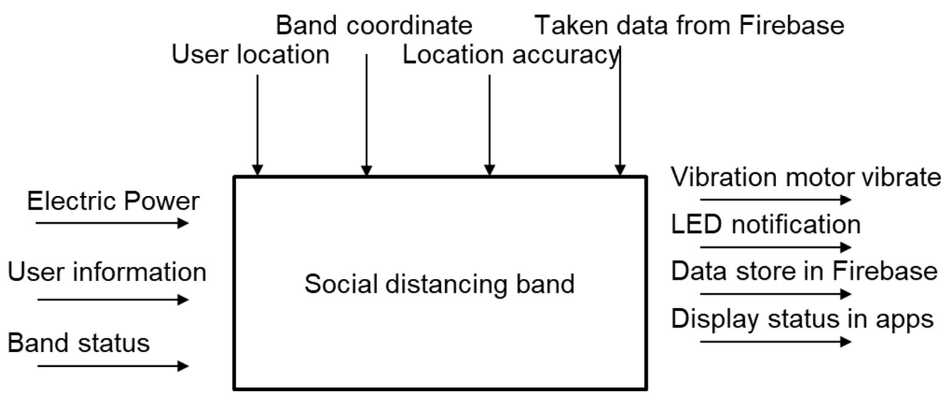


Figure 3.2 Functional Decomposition

3.2 Design

Concept selection is a decision process, in which the design team selects one or a few product concepts for further development. Here is the final design of our social distancing band:

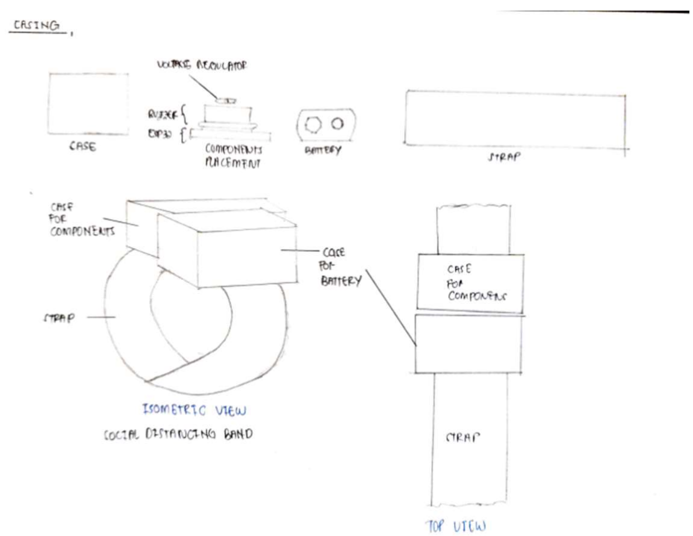


Figure 3.3 Social Distancing Band Final Design

3.3 Concept Screening

To let the social distancing band, perform what we wanted, we are proposed to use GPS and beacon to detect user location and distancing respectively. For this, we propose to use WifiLocation and Bluetooth beacon vice versa.

3.3.1 WifiLocation

The reason we use GPS to detect our user's location is that we can detect the location in real-time. When the user was diagnosed COVID positive and asked for a home surveillance order, we can know that the user does not violate the rules, and also can inform the authorities when the user tries to violate the order.

Geolocation alludes to the distinguishing proof of the geographic area of a client or processing gadget through an assortment of information assortment components. Ordinarily, most geolocation administrations use network directing addresses or inside GPS gadgets to decide this area.

By using Geolocation, the data will receive the data from the IP address, then using the IP address to send the data to the Geolocation, then it is transmitted to the satellite to receive the current coordination. Then it will send the data to the device we are using.

Google Geolocation is an API that can use Wi-Fi to detect the location since it is open source and free for the public, and also Geolocation is compatible with the Firebase database. Also, it does not require inserting any extra hardware, unlike the counterpart we were considering.

