Faculty of Electrical and Electronic Engineering Technology

SMART SAFETY DEVICE FOR E-HAILING USERS WITH IOT AND GPS TRACKING USING RASPBERRY PI

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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SMART SAFETY DEVICE FOR E-HAILING USERS WITH IOT AND GPS TRACKING USING RASPBERRY PI

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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2022/2023

DECLARATION

I declare that this project report entitled "**Smart Safety Device For E-hailing Users With IOT and GPS Tracking Using Raspberry Pi**" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Student Name : **NUR AZIAH BINTI AHMAD**

Date : 27/01/2023

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

Signature : .....

Supervisor Name : **RADI HUSIN BIN RAMLEE**

Date : 28 JANUARY 2023

DEDICATION

To everyone, I would want to express my gratitude to every person that helped me to bring this project to a successful end,

and

To my research supervisor, Mr Radi Husin Bin Ramlee, I would like to convey my gratitude for his important guidance, patience, and counsel throughout the project's growth,

and

Additionally, I would want to thank my supportive parents and friends who have supported me and gave me encouragement during the entire process.

ABSTRACT

Due to increased use of e-hailing services, passenger safety has become the primary concern during the services. E-hailing passengers have consistently reported criminal cases such as sexual assault and robbery. The only way to solve this problem is to assist the passenger by providing an emergency notice to their surroundings and family, as well as a mechanism that can help the users to defend themselves when they are in danger. This project will be built by designing the switch button, buzzer, LED mechanism with IoT device and Raspberry Pi. These designs will be part of a smart safety device for e-hailing passengers, which will provide alerts to surrounding and saved contacts and can also be used as a self-defense mechanism during a dangerous situation by flashing the attacker. This device can also notify and alert the police and the saved contact by sending email to them about the user's safety. This project is much easier to use and much more efficient than the existing device in informing emergency contacts, police station and surrounding areas, as well as assisting the passengers in danger.

ABSTRAK

Disebabkan peningkatan penggunaan perkhidmatan e-hailing, keselamatan penumpang telah menjadi kebimbangan utama semasa perkhidmatan. Penumpang e-hailing secara konsisten melaporkan kes jenayah seperti serangan seksual dan rompakan. Satu-satunya cara untuk menyelesaikan masalah ini ialah membantu penumpang dengan memberikan notis kecemasan kepada persekitaran dan keluarga mereka, serta mekanisme yang boleh membantu pengguna untuk mempertahankan diri apabila mereka berada dalam bahaya. Projek ini akan dibina dengan mereka bentuk buzzer, mekanisme LED dengan peranti IoT dan Raspberry Pi. Ini akan menjadi sebahagian daripada peranti keselamatan pintar untuk penumpang e-hailing, yang akan memberikan amaran kepada kenalan di sekeliling dan disimpan dan juga boleh digunakan sebagai mekanisme pertahanan diri semasa situasi berbahaya dengan memancarkan penyerang. Peranti ini juga boleh memberitahu dan memaklumkan kepada polis dan kenalan yang disimpan dengan menghantar e-mel kepada mereka tentang keselamatan pengguna. Projek ini lebih mudah digunakan dan lebih cekap daripada peranti sedia ada dalam memaklumkan kenalan kecemasan, balai polis dan kawasan sekitar, serta membantu penumpang dalam bahaya.

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CHAPTER 1

INTRODUCTION

1.1 Background

In today's world, safety have become one of the primary concerns of the safety issue. This concern rises with the rise of reported cases from security issues likes social problems, terrorism, kidnapping and increased crimes during the use of e-hailing services. In this study, the safety concerns associated with using e-hailing services will be given additional attention. Ride-on-demand e-hailing platforms are extremely convenient for people who required transportation services right away or when the people are touring alone at the moment. However, a notable issue encountering the e-hailing services in Malaysia. Over the last five years, there have been numerous reports of passengers being sexually harassed, raped, robbed, or murdered by the e-hailing drivers.

For instance, in 2017, an Uber driver in Selangor was arrested for allegedly robbing two teenagers after forced the teenagers to change their destination and leaving them stranded in Kajang, Selangor. Some women passengers would also start receiving multiple unknown calls and texts as the drivers have the women passenger's contact information. These crimes have increased the passenger's concerns about the safety of ride-hailing platforms. To address the safety issue that has plagued ride-hailing services since their inception, an IoT-based safety device for e-hailing users has been designed to improve their safety while using the e-hailing services. In Chapter 3, the system will be explained in greater detail.

1.2 Importance of the Study

Based on the Department of Statistics Malaysia Official Portal[1], Figure 1 shows that although Malaysia's crime index ratio per 100,000 people decreased to 256.6 in 2019 from 273.8 in 2018, seven states still had crime indexes that were higher than the national average which are Kedah (258.3), Johor(262.4), Melaka(275.9), Pulau Pinang(295.0), Negeri Sembilan(295.4), Selangor(304.3), and W.P. Kuala Lumpur (592.3). More than half of Malaysia's population resides in these big cities, which make up the majority of the nation's population. It is predicted that the number of crimes every year will continue to remain unacceptably high in the near future.

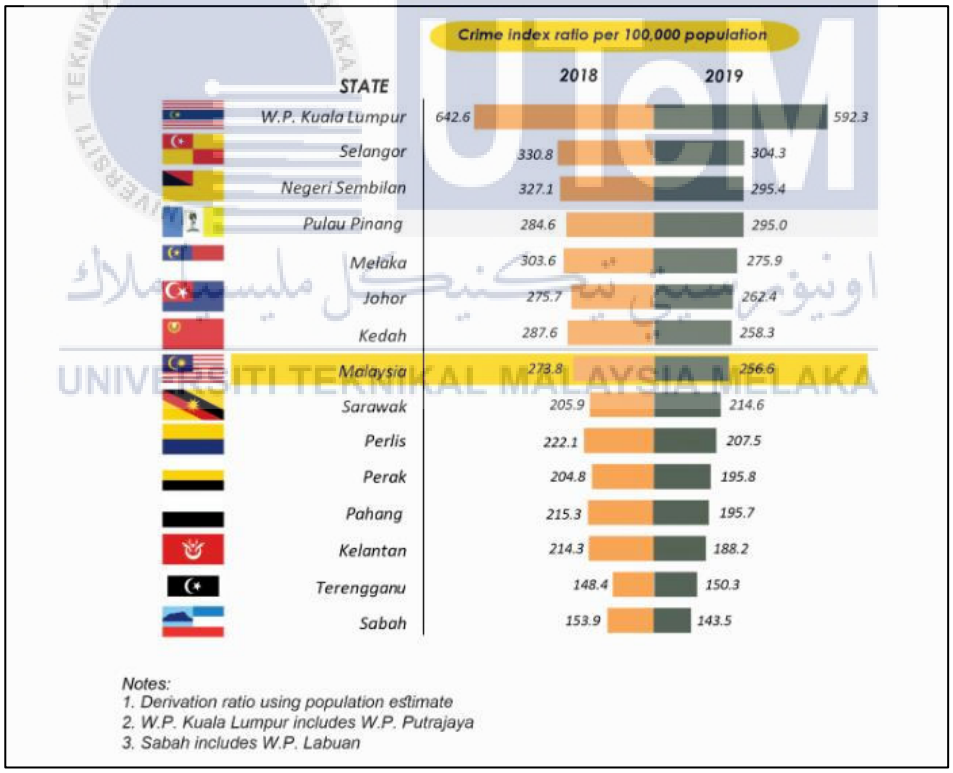

Figure 1: Statistic of crime index ratio in Malaysia (Department of Statistics, Malaysia, 2020) [1]

From the Department of Statistics Malaysia Official Portal[1], Figure 2 shows that across the country, there were 83456 crime cases in 2019, with violent crimes making up 19.8% of those instances while property crimes accounted for 80.2%. Robberies, which frequently occur in Malaysia when a person is alone, accounted for 59.0% of violent crimes and 46.1% of property crimes. Vehicle theft was the most frequent type of property crime. As a result, it's critical to create a system of personal safety and security that is more trustworthy and capable of lowering crime rates not just in Malaysia but globally. Personal safety can be improved with the help of cutting-edge technologies like the IoT. The results of this study could lead to a safer community with fewer crimes committed against people.

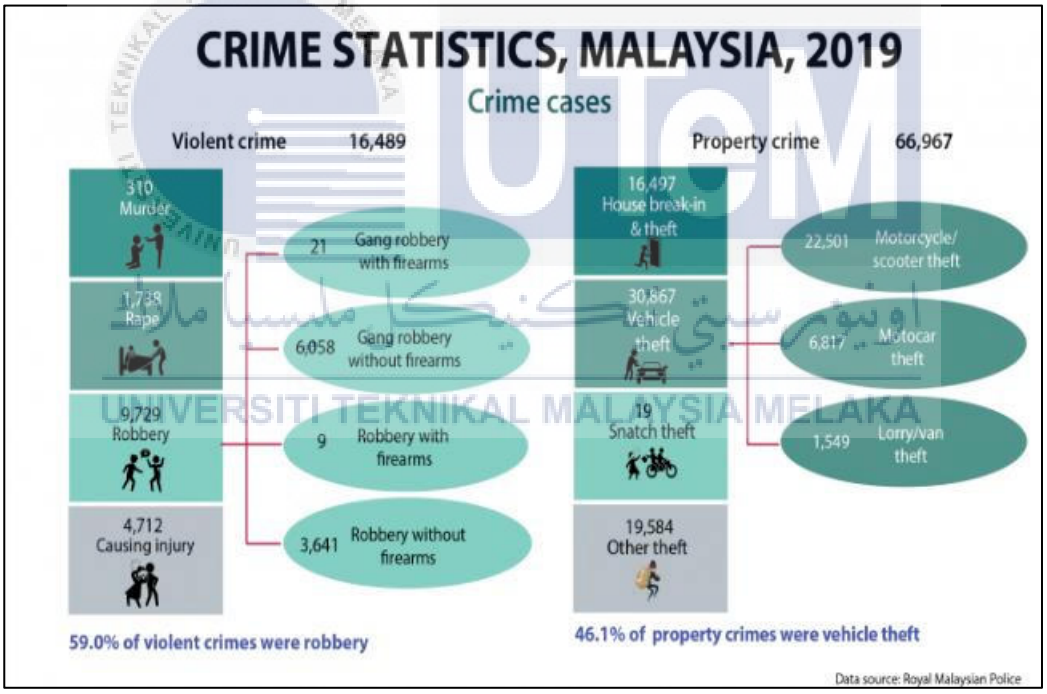

Figure 2: Cumulative number of crime cases in Malaysia in 2019(Department of Statistics, Malaysia, 2020)[1]

1.3 Problem Statement

During the e-hailing riding services, if the user uses the service by him/herself, the user will be alone with the driver, and this will increase the rate of crime to happen. Not just e-hailing users, but also those who are more vulnerable to risk, including women or children, frequently become victims of crimes committed today. They require the world's attention. There are some limitations to previous literature done by other researchers that proposed to do the application of the safety system. This is due to the fact that when a user encounters a risk, they will likely become bewildered and panicked, making it challenging for them to open their phone and activate the safety system application.

A smart safety device system has been proposed to help the user to notify and alert their surroundings and their family when the user sensed the danger. The suggested design uses GPS modules, a Simple Mail Transfer Protocol (SMTP) and Twilio to warn the user's family, the police, and the surrounding area when they believe they are in danger or believe something awful will happen to them in any given situation. Pushing a button on the device will activate the GPS module, the SMTP, Twilio's API and the buzzer, which will emit an alert to the surrounding area and notify the user's family or friends.

Even after notifying the surrounding and family, the percentage of the driver to do the sexual crime or robbery still big enough as the users still be alone with the drivers. To solve this problem, a self-defense mechanism also has been implemented in this smart safety device. The device must not only provide an alerting system but also a self-defense tool so that the victim can run away from the danger situation if help is delayed. The inclusion of an LED mechanism provides self-defense by flashing the attacker and thus acting as a self-defense tool.

1.4 Project Objective

These three objectives must be achieved by the end of this project, which are as follows:

a) To study the implementation of IoT for Smart Safety Device For E-hailing Users with IoT and GPS Tracking Using Raspberry Pi

b) To develop a device that can help the e-hailing users and any people to safely remove themselves from potentially dangerous situations

c) To assess the accuracy and dependability of the proposed project

1.5 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scopes of the project are defined as follows:

a) The device only sends to one emergency contact numbers to send the alert and warning message.

b) The device cannot be used in many ways, it only can be used for emergency purpose like alerting the surrounding.

c) It designed to be a unisex wearable device which is a keychain that can be used by both man and woman

d) The smart safety device is simple to use and can be operated by anyone

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the goal of this literature review is to look at and conduct research on previously completed projects involving smart safety device systems. Next, it also used to evaluate the main justification for creating a personal safety and protection system as well as the ideas, concepts, and techniques employed in its creation. The research is based on a five-year study from the date the project is implemented. It can be used as a resource. Furthermore, the appropriateness of the implemented project's search method will be discussed, reviewed, and determined. In order to make the software and hardware used in the proposed project more accurate during assembly session, the advantages and disadvantages of software systems and hardware must be evaluated carefully.

2.2 Existing Projects

2.2.1 Personal Device Assistance for Woman Safety

Based on the project proposed by(Dr. B Srikanth, D. Adi Chandra Narayana, M. Sai Nitish, B. Abhishek and A, Adi Narayana, 2020)[2], this paper proposed a system for detecting the user's safety that makes use of GPS and GSM modems. The system can be linked to the alarm system to notify the neighbors and surrounding. A GPS receiver that receives location data from satellites in the form of latitude and longitude, a microcontroller,

and a GSM modem are used in this detection and messaging system. The GSM modem sends the SMS message to the specified mobile phone number and emergency number.

In this proposed system, a night vision camera that records live image and videos also have been installed on the Raspberry Pi, which allows the system to go for automation and help to find the human or any problem detected using the sound sensor, and the image is automatically captured and sent to the user using IOT technology based on the sound produced. When the user feels they are in danger and requires self-defense, the user can activate the switch assigned to them.

