SMART BLIND STICK WITH EMERGENCY BUTTON USING INTERNET OF THINGS (IoT)

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SMART BLIND STICK WITH EMERGENCY BUTTON USING INTERNET OF THINGS (IoT)

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ABSTRAK

Orang buta sukar untuk mengesan kehadiran sebarang halangan di laluan mereka semasa bergerak dari satu lokasi ke lokasi lain. Selain itu, sistem sedia ada mempunyai banyak batasan seperti tidak mempunyai butang kecemasan dan GPS. Hasilnya, Smart Blind Stick dengan Butang Kecemasan menggunakan Internet of Things (IoT) dicadangkan sebagai penyelesaian untuk membantu orang cacat penglihatan dalam kehidupan seharian mereka tanpa bantuan orang lain. Motivasi untuk membangunkan projek yang dicadangkan ini adalah kerana tiada inisiatif untuk orang buta berasa selamat apabila mereka berjalan di luar tanpa penjaga. Penderia ultrasonik, penderia air, butang kecemasan dan modul GPS digunakan dalam projek ini. Kayu buta dilengkapi dengan sensor ultrasonik untuk mengesan sebarang halangan dalam julat 50 sentimeter di hadapan orang buta dan sensor air dipasang di bawah kayu buta untuk mengesan kehadiran air dan permukaan basah. Kemudian, buzzer membantu orang buta dalam mengesan halangan yang tepat dan kawasan permukaan basah di hadapan mereka menggunakan buzzer. NodeMCU digunakan sebagai pengawal. Tambahan pula, kerana orang buta tidak dapat melihat jalan raya, mereka lebih mudah tersesat. Dengan menggunakan penjejak GPS, penjaga boleh mengesan lokasi orang buta. Jadi, dengan GPS pada kayu, penjaga tidak lagi takut tentang orang buta dan akan dapat mengesan lokasi mereka. Selain itu, jika orang buta berada dalam kecemasan, mereka boleh menekan butang kecemasan pada kayu mereka, dan penjaga akan menerima pemberitahuan amaran, yang akan muncul pada Aplikasi Blynk. Data dihantar melalui modul Wi-Fi iaitu papan NodeMCU. Lokasi orang buta akan dihantar ke aplikasi Blynk dan ia akan dipaparkan dalam aplikasi Blynk. Metodologi Rapid Application Development (RAD) digunakan sebagai panduan untuk melengkapkan sistem yang dicadangkan daripada fasa perancangan keperluan kepada fasa penggunaan sistem. Pada akhirnya, objektif sistem yang dicadangkan dipenuhi, dan kefungsian sistem seharusnya dapat mengesan halangan dan kawasan permukaan basah serta dapat menghantar pemberitahuan amaran dan lokasi orang buta kepada aplikasi Blynk.

ABSTRACT

A blind person finds it difficult to detect the presence of any obstacles in their path while moving from one location to another. Aside from that, the existing system has a lot of limitations such as do not have an emergency button and GPS. As a result, the Smart Blind Stick with Emergency Button using the Internet of Things (IoT) is proposed as a solution to assist visually impaired people in their day-to-day living without the assistance of others. The motivation to develop this proposed project is because there is no initiative for blind people to feel safe when they walk outside without guardians. An ultrasonic sensor, water sensor, emergency button and GPS module are used in this project. The blind stick is equipped with ultrasonic sensor to detect any obstacles in a range of 50 centimeters in front of blind people and a water sensor is attached under the blind stick to detect presence of water and wet surfaces. Then, the buzzer assists blind people in locating the exact obstacles and the wet surface area in front of them using a buzzer. The NodeMCU is used as the controller. Furthermore, because blind people cannot see the road, they are more likely to become lost. With the using of GPS tracker, the guardian can track the location of the blind people. So, with the GPS on the stick, the guardian will no longer be afraid about blind people and will be able to track their location. Aside from that, if blind people are in an emergency, they can press the emergency button on their stick, and the guardian will receive an alert notification, which will appear on the Blynk Application. The data is transmitted through the Wi-Fi module which is NodeMCU board. The location of blind people will send to the Blynk application, and it will display in the Blynk application. The Rapid Application Development (RAD) methodology is used as a guidance to complete the proposed system from the requirement planning phase to the system deployment phase. At the end, the objectives of proposed system are met, and the functionality of the system should be able to detect the obstacles and the wet surface area and able to send the alert notification and location of the blind people to the Blynk applications.

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LIST OF SYMBOLS

cm	Centimetres
MHz	Megahertz
uS	Microseconds
m	Metres

LIST OF ABBREVIATIONS

CPU	Central processing unit
ETA	Electronic Travel Aids
GPS	Global Positioning System
IOT	Internet of Things
IEEE	Institute of Electrical and Electronics Engineers
LED	Light-emitting diode
PWM	Pulse-width modulation
RAD	Rapid Application Development
SDLC	System Development Life Cycle
UMP	Universiti Malaysia Pahang
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Introduction

According to statistics from the Jabatan Kebajikan Masyarakat, there are approximately 53,825 thousand blind people in Malaysia (*Jabatan Kebajikan Masyarakat*, n.d.). Blindness in general refers to the condition of people with visual impairments. Blindness is divided into two categories for classification which is total blindness and low vision (Chandra et al., 2022). They have very limited vision if they have low vision. Low vision is defined as a loss of vision that cannot be corrected with glasses, contacts, or surgery. It is not blindness because some vision remains. Blind spots, poor night vision, and blurry vision are all symptoms of low vision. Total blindness denotes the inability to see anything and the absence of light. Most people who use the term "blindness" mean total blindness.

Blind people rely solely on their hearing and touch senses (Romadhon & Husein, 2020). Many factors influence the occurrence of visual disturbances, including accidents, congenital defects, and bad habits, all of which can result in a reduction in sight sensory capability. Because blind people have limited vision, their mobility to carry out activities is limited.

The number of visually impaired people is expected to increase in the future for a variety of reasons. Because visual information is required for most navigational tasks, visually impaired people face difficulties due to a lack of necessary information about their surroundings. Physical movement can be difficult for visually impaired people because it can be difficult to distinguish where he is and how to get from one place to another (Riazi et al., 2016). To help him navigate unfamiliar terrain, he will bring a sighted family member or friend.

As a result, in order to get around, they must rely on a variety of tools and techniques. Orientation and mobility specialists, for example, assist and train visually impaired and blind people to move independently and safely with their remaining senses. Many recent techniques based on signal processing and sensor technology have been developed to assist blind people in moving more freely (Panicos Kyriacou, 2017). With the advancement of modern technology, a wide range of Electronic Travel Aids are now available (ETAs). These devices function in the same way as radar systems, which use ultrasonic sensors to detect obstacles such as fixed and moving objects (Bishop, 2008). Therefore, this project proposes the design and development of a portable smart stick for them to use and navigate in public places. The blind stick is equipped with an ultrasonic sensor to assist visually impaired people when using a walking stick by detecting surrounding objects and situations.

1.2 Problem Statement

According to a World Health Organization (WHO) report, at least one person in the country is blind due to eye diseases such as diabetes retinopathy (diabetes eye disease), glaucoma (high intraocular pressure-related eye disorders), and cataract (Bourne et al., 2021). The lives of blind people are extremely difficult and demanding. The ability to detect obstacles as they walk is the most important feature. When using a standard blind stick, blind people cannot easily identify obstacles or stairs.

The blind traveller should rely on other guides such as a blind cane, people information, trained dogs, and others (Gend et al., 2021). Because they cannot see, they are frequently struck by roadside objects such as walls, cars, and people, and as a result, they may sustain serious injuries.

One of the current issues for visually impaired travellers is identifying wet surfaces. Because wet surfaces are hazardous for blind people to cross and identify (Natarajan et al., 2022a). Other than that, the normal blind stick has no safety features and guardian cannot track the location of the user when they are having an emergency situation.

One of the initiatives aimed at making blind people feel safe when they go out without their guardians is Smart Stick. The Smart Blind Stick is designed to help blind people overcome obstacles (Binti Rosman, n.d.). This stick will contain a sensor that will detect any object or human in its path. This system uses GPS on this stick to track where they go, and when blind people press the emergency button, the guardian receives an alert notification.

1.3 Objectives

The following is the project's objectives:

i. To study the existing blind stick system that can help blind people walk safely.
ii. To develop smart blind stick system using Internet of things (IoT) technology with emergency button system.
iii. To test the functionally of the proposed system.

1.4 Scope

The following are the project's scope:

- User Scope:
    i. Blind people
    ii. Keeper/Guardian

- System Scope:
    i. Can detect obstacles and wet surface areas, and alert blind people via buzzer when there are obstacles or objects in their path.
    ii. Guardians or families can track blind people whereever they go.
    iii. Blind people can press the emergency button if an emergency occurs and the guardian will receive alert notification.
    iv. This system only compatible with Android.

1.5 Thesis Organization

There are three chapters in this project thesis. The planned project is described and developed in **Chapter 1,** which includes an introduction, problem statement, objective, and scope.

Chapter 2 discusses the literature review quickly, providing a concise description of the source for the review despite following an organizational pattern and combining summary and synthesis.

Chapter 3 covers research methods, the system development lifecycle, the framework, the context diagram, the data flow diagram, the entity connection diagram, and the system database design.

Chapter 4 describes the implementation design and outcome. This chapter provides a detailed description of the system interface and functionality. The results of system testing are discussed. This chapter clearly reports all tests and results performed on a developed system.

Finally, **Chapter 5** serves as the overall conclusion for the entire thesis and system that has already been developed. This chapter highlights the development system's accomplishments and contributions, future works, project constraints, and project completion.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

When visually impaired people try to navigate at home or elsewhere, they encounter a number of challenges (Ultrasonic Sensor-Aided Intelligent Walking Stick for Visually Impaired | Request PDF, n.d.). Walking sticks are commonly used to address these issues. Later, advancements in walking sticks were made using a variety of methodologies, resulting in significant improvements over previous versions. The electronic industry interfered and modified the way walking sticks were constructed, giving rise to the term "smart sticks". Unfortunately, as the use of sensors increased, so did the cost, making it unaffordable for the poor. This project intends to use fewer sensors in order to lower the cost of the device while maintaining the required accuracy and facilities. Using a single sensor, this system will be able to detect obstacles in its path. A brand-new alerting mechanism has been created. This system also seeks maximum accuracy at the lowest possible cost while ensuring user safety.

A wearable health monitoring system is the most popular Internet of things application right now. Similarly, several wearable devices are designed for the blind. Only a few systems are covered in this section. A sensor-assisted stick for blind people is a wearable device that consists of a light-weight blind stick and an object detection circuit that uses a sensor. Its primary purpose is to assist the blind person in safely moving from one location to another while avoiding potential impediments. The device recognises both fixed and moving objects, which could help prevent accidents.

The main goal is to create an app that allows blind people to identify impediments and walk freely. An innovative stick is designed to help visually impaired people navigate. Ultrasonic sensors are used in this technology to detect obstructions using ultrasonic waves. The sensor receives data from the Arduino after sensing the obstructions. The Arduino analyses the data and determines whether the impediment is close enough to the person. If the impediment is not close to the system, nothing happens. If the impediment is close enough to the system, a signal is sent to the buzzer. Blind people are guided along a safe path using a multitasking stick (Murali et al., 2017).

2.2 Existing Systems

2.2.1 Ultrasonic Sensor Based Smart Blind Stick (System A)

This study proposes the development of a walking stick that can detect impediments in a blind person's path (SVS College of Engineering & Institute of Electrical and Electronics Engineers, n.d.). The goal is to make the system less sensitive to environmental noise. The technology is inexpensive and small enough to be carried on a walking stick. To identify objects on the right, left, and in front, the proposed system employs a PIC microprocessor and three ultrasonic sensors. The PIC microcontroller must be programmed to calculate the distance of any item from the sensor. The microcontroller is programmed using the C programming language. A buzzer sounds when an obstacle is detected. The overall system is represented by a block diagram.