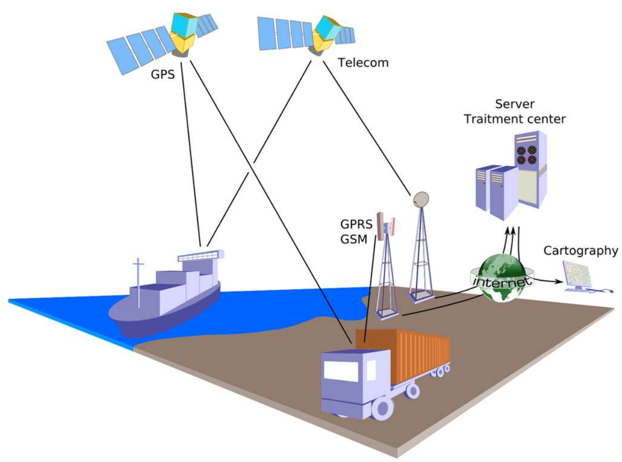


Figure 3.4 Geolocation Work Mechanism

For social distancing, we are using Bluetooth to detect the distance between each other. So the band will detect the distance using Bluetooth and alert the user about social distancing. With the mobile app, we can monitor the band status, so that we can ensure that social distancing is achieved.

3.4 Hardware & Software

For the electronic hardware, we are choosing the ESP32 Devkit as our main microcontroller unit (MCU). This is because it has built-in Wi-Fi and Bluetooth, and it has high programming memory space compared to its counterparts, such as ESP8266 for Arduino UNO. And it is also lightweight, only weighing 10.3 g. And has a small footprint when we put it in our arm (25.4mmx48.26mmx3mm(+-0.2mm). ESP32 has 30 general input-output pins. To let the user, know when they are violating the rule, we are using a vibration motor and a built-in LED pin that can be found on ESP32. With these combinations, the users will be notified of the violation and take action. We are using the 3.7V lithium polymer to power the whole circuit. For the sensor, we will be using an ultrasonic sonic sensor to detect the surroundings. To detect location, we are using the NEO 6 GPS module to ensure the user does not violate the HSO. Those are the initial plans that we were planning to use. We are using Arduino software to develop ESP32 since it does natively support the ESP32 Dev Kit.

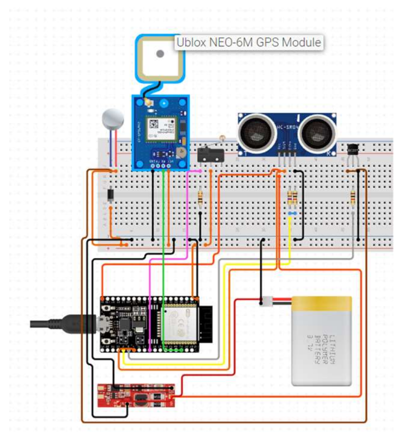


Figure 3.5 Initial Electric Design of the Social Distancing Band.

However, we found out that the initial plan has severe problems and limitations for the social distancing band. We have been fixing it with various solutions along the way.

3.4.1 Sensor

For the sensor case, an ultrasonic sensor can detect an object, however, it would not distinguish between human and non-living object, also the object is huge for the social distancing band, and the ultrasonic sensor can only detect 180 degrees, that's mean it requires 2 ultrasonic sensors to make the social distancing band work. To combat this problem, we are using the BLE Bluetooth that we can find on the ESP32. Then using the scanning device coding, we manage to replicate the purpose of the ultrasonic sensor, at the same time settling the problem of detecting between person and object.

Figure 3.6 Ultrasonic Sensor

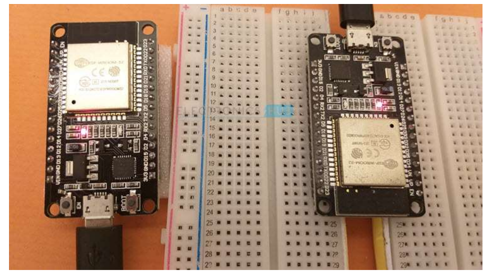


Figure 3.7 BLE Bluetooth ESP32

3.4.2 Location detection

After that, we found out that the NEO 6 GPS module requires additional software to let the module work fine. The problem is that software requires a subscription with payment to work, and also it is heavy and clunky when we use it. To solve this problem, we decided to switch to Wifilocation using Google Geolocation API and using the wifi that is available in ESP32. With this, we can detect locations with high accuracy and it will constantly send the data to and from the apps.