Figure 3: Hardware Kit Image[2]

2.2.2 Smart Shield for Women Safety

Based on a proposal by (Rachana B.Pawar, Manali H. Kulabkar, Kirti S. Pawar, Akhata R. Tambe and Prof. Smita Khairnar, 2018)[3] this project helps the user by give alert to their beloved or their surrounding by activated an alert message and generated it along with the victim's current location, using the GPS module. Using the GSM module, the message is forwarded to the victim's family and the nearest police station.

At the same time, the camera begins capturing images and audio, which will serve as evidence and aid the police in locating the perpetrators. The buzzer emits an extremely irritating and loud sound, drawing the attention of nearby people and distracting the attacker. The Shock Circuit System, which generates an electric jolt, provides immediate defence to the user.

Figure 4: Prototype Smart Shield for Women Safety[3]

2.2.3 SafeBand: A Wearable Device for the Safety of Women in Bangladesh

Based on a proposal by (Muhammad Nazrul Islam, Nuzhat Tabassum Promi, Fatema Alam Binte and Syeda Nusraht Khaledur, 2018)[4], the goal of this article is to design and develop the 'SafeBand', a safety device that can be worn by users to protect them against physical harassment. The 'SafeBand' technology comprises of a victim-wearable band and two smartphone apps for the victim and police.

The device, which has a button and a light, can be worn as a bracelet or a locket by the user. When the user (victim) pushes the button, the system uses GPS to detect the user's location and sends the location message to the nearest police station and previously saved contacts (number of relatives).

Figure 5: Safety Band and Circuit Box[4]

2.2.4 Design of a Smart Safety Device for Women using IoT

Based on the project proposed by (Wasim Akram, Mohit Jain and C. Sweetlin Hemalatha, 2019)[5]. This project assists a user who may be in an unsafe situation by prepared for any situation that might go against the user's will. The ATmega328 microcontroller is used in this project. It has a fingerprint reader to turn it on, a GSM (Global System for Mobile Communications) module to send alert messages, a buzzer to warn the surrounding area, and a shock wave generator for self-defense.

When the user starts to activate the device, it begins scanning the user's fingerprint every minute. When no fingerprints detected, the device activates, sounding a buzzer to alert the public nearby and the GPS receives latitude and longitude data, which is delivered to both the LCD and the GSM. The message will be forwarded to the user's family and friends via modem. As a result, even if the user is knocked down from behind and unable to activate an alarm, the gadget will transmit the emergency message automatically.

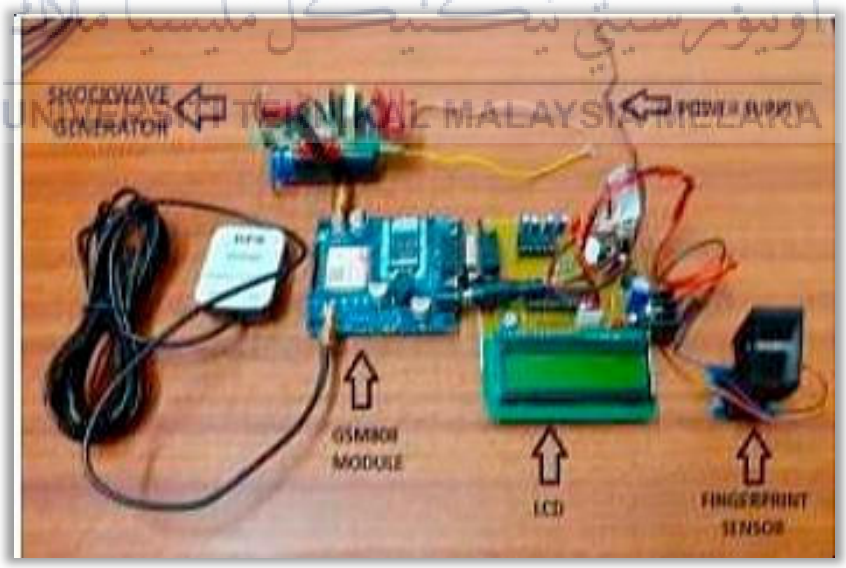

Figure 6: Proposed Hardware Design for Women Safety[5]

2.2.5 Women Safety Device using GPS and GSM Modem

Based on the project proposed by (Likhitha K.N. and Hemalatha K.N, 2019)[6], the proposed design used GPS and GSM modules to detect and alert the user in danger. A self-defense tool in the shape of an LED mechanism is also included in the system. In order to identify and transmit data, a GPS receiver, a microcontroller, and a GSM modem are used. Satellites circling the Earth send precise position data to GPS receivers in the form of latitude and longitude. This information is processed by the microcontroller and then sent to the user via GSM modem using AT commands then it sends SMS messages to a predefined list of mobile phone numbers.

When a threat to the user's security arises and the user requires self-defense, the user can use this device by pressing the SOS button. By pressing the button, the entire system is activated, and an SMS with location information is immediately sent to the concerned person via GSM and GPS and at the same time, LED mechanism can be flashed on the attacker to blind then attacker and provide the victim with an escape window.

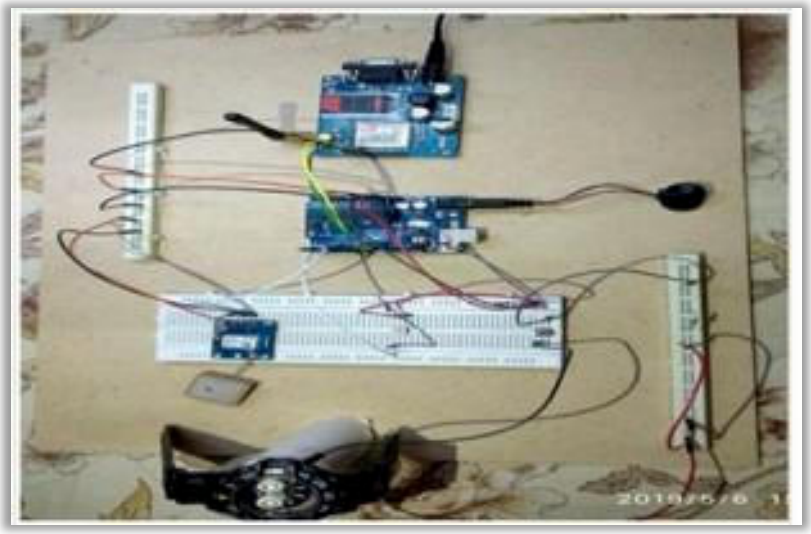

Figure 7: System Overview of Women Safety Device[6]

2.2.6 An IoT Based Smart Wearable Device for Women Safety

Based on the project proposed by (N. Penchalaiah, M. Susmitha, C. Vinay Kumar Reddy, D.V. Pavan Kalyan Rao and D. Sreelekha, 2021)[7], the main aim of this paper is using Raspberry Pi to increase the safety and security of the user. This is accomplished through the use of Python programming. The Raspberry Pi includes a temperature sensor, heart rate sensor, GPS module, and camera module.

When the user is in danger, an alert system will be sent to the appropriate authorities, either automatically or manually. Furthermore, voice information can help at-risk user because the user couldn't press the button at the time, user can simply say "help" and an SMS alert with the location and captured image will be sent to the guardian's or police.

Figure 8: Hardware implementation of SMS sending [7]

2.2.7 Anti-Molestation: An IoT based Device for Women's Self-Security System to Avoid Unlawful Activities

Based on the proposal by (Md. Imtiaz Hanif, Shakil Ahmed, Wahiduzzaman Akanda and Shohag Barman, 2020)[8]. An Internet of Things (IoT)-based embedded device has been built in this research that can communicate with law enforcement authorities on demand by dialling "999." (An Emergency Telephone Number in Bangladesh). The device uses an Arduino Pro-Mini Microcontroller with a GSM (Global System for Mobile Communication) module to send SMS (short messaging service) messages to law enforcement and relatives with the victim's current location (General Packet Radio Services).

The form factor of the suggested device is considerably too small, and it be easily carried out anywhere and at any time. The device is "Plug & Play," which means it can be turned on and off with a single button. Furthermore, the device is reasonably priced, making it accessible to people of all financial levels.

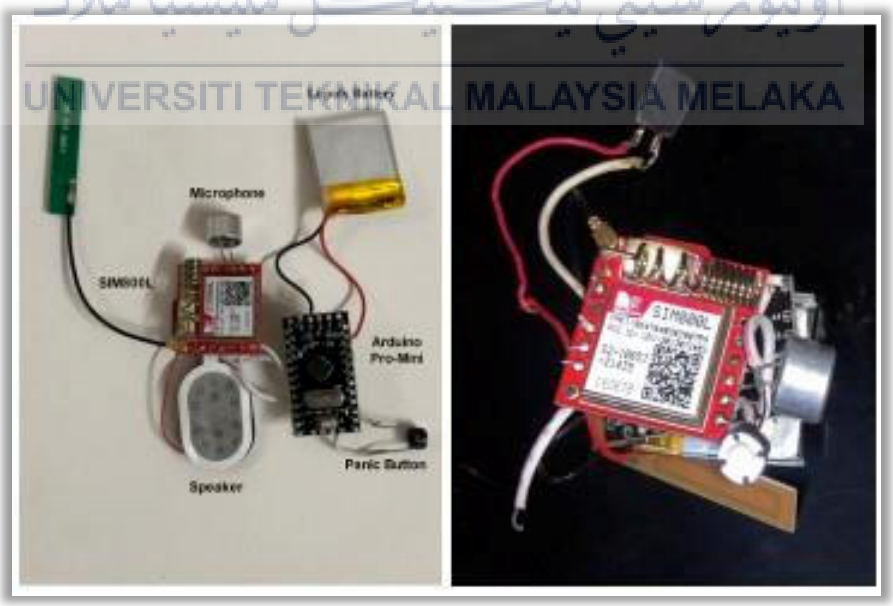

Figure 9: Developed Form Factor of the Anti-Molestation Device[8]

2.2.8 An Application on Women Safety Using Embedded Systems and IoT

Based on the proposal by (K Hari Kishore, Eswar Teja Ravuri, Pavan Kumar Sankarasetty, Vamsi Krishna Mogiicharla and E Raghveera, 2021)[9]. The writers devised a solution in which the user's alert messages and current location are automatically sent to their family when they are in danger without any response from the user. It has been accomplished by using the PPG (Photoplethysmography sensor) pulse rate sensor to measure the abnormal rise in heart rate when the user is in danger.

PPG sensor is used to measure a person's heart rate and it for the fingers. If it remains high for an extended period of time with no interaction from the user, the SMS alert will be sent along with the location to relatives and emergency services. The device has been developed in the form of a wearable that can be worn on the hand and cannot be identified as a tracking or safety device.

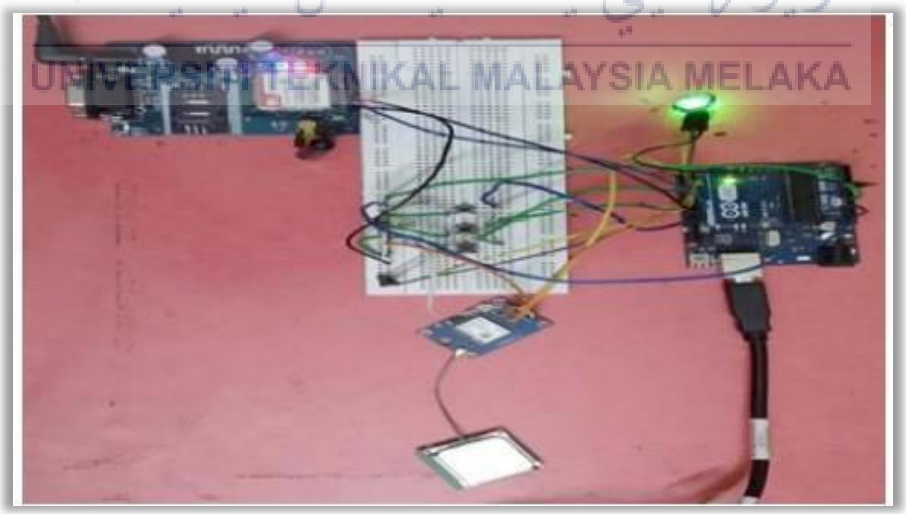

Figure 10: Hardware Implementation of Wearable Women Safety[9]

2.2.9 Women and Children Safety System with IoT

Based on the proposal written by (S.RahmathNisha, Dr.C.Shyamala, Dr. D Sheela, M. Abirami, M.Harshini and R. Keerthana, 2021)[10]. This paper configuration is suitable for both guardians and ladies. Both the users have GPS-enabled advanced mobile phones. The application is used to track the users' location for Android usage execution, and it makes use of two primary administrations which are GPS and SMS. GPS is used by local governments, and SMS is used for communication.

The solution for following and missing people is achieved through the use of GPS and GSM innovations. To cover all of the highlights, the most widely used working framework is Android. SMS is used to communicate SDK devices, and Eclipse, which supports Android, is used. The reason for choosing Android OS is to reach out to a larger audience and also there are a lot of people who use Android phones.