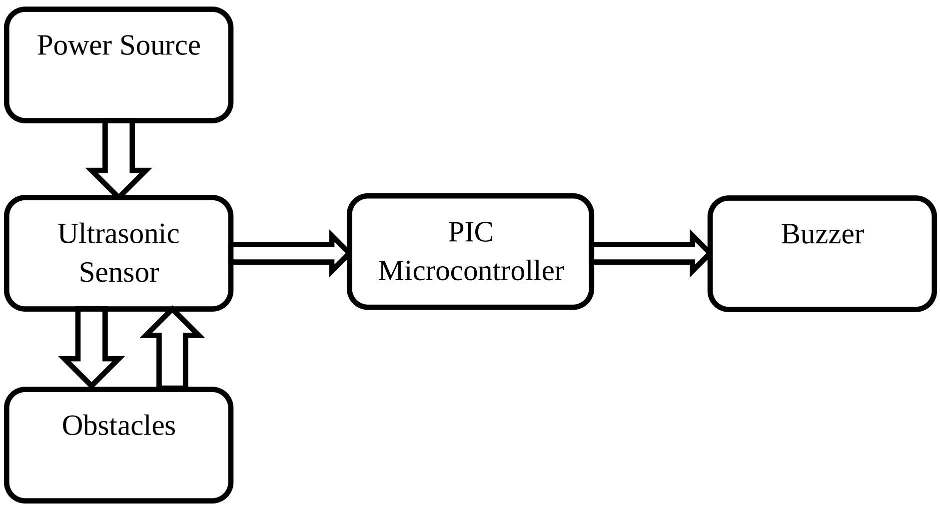


Figure 2.1: The overall system is depicted as a block diagram

When the sensor receives the trigger pulse, the MCU waits for a high edge on the selected sensor's ECHO line. It seeks a rising edge along the same line. The loop will continue if the bit is received; otherwise, it will end. If several rounds have been completed without receiving a high edge pulse on the MCU's I/o line, a sensor problem has occurred. Check the sensor's power line to see if it is properly connected or if the ECHO line from the sensor to the MCU is damaged to detect a malfunction.

TIMER1 is activated when the high edge of the ECHO line is received. It will determine the pulse width. To start the counter, write a 0 to the counter register (TMR1) and a 1 to the TMR1ON bit. Timer1 must be configured with a preorder value of 1:2. As a result, its counting frequency is half that of the CPU. The timer operates at 2.5 MHz at a CPU frequency of 5 MHz (crystal oscillator frequency, 20 MHz). The time interval is 0.4 microseconds.

The I/O line connected to the ECHO signal, which is a sensor output, must be monitored to identify the pulse's falling edge. The loop will continue if it receives a high; otherwise, it will break. Set the TMR1ON bit to 1 to pause the timer. The result variable is then copied from counter register TMR1. The value of the result variable is returned after being multiplied by the timer's period of 0.4 microsecond. The pulse length in microseconds (uS) is calculated and returned by the function (cm). The flow chart of the proposed system is shown in Figure 2.2.

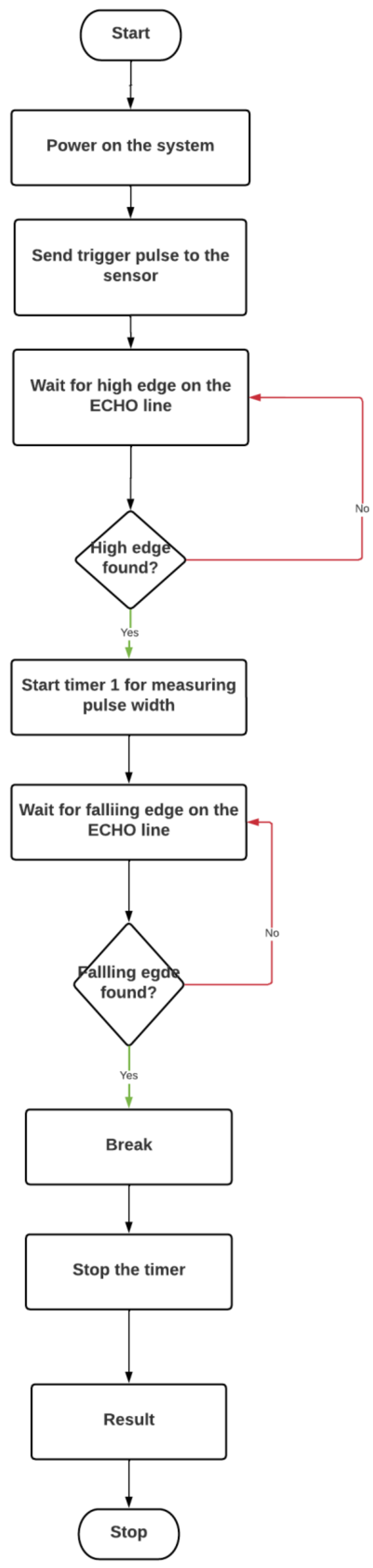


Figure 2.2: Flow chart of a proposed system

After various obstacles were placed at various distances from the blind stick, the output voltage on the sensors' ECHO pins was measured. The output voltage increases as the distance between the obstacles and the blind stick increases. The working range of the proposed blind stick is 5-35 cm. The Smart Blind Stick with Ultrasonic Sensor is depicted in Figure 2.3.

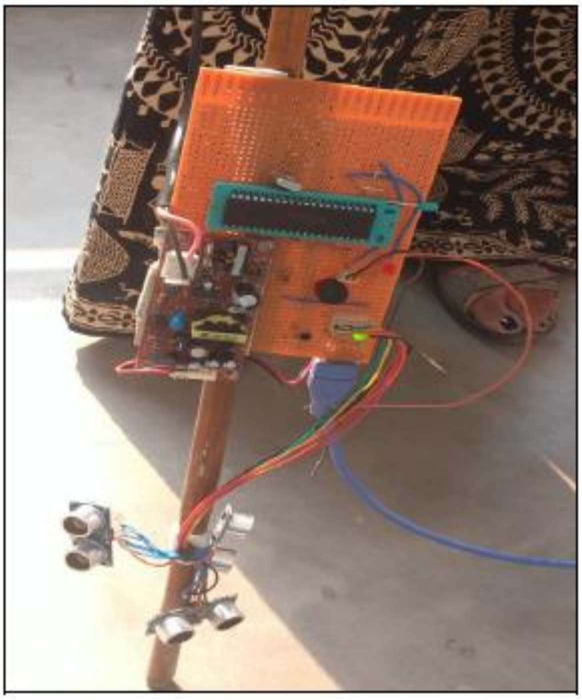


Figure 2.3: Smart Blind Stick with Ultrasonic Sensor

This smart blind stick system based on an ultrasonic sensor has been proposed and successfully implemented. The blind can use it as an effective navigation tool. A buzzer sounds to alert the concerned person when an obstacle in their path is detected. Any obstacle within a 5-35cm range can be detected by the implemented system.

2.2.2 Design and Implementation of Superstick for Blind People using Internet of Things (System B)

The proposed system's function is to provide blind people with sensory assistance for specific purposes (Singh et al., 2021). The circuit is powered by a 5V power supply that keeps the power supply output constant. To track targets, ultrasonic and infrared sensors are commonly used. When an object comes too close, the ultrasonic sensor detects it and sends data to the Arduino UNO by calculating the distance between the object and the operator. An entity calculates the distance by calculating the difference between the transmitted and received signals. The speed of the air traffic signal is 341 metres per second (distance=speed*time). The amount of time that has passed between signal transmission and reception is calculated. Because the signal's distance travel is doubled, it is divided by two, i.e., the Distance=*Distance/2 IR sensor is mounted to the right and left of the handle to detect the item. It detects objects that are closer due to the limited range. The command tells Arduino to perform operations, collect data, and measure 14 conditions. When an object is closest to the speaker or microphone, the order is transmitted to the recipient. The command has already been saved in the voice replication module, and the user has received an object warning message. If the target and the blind people are separated by 30 inches, the command will be executed when the barrier is closest to the person. If the object is between 60 and 90 degrees, it will send.

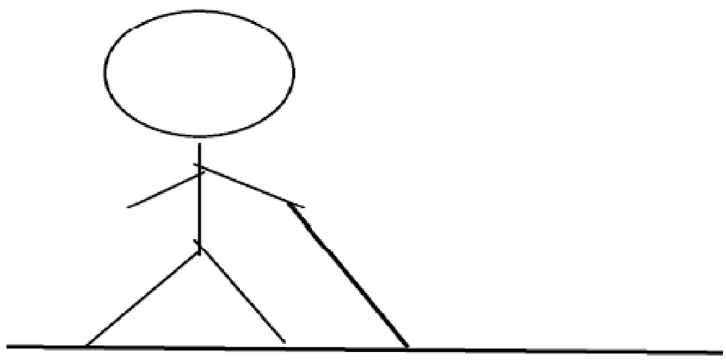


Figure 2.4: Super stick allows blind people to walk

This Super Stick has a sensor that detects lighting conditions and a controller that allows a visually impaired person to locate the stick. The sound producing sensor provides various inputs to the individual. As previously stated, instead of a buzzer, this system should use a sensor that shakes to indicate engine activity, as shown in Figure 2.5, the flowchart for using a super stick for blind people.

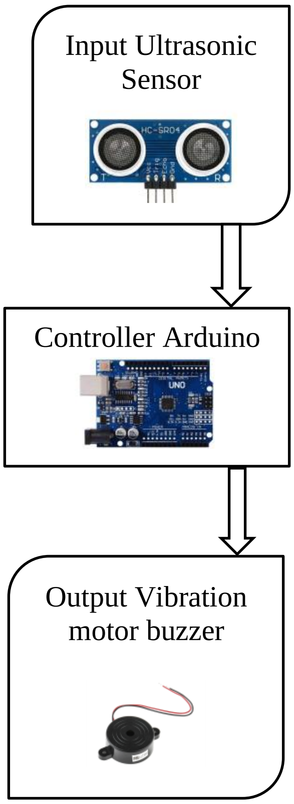


Figure 2.5: Superstick flowchart for blind people

When the super stick detects an obstruction or a halt in front of it, it vibrates the stick and even emits an alarm tone, allowing the visually impaired person to remain safe. Figure 2.6 depicts tracking with a clapping switch and a buzzer.

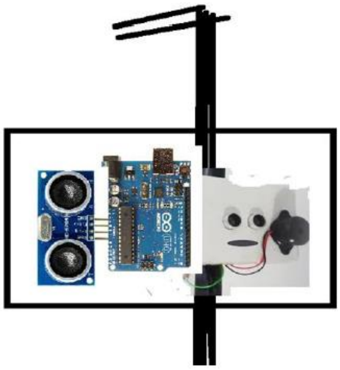


Figure 2.6: Superstick implementation for blind people

Finally, Super Stick is a device that enables visually impaired people to live as normal a life as possible. Safeguards are also used in the framework to ensure their safety. All visually impaired people would benefit from this initiative because it would make commuting easier for them. It was done to help visually impaired people advance in their careers. To assist and protect special people, the actual super stick, as shown in Figure 2.7, is required.

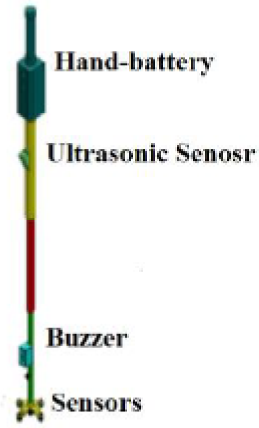


Figure 2.7: Actual Superstick for the visually impaired

The Super Stick detects potential hazards in the environment and alerts the visually impaired individual with a sound or a small firm vibration. Tracking can also be done with a clapping switch and a buzzer.

2.2.3 IoT based Smart Stick with Automated Obstacle Detector for Blind People (System C)

This proposed system contributes to the development of an IoT-enabled smart stick for blind people, which replaces the traditional blind people's stick with automated technology (Natarajan et al., 2022b). Impediments in people's paths can be detected and removed using the system. To identify the obstacle and determine its range, ultrasonic and infrared sensors are attached. Both sensors are used to achieve the best results while maintaining the highest level of precision. To detect wet areas on the surface, a water sensor is also included. The water sensor is located on the device's lower tip, which is surface sensitive. The sensors are all connected to the Arduino UNO, and each one performs the function that has been assigned to it. The sensors receive data, which is processed by the microprocessor and returned to the sensors.

When an obstacle is detected, the microprocessor sends a signal to the buzzers, which activate and warn the user. The sensors function as detectors, detecting any obstacles in the people's path. The sensor can detect any solid and stable substance within a 100cm range. The ultrasonic sensor uses waves to detect obstacles in the path, whereas the infrared sensor uses light rays to detect substances in the path. When an obstacle is detected, a speaker and an LED light are installed to alert the user. Because blind people cannot see the LED, the speaker is linked to the Arduino. When the sensor detects an obstacle within a 100cm range, a buzzer sound will be heard. A flowchart of the process is shown in Figure 2.8.