3.4.3 Power supply

For the power supply, we are swapping it to a replaceable non-rechargeable 9V battery as our main supply, this is because we can minimize the whole circuit dimension so that it will fit in the user's arm. Also since it is a swappable battery, use does not need to charge the battery. Hence it is suitable for areas that have scarce electricity such as rural areas. This application, this application is suitable for schools located in rural areas, since the social distancing band only uses low power to run the whole entire process.

3.5 Mobile Application

For the mobile application, we are proposed to use 2 software to complete our apps development. The first software was using Figma, while the other one is using Android Studio. In the end, we are choosing to use Android Studio since it is free and open-source, unlike Figma, we have to pay the Bravo subscription to enable the Google Firebase as our firebase. For the database, we are using Google Firebase instead of SQL database. This is because it is free and also it is easier to develop with the use of the Android Studio.

3.6 Hardware Programme Flow

Below is the flowchart of our hardware:

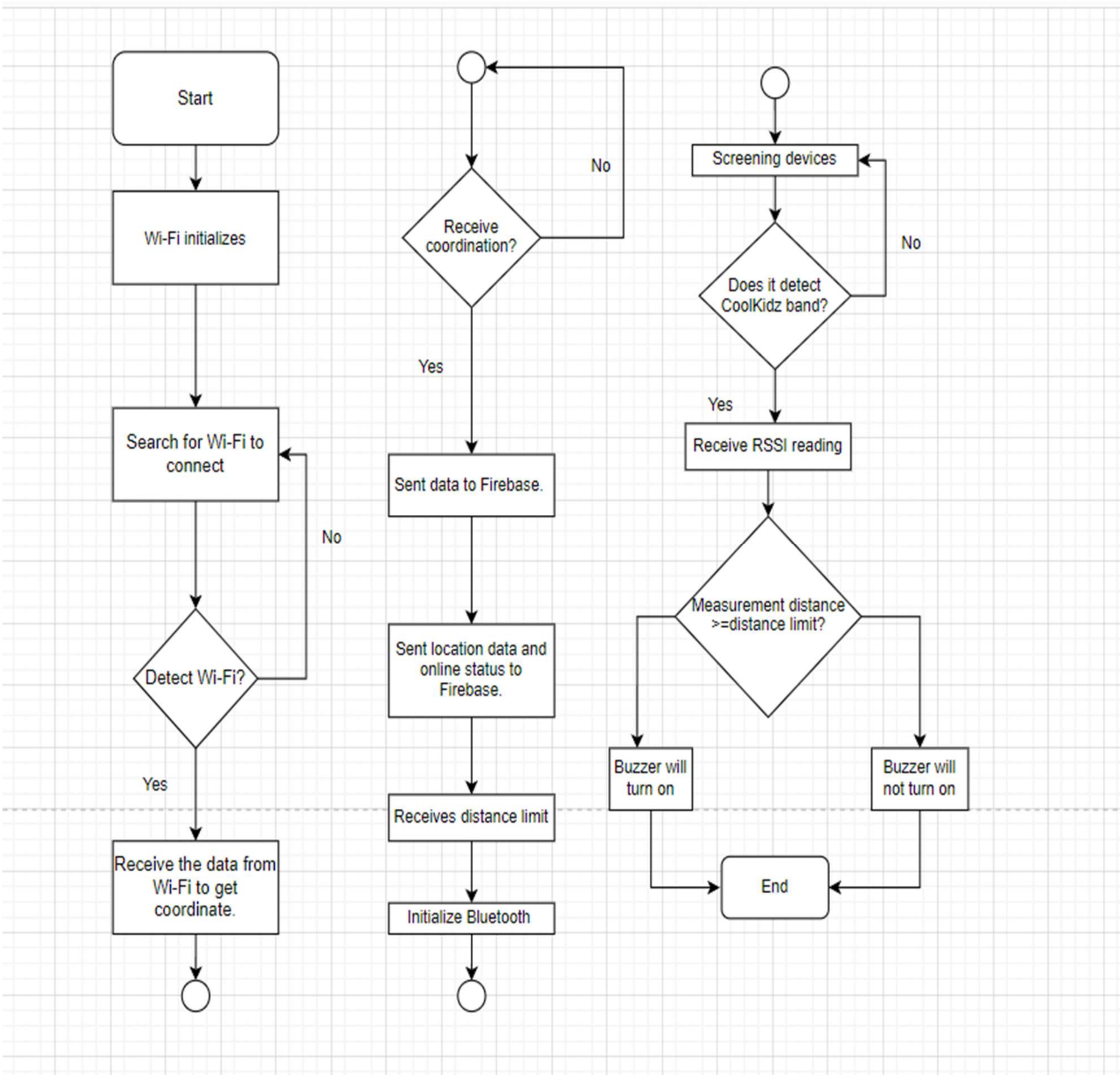


Figure 3.8 Hardware Flowchart

3.7 Software Programme Flow

Below is the software programme flowchart of our social distancing band.

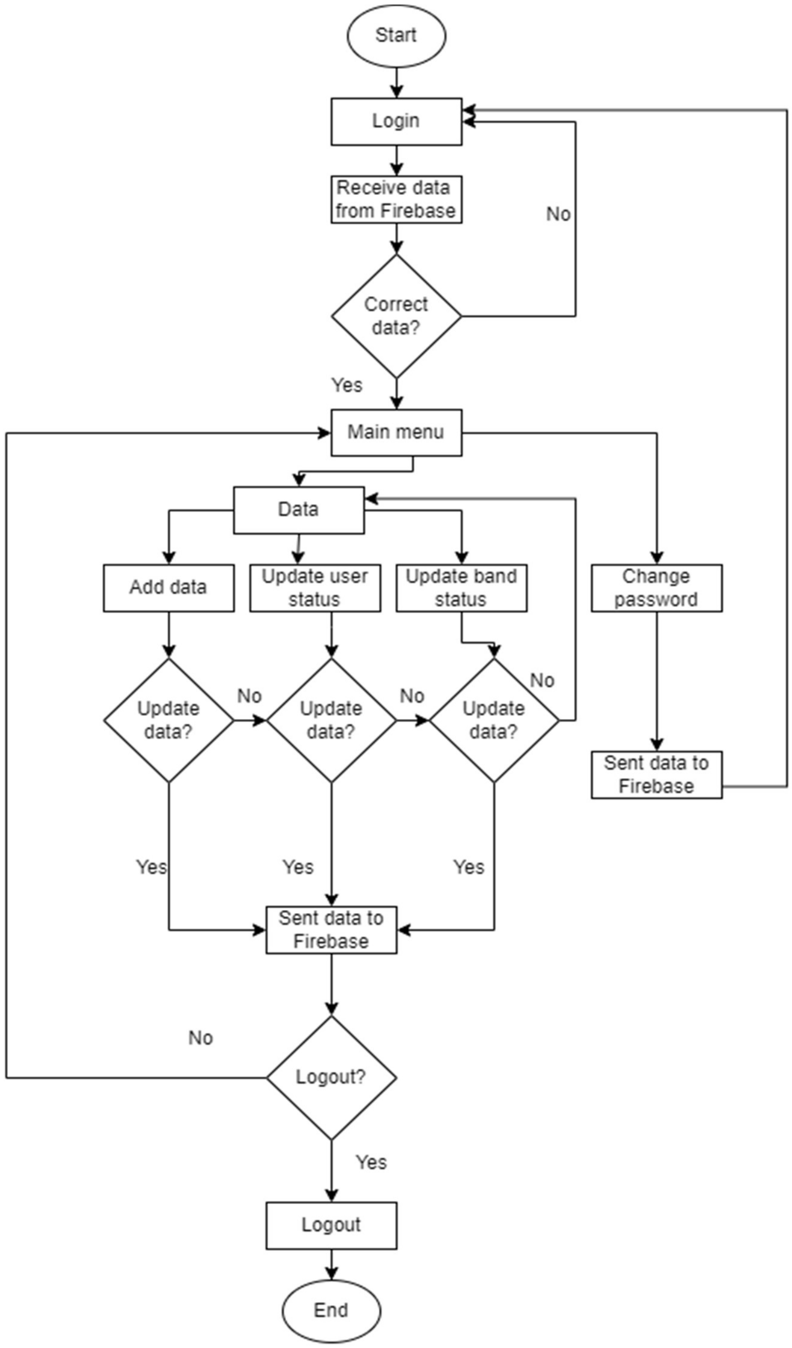


Figure 3.9 Software Programme Flowchart

CHAPTER 4

TESTING

4.1 Introduction

Testing is one of the most important elements in prototyping and also design projects since it's the only way for the designer or developer to check if the prototype would work just as they intended it to be. The required testing had been done to make sure that the designed simulation would meet the design requirements and were to be divided into few sections for better and detailed explanations and presentation.