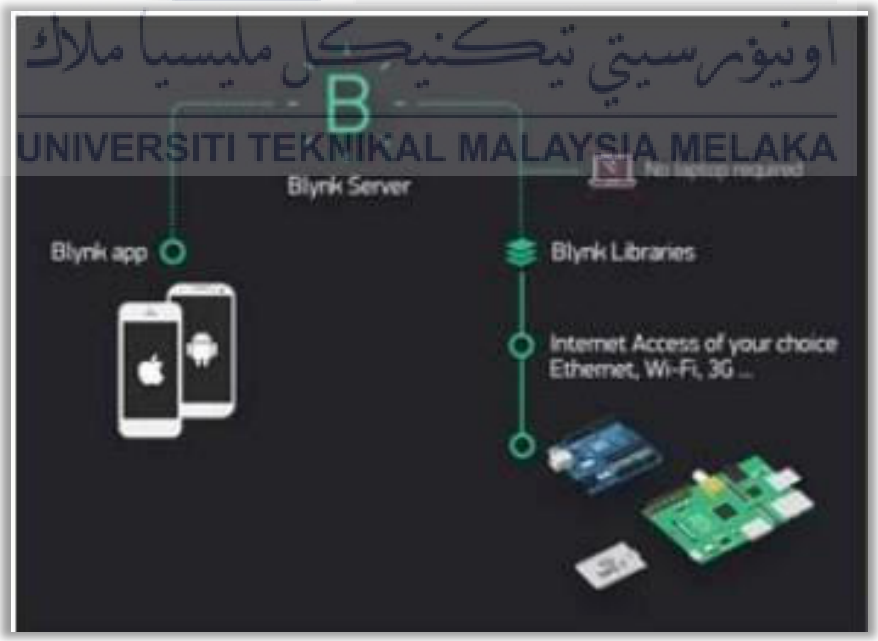

Figure 11: BlynkIoT Platform[10]

2.2.10 A Smart Wearable Device Based On Internet of Things For The Safety Of Children In Online Transportation

Based on the project proposal written by (Elsyea Adia Tunggadewi, Eva Inaiyah Agustin and Riky Tri Yunardi, 2021)[11]. This project uses Internet of Things (IoT), a cutting-edge technology that is less expensive and easier to use for kids because it only requires a small amount of knowledge, such as pressing a button on the device screen in an emergency to send the location as well as images to the parent's telegram application. In this situation, the telegram ID is inputted, and the tool will send the location and photographs to the telegram ID depending on the data.

In the process of working on this device, several steps have been completed. It started with system design and modelling and moved to the establishment of a system-wide telegraph ID database. Finally, testing and analysis were conducted, beginning with the creation of tools, then testing designed controllers in the form of Raspberry Pi, testing camera and GPS, continue with sending the results of camera and GPS tests to the mobile cell, testing IoT as the most recent technology and testing the overall system's success.

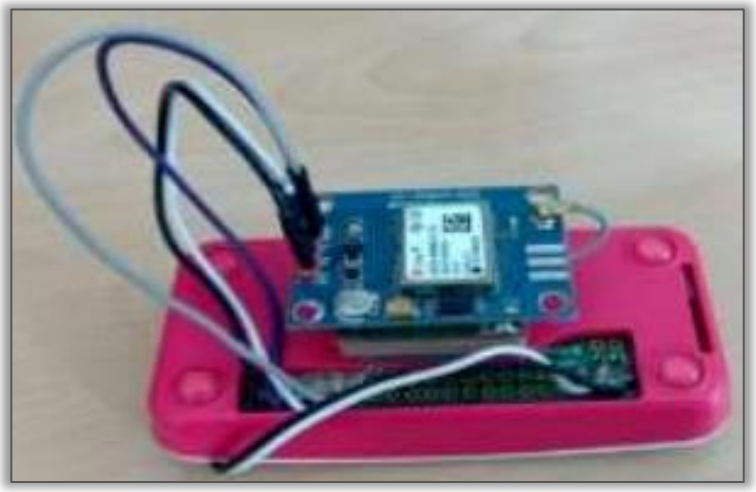

Figure 12: Child Safety Tools in Online Transportation[11]

Table 1: Comparison of existing projects

NO	AUTHOR	PERFORMANCE PARAMETER	HARDWARE	METHOD
1	Dr. B Srikanth, D. Adi Chandra Narayana, M. Sai Nitish, B. Abhishek and A, Adi Narayana	• **Detection and messaging system** • **Self-defense tool** • **Sent SMS of user's Google location** using GSM and GPS	• LCD • Raspberry Pi 3 • Sound sensor • Buzzer • GPS module • GSM module • Button • Power Supply	• Night vision camera • Capture image to IoT technology • **SMS Google location mechanism**
2	Rachana B.Pawar, Manali H. Kulabkar, Kirti S. Pawar, Akhata R. Tambe and Prof. Smita Khairnar	• **Wearable device** • Sensor activated when the targeted heart rate is achieved • **GPS tracker send current location** • GSM module **send alert message to pre-registered mobile numbers**	• Pulse rate sensor • Temperature sensor • Fall Detector • Camera • Buzzer • GPS module • GSM Module	• Smart wearable jacket • Shock mechanism circuit • **Manual switch** • Auto Mode (Using sensors) • By Falling (Fall Detector)
3	Muhammad Nazrul Islam, Nuzhat Tabassum Promi, Fatema Alam Binte and Syeda Nusraht Khaledur	• **Button pressed to determine user's location** • **Send a message with location to nearest police location** • **Wearable device**	• GPS module • GSM module • LED • Button	• Hardware interface • **Wi-fi Module** • Danger signal • Software interface • Web Server • User Application SafeBand
4	Wasim Akram, Mohit Jain and C. Sweetlin Hemalatha	• Provide security by fingerprint-based method • **Alerting people nearby and police station** • Attack perpetrator using self-defense shockwave generator	• Power supply • Transformer • Switch • Fingerprint sensor • LCD	• Fingerprint-based method • Shockwave generator • Mobile application

		• Send message and audio recording		
5	Likhitha K.N and Hemalatha K.N	• **Provide alert and safety system** • **Tracking location** • **Blind the attacker using self-defense tool LED mechanism**	• GPS module • GSM module • Button • Arduino Uno	• **LED mechanism** • **SOS button**
6	N. Penchalaiah, M. Susmitha, C. Vinay Kumar Reddy, D.V. Pavan Kalyan Rao and D. Sreelekha	• Using voice information to alert the danger • Send location by tracking it	• LCD • Buzzer • GSM module • GPS module • Pulse rate sensors	• Voice Tool • Manual mechanism • **SOS button** • Automated mechanism • Abnormality sensors • Alert mechanism
7	Md. Imtiaz Hanif, Shakil Ahmed, Wahiduzzaman Akanda and Shohag Barman	• Send SMS with current location • Make call by pressing a button	• Arduino Pro-Mini • Panic button • Power supply • Microphone • Speaker	• **Alert mechanism** • Calling mechanism • **Location sending mechanism**
8	K Hari Kishore, Eswar Teja Ravuri, Pavan Kumar Sankarasetty, Vamsi Krishna Mogiicharla and E Raghveera	• Send location to family members when there is no response from the user • Measured abnormal rise in heart	• Pulse rate sensor • Vibration motor • GPS module • GSM module • Button	• Mode button • Sleep button • **Emergency button** • Abnormality sensor
9	S.RahmathNisha, Dr.C.Shyamala, Dr. D Sheela, M. Abirami, M.Harshini and R. Keerthana	• Finding lost users • Follow user development outside from the house	• Heartbeat sensor • Temperature sensor • Motion Sensor • GPS module • GSM module	• Alert mechanism • **Location sending mechanism**
10	Elsyea Adia Tunggadewi, Eva Inaiyah Agustin	• Identify user's problem in online transportation	• Raspberry Pi Zero W • GPS module	• Alert mechanism

	and Riky Tri Yunardi	• Display user's location • Sent location and photo via Telegram application	• GSM module	

2.3 Software

2.3.1 Raspberry Pi OS

Raspberry Pi OS, formerly known as Raspbian, is the primary and most extensively used operating system for the Raspberry Pi Zero. It can run non-Linux operating systems like RISC OS and NetBSD, despite the fact that it was developed for Linux. Raspberry Pi OS is a Debian Linux-based open-source operating system created specifically for Raspberry Pi boards. The Raspberry Pi OS is also available on ARM-based single-board computers. Raspbian is the operating system for the Raspberry Pi 32-bit, while Debian ARM64 is the operating system for the Raspberry Pi 64-bit. The Raspberry Pi OS has grown greatly over time, much like the Pi hardware. Pi OS now supports 32-bit and 64-bit images, which is the most noticeable upgrade.

2.3.2 PuTTY Software

PuTTY is a telnet and SSH client for Windows created by Simon Tatham. PuTTY is a free, open-source software whose source code is produced and maintained by a community of volunteers. For Windows and UNIX platforms, PuTTY employs network protocols such as Telnet and rlogin in conjunction with an xterm terminal emulator. To allow a remote session on a machine across a network, PuTTY leverages all of the

aforementioned protocols. It is a popular text-based communication tool as well as a popular program for connecting Linux servers to Windows-based devices.

2.3.3 Bonjour Software

Bonjour is Apple's implementation of the Zero Configuration Networking (Zeroconf) standard, a set of protocols that enables certain types of communication between networked devices, applications, and services. It connects to resources and shares them without the need for any configuration. In most home networks, Bonjour software is used to share printers across Windows and Apple devices. Zeroconf is a collection of open Layer 2 protocols for quickly establishing an IP network. After a trademark dispute with a business called Tibco Software, Apple changed the name to Bonjour in 2005. Regardless of whether Windows, macOS, or Linux is used, files can be shared.

2.3.4 VNC Viewer

Virtual Network Computing (VNC) is a graphical desktop-sharing system that utilizes the Remote Frame Buffer protocol (RFB) to remotely control another computer in computing. It transmits keyboard and mouse input from one machine to another via a network while relaying graphical-screen changes. VNC is platform agnostic, supporting a wide range of GUI-based operating systems as well as Java clients and servers. Multiple clients can connect to a VNC server simultaneously. Two frequent applications for this technology are remote technical assistance and reading data on a work computer from a home computer, or vice versa. VNC Viewer software, which can be installed on a computer, tablet, or smartphone, allows you to connect to and operate a machine in another place.

2.4 Hardware

2.4.1 Arduino Uno

Arduino Uno[12] is a microcontroller board created by Arduino.cc, an open-source electronics platform based primarily on the AVR microcontroller Atmega328. In addition to the ATmega328P, it includes various components that assist the microcontroller, such as a crystal oscillator, serial communication, a voltage regulator, and so on. The Arduino Uno contains a USB interface, six analogue input pins, and fourteen digital I/O ports for interfacing to external electronic circuits. PWM output is possible on six of the 14 I/O ports. Designers can use it to control and perceive external electronic equipment in the real environment.

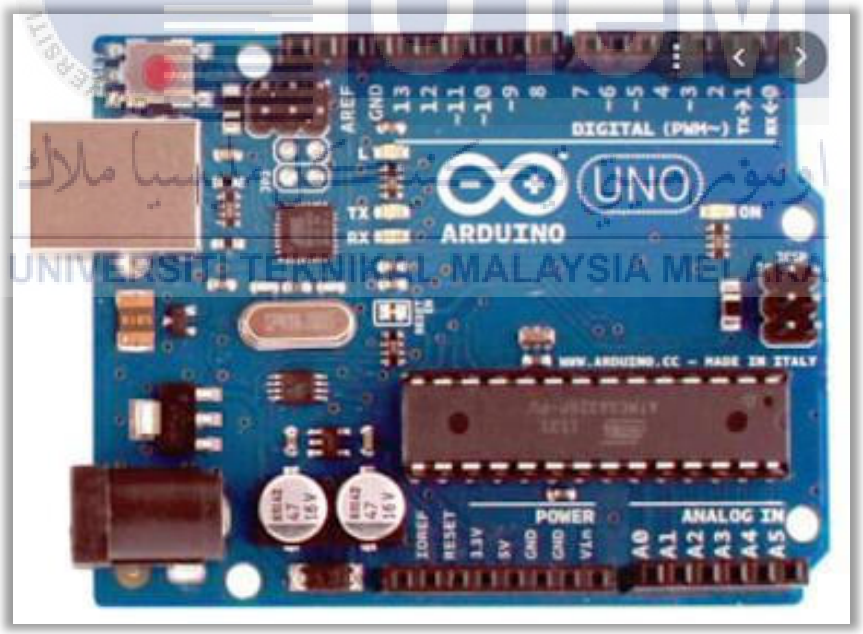

Figure 13: Arduino Uno[13]

Table 2: Arduino Uno Specification

Specifications	Arduino Uno
Microcontroller	ATmega38P
Operating Voltage	5V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0-A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
Bluetooth	BLE&Bluetooth 4.2
DC Current on I/O Pins	40mA
DC Current on 3.3V Pin	50mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2kB
EEPROM	1kB
Frequency (Clock Speed)	16MHz

2.4.2 Arduino Nano

The Arduino Nano is the tiniest and most breadboard-compatible Arduino board. Pin headers and a Mini-B USB connector are included in the Arduino Nano for easy breadboard attachment. The original Nano is the Arduino Nano family's oldest board. It is designed for use with a breadboard and lacks a dedicated power jack. The ATmega328P

Microcontroller is also used in the Arduino Nano. Arduino Nano has the identical technical specifications [14] with Arduino UNO.

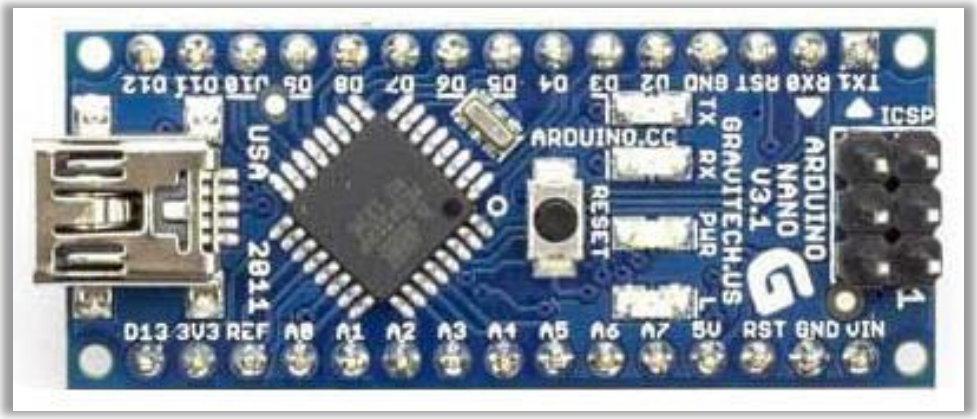

Figure 14: Arduino Nano [15]

2.4.3 Arduino Mega

The Arduino Mega 2560 is an open-source, Arduino-designed development board. The Arduino Mega 2560, which is known for its capability to handle more complex projects, provides plenty of room and opportunities for the projects. It is perfect for 3D printers and robotics projects, with 54 digital I/O pins, 16 analog inputs, and a large space.