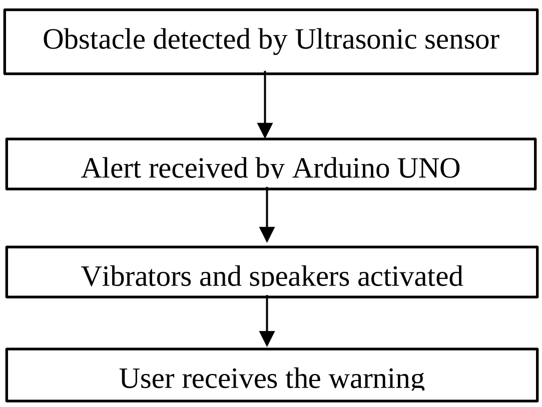


Figure 2.8: The flowchart of the process

The system's architecture is divided into two layers or sections. The Arduino Uno ATmega328P microcontroller is more powerful, with an input voltage range of 7 to 20 volts and 6 analogue inputs. It has 14 digital inputs, including 6 PWM outputs for continuous operation. The board includes a number of sensor operations for detecting different types of obstacles. The sensors include a water sensor, an infrared sensor, and an ultrasonic sensor, as shown in Figure 2.9.

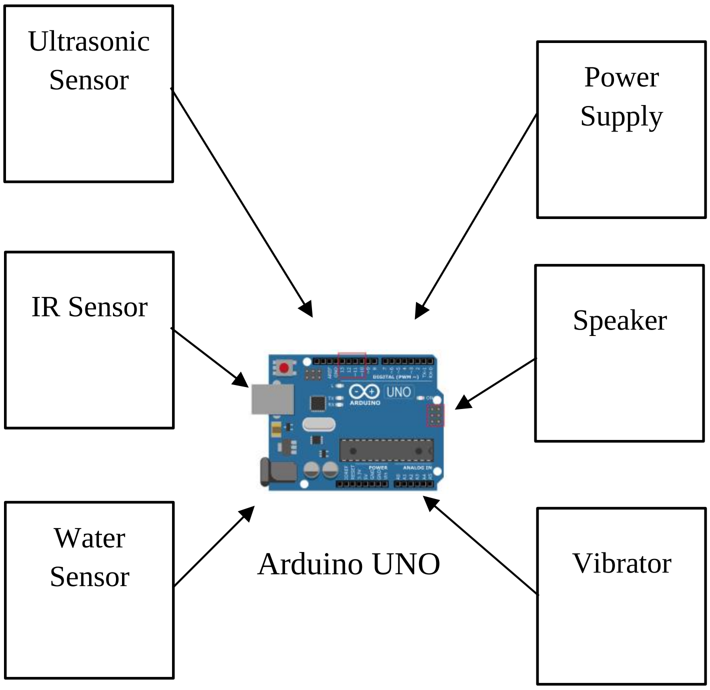


Figure 2.9: Diagram of System Architecture

The results were successfully observed in accordance with the implementation concept. The device's results matched the proposed system. No response is displayed when the distance between the person and the obstacle exceeds 100cm. When the distance between the obstacle and the person is less than 100cm, the buzzer will begin to alert the person via a speaker. In all cases, the accuracy is greater than 90%, and it is 100% in cases less than 50m and greater than 100m. The same thing happens when the person is less than 50cm away from the obstacle. The expected outcomes are shown in Table 2.1.

Sensor to obstacle detect	Type of warning	Accuracy
>100cm	Nil	100%
<100cm	Buzzer warning	91%
<50cm	Buzzer Warning	99%

Table 2. 1: Result

This proposed system would use technology to physically assist the blind. The physical device has the potential to be successful and useful in the everyday lives of blind people. To model and represent a smart stick for obstacle and shallow place detection, this system used an Arduino UNO microprocessor, ultrasonic and infrared sensors, and a buzzer for alerting.

2.3 Analysis/ Comparison of Existing System

After a thorough examination of each of the selected existing systems. The comparison of three existing systems chosen for the literature study and the proposed system is summarised below.

2.3.1 Table of Comparison on Existing System

The advantages and disadvantages of the technique were compared in Table 2.2 below.

Features	System A	System B	System C	Proposed System
Sensor Used	-Ultrasonic sensor	-Ultrasonic sensor -IR sensor	-Ultrasonic sensor -IR sensor -Water sensor	-Ultrasonic sensor -Water sensor
Hardware Used	-PIC microcontroller -Buzzer	-Arduino UNO -Buzzer	-Arduino UNO -Buzzer	-NodeMCU -Buzzer

		-LED		-GPS module
Detection features	Detect obstacles	Detect obstacles and their range	Detect obstacles and wet surface	Detect obstacles and wet surface
Software	MPLAB	Arduino IDE	Arduino IDE	Arduino IDE
Mobile Application	No	No	No	Yes (Blynk Application)
Wi-Fi communication	No	No	No	Yes
Advantages	-Can detect obstacles in front, left and right within a 5-35 cm range. -Can alert user using buzzer	-Capable of detecting obstacles and determining their range -Use a buzzer to notify the user	-Capable of detecting obstacles and their range. -Capable of detecting wet surfaces. -Detects obstacles within a 100cm range. -A buzzer be used to alert user	-Detect obstacles within a 50 cm range. -Capable of detecting wet surface. -Use a buzzer to notify the user. -Has emergency button so the user can push the button when emergency occur. -Can track the stick by using the GPS.
Disadvantages	-Unable to detect a wet surface. -There is no emergency button -There is no GPS.	-Unable to attach GPS because the path's coordinate has changed. -Required the assistance of	-The sensor must be properly maintained and handled in a safe manner, and the connection must be tested before use.	-The sensor must be properly maintained and handled without damage before use. -The ultrasonic sensor should

		the small sensors. -The wet surface cannot be detected. -There is no emergency button and GPS.	-The ultrasonic sensor should always face forward, and the IR sensor should always downward toward the ground. -There is no GPS and emergency button	always face forward, and the water sensor should always face downward toward the ground to improve accuracy.

Table 2. 2: Table of comparison between four system

To summaries, an ultrasonic sensor was commonly used in three of the existing stick system. As a result, because all three existing systems use ultrasonic sensors, the proposed system will used as well. The ultrasonic sensor was designed to detect any obstacles within a 5-35 cm range in System A. The ultrasonic sensor in System B can detect any obstacles within a range of 90 inches, whereas the ultrasonic sensor in System C can detect obstacles within a range of 100 cm and the proposed system can detect obstacles within a range of 50 cm. The IR sensor was used to detect the distance between obstacles in the System B and System C. Another sensor used in System C is a water sensor, which is used to detect wet surfaces. This proposed system will also use a water sensor after reviewing the System C because water sensor very important for blind people to detect the wet surface area, which will help to improve the proposed system for the blind. All existing systems were developed using the Arduino Uno and were designed to alert the user when sensors detected obstacles. But, in this proposed system will be used NodeMCU as a microcontroller. The C high level programming language was used in these three existing systems. GPS and an emergency button will be added to the proposed system. As a result, the guardian can track the blind people's location wherever they go, and if there is an emergency, he or she can press the emergency button. The emergency button sends a notification to the user's guardian. As a result, the guardian will receive alert notifications.

2.3.2 Relevance to propose research

To compare the three existing systems with the new proposed system, the ultrasonic sensor will be used to detect obstacles in the proposed system. It will also send data to the user and sound an alarm if the sensor detects any obstacles. When a buzzer sounds, this warning feature can notify the blind people that they need to change their route. Next, a water sensor is used to detect any wet surface area. As a result, when the blind people realize there is water ahead of them, they will alter their path to avoid falling. In reference to all existing systems, the Arduino IDE software will be an appropriate software to program. The Blynk Application was used as the mobile application. The proposed system will be based on the concept of the Internet of Things (IoT).

2.4 Summary

In conclusion**,** the smart walking stick built with extreme precision will allow blind people to move from one location to another without the assistance of others. This could also be considered a crude method of providing vision to the blind. This smart stick reduces visually impaired people's reliance on other family members, friends, and guide dogs. The proposed combination of different working units produces a real-time system that monitors the user's position and provides dual feedback, making navigation safer and more secure. The smart stick detects objects or obstacles in front of users and sounds an alarm. To summarise, selecting an appropriate technique is critical to ensuring that the system is implemented successfully and that the goal is met.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will go over the project methodology, which will outline the project development process. The system development methodology that guides the researcher through the process of structuring, planning, and developing the system. For developing the proposed system, the agile and Rapid Application Development (RAD) models are the best available methodologies.

3.2 Project Management Framework

A methodology in system development is important because it provides the researcher with a comprehensive framework for designing a system, reducing the number of errors and delays during system deployment. A well-chosen methodology enables the researcher to create a good project, improve time and cost estimates, and provide a thorough understanding of the system to the client, researchers, and end users. Agile and RAD are the two types of system development methodologies. Each methodology has benefits and drawbacks.

3.2.1 Agile Model

The Agile Software Development Life Cycle (SDLC) model is a hybrid of iterative and incremental process models that places a premium on process adaptability and customer satisfaction by delivering a working software package as soon as possible. Agile methodologies break the product down into small incremental builds. These builds are available in several iterations. The customer and key stakeholders are shown a working product at the end of the iteration. According to the Agile model, each project must be handled differently, and thus current methods must be tailored to best meet the project requirements. Tasks in agile are divided into time boxes, which are short time periods for delivering specific features for a release. Iterative methods are employed, with dealing software being delivered at the conclusion of each iteration. In terms of features, each build is incremental; the final build contains all the features required by the customer (SDLC - Agile Model, n.d.).

3.2.2 RAD Model

Once the requirements are frozen in the RAD model, the only coding process begins, followed by the testing process. The customer must wait a long time to see the finished product. By the time the product is developed, the customer's business needs may have changed. One of the primary advantages of the RAD model is its speed. The product can be delivered quickly because the RAD model uses CASE tools to automate major processes in the RAD lifecycle. RAD ensures product quality by regularly involving users throughout the product's lifecycle. The user reviews each prototype, which aids in the identification of any major issues. The RAD model makes it easier for users to suggest changes because it is changeable. (RAD Model - Phases, Benefits, and Drawbacks | ArtOfTesting, n.d.).

3.2.3 Methodology for Proposed System

According to the analysis results, the RAD model is the best methodology for the proposed system. In contrast to Agile, rapid application development prioritises rapid prototyping over more expensive planning. While both RAD and Agile place a premium on early software delivery and the ability to meet changing requirements even late in the development process, Agile is more specific in defining its methods, work environments, and ideals. As a result, the RAD methodology can be concluded to be much more malleable, emphasising precise and timely results with no major rules. When it comes to designing a job in a short amount of time, RAD is the best option because it produces from a standpoint that focuses on immediate actions and results. The RAD model is used in the following phases of development: requirement planning, user design, construction, and cutover (Waterfall vs RAD vs Agile: Difference | What Method Is the Best?, n.d.).

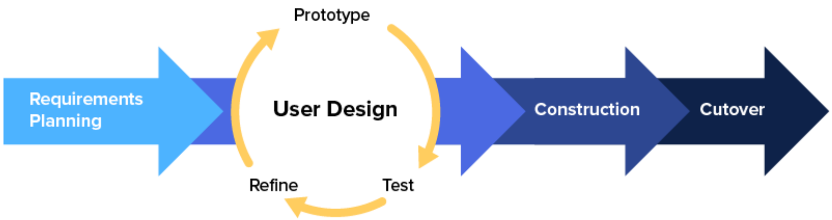


Figure 3. 1: The RAD model

3.2.3.1 Requirements Planning

The proposed system was designed during requirement planning to detect obstacles, wet surface area, and alert the user if any were encountered. The system's operating functionality will be to detect obstacles in front of the user within a 50 cm range of the system and to alert the user if the obstacles are close to them. The target users are blind people because the device is primarily used by them. The smart blind stick must detect obstacles and wet surface areas, and blind people must be able to press the emergency button in an emergency. Aside from that, the guardian will always be able to track the blind people wherever they go. If the blind people press the emergency button, the guardian will be notified. During this stage, it must determine the project's goals and expectations, as well as current and potential issues that must be addressed during construction.