4.2 Social Distancing of 1 Meter

Figure 4.1 1 Meter Social Distancing Band Test

This is testing social distancing measurement using measurement tape. For further explanation, please refer to the video link in Chapter 5 Prototype Development.

4.3 Mobile Apps

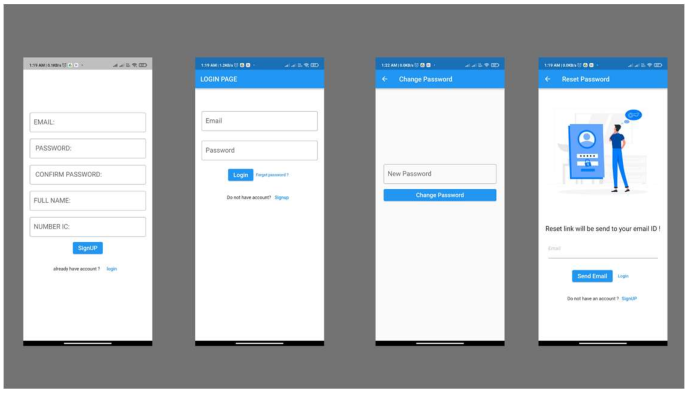


Figure 4.2 UI for user to Log In

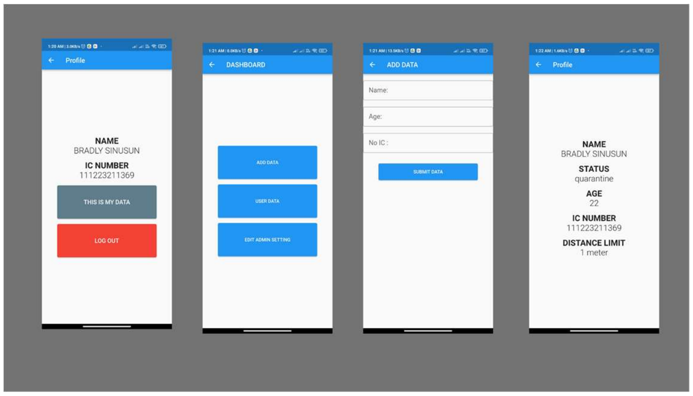


Figure 4.3 UI for user's detail

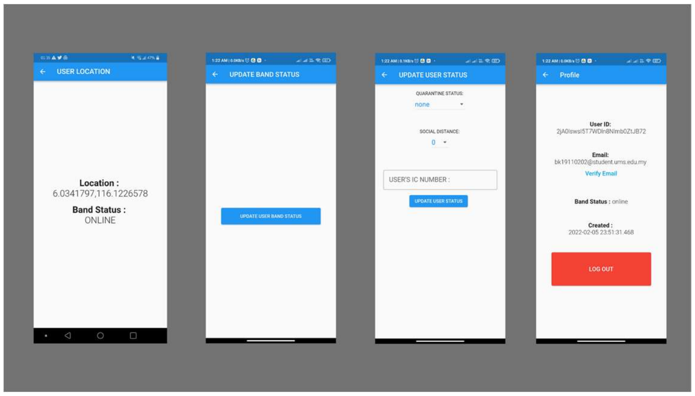


Figure 4.4: UI for User's Location & Update User Status

This is the user interface (UI) for application and for further explanation please refer to the video link in prototype section. Below is the link for the source code:

Application source file:

https://github.com/wonnur/Cool_Kidz.git

ESP32 coding source file:

https://drive.google.com/file/d/1FrQsz0VzsNz66GMM_DeUHNHrm7_MHG8P/view?usp=sharing