Figure 15: Arduino Mega [16]

Table 3: Arduino Mega specification

Specifications	Arduino Mega
Microcontroller	ATmega38P
Operating Voltage	5V
Input Voltage Limits	7-20V
Analog Input Pins	6 (A0-A5)
Digital I/O Pins	54 (Out of which 15 provide PWM output)
DC Current on I/O Pins	40mA
DC Current on 3.3V Pin	50mA
Flash Memory	256 KB (8 KB is used for Bootloader)
SRAM	8kB
EEPROM	4kB
Frequency (Clock Speed)	16MHz

2.4.4 Raspberry Pi Zero W

The Raspberry Pi Zero is the Raspberry Pi Foundation's smallest computer board. The Pi Zero, which was introduced in 2015, is half the size of a conventional Raspberry Pi board, measuring only 6.5cm by 3cm. The single-core Broadcom CPU is the same as the original Raspberry Pi, although it runs at 1GHz. The Raspberry Pi Zero W, which came out two years after the original, features the same components as the original but added an 802.11n wireless card and Bluetooth 4.1. Because of the added functionality, it costs slightly more than its predecessor. The Raspberry Pi Zero W is the tiniest member of the Raspberry Pi family, yet it still packs a punch with Wi-Fi, Bluetooth, mini-HDMI, micro-USB, and a camera socket.

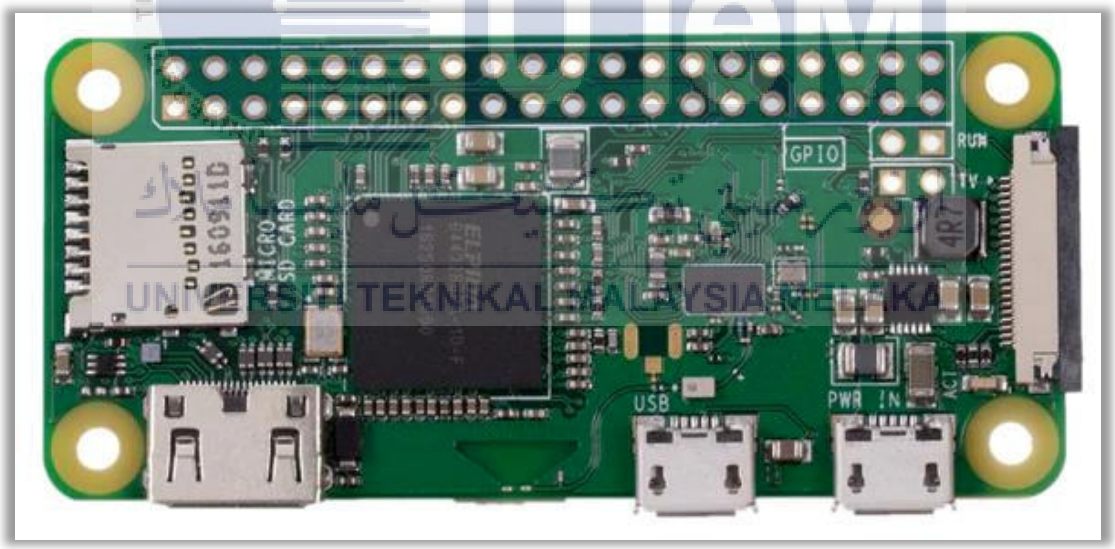

Figure 16: Raspberry Pi Zero W [17]

Table 4: Raspberry Pi Zero W features and specification

Features/Specification	Raspberry Pi Zero W
Release Date	28 February 2017
SoC/SIP	Broadcom BCM2835 + 512MB RAM
Core Architecture	Single core, 32-bit, ARM11
GPU	VideoCoreIV
GPU Clock	1 GHz
Memory/OS storage	microSD
USB	1 x USB OTG
HDMI	1 x Mini
Wireless	802.11 b/g/n, Bluetooth 4.1, BLE
Antenna	PCB antenna
GPIO	40-pin Bare Pads
Operating System	Raspberry Pi OS
Dimension	30mm x 65mm x 13mm (HxWxD)

2.4.5 Raspberry Pi Pico

Raspberry Pi Pico the first MCU board designed by Raspberry. The Pi Pico is a low-cost option to older Arduino boards, based on their proprietary (but open-source) RP2040 microcontroller. It is designed to outperform older, Atmel-based micros like the Arduino Nano and Micro. It is a big step forward in the world of MCUs, powered by a dual-core Arm Cortex-M0+ processor with 264 kB of onboard memory and the ability to expand it. The combination of low power consumption and 34 GPIO pins makes it ideal for small scale projects and wearables. The 8 programmable I/O or PIO pins allow the user to configure any protocol they want, such as UART, SPI, I2C, or any other homemade signal communication.

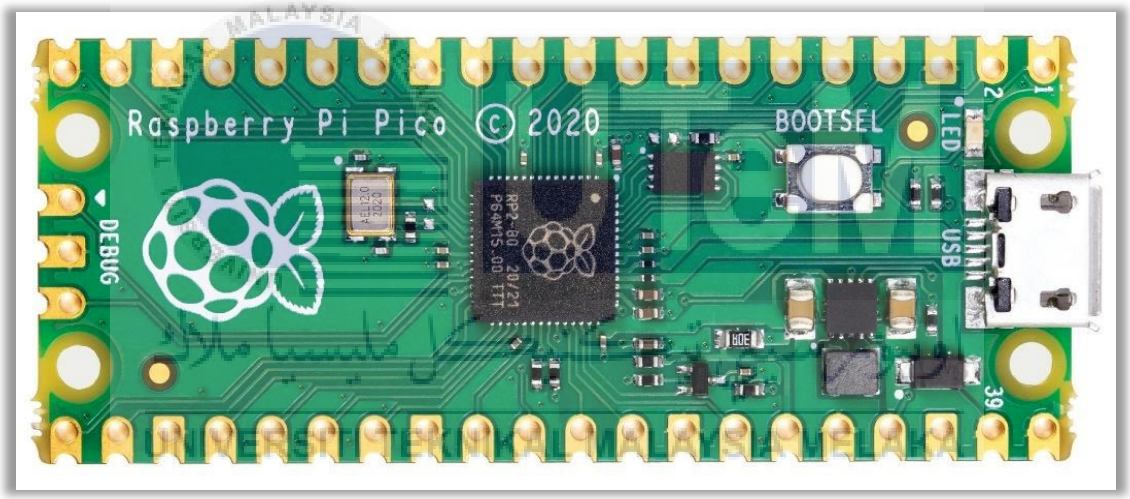

Figure 17: Raspberry Pi Pico [17]

2.4.6 Comparison between Arduino Uno, Arduino Nano and Arduino Mega

The Arduino Nano and Arduino UNO have a lot in common. Because they both use the ATmega328P CPU, they can share the same program. One noteworthy difference between the two is that the Arduino UNO is double the size of the Arduino Nano, requiring more room on the user's project. Furthermore, the Arduino Nano is compatible with breadboards, whereas the Arduino Uno is not. A conventional USB cable is required to

program an Arduino Uno, whereas a miniUSB cable is required for the Arduino Nano. The Arduino Mega outperforms the Arduino Nano in terms of speed and quantity of I/O pins. The Arduino Mega is best suited for projects that require a large number of I/O pins and a variety of connection protocols. The following table[18] provides a more detailed comparison:

Table 5: Comparison of Arduino Uno, Arduino Nano and Arduino Mega

Feature/Specification	Arduino Uno	Arduino Nano	Arduino Mega
Processor	ATmega328P	ATmega328P	ATmega328P
Operating/Input Voltage	5V / 7-12V	5V / 7-12V	5V / 7-12V
CPU Speed	16 MHz	16 MHz	16 MHz
Analog In/Out	6 / 0	8 / 0	16 / 0
Digital IO/PWM	14 / 6	14 / 6	54 / 15
EEPROM/SRAM [kB]	1 / 2	1 / 2	4 / 8
Flash	32	32	256
USB	Regular	Mini	Regular
USART	1	1	4

2.4.7 Comparison between Raspberry Pi Zero and Raspberry Pi Pico

The Raspberry Pi Zero has a larger footprint than the Raspberry Pi Pico. With built-in Wi-Fi, HDMI, camera, and USB interfaces, it may be used as a computer, but the Raspberry Pi Pico lacks processing power, memory, and a CSI interface. Raspberry Pi Zero is intended for use in IoT and embedded applications where network connectivity and computing power are critical. In order to function and execute the programs, the Raspberry Pi Zero will need an operating system. The following table[19] provides a more detailed comparison:

Table 6: Comparison of Raspberry Pi Zero and Raspberry Pi Pico

Feature/Specification	Raspberry Pi Zero	Raspberry Pi Pico
RAM	512MB	264KB
HDMI Port	Mini HDMI	No
GPIO	Has 40 pins	Has 26 pins
SD/MMC	microSD	No
Camera	Yes	No
Wi-Fi 802.11n	Yes	No
Bluetooth	BLE&Bluetooth 4.2	No

2.5 Summary

Based on several projects that have been implemented in the literature review, the smart safety device for users is a project that is primarily new in the field of IoT since people does not have enough knowledge about this device and nowadays people have become more aware with their safety so the device has been exposed more to people. As the proposed project is the safety device for e-hailing service, it is also one of the brand-new device projects in the field of IoT, especially since e-hailing services have become more popular than traditional taxis for a variety of reasons. In the one of the literature review, project implemented by Likhitha K.N. and Hemalatha K.N prioritizes consumer safety for users. The researchers used the microcontroller which is Arduino Uno to control all aspects of their project. GPS module also have been used to give the user's location to the user's family and surrounding area when users facing a danger. The following tasks will be adapted for a variety of purposes. The self-defense tool in the form of an LED mechanism, like the project implemented by Likhitha K.N and Hemalatha K.N will be implemented in the project smart safety device for e-hailing users.

Next, to improve the project smart safety device for e-hailing users, a wearable device will be designed so that people can wear it while using e-hailing services, similar to the SafeBand project, which was implemented by Muhammad Nazrul Islam, Nuzhat Tabassum Promi, Fatema Alam Binte, and Syeda Nusraht Khaledur. A wearable device, such as a keychain that can be worn by anyone, regardless of gender will be implemented in project smart safety device for e-hailing users as it can be used by anyone and synchronously it will secure the user's safety. When the user (victim) presses the button, GPS is used to determine the user's location, and the location will be sent to the emergency and saved contacts or through the e-mail. The device is suitable to help the users when they are in

danger as the size of smart keychain is small and the user can hide it from the criminals. This device can also alert the surrounding as the buzzer will be activated and loud sound will be produced after the push button was pushed.

In conclusion, the direction of this project can be seen, and the outcome later can be predicted by researching and conducting a literature review from the previous projects. The previous projects had demonstrated a variety of ideas and methods for detecting danger, both physically and non-physically. The safety device, for example, has an alert mechanism that can alert the surrounding area, as well as a self-defense tool that can assist the user in fleeing a dangerous situation. These parameters can all be used to alert the surrounding area and the user's family in different ways, each with its own set of advantages and disadvantages.

CHAPTER 3

METHODOLOGY

This chapter will go over the project implementation approach, which includes a project block diagram and a project flow chart. To provide a thorough knowledge of the project's flow, each operation will be illustrated as a flow chart. Additionally, methods for connecting networks and circuit diagrams will be included and discussed. Following that, the use of tools such as the Raspberry Pi Zero W, Simple Mail Transfer Protocol (SMTP), Twilio, buzzer, switch button, resistor, GPS module and LED mechanism will be discussed. This methodology is critical to ensure that the smart e-hailing safety device for users works as intended.

3.1 Introduction

This project relies heavily on procedure and planning. This project will include all required components and will be completed according to the schedule. As a result, each of the above objectives can be accomplished effectively. This chapter will go over every technique that could be used in this project's research in detail. There are a few key steps to consider in order to finish this project research. The most crucial step is to conduct research and gather all relevant information from journals, the Internet, and research papers. Information about similar projects or prototypes will help to figure out how to finish this project.

The next step is to learn more about the safety device system, such as how it detects danger and how it assists the user by alerting the surrounding area and family. This step also examines the elements and items that will be used to solve the problem stated in the problem

statement in the systems that will be used. The goal of this step in the process is to understand and provide a clear picture of the study.

The third stage includes analyzing the relevant project or safety device component, as well as checking up on the system devices. Raspberry Pi Zero W, SMTP, Twilio, buzzer, switch button, resistor, GPS module and LED, were chosen as components for building this project prototype in order to make this research project successful. This is due to the fact that when the device is turned on, its location is tracked and sent to the targeted recipients by using the e-mail. Simultaneously, the buzzer will produce a loud sound to alert those nearby that the user is in danger and a SMS will be send to the targeted number.

Aside from that, the LED mechanism will be used as a self-defense tool to help the user get out from the dangerous situation. After the hardware and software are known, a flowchart of the overall smart safety device for e-hailing users can be created. If all the steps of the concepts are followed, all of the research objectives should be met and in accordance with the proper method and sequencing.

3.2 Project Workflow

Creating an organized and efficient workflow is critical to identifying and ensuring the success of a project. A well-organized and planned strategy is required for a successful effort. When the planning phase is completed, the next step is to conduct research. A project must be implemented to make things easier. Detailed study allows any potential issue to be recognized and prevented during the project's implementation. As a result, the project's design has been finalized, and it is now ready to be implemented. The efficiency of the project was assessed once it was done.