3.2.3.2 User Design

Following the scoping of the project, development can begin, fleshing out the user design through multiple prototype iterations. The developer must work diligently during this phase to ensure that all the planning discussed in the Requirement Phase was followed. The project must be tried and tested by the developer until all sides and errors are satisfied. This stage aims to eliminate the possibility of future errors. The final product is created during the finalisation stage after the client and developer have agreed on it.

3.2.3.3 Construction

The emphasis during the construction phase was on developing the project based on all the thoroughly examined research, requirements, and design. The "Smart Blind Stick with Emergency Button" IoT development began with the programming of the Arduino IDE software to match the project's requirements and functions. Connecting wires connect the project component to the board. During this phase, the smart application development also began, with the smart application created using the Blynk App. In summary, tasks for the development of a system and a smart application were completed.

3.2.3.4 Cutover

Finally, the system tests the cutover phase by reading all the sensors' data. If a problem is discovered, it will be resolved immediately before the system is launched to ensure that the system launched is successful and operates normally, that it has been successfully developed, and that it is ready to use. When the system's development is finished and it is ready to be delivered to blind people and their guardians, the cutover phase begins.

3.3 Project Requirements

A few key elements of the project requirements are user requirements, functional and non-functional requirements, limitations, and potential constraints that will be encountered during the project's development.

3.3.1 User Requirements

User requirements play an important role in the development of this smart blind stick system because they provide a better understanding of how the system will work. Even if user requirements lack specifics about what must occur in the system, they are still useful because they establish expectations for overall system functionality. The survey response for user requirements is shown in Table 3.1. Interviews with blind people at MAB Kinta Valley Rehabilitation Centre were conducted as part of this survey.

Question	Response
Do visually impaired people encounter difficulties when walking in public?	- Yes
How do you think visually impaired people identify a situation or location?	- Listen to the surrounding environment - Tally the steps - Take someone with them when walking in a new place to help them get acclimated - Inquire of those around them
In your opinion, the ultrasonic sensor and water sensor detect obstacles and wet surface areas. Can this sensor assist them in their daily lives?	- Yes
Can a Global Positioning System (GPS) tracker assist a guardian/keeper in tracking the location of blind people in an emergency?	- Yes
Can the existence of this Smart Blind Stick help the visually impaired in their daily activities?	- Yes

Table 3. 1: The response from survey for user requirements

3.3.2 Functional Requirements

The functional requirement is a mandatory requirement in this project that focuses on the user requirements. The tools and functions of the "Smart Blind Stick with

Emergency Button using Iot" are the primary focus of this section. This project's functional requirements are as follows:

i. The system should be able to detect obstacles in front of the smart blind stick within a range of 50 cm.

ii. The system should be able to detect wet surface area.

iii. The system shall alert the user by using the buzzer when the system detects any obstacles and wet surface area.

iv. The system shall alert the guardian by send the notification when the user in emergency.

v. The system shall allow the user to push the emergency button when emergency occur.

vi. The system shall authenticate a user when he or she try to login into the application.

vii. The system shall allow the guardian to track the location of blind people all the time.

viii. The system shall allow user to on/off the smart blind stick depending on the user’s personal preferences.

3.3.3 Non-Functional Requirement

These are the attributes, in addition to everything described in the functional requirements. In comparison to functional requirements, this is optional, and it primarily focuses on the client's expectations. Non-functional requirements for this project include availability, usability, portability, and space efficiency.

i. Availability

The "Smart Blind Stick with Emergency Button using IoT" requires an ultrasonic and water sensor to detect obstacles and wet surface area. The buzzer will alert the user if the stick detects obstacles or a wet area. The Blynk application will notify the user's guardian if the user presses the emergency button. The Blynk applications and smart stick must be always available to ensure the safety of blind people.

ii. Usability

The Smart Blind Stick implementation should be possible using end-user-accessible technologies.

iii. Portability

The system should be able to function in a variety of environments and the mobile interfaces must be Android-compatible.

iv. Space Efficiency

The system allows for obstacle detection within the range of 100 cm.

3.3.4 Limitation

The project's limitation is that the batteries must be replaced properly and turned off when not in use. Aside from that, exercise extreme caution when handling the stick. Sensors must be properly maintained and handled, and connections must be double-checked before use. The ultrasonic sensor should always be oriented forward rather than backward to improve accuracy, and the water sensor should always be oriented downward toward the ground.

3.3.5 Constraint

The following are the project's constraints: If the network connection is terminated or unstable, the Blynk application will be unable to display the user's current location. Therefore, the GPS is difficult to get the location when in an indoor. Finally, the smart blind stick is unable to distinguish between different types of obstacles.

3.4 Proposed Design

Proposed design refers to the process of defining the architecture, modules, interfaces, and data for a smart blind stick system to meet specified requirements. System design is the application of system theory to the creation of products. This Smart Stick with emergency button using IoT comes with a flowchart, architecture design, context diagram, use case diagram & description, activity diagram, and user interface.

3.4.1 Architecture Design

Figure 3.2 shows the architecture design of the proposed system. The NodeMCU microcontroller is used in this proposed system. As a smart blind stick system, it includes sensors such as an ultrasonic sensor and a water sensor. Sensors are linked to an NodeMCU microcontroller. The two buzzers used in this proposed system are buzzer 1 and buzzer 2. Buzzer 1 detects obstacles and beeps with a high beep, while buzzer 2 is used by the water sensor and beeps with a low beep. The NodeMCU is linked to the GPS module, allowing the stick's location to be sent to mobile applications which is Blynk applications that be used in this proposed system. By logging into the applications, the guardian can see the location of the blind people.

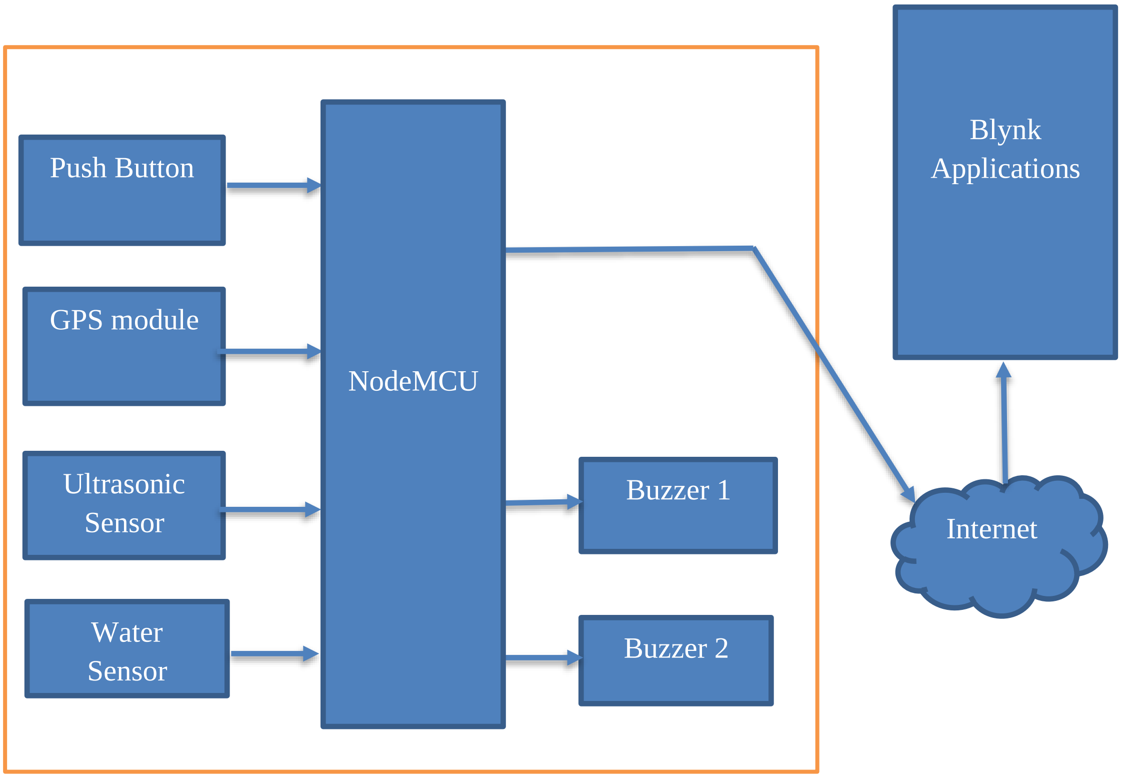


Figure 3.2: The Architecture Design of the Proposed System

3.4.1.1 Proposed System Design

Figure 3.3 depicts the proposed project's design. All the component such as NodeMCU, ultrasonic sensor, water sensor, buzzer, GPS module and push button are attached in this stick. The detail information about this stick will explain in Figure 3.15. Aside from that, because the NodeMCU has its own Wi-Fi module, the GPS module on this stick will send the location of the blind people to the Blynk Application. Aside from that, blind people can press the emergency button to notify their guardian when they are in emergency situation. The guardian will be notified of the alert notification via their Blynk application.

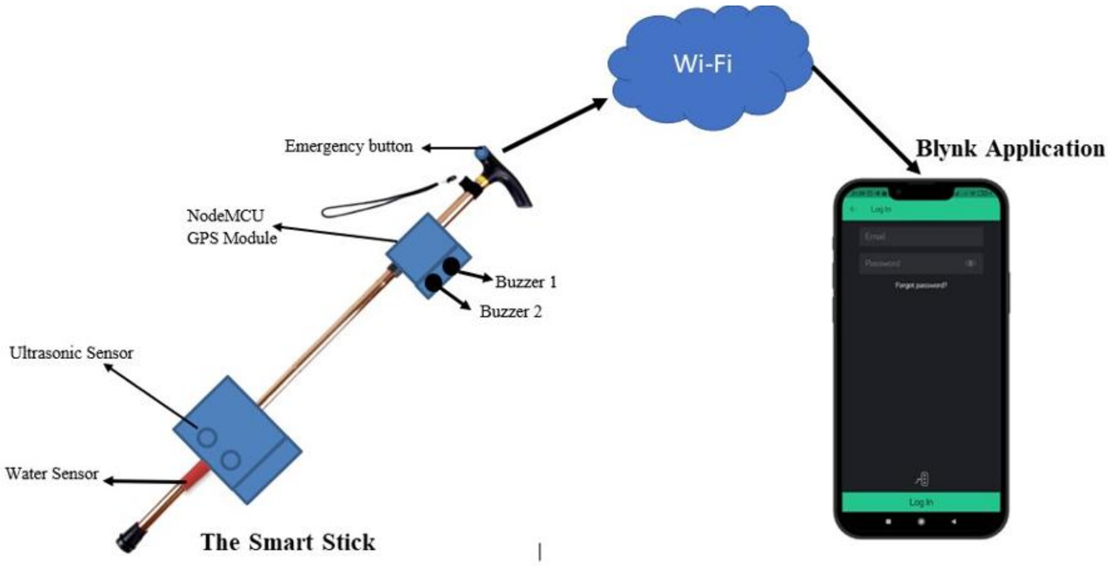


Figure 3.3: The Proposed Design of the Proposed Project

3.4.2 General Flowchart

Figure 3.4 depicts the overall flow chart of the system, beginning with hardware implementation and ending with software implementation. The proposed system is a smart blind stick with an emergency button system using IoT that can detect obstacles and wet surface areas. First, the sensors and microcontroller must be linked. The power must be turned on in order to establish a connection. The sensors will then detect the obstacles and wet surface. The sensors will continue to feed data to the microcontroller. The data from the sensors will be received by the NodeMCU microcontroller and processed. If these sensors detect obstacles or water, the buzzer will alert the user. The

GPS module pinpoints the location of the stick. If the user presses the emergency button, a notification is generated and sent to the Blynk applications. If an alert is generated when the user presses the emergency button, the Blynk application will display the alert notification. Because there is a GPS module on the stick, the guardian can view the user's location.