4.4 Location

Here are the results of our location that compared from the database and the mobile apps:

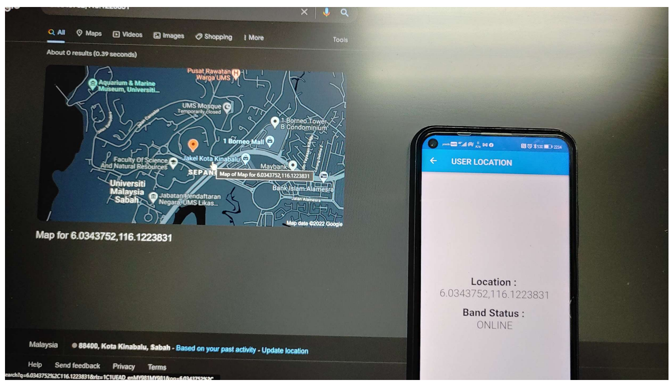
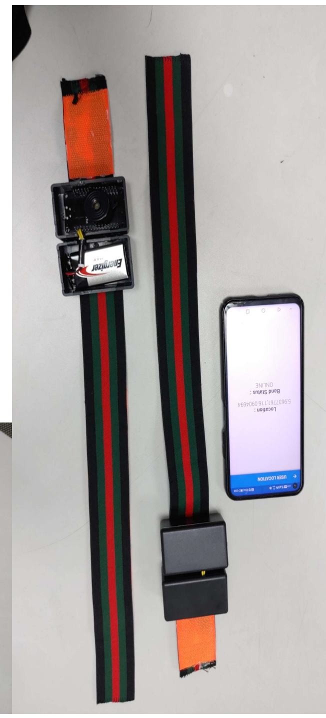


Figure 4.5 Location Detection between Database and from the Apps

CHAPTER 5

PROTOTYPE DEVELOPMENT

Here is our final prototype of our Social Distancing Band, we called it Cool Kidz Social Distancing Band, which is more into the kids' vibes.



Here is our YouTube link and APK apps files, for further explanation of our CK'z Social Distancing Band:

https://www.youtube.com/watch?v=9DjNAJMLBxA

APK link:

https://drive.google.com/file/d/1q1ovERJj2QHKjHyubYesTjv3WByi3tHf/view?usp=sharing

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https://doi.org/10.46501/IJMTST0706019

APPENDICES

APPENDIX A: DATASHEET, SPECIFICATIONS

[Specifications]

- Product Category: WiFi Modules (802.11)
- Protocol Supported: 802.11 b/g/n
- Frequency: 2.4 GHz to 2.5 GHz
- Data Rate: 150 Mb/s
- Interface Type: Serial
- Output Power: 20 dBm
- Operating Supply Voltage: 2.7 V to 3.6 V
- Minimum Operating Temperature: - 40 C
- Maximum Operating Temperature: + 85 C
- Size: 52(L)x28(W)x14(H) mm
- Weight: 10g

[Highlight]

- NodeMCU based on ESP-WROOM-32 module
- Based on ESP32 DEVKIT DOIT
- 30 GPIO Version
- ESP32 is a dual core 32-bit processor with built-in 2.4 GHz Wi-Fi and Bluetooth
- 4MByte flash memory
- 520KByte RAM
- 2.2 tp 3.6V Operating voltage range
- In breadboard friendly breakout
- USB microB for power and Serial communication, use to load program and serial debugging too

Figure A-1: Specifications of ESP32

Figure A-2: Dimensions of the Casing

APPENDIX B: FUNCTION OF SOURCE CODE

```
if (sensorName.startsWith(str)) {
  rssi = device.getRSSI();
  Serial.print("RSSI: ");
  Serial.print(rssi);
  m_dis = cal_dis(rssi);
  Serial.print("  measured distance: ");
  Serial.println(m_dis);

}
```

Figure B-1: Getting RSSI Value from Device

```
float cal_dis(float x) {
  float cal_d;
  float a = M_Pwr - x;
  float b = 10 * N;
  float c = a / b;
  cal_d = pow(10, c);
  return cal_d;
}
```

Figure B-2: Converting Value from RSSI Value to Meter.