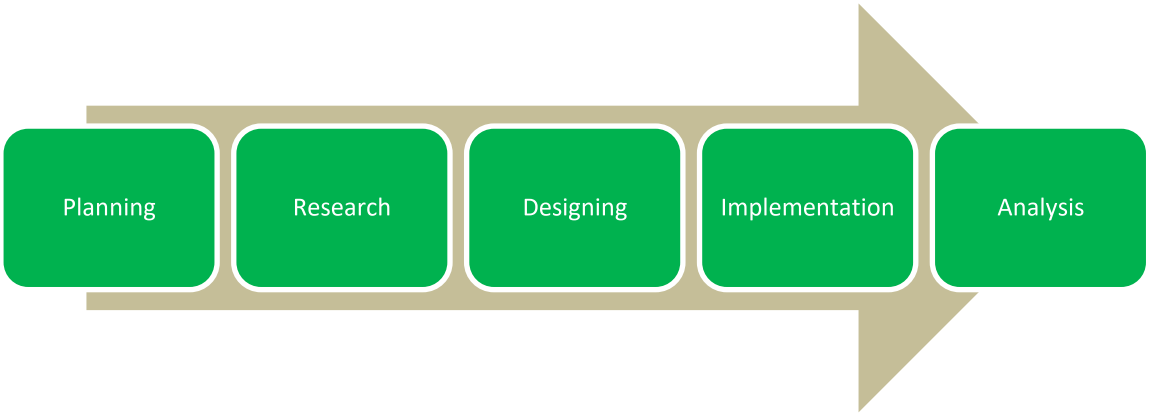

Figure 18: Project workflow

3.3 Methodology

A flowchart is a representation of the solution to a problem that illustrates the individual steps of a process in sequential order. From day one until the day of the presentation, a Gantt chart will assist in the completion of this Bachelor Degree Project (BDP). The project's process can be well-managed if both the flowchart and Gantt Chart planning are followed, as the time allotted for each process is already divided and can be focused until the project is completed. Tables 7 and 8 each display the Gantt charts for this project's Bachelor Degree Project 1 (BDP1) and Bachelor Degree Project 2 (BDP2), respectively. The project is divided into two parts, with Bachelor Degree Project 1 (BDP1) primarily concentrating on the statement of the problem, the literature review, and the findings for conceptual design, and Bachelor Degree Project 2 (BDP2) more focused on creating prototypes, generating reports, and designing hardware and software.

3.3.1 Flowchart Bachelor Degree Project (BDP)

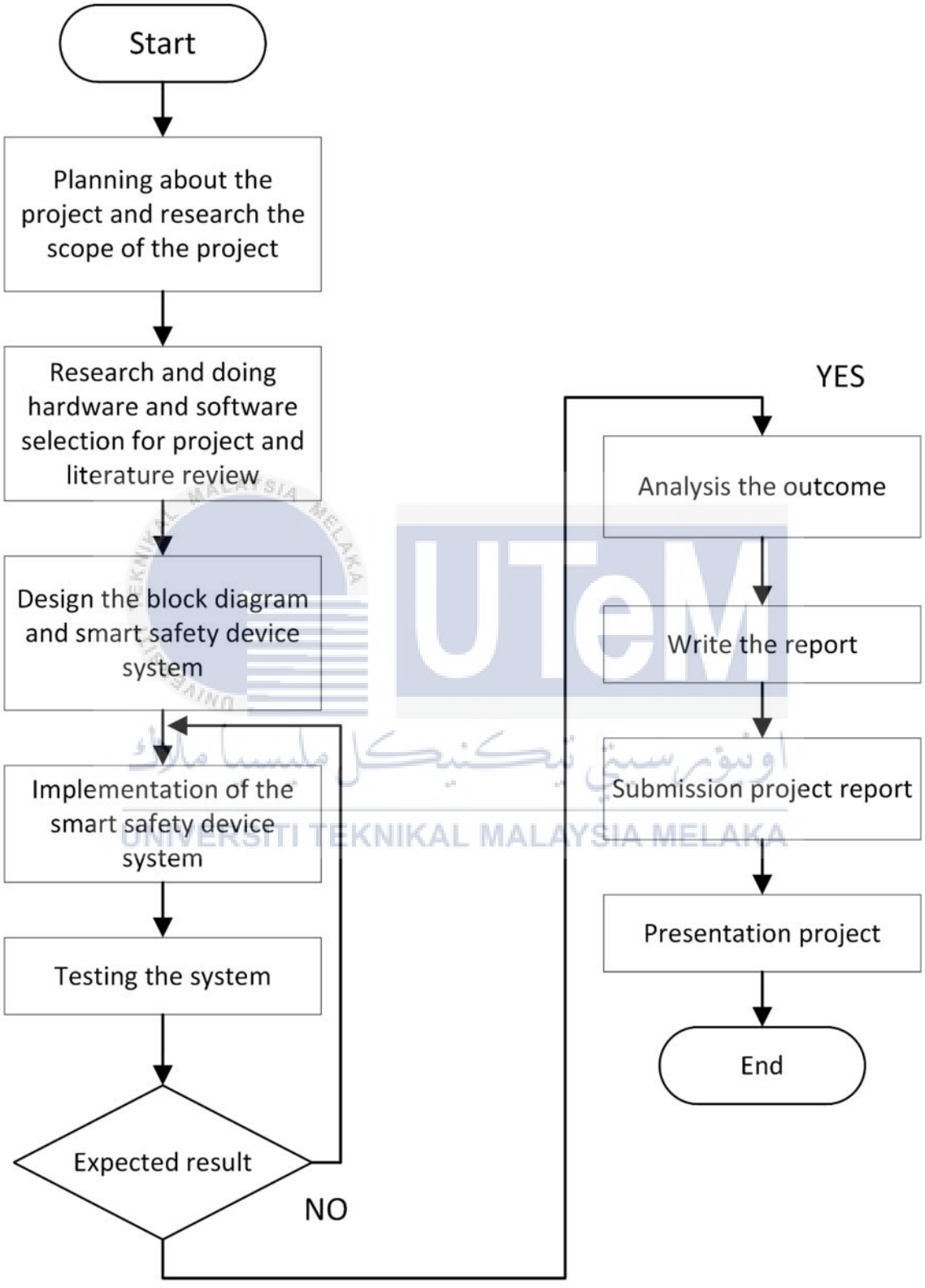

Figure 19: Flowchart Bachelor Degree Project (BDP)

3.3.2 Gantt Chart

Table 7: Gantt Chart of Bachelor Degree Project 1 (BDP1)

Project Activities	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Project Briefing and Title Registration														
Project Planning														
Literature Review														
Conceptual Design & Component Selection														
Report Writing &Presentation														

Table 8: Gantt Chart of Bachelor Degree Project 2 (BDP2)

Project Activities	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Hardware Testing														
Claim Form submission														
Program development														
Data analysis														
Poster preparation														
Report Writing & Presentation														

3.4 Experimental setup

The project is proposed to be designed as shown in the block diagram below. This block diagram together with the interconnected implementation design, will contribute to the successful completion of the project.

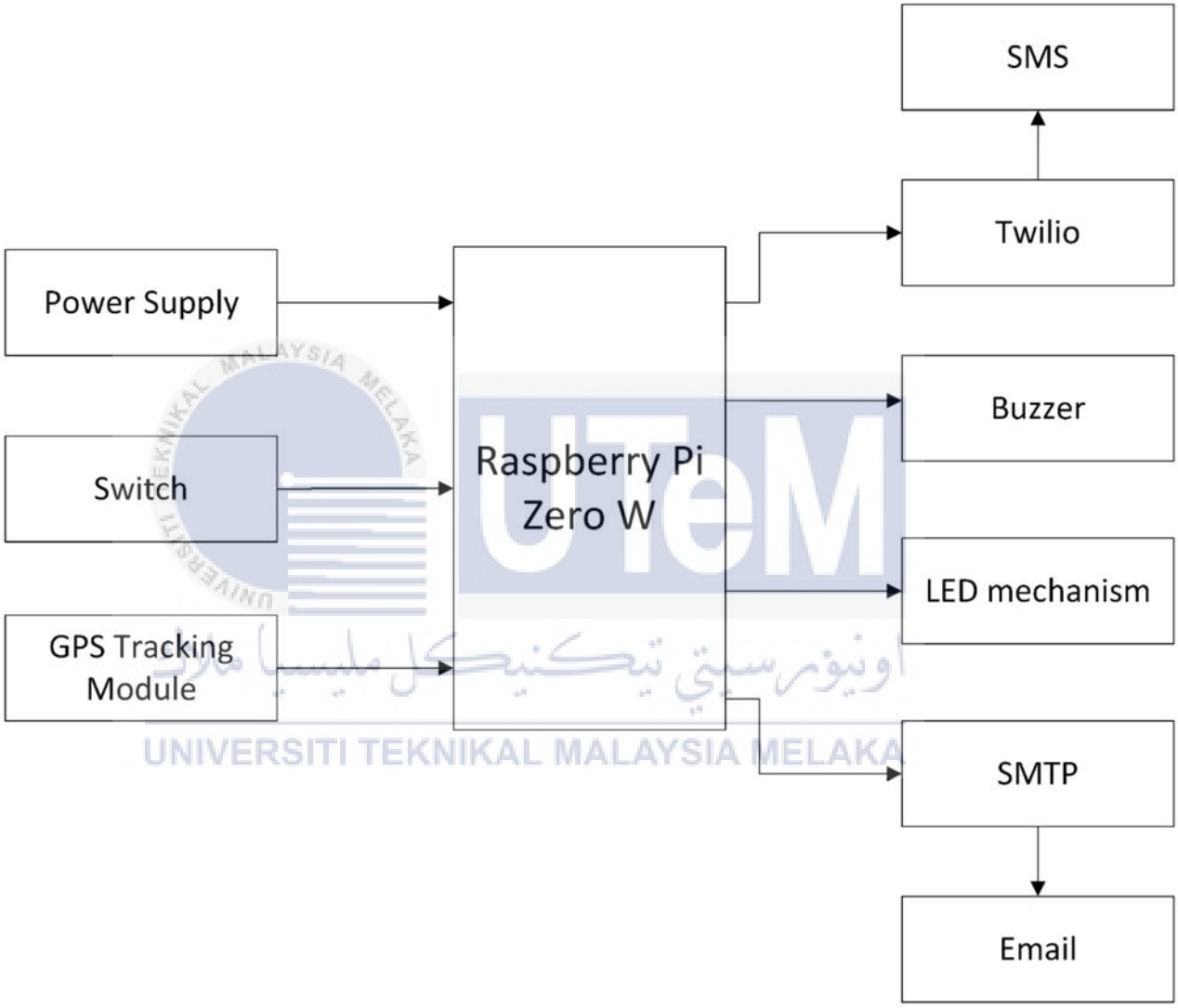

Figure 20: Project Block Diagram

The project block diagram indicates that the project will be activated when the switch button is pushed by the user. When the user pushed the switch button, the GPS tracking module will track the user position location and then message that consists of alert message and the location will be send to the pre-set recipients by e-mail. Twilio's API will simultaneously send an SMS message to the designated emergency contact listed on this device. Simultaneously, the buzzer will be triggered to alert the passersby about the incident that is going to happen or already happened. Following the push of the button, the LED mechanism will also turn ON and the LED system can be employed by the user as a self-defense tool to get out of the dangerous circumstance.

3.5 Equipment

This research focuses on the materials used in the project. There are two types of equipment required to execute this project. The first equipment is the software which is Raspberry Pi OS, which was implemented in this project to link all of the components with Raspberry Pi Zero W. Next, PuTTY software and Bonjour Software also has been used to connect the Raspberry Pi Zero W to the laptop by using the USB cable. VNC Viewer has been used to remotely control the Raspberry Pi during the set up and interfacing the GPS module and other system to Raspberry Pi Zero W. Programmatically sending and managing SMS has also been done using Twilio's SMS API platform. The SMTP protocol has also been implemented into the program code to send emails to numerous recipients that include alert messages and the tracking information that receive from the GPS tracking module. The second equipment used are the hardware such as Raspberry Pi Zero W, GPS tracking module, buzzer, switch button, resistor and LED.

3.5.1 Twilio

Twilio is a cloud communication platform as a service (CPaaS). By using building blocks called APIs, it helps software developers in creating user experiences. The entire communication process is simplified by this. The APIs (Application Programming Interfaces) that Twilio uses power its communications platform. Behind these APIs is a software layer that links and enhances global communication networks, enabling the users to phone and message anyone anywhere in the globe. From SMS to Voice to Wireless, Twilio offers a wide variety of APIs.

Figure 21: Send a text message from Python [20]

3.5.2 Simple Mail Transfer Protocol (SMTP)

The Simple Mail Transfer Protocol (SMTP) is a protocol that manages email transmission and mail server routing. The technology used for email communication is called an SMTP server. Python has the smtplib module, which defines an SMTP client session object that can be used to send email to any computer connected to the Internet and running an SMTP or ESMTP listener daemon. Each SMTP server has a different address, and the mail client that was used must be configured to utilize that address.

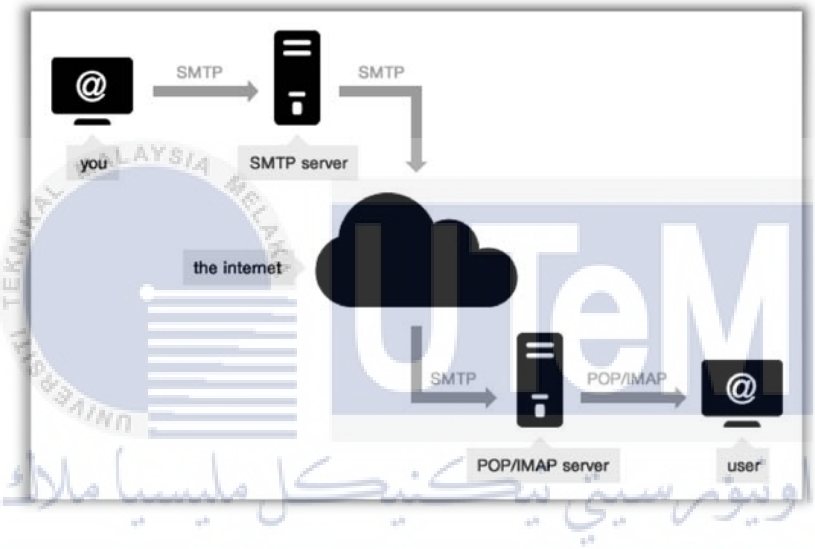

Figure 22: Send Email using SMTP [21]

3.5.3 Raspberry Pi Zero W

The Raspberry Pi known as a credit-card-sized computer, has shrunk even more, measuring only 65mm length by 30mm wide and selling for a very low price. Because of the integration of wireless LAN and Bluetooth, the Raspberry Pi Zero W is ideal for developing embedded Internet of Things (IoT) projects. The Pi Zero W is designed to be as small and versatile as possible, with tiny connections and an unpopulated 40-pin GPIO.