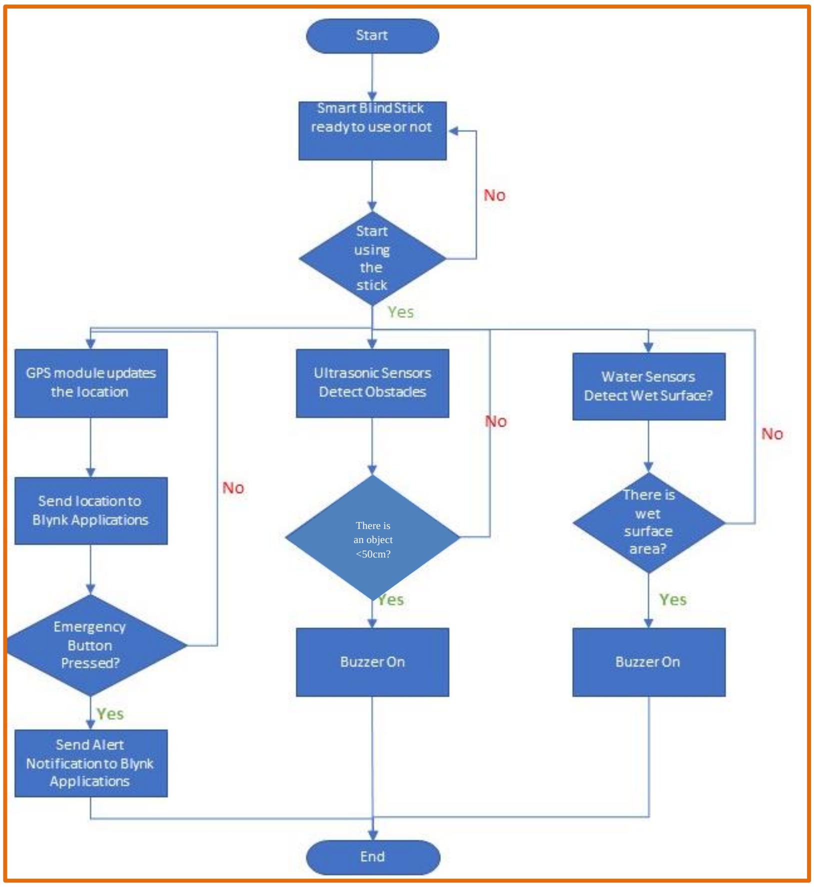


Figure 3.4: The General Flowchart of Proposed System

3.4.3 Hardware Flowchart

Figure 3.5 shows the hardware flowchart. The hardware consists of the NodeMCU, which serves as a microcontroller, sensors, and a GPS module. The hardware must perform the smart blind stick with emergency button, with sensors detecting obstacles and wet surface area. The sensors will send the signal to the NodeMCU microcontroller. The digital signal is then sent to the NodeMCU board for data processing, which results in the detection of obstacles and wet surface area. To allow data transmission, the NodeMCU's power must be turned on, and the power supply must be available because the sensors require power to function. When the NodeMCU is turned on, the connection between the Node MCU and the sensors is established, and the sensors are ready to send signals to the NodeMCU board.

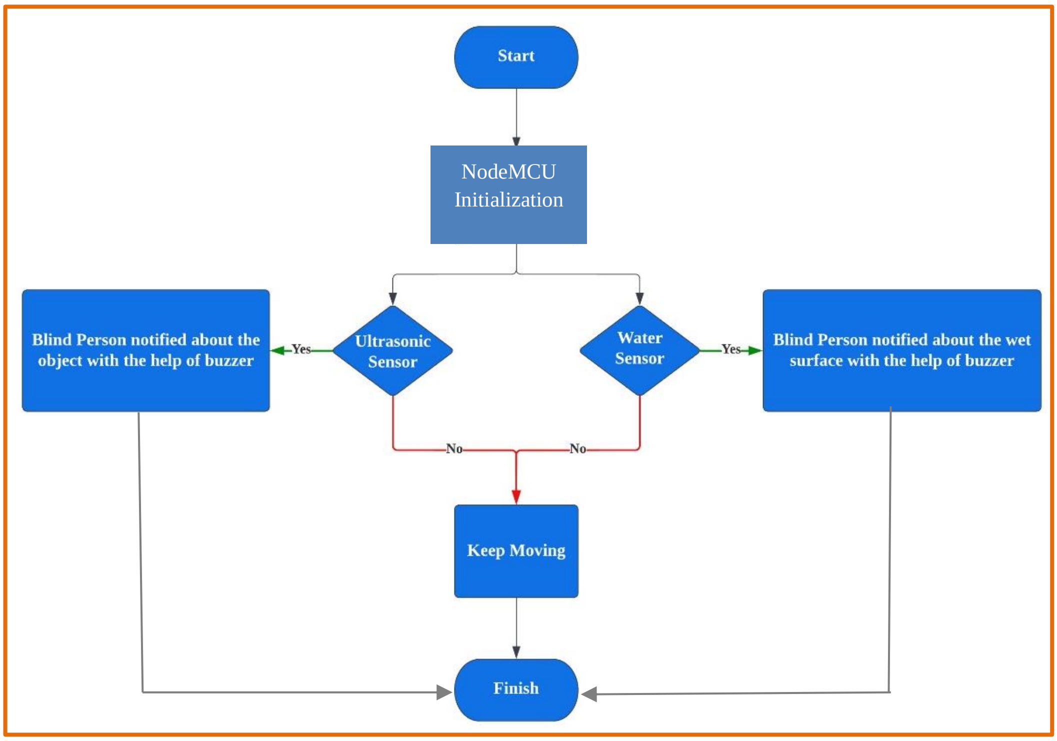


Figure 3.5: The Hardware Flowchart

3.4.4 Software Flowchart

Before the guardian can use the Blynk application, the guardians must first download and login for it. The guardians must log in to this application using the username and password that developer have been created. Both a valid password and a username must be entered. Both the username and password will be validated. If the user's username and password match those in the database, the guardians are granted access to the Blynk application; otherwise, the process returns to the login page. If the guardian's identity as a user is verified, he or she is granted access to the Blynk applications. The guardian will be able to track the location of the blind people using the applications. Figure 3.6 depicts the software flowchart, while Figure 3.7 depicts the system's sub-process after login.

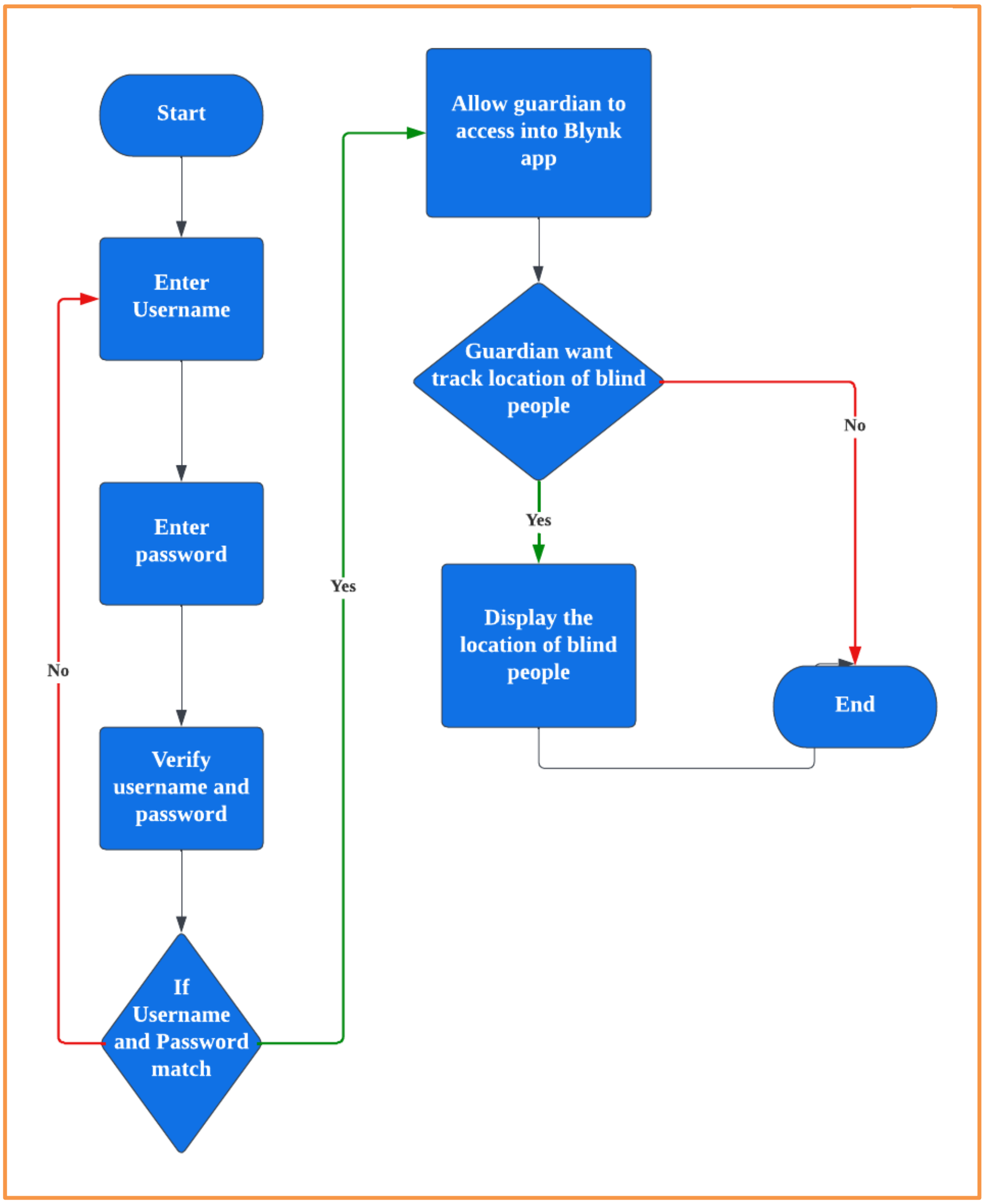


Figure 3. 6: The Software Flowchart

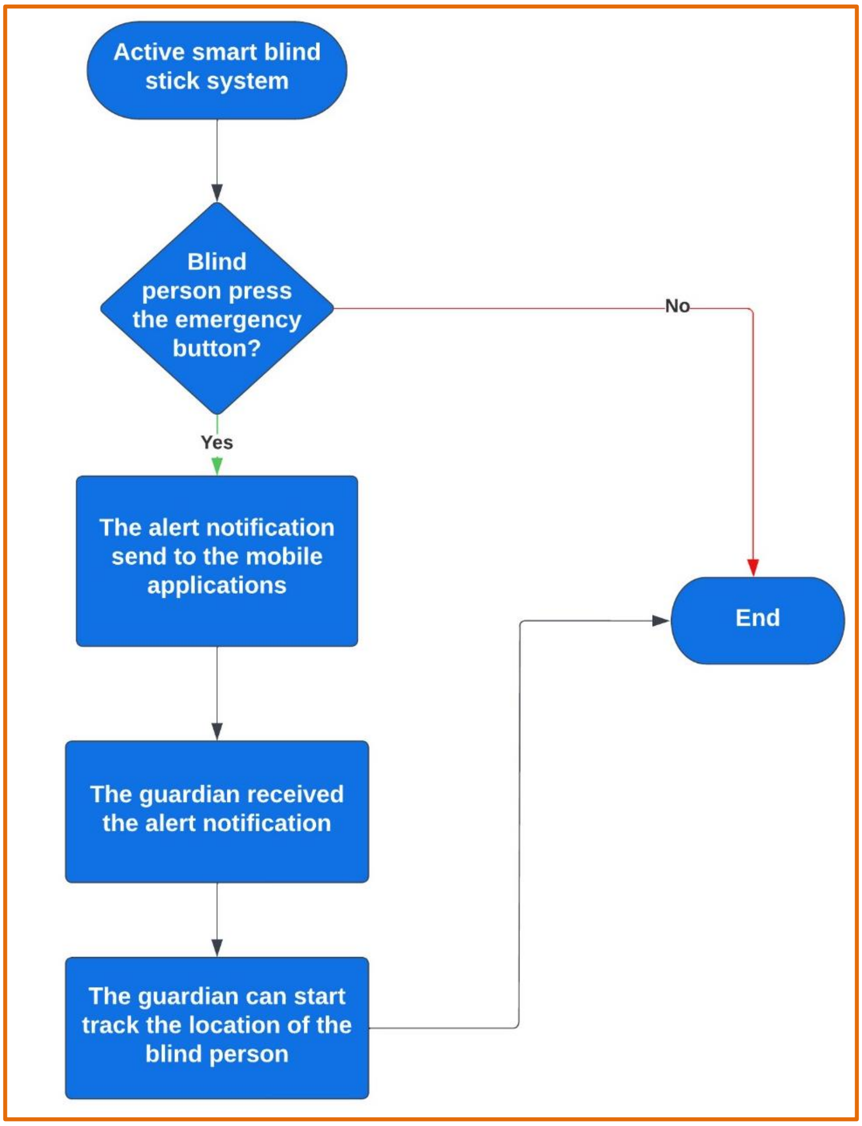


Figure 3.7: The sub-process of the system after login

3.5 Context Diagram

The context diagram of the proposed system is shown in Figure 3.8. The context diagram depicts the information flow between the system and external entities to describe the system's context and boundaries, as well as the relationship between the system and external entities. A blind person, a guardian, and an NodeMCU microcontroller are examples of external entities. If the blind person presses the emergency button, the guardian may receive an alert for detecting obstacles and wet surface areas, while the blind person may receive an alert for detecting obstacles and wet surface areas. The guardian can then access the Blynk application, receive alert notifications, and track the location of the blind people. Finally, the NodeMCU microcontroller sends the data to the system.

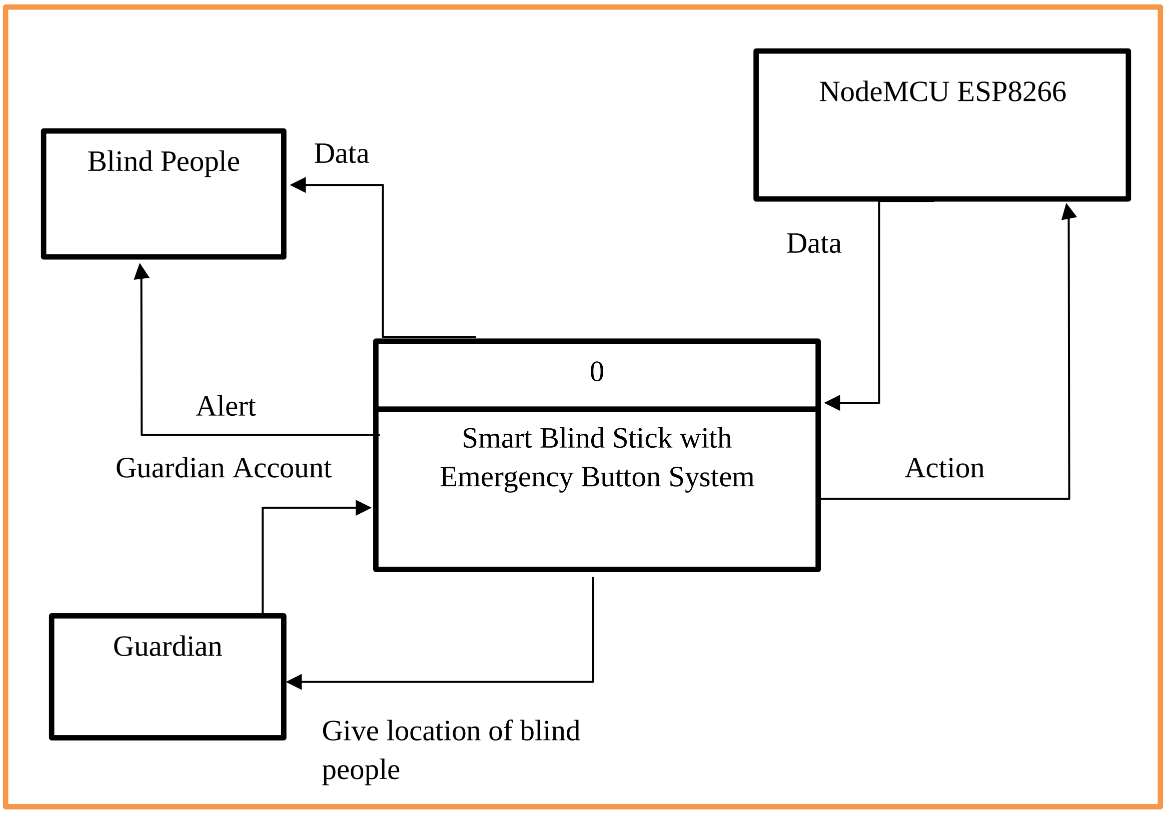


Figure 3.8: The Context Diagram of Proposed System

3.6 General Use Case Diagram

Figure 3.9 depicts the relationships between the system, actors, and the use case in the use case diagram, which is a visual representation of the system's behaviour. The use case describes the activities that the actors could perform with the system's assistance. The guardian can login, track the blind person's location, and view the alert notification by accessing the Blynk applications, whereas the blind person can press the emergency button if they are in an emergency situation such as being lost or in an unknown location, and will receive an alert from the system with the sound of a buzzer if there are obstacles and wet surface area.

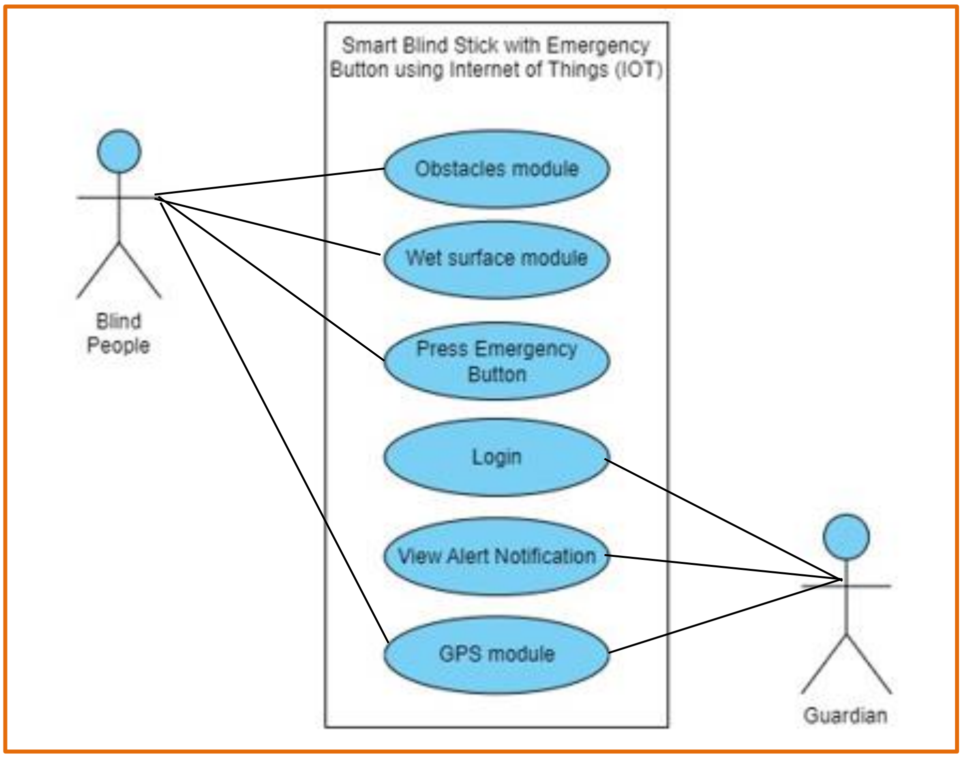


Figure 3.9: General Use Case Diagram

3.7 Module of Smart Blind Stick with Emergency Button

A module diagram is a structural diagram that depicts the module's arrangement and organisation in the system. It gives a high-level overview of the class diagram. This system is made up of the Login Module, the View Location Module, the View Alert Module, the Obstacles Module, and the Wet Surface Module. Figure 3.10 depicts the system's module diagram.

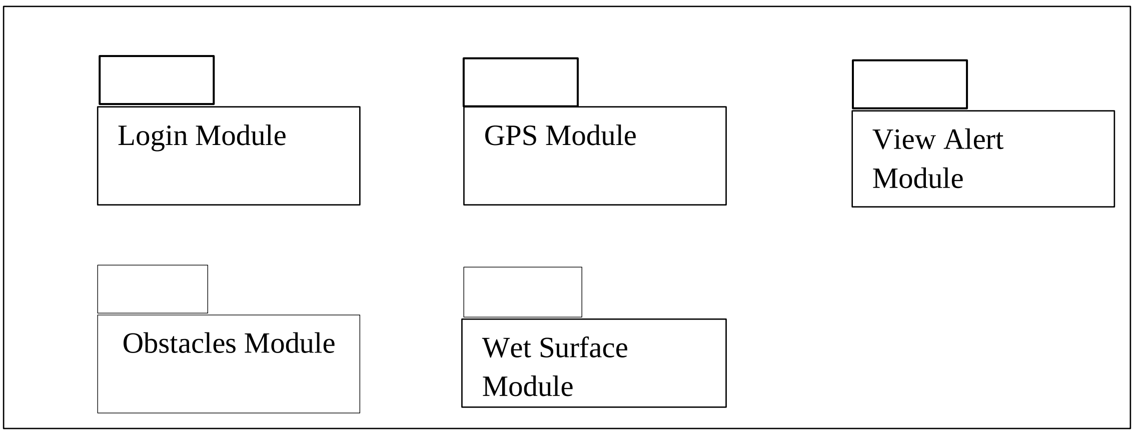


Figure 3.10: The module of the propose system

3.7.1 Login Module

This module allows the guardian to confirm system access by entering details such as a username and password. It is a security feature that ensures only authorised guardian have access to the system to ensure safety of the blind person.

3.7.2 GPS Module

The guardian can use the Blynk application to locate the blind person. The guardian should be able to track the blind person's location at all times, no matter where they go.

3.7.3 View Alert Module

The guardian receives and views an alert notification when a blind person presses the emergency button on their stick.

3.7.4 Obstacles Module

This module allows blind people to change their path when an ultrasonic sensor detects an obstacle by beeping loudly with a buzzer.

3.7.5 Wet Surface Module

This module notifies blind people when the system detects a wet surface area by beeping a low beep with a buzzer.

3.8 Use Case Diagram and Description

In this project, a Smart Blind Sticks with Emergency Button use case is a written description of how the guardian will perform tasks on the mobile applications. It describes how the system responds to a user's request. Each use case is represented by a simple series of steps that begin with the user's goal and end when that goal is met.

3.8.1 Use Case Diagram and Description for login

Figures 3.11 and Table 3.2 show the Use Case Diagram and Description for logging in.

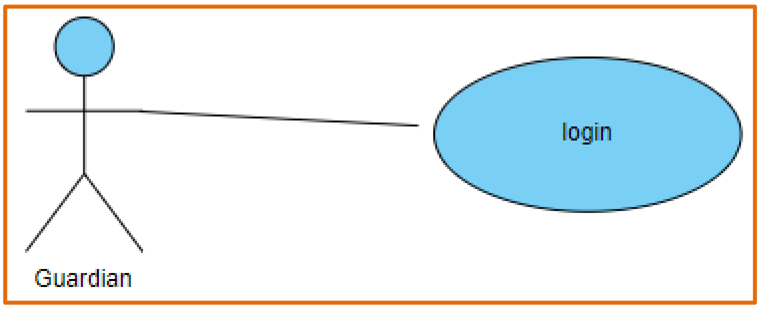


Figure 3.11: Use Case Diagram for login

Use Case Name	Login	
Description	User be able get signed in into the system	
Actors	Guardian/keeper	
Pre-Condition	1. Open the Blynk applications 2. Log in into the system	
Basic Flow	**Actor Action**	**System Action**
	Guardian enter his/her username and password in the login form	The system will check to see if the user is registered. If the user is registered, user will be able to access to the Blynk app; if the user is not registered, the system will prompt the user to register.
Alternative Flow	Does not click Login	
Post-Conditions	Guardians have access to the system	

Table 3.2: Use Case Description for login

3.8.2 Use Case Diagram and Description for track location

Figures 3.12 and Table 3.3 show the Use Case Diagram and Description for Tracking Location.

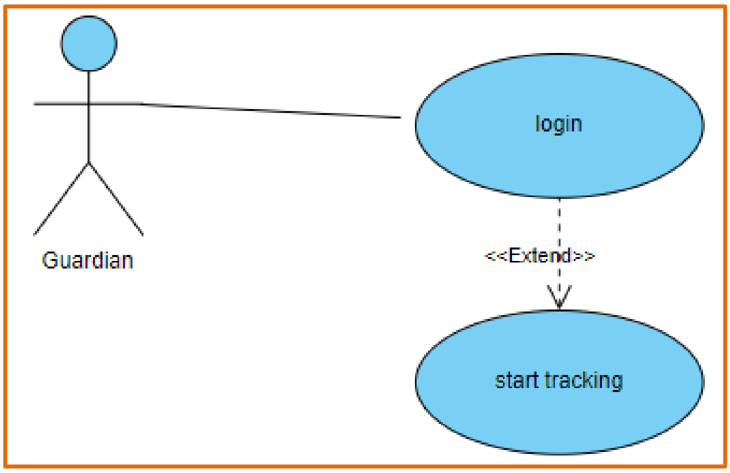


Figure 3.12: Use Case Diagram for track location

Use Case Name	Track location	
Description	User be able to track location of the blind person	
Actors	Guardian/keeper	
Pre-Condition	1. Open the mobile applications 2. Log in into the system 3. Can view the location of blind people	
Basic Flow	**Actor Action**	**System Action**
	Guardian login into the Blynk application	The system will display the location of the blind people
Alternative Flow	None	

Post-Conditions	Guardians be able to track the blind people

Table 3.3: Use Case Description for track location of blind people

3.8.3 Use Case Diagram and Description for view alert notification

Figures 3.13 and Table 3.4 show the Use Case Diagram and Description for viewing alert notifications.