3.5.4 GPS Tracking Module

GPS tracking modules contain very small CPUs and antennas that receive data from satellites directly over specified radio channels. Each visible satellite will then provide timestamps and other data to it. The Raspberry Pi's location is determined by a GPS tracking module, which is especially significant if the Raspberry Pi is used for outdoor projects. The CP2102, a stable and fast USB to UART Bridge chip, is used in this Raspberry Pi GPS Module. It is simple to install on Raspberry Pi model like model A/A+/Zero/2/3B/3B+. The chip has a L80-39 GPS chip. The L80-39 can communicate with satellites by USB or UART and has 66 search channels and 22 simultaneous tracking channels.

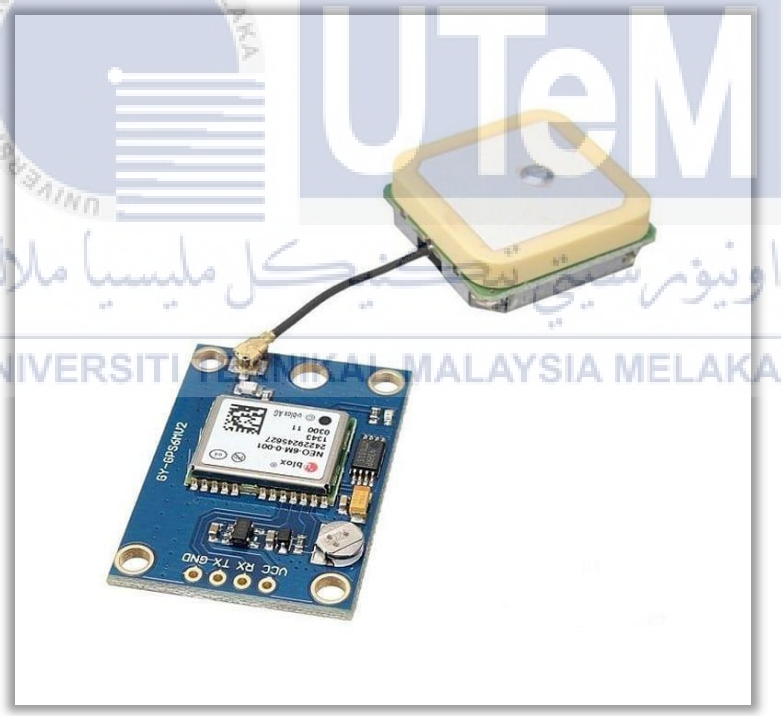

Figure 23: GPS tracking module [22]

3.5.5 Buzzer

A buzzer is an electronic, piezoelectric, or mechanical device that emits an audible signal. The fundamental goal is to convert an audio signal into a sound signal. It's typically found in DC-powered clocks, alarm devices, printers, alarms, laptops, and other electronic gadgets. Depending on the various designs, it may emit various sounds such as alert, melody, bell, and siren. Figure 21 shows the pin layout for the buzzer. There are two pins on it, one positive and the other negative. The positive terminal of the buzzer is represented by the '+' sign or a longer terminal. The '-' symbol or short terminal represents the negative terminal, which is connected to the GND terminal.

Figure 24: Buzzer [23]

3.5.6 Push Button

A push button is a simple switch mechanism for controlling a machine or process. Push buttons are simple machine or appliance power control switches. These are usually metal or thermoplastic switches that allow the user convenient access. It is divided into two types which are momentary and non-momentary. Push button switches come in a variety of forms depending on the application. A push button switch is a small, sealed mechanism that, when pressed, completes an electric circuit.

Figure 25: Push button [24]

3.5.7 Resistor

The term "resistor" refers to a passive electrical component with two terminals that is employed in electrical circuits to limit or regulate the flow of current. A resistor's primary function is to lower the voltage and reduce current flow in a specific area of the circuit. It is constructed with copper wires that are wound tightly around a ceramic rod, and the resistor's outside is painted with insulating paint.

Figure 26: Resistor [25]

3.5.8 LED

LEDs are semiconductor devices that release light when an electric current passes through them. An LED emits light as current flows through it as the electrons and holes recombine once more. LEDs only permit current to travel in one direction, blocking it from doing the opposite. Heavily doped p-n junctions are found in light-emitting diodes. An LED will emit colored light at a specific spectral wavelength when forward biased depending on the semiconductor material used and the level of doping. In the illustration, an LED is enclosed in a translucent cover that allows the light it emits to shine through.

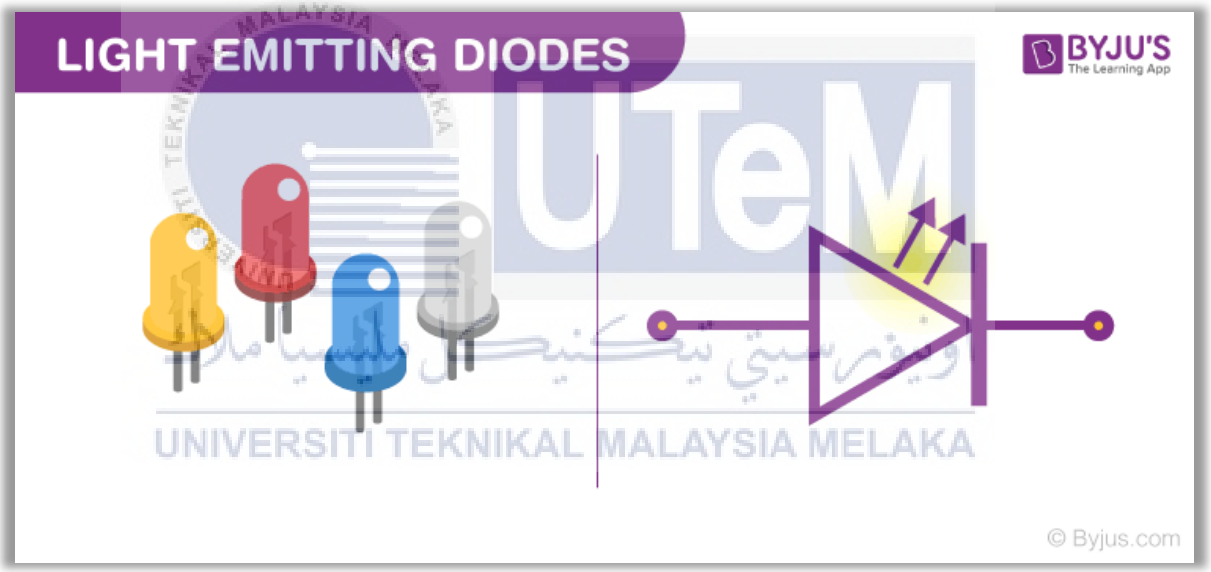

Figure 27: Light Emitting Diodes (LED) [26]

3.6 Overall System Flowchart

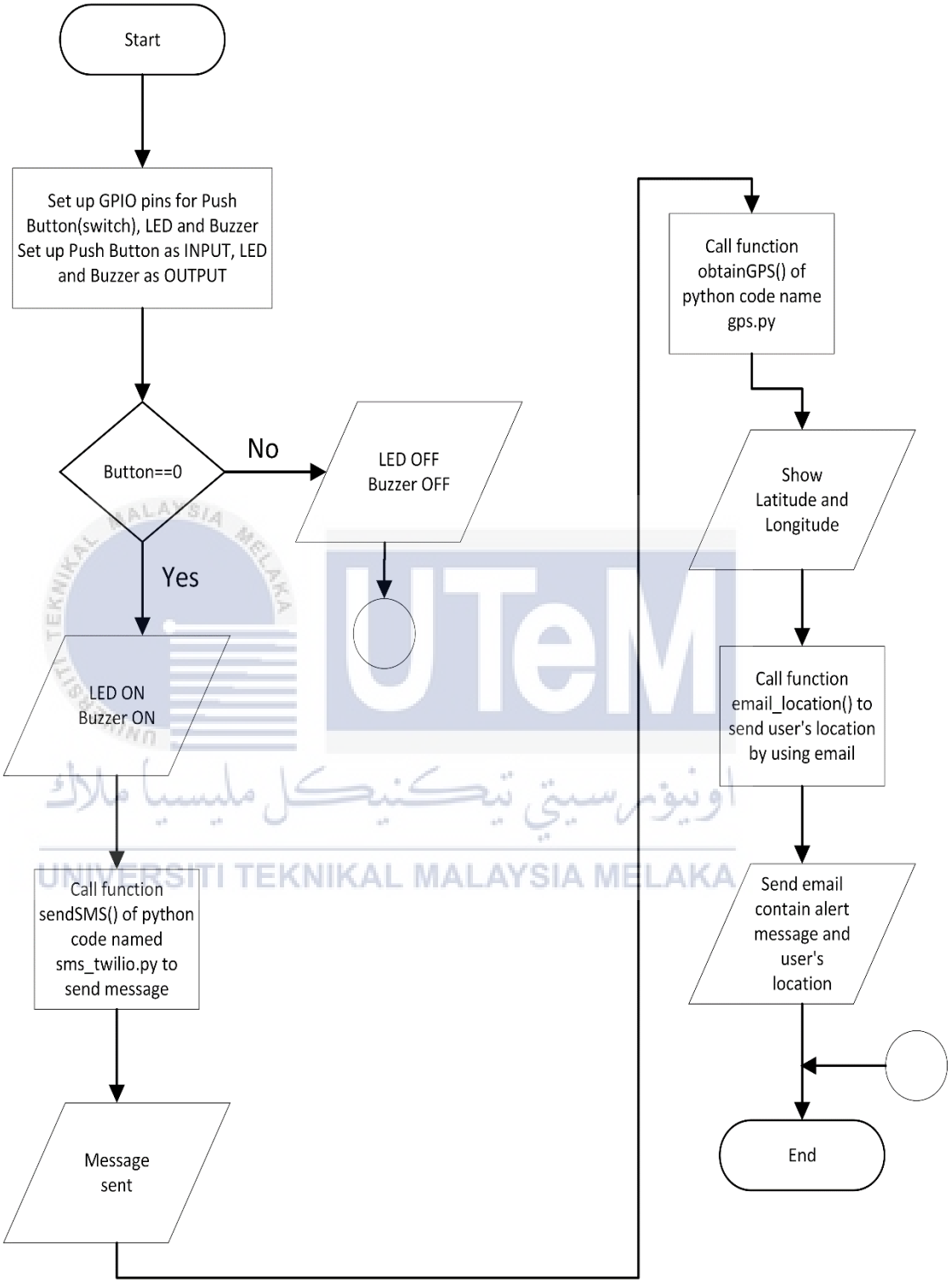

Figure 28: Overall System Flowchart

Figure 28 illustrates the logical sequence of the system that has been designed. The system's GPIO pins 27, 17, and 23 are preconfigured to function as the push button(switch), LED, and buzzer, respectively, when it is turned on. The push button has been designated as input, and the LED and buzzer have been designated as outputs. The output of the system can be sent to the predefined person by using two ways which are by using the Twilio's API and the next one is by using the email which the one that used SMTP library.

After everything is set up, the system will begin running by analyzing the push button's value. Both the LED and buzzer will be activated if the push button is grounded or has a value of 0. This will turn ON the system. The position will also be tracked as an alert message is generated using the Twilio API. The user's location and an alert message will then be included in an email that is also forwarded to the predetermined email recipients. Both the LED and buzzer will not operate if the push button is not grounded.

3.7 Summary

As a summary, Raspberry OS and VNC Viewer has been used to connect the other electronics to the Raspberry Pi Zero W for the software portion. In terms of the hardware, the software will be built on the Raspberry Pi, and other hardware will play their respective roles in ensuring the smooth operation of the smart safety device for e-hailing users.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The project's findings will be discussed in this section together with all the information needed to support their validity and accuracy.

4.2 Raspberry Pi Zero W Setup

Raspberry Pi Zero W has been set up by using USB cable to laptop and the Putty software and Bonjour software also have been used to complete the set up. SD Card name SDXC card has been flashed with Raspbian OS using balenaEtcher and the SD card will be named as boot(E:) and the file will be listed in that card.