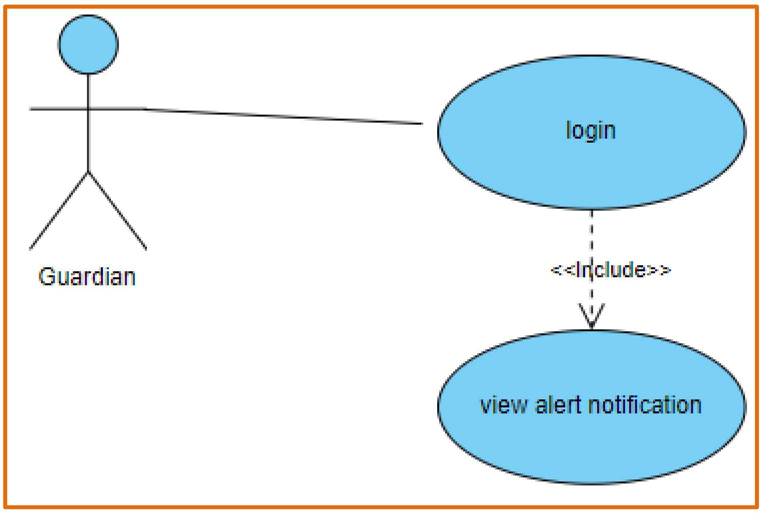


Figure 3.13: Use Case Diagram for view alert notification

Use Case Name	View alert notification	
Description	User be able to view alert notification	
Actors	Guardian/keeper/Blind people	
Pre-Condition	1. Open the Blynk applications 2. Alert notification will pop up if blind people click emergency button on their stick	
Basic Flow	**Actor Action**	**System Action**
	The blind people click the emergency button on their stick	The system will display the alert notification

Alternative Flow	None
Post-Conditions	Guardians will be able to view the alert notification

Table 3.4: Use Case Description of view alert notification

3.9 Activity Diagram

Figure 3.14 depicts an activity diagram of a Smart Blind Stick with Emergency Button System using Internet of Things, which depicts a series of actions or the flow of control.

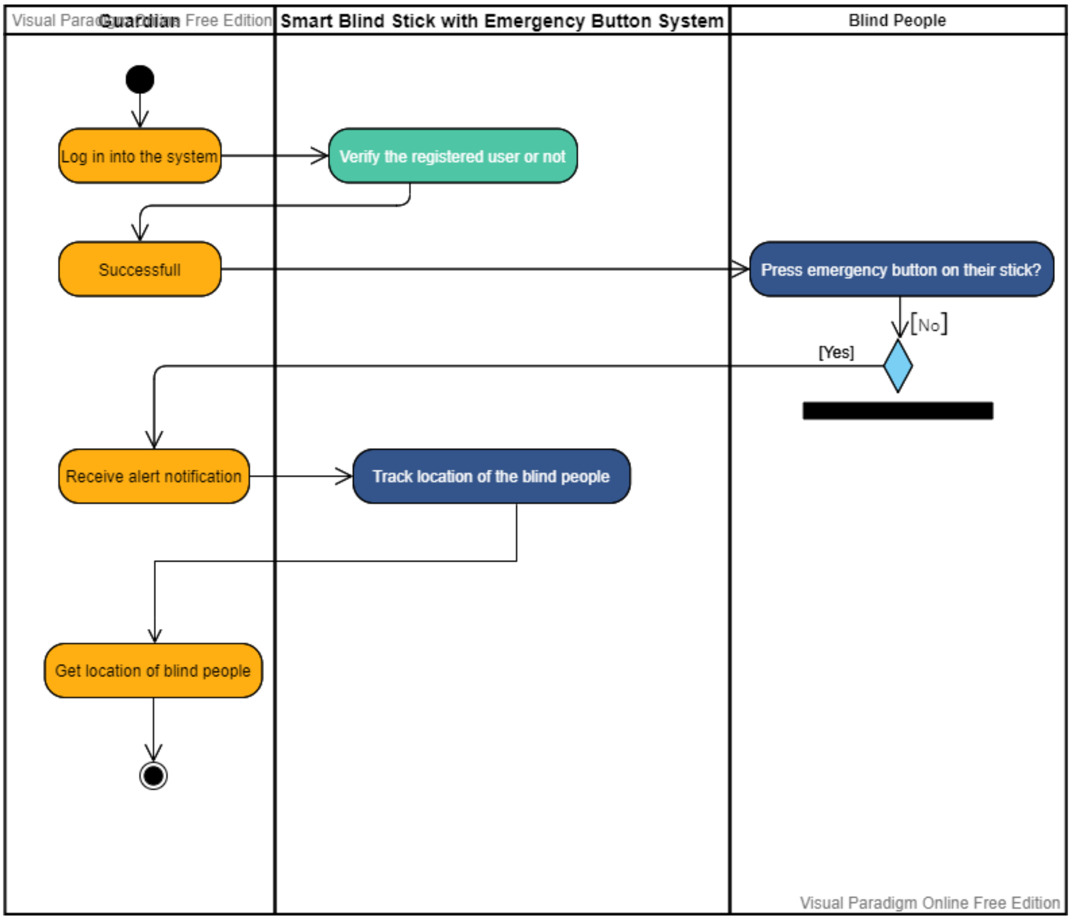


Figure 3.14: Activity Diagram for Smart Blind Stick with Emergency Button using Internet of Things

3.10 Proof of Initial Concept/Prototype

A Smart Blind Stick with Emergency Button using Internet of Things System Proof-of-Concept project is a pre-prototype project. It is used to determine whether it is possible to implement specific functionalities while also producing a working product. In contrast, a prototype focuses on the full functionality of all included features.

3.10.1 Smart Blind Stick with Emergency Button using IoT

Figure 3.15 depicts a proposed Smart Blind Stick with an Emergency Button using Internet of Things. Ultrasonic sensors are used in the proposed system to detect obstacles in the path of blind people. If the sensor detects an impending obstacle, the buzzer will sound. Following that, a water sensor will be used to detect water in the path of the blind person. If the sensor detects this type of water, the buzzer will sound again, but this time in a different tone (low beep) than when obstacles are detected (high beep), in order to distinguish water from other impediments. The NodeMCU will send the system's GPS coordinates to the Blynk App. In an emergency, blind people can press a button on their stick to alert their guardian.

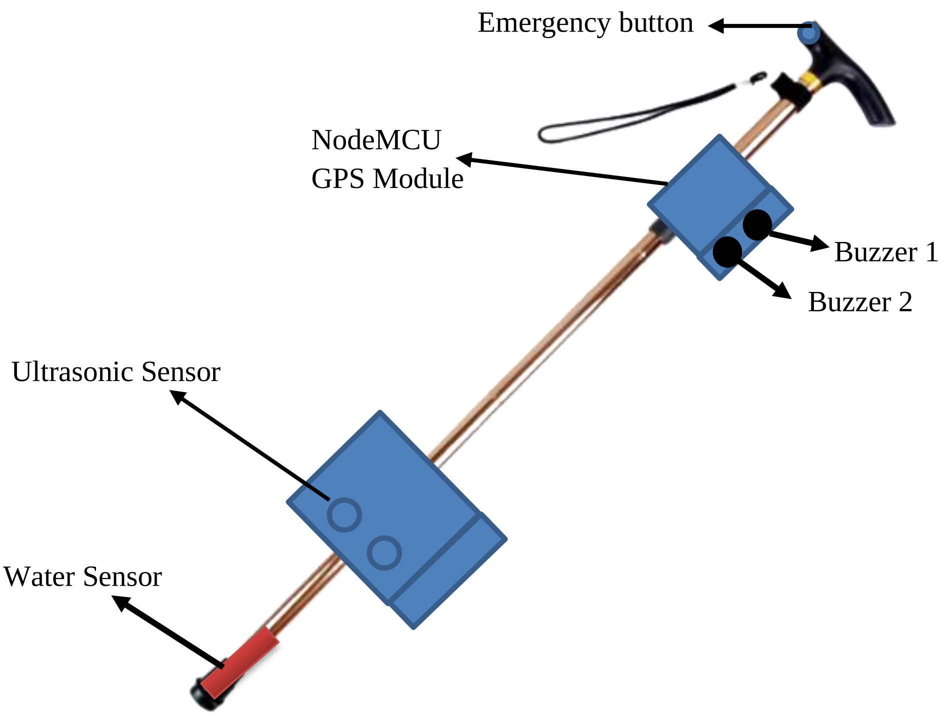


Figure 3.15: Prototype of Smart Blind Stick with Emergency Button

3.11 Propose Interface Design (Using Blynk Application)

The design interface is critical in meeting user expectations and supporting the effective functionality of the Smart Blind Stick with Emergency Button using IoT system. A well-executed user interface facilitates effective interaction between the user and this mobile app through contrasting visuals, clean design, and responsiveness.

With this application which is The Blynk App allows to create amazing interfaces for Smart Blind Stick with Emergency Button using IoT systems by utilising the various widgets that are provided. Blynk Server, on the other hand, oversees all communications between the smartphone and the sticks. When the blind people press the emergency button on their stick, the alert notification will be sent to the Guardian and Guardian be able to track location of the blind people.

3.11.1 Create Account

The user does not need to create an account because the developer will create one for them when they purchase this smart blind stick with emergency button. The user only needs to provide the developer with the information they require, such as their email address, to register for mobile applications. After the developer has registered the account, the developer will provide the user with the password to access the Blynk applications.

3.11.2 Login

Figure 3.16 depicts the login interface. This interface is used to validate the user's authorization and identification. When a user enters a username and password, the system validates the data by searching the database for matching records; if the validation is successful, the user is logged in.

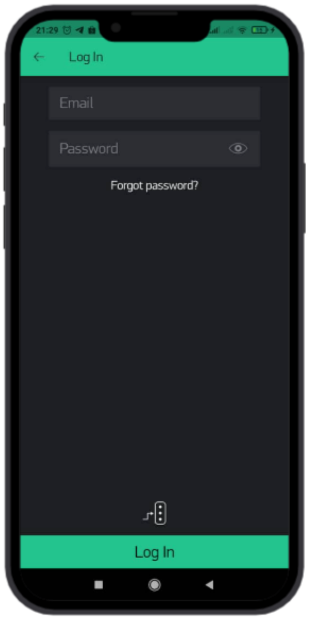


Figure 3.16: Login Interface

3.11.3 Tracking

As shown in Figure 3.17, the guardian can use this interface to track the location of blind people, and the system will display the location of the blind people.

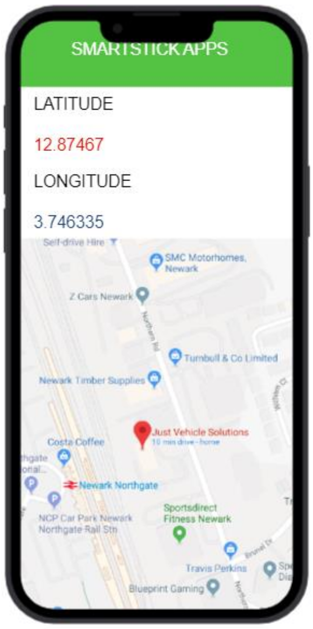


Figure 3.17: Tracking Interface

3.11.4 Alert Notification

The Figure 3.18 below shows the alert notification. The guardian will be alert by received the notification into the Blynk Apps.