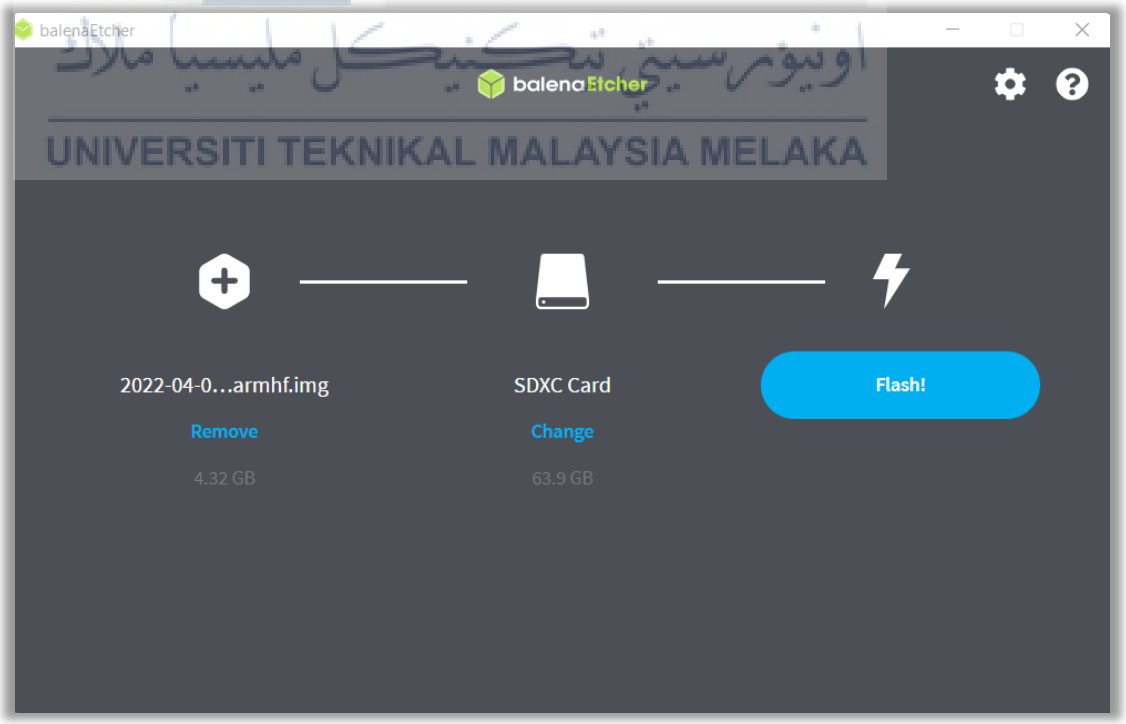

Figure 29: Flashed SDXC card with Raspbian OS

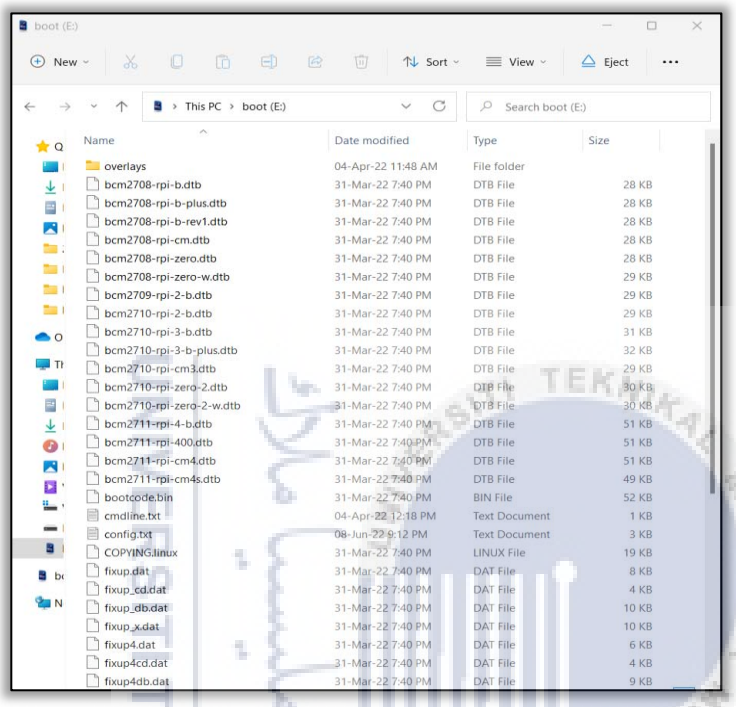

Figure 30: The content of boot(E:)

Next, the Raspberry Pi Zero W has been booted. The Raspberry Pi will be booted up after the USB cable is attached to the USB port, as shown by the yellow LED.

Figure 31: Raspberry Pi Zero W first boot

When raspberrypi.local first inserted in PuTTy, it was unable to open the connection and displayed the message "Host does not exist." The Bonjour software was then installed, which updated the drivers and appeared in the Network Connection, allowing it to connect to raspberrypi.local. VNC Viewer was used to connect the raspberrypi.local host to the VNC Viewer. “pi” has been set as the username, and “raspberry” has been set as the password.

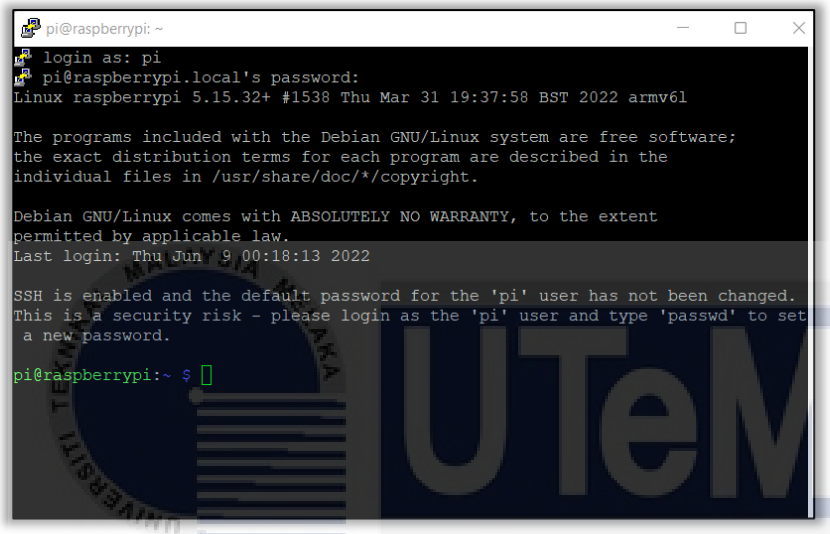

Figure 32: Raspberry Pi connected to the PC

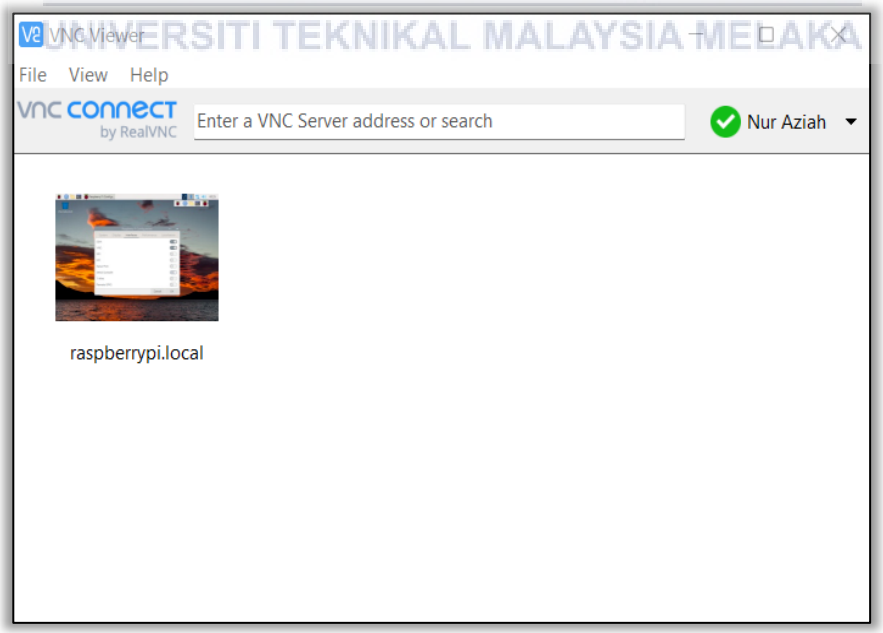

Figure 33: VNC Viewer Connection

4.3 Project Prototype and Pin Connection

Figure 34 showed the smart safety device's complete circuit connections. It is temporarily attached to a breadboard to ease the handling during the experiments. The system's main controller, a Raspberry Pi Zero W, will be powered by a 10000 mAh power bank via a micro-USB connector. The Raspberry Pi Zero W only has one set of UART pins. The Raspberry Pi Zero W and GPS module are connected via this UART pin. The transmit (TX) pin of the GPS tracking module is connected to the microcontroller's receive (RX) pin, and the GPS tracking module receive (RX) pin is connected to the microcontroller's transmit (TX) pin. The Raspberry Pi Zero W has also been supplying 3.3V to the GPS module.

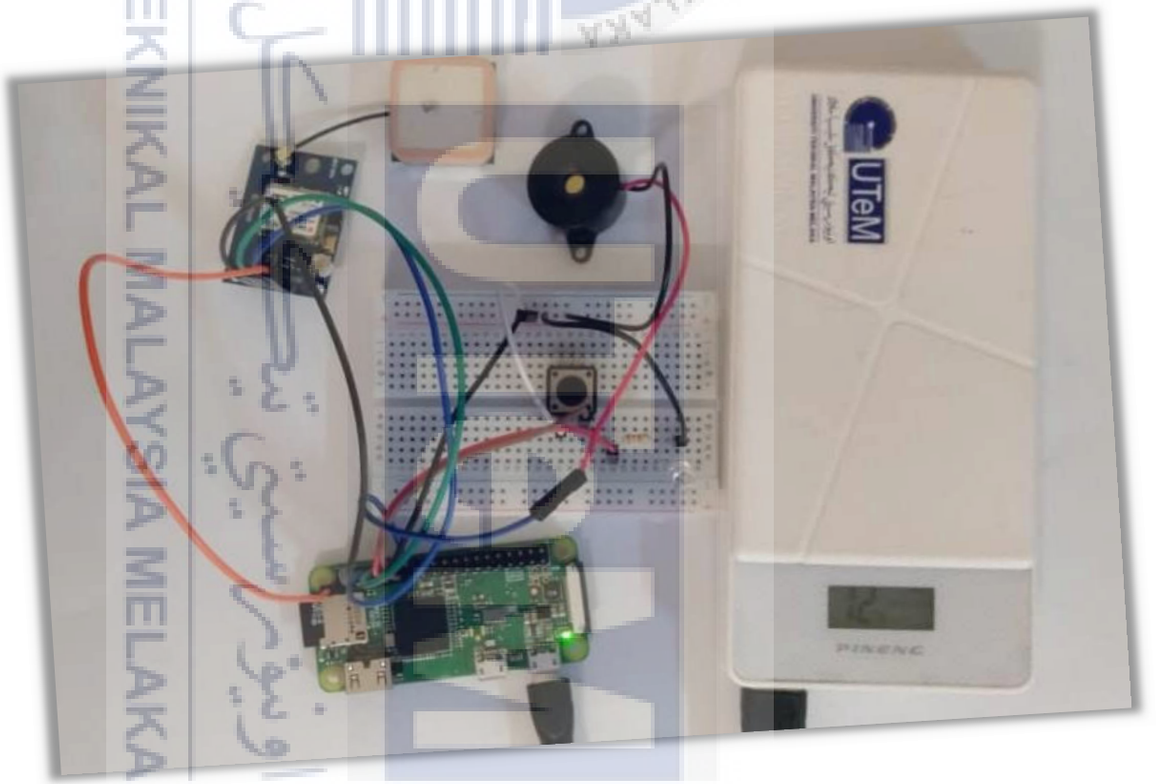

Figure 34: Prototype of Smart Safety Device

Table 9: Pin connections

Modules	Modules' Pins and Ports	Raspberry Pi's Pins and Ports
Buzzer	VCC GND	GPIO 23 Ground
LED	Anode Cathode	GPIO 17 Ground
GY-NEO6MV2 GPS Tracking Module	VCC TX RX GND	3V3 RX TX Ground

4.4 System Features

4.4.1 Real-time Map View

The real-time map view is implemented into this safety device to improve the system's safety feature. With the help of this capability, all predefined recipients of the e-mail such as the user's family or the police can instantly access Google Maps by clicking a link that provides the latitude and longitude of the user. The user's coordinates for Latitude and Longitude will be tracked and generated into a Google Maps link once the smart safety device has been activated.

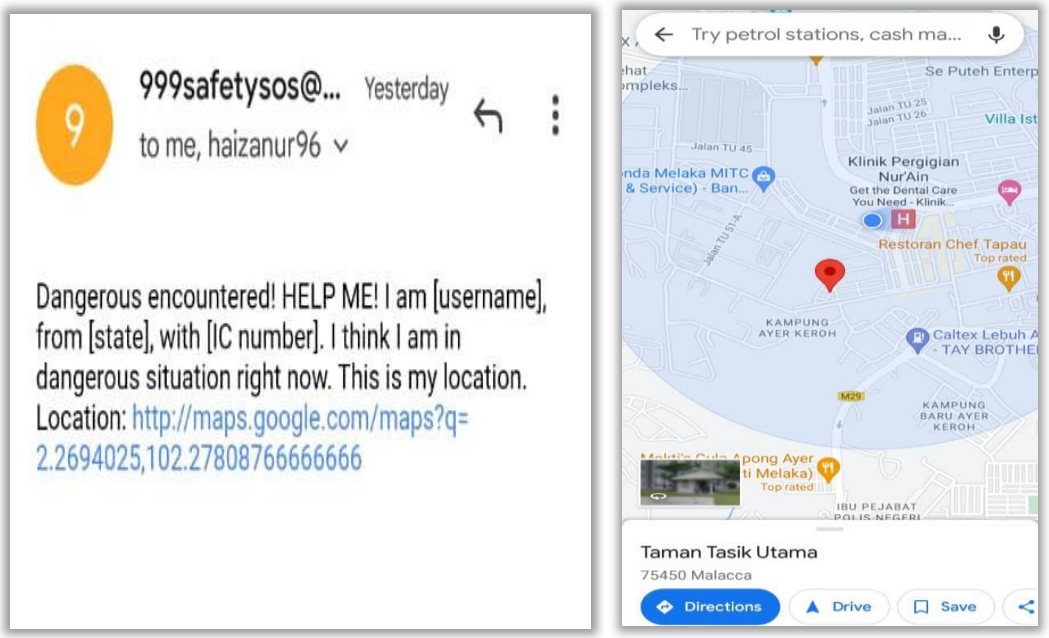

Figure 35: Real-Time map view

4.4.2 Real-time Notification

Real-time notification is a further safety feature that is provided to alert the system's designated emergency contacts that the user is in danger. The main program will call the real-time notification feature each time the system is activated. It functions by delivering an alert message to the predefined contact. The first option of real-time notification is using the Twilio's API. The main program which is main.py will call the function in sms_twilio.py program, then send an SMS with the alert message to the predefined contact.

The SMS message is represented in Figure 36, where the emergency message displays a warning that the user is in danger and instructs a predefined contact to check their email because it contains the user's location. The risk of victimisation can be decreased by the emergency contacts taking immediate action to file a police report and look for the user.

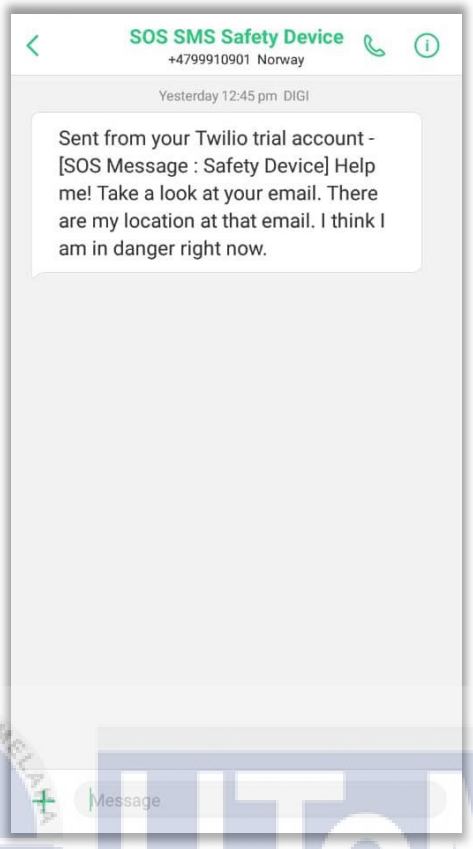

Figure 36: Send SMS to predefined contact

The second option of real-time notification involves using Python's SMTP library to send an email that includes the user's latitude and longitude as well as a link that opens the user's latitude and longitude on Google Maps. With it, the user who is in a risky circumstance can rapidly get the track from the predefined recipients. The predefined recipients like the user's family can get to act quickly to save the user by report it to the police or asking their relative for help. This also can ease the police work as the predefined recipients can also be set as the email of police station. This real-time notification will be activated, as in the main.py, a function email_location() will be called. This will work by sending the content like in Figure 37.

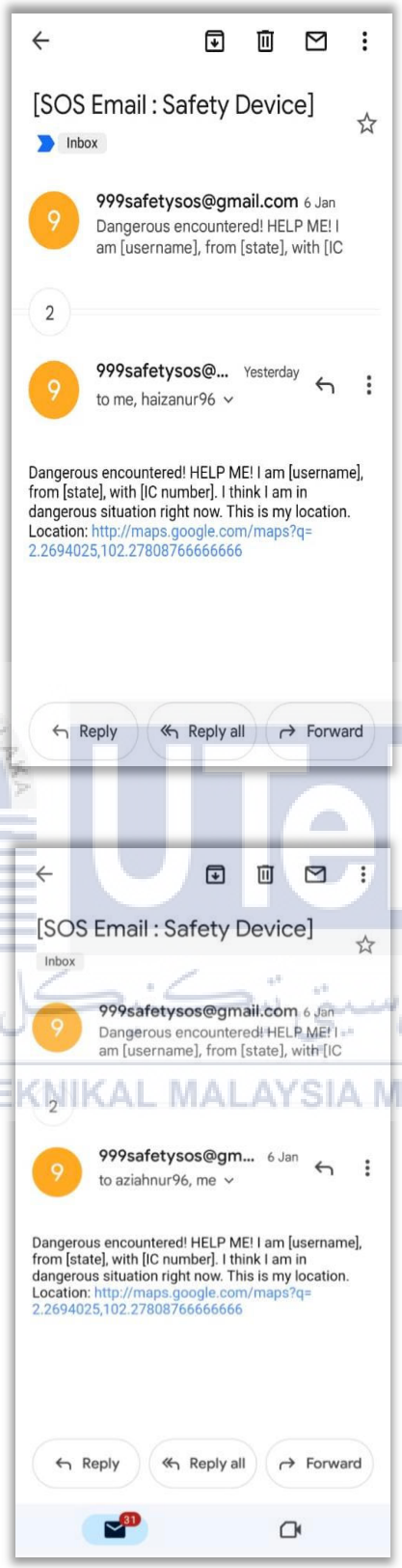

Figure 37: Send E-mail contain alert message and Google Maps link to multiple accounts

4.5 Result Summary and Analysis

Based on Figure 38, which is the output that produced in the Geany Programmer Editor, the message “Emergency button pressed...” will be displayed when the user pushed the push button to activate the safety device. As the button pushed, the LED and the buzzer will turn ON at the same time. The buzzer will produce a loud sound and the LED will be light up. This LED can be used by the user to flash the eyes of the attacker. The messages “LED on...” and “Buzzer activated...” will also be shown as these occur. As the sendSMS() method from sms_twilio.py is used in the main.py application, the message “Sending SMS...” will also be shown.

The Twilio free account information has been defined in this sms_twilio.py file, including the account SID, the auth token, and the messaging service ID. The alert message that has been constructed will be sent to the one contact number that has been predefined in this code. During this time, a SMS will be sent to the saved contact and thus notify them about the situation that the user occurred. The phrase “SMS sent” will be shown when the SMS has been sent successfully. As soon as the program calls the function obtainGPS(), it will produce the message “Get position..” and obtain the coordinates of the user. As shown in Figure 38, when the GPS has been successfully activated, it tracked the coordinate of the location and give the output of the Latitude as 2.2694025 and the Longitude is 102.27808766666666.

Following the call of function email_location() in the main.py program, the message “Sending Email...” will be shown. Multiple recipients can be set up in the email location.py file so that the email's content can be sent to a number of people. Mail information also has been established and set up there. In this program, the coordinates will be tracked, thus the GPS connection has also been set up. As the coordinates has been tracked, a link of google maps will be produced and this link will be sent to the predefined recipients. “Email sent”

message will be shown once the email has been sent successfully. When each of these has completed with success, the buzzer will turn OFF and the message "Safety system finished" will be shown.

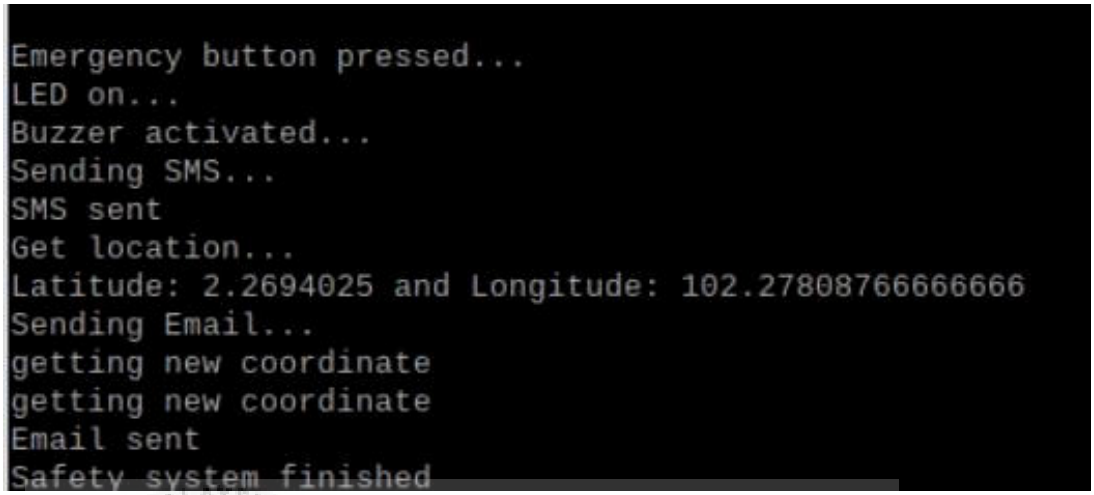

Figure 38: Output analysis using Geany Programmer Editor

CHAPTER 5

CONCLUSION

5.1 Conclusion

In conclusion, life is important to every people. People must be extra careful when they go out anywhere or when they used the e-hailing services alone. As e-hailing services have become very popular in our country, people safety during e-hailing services have also become a very concerned things to people as their beloved life is in stake. This project sparked the idea to implement a design that can ensure people and their beloved about their safety when using the e-hailing services or when they encountered a danger situation. As the device have been designed as a wearable device which is a keychain, it can be used without regarding the genders.

This project has successfully established an IoT-based personal safety and protection system. The project smart safety device for e-hailing users have implemented the alerting system to alert the surrounding by pushing the button to activate the device and at the same time, the device will track the user's location and the location will be sent to the targeted recipients. Concurrently, the device will activate the buzzer to alert the surrounding about the user's safety and alert message will be send to the emergency contact. As a self-defense mechanism also has been implemented in this device, this smart safety device can also help the user to escape themselves from the danger situations. This device is the product of a combination of software and hardware that has been programmed.

5.2 Recommendation for Future Work

Several suggestions might be made for future work to get around the difficulties and improve the overall functionality and capabilities of the system created. First, by combining all of the hardware into an integrated circuit design, the size of the prototype can be reduced. The prototype is huge and heavy for practical use in this project because the hardware is purchased and installed separately for testing. A PCB could be created in the future to fit all the hardware on a compact circuit board, which would make the device lighter and smaller.

Next, because of the budget constraints, a sizable 10000 mAh power bank was used in this project. It is advised that the power bank be replaced in future work with a built-in lithium-ion battery that is kind of similar to a phone battery to improve the endurance of the device's idle mode and lengthen the battery life. Last but not least, one of the project's constraints is that SMS sent from the Free Twilio Trial Account will start with the phrase "Sent from a Twilio Trial Account". If the system created in the future is going to be produced in big quantities, Twilio subscription can be done to easily solve this problem because it is more cost-effective when the subscription fee is divided into the production cost of each device.

5.3 Project potential for commercialization

A multiple type of wearable device might also be created using this prototype in a similar manner. The type of wearable device like necklace, keychain or remote can be implemented and designed in the safety device. The design will be made to be more lightweight and smaller so that it could be carried around more conveniently. Next, the smart safety device is accessible to everyone and portable. According to the needs of the customer, it may contain a facility for various contact information entry. As it also portable, it can be carried by everybody and everywhere. There is also a possibility of adding more defense capabilities, which can be controlled by numerous monitoring systems. The defense capabilities like pepper spray and electroshock may be added so that it can help the users to defense themselves and also flee themselves from the dangerous situation.

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APPENDICES

Appendix 1: Python Coding for Raspberry Pi Zero W

Code: main.py

```
import RPi.GPIO as GPIO
from sms_twilio import*
from gps import*
from email_location import*
from time import sleep
import time
import signal

BUTTON_GPIO = 27
LED_GPIO = 17
BUZZER_GPIO = 23

GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(BUTTON_GPIO, GPIO.IN, pull_up_down=GPIO.PUD_UP)
GPIO.setup(LED_GPIO, GPIO.OUT)
GPIO.setup(BUZZER_GPIO, GPIO.OUT)

while True:
  if GPIO.input(BUTTON_GPIO)==0: #0 means pressed #shorted to GROUND
    print("Emergency button pressed...")
    GPIO.output(LED_GPIO, True)
    print("LED on...")
    GPIO.output(BUZZER_GPIO, True)
    print("Buzzer activated...");

    print("Sending SMS...")
    sendSMS() #send sms using Twilio
    print("SMS sent")

    print("Get location...")
    obtainGPS() #show Latitude and Longitude

    print("Sending Email...")
    email_location()  #Email Google Maps to a number of people

    print("Safety system finished")
    sleep(0.5)

  else:
    GPIO.output(LED_GPIO, False)
    GPIO.output(BUZZER_GPIO, False)
    sleep(0.5)
```

Code: sms_twilio.py

```
from twilio.rest import Client

def sendSMS():

  account_sid ="AC1970cf20d7988e7e966d931536726xxx" # Put Twilio account SID
here
  auth_token ="cb7124f913c7f1d5196356a52ff87xxx" # Put auth token here
  message_service_id="MG16765f16991a0824d7d60b9fc13a1xxx"

  client = Client(account_sid, auth_token)

  message = client.api.account.messages.create(
  to="+6011xxxxxxxx", # Put predefined cellphone number here
  from_=message_service_id, # Put message service ID here
  body= "[SOS Message : Safety Device] Help me! Take a look at your email. There are
my location at that email. I think I am in danger right now.")
```

Code: gps.py

```
import serial
from time import sleep
import string
import pynmea2
#mport = "/dev/ttyAMA0" #for Raspberry Pi pins
#mport = 'COM9' #choose your com port on which you connected your Neo 6M GPS
#mport = "/dev/ttyUSB0" # for Raspberry Pi USB

def obtainGPS():

  dataR = []
  while(dataR == []):
    try:
      port="/dev/ttyS0"
      ser=serial.Serial(port, baudrate=9600, timeout=1)
      dataout = pynmea2.NMEAStreamReader()
      newdata=ser.readline().decode('unicode_escape')
      #newdata=ser.readline()
      #print(newdata)

      if newdata[0:6] == "$GPRMC":
        newmsg=pynmea2.parse(newdata)
        #print(newmsg)
        lat=newmsg.latitude
        lng=newmsg.longitude
        dataR = [lat,lng]
        gps = "Latitude: " + str(lat) + " and Longitude: " + str(lng)
        print(gps)
```

```
    except:
      time.sleep(0.1)

  return dataR
```

Code: email_location.py

```
import time

import serial

import string

import pynmea2

import smtplib

from email.mime.multipart import MIMEMultipart

from email.mime.text import MIMEText


def email_location():

  #setting up mail information

  fromaddr = "999safetysos@gmail.com"

  pword = "iqsghnbvgvgwqtih"

  toaddr = ["xxxxxxxxxx@gmail.com", "xxxxxxxxxx@gmail.com"]

  msg = MIMEMultipart()

  msg['From'] = fromaddr

  msg['To'] = ", ".join(toaddr)

  msg['Subject'] = "[SOS Email : Safety Device]"


  #setup the serial port to which GPS is connected to

  port = "/dev/ttyS0"

  ser = serial.Serial(port, baudrate=9600, timeout=0.5)

  dataout  = pynmea2.NMEAStreamReader()
```

```
dataR = []
while(dataR == []):
  try:
    newdata = ser.readline().decode('unicode_escape')
    print ("getting new coordinate")
    if newdata[0:6] == "$GPGGA":
      newmsg = pynmea2.parse(newdata)
      newmsg=pynmea2.parse(newdata)
      newlat = newmsg.latitude
      newlong = newmsg.longitude

      lat  = str(newlat)
      lon = str(newlong)
      dataR = [lat,lon]
      content = "Dangerous encountered! HELP ME! I am [username], from [state], with [IC number]. I think I am in dangerous situation right now. This is my location. Location: " + "http://maps.google.com/maps?q=" + lat + "," + lon
      Email = content
      msg.attach(MIMEText(Email, 'plain'))

      server = smtplib.SMTP('smtp.gmail.com', 587)
      server.starttls()
      server.login(fromaddr, pword)
      text = msg.as_string()
      server.sendmail(fromaddr, toaddr, text)
      server.quit()
      print("Email sent")
      time.sleep(3)
```

```
    except:
      time.sleep(3)


return dataR
```