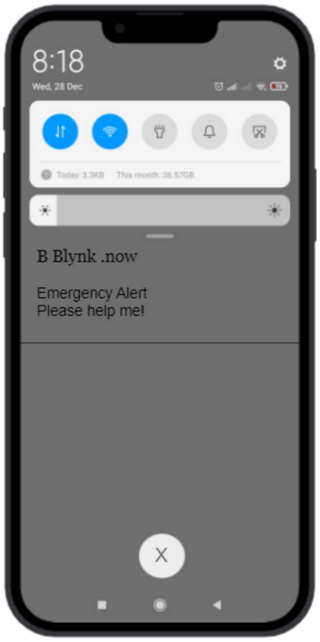


Figure 3.18: Alert Notification

3.12 Data Design

The various types of data stored in the Smart Blind Stick with Emergency Button using IoT System, their relationships, and the various ways that data can be grouped or organised are depicted in data design.

3.12.1 Entity Relationship Diagram (ERD)

Figure 3.19 depicts the proposed system's ERD, which consists of three files representing the database tables. There are Apps, Guardians, and Blind People. Table 3.5 contains email_guardian as the primary key and password in Guardian tables. The primary key in the second table, Blind People (Table 3.6), is buttonID, and the foreign key is systemID. In Table 3.7, the third type of table is an Apps table, which contains systemID as the primary key, as well as latitude, longitude, speed, direction, and satellite.

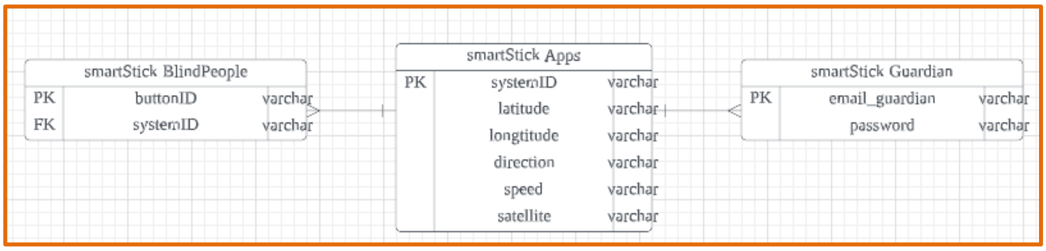


Figure 3.19: ERD for Smart Blind Stick with Emergency Button System

3.12.2 Data Dictionary for Guardian

Attribute	Data Type	Length	Description	Key
email_guardian	varchar	50	Email	Primary key (PK)
password	varchar	50	Password	

Table 3.5: Guardian Data Dictionary

3.12.3 Data Dictionary for Blind People

Attribute	Data Type	Length	Description	Key
buttonID	int	14	Button emergency on stick	Primary key (PK)
systemID	int	15	System identification	Foreign key (FK)

Table 3.6: Data Dictionary for Patient

3.12.4 Data Dictionary for Apps

Attribute	Data Type	Length	Description	Key
systemID	varchar	15	System identification	Primary key (PK)
latitude	varchar	50	Latitude	

longitude	varchar	50	Longitude	
direction	varchar	50	Direction	
speed	varchar	50	Speed	
satellite	varchar	50	Satellite	

Table 3. 7: Apps Data Dictionary

3.13 Hardware and Software

This proposed system necessitates the presence of certain hardware components or other software resources on this project. These requirements, known as hardware and software requirements, are frequently used as a guideline rather than an absolute rule. Hardware refers to the system's physical and visible components, such as a NodeMCU, GPS module, buzzer, and sensor. Software, on the other hand, is a set of instructions that allows hardware to perform a specific set of tasks.

3.13.1 Hardware Requirements

Hardware requires software to function properly. If the proper hardware is not used, this project may not run efficiently or at all. When making decisions about this proposed system, it is critical to consider both, as this can affect how the project proceeds.

3.13.1.1 NodeMCU ESP8266

Figure 3.20 show the NodeMCU that used in the proposed system as a microcontroller. The NodeMCU (Node Microcontroller Unit) is a free and open-source software and hardware development platform based on the ESP8266, a low-cost System-on-a-Chip (SoC). The Expressive Systems ESP8266 includes all of the necessary computer components, including a CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. As a result, it's an excellent choice for any Internet of Things (IoT) project.

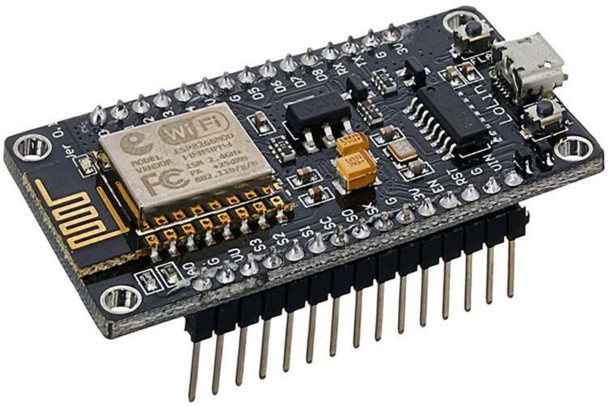


Figure 3.20: NodeMCU ESP8266

3.13.1.2 Ultrasonic Sensor

Figure 3.21 depicts the ultrasonic sensor that used to detect any obstacles in front of the blind people. An ultrasonic sensor is an electronic device that measures the distance between two objects using ultrasonic sound waves and converts the reflected sound into an electrical signal. An ultrasonic sensor detects any obstacles in the path of blind people. Ultrasonic waves travel faster than audible sound, which blind people can hear. The transmitter, which emits sound using piezoelectric crystals, and the receiver, which encounters the sound after it has travelled to and from the target, are the two main components of ultrasonic sensors.

Figure 3.21: Ultrasonic sensor

3.13.1.3 Water sensor

Figure 3.22 depicts the water sensor that used to detect any water and wet surface area. A water detector is an electronic device that detects the presence of water and sends out an alert in time to prevent water leakage. This water sensor detects wet surface areas and alerts blind people when there is water or a wet surface area in front of them. A common design is a small cable or device that lies flat on the floor and reduces resistance between two contacts by utilising the electrical conductivity of water. When enough water is present to bridge the contacts, the device emits an audible alarm and provides additional signalling.

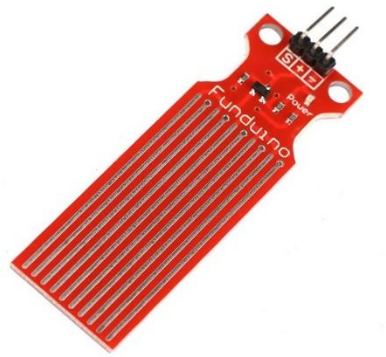


Figure 3.22: Water sensor

3.13.1.4 GPS module

Figure 3.23 show the GPS that be use in this project for guardian to trace the location of the blind people. The Ublox Neo 6M GPS Module is a full GPS module based on the Ublox Neo 6M. This module makes use of the most recent Ublox technology to provide the most accurate positioning information. It also has an external GPS antenna and TTL UART connections. This module includes an onboard rechargeable lithium-ion battery, allowing it to hot start in most cases and obtain a GPS lock faster. This GPS is very good and has a high precision binary output.

Figure 3.23: GPS module

3.13.1.5 Buzzer

Figure 3.24 shows the buzzer that be used in the proposed system to alert the blind people when detect the obstacles and the wet surface area. A piezo buzzer is a piece of electronic equipment that emits a tone, alarm, or sound. It is lightweight, has a simple design, and is usually cheap. However, depending on the piezo ceramic buzzer specifications, it is also dependable and can be built in a variety of sizes to produce different sound outputs across varying frequencies.

Figure 3.24: Buzzer

3.13.1.6 Push Button

Figure 3.25 depicts the push button that be used as an emergency button in the proposed system. The blind people can press the button to alert their guardian. A simple in-out mechanism controls push button switches. It can either break, turn off, or turn on a circuit. They can also serve as an input for a piece of equipment's user interface or start/stop a specific function. Push button switches are classified as either momentary, which means the switch function only lasts as long as the operator presses the button, or maintained, which means the switch function remains latched in that status after it has been actuated.

Figure 3.25: Push Button

3.13.1.7 Battery

The 18650 battery is a Li-ion rechargeable battery with a capacity of 2000 mAh. An 18650 cell can be charged and discharged 1000 times without losing much battery capacity. They are safe to use, friendly to the environment, and have a long battery life. It has a high energy density and provides our device with excellent continuous power sources. It should be used in conjunction with a protection circuit board that protects the battery from over-charge, over-discharge, and over-current draw.

Figure 3.26: 18650 lithium battery

3.13.1.8 Battery Holder

A battery holder's primary function is to keep cells in place safely and securely while transmitting power from the batteries to the device in question.

Figure 3.27: Battery Holder

3.13.2 Hardware Support

The table 3.0 below show the hardware support that been used in the proposed system.

Hardware	Function
Laptop HP notebook	A machine required for system development; it serves as a medium for

	code writing, software installation, system design, and so on.
Blind stick	-To attach all its components -It will be used by blind people
Buzzer	It will notify blind people of any obstacles or wet surfaces by emitting a low or high beep.
Smartphone	Redmi Note 8, to see if the Blynk apps work and for guardians to see the location of blind people.
Breadboard	To construct and test ultrasonic circuits without the need for soldering
NodeMCU	It will be used as a microcontroller in an open source IoT platform.
Water sensor & Ultrasonic sensor	It had to detect the obstacles as well as the wet surface area.

Table 3.8: Hardware Support

3.13.3 Software Requirements

3.13.3.1 Arduino IDE

Figure 3.26 show the software that be used to program the proposed system. The Arduino IDE, also known as the Arduino Integrated Development Environment, is a platform that lets users write code and communicate with hardware. The environment is open-source software written in Java. The Arduino IDE is compatible with Windows, Mac OS X (Apple), and Linux operating systems. The Arduino IDE supports structured C or C++ programming languages.

Figure 3.28: The logo of Arduino IDE

3.13.3.2 Blynk Application (Legacy)

Figure 3.27 depicts the Blynk application that been used in the proposed system as a mobile application for the guardian to trace the location of the blind people and also can view the alert notification by the blind people when blind people press the emergency button. Blynk is an IoT platform for iOS and Android smartphones that controls Arduino, Raspberry Pi, and NodeMCU via the Internet. This application is used to compile and provide the appropriate address on the available widgets in order to create a graphical or human machine interface (HMI). The Internet of Things inspired the development of Blynk. It can remotely control hardware, display sensor data, store data, visualise it, and do a variety of other interesting things.

Figure 3.29: The logo of Blynk apps

3.14 Testing Plan/Validation

Testing is a procedure that takes place only after the development process is complete. It will assess the performance of the system in terms of both functional and non-functional requirements. Table 3.9 shows the Mobile Application Testing Plan, while Table 3.10 shows the Sensors, Hardware, and Database Connecting Testing Plan.

3.14.1 Mobile Application Testing Plan

Test Care	Test Data	Expected Result	Actual Result	Pass/Fail	Comment
Login with correct username and password	Username: abbysahira@gmail.com Password: maker	Login successful and redirect to the Blynk Apps			
Login with incorrect username and password	Username: abbysahira Password: 123456	Login unsuccessful and error message pops up and returns login page			
When tracking	Null	Display the location of blind person			
When view alert notification	Null	Display the message of notification			

Table 3.9: Mobile Application Testing Plan

3.14.2 Sensors, Hardware, and Database Connection Testing Plan

Test Care	Test Data	Expected Result	Actual Result	Pass/Fail	Comment
When stick power on	Null	The system is active and can be used			
Ultrasonic sensors within range 50 cm	Walking by the sensor	Detect obstacles			
Water sensors	Walking by the sensor	Detect wet surface			
Buzzer	Notify the obstacles and wet surface area	Buzzer triggered			
Emergency button	Press the emergency button	Send alert notification to the guardian			
GPS	Null	Display the location of the blind person			

Table 3.10 Sensors, Hardware and Database Connecting Testing Plan

3.15 Potential Use of Proposed Solution

The proposed system is a Smart Blind Stick with an Emergency Button using IoT that is capable of automatically detecting obstacles and wet surface areas when sensors detect them, and when the blind person presses the emergency button, the stick will send an alert notification to the guardian via a Blynk application. This system is designed to be mounted on the underside of a stick. When ultrasonic and water sensors detect obstacles or wet surfaces, it detects them automatically. This is suitable for use in public places.

Smart Blind Stick with Emergency Button using IoT is a system designed to make life easier for blind people as a potential application of this proposed system. The following are the most significant contributions: For starters, blind people can walk freely without needing to be watched by others. The stick will have a sensor that will detect any obstacles in its path. The keeper or guardian does not need to be concerned about where blind people want to go because the Blynk app's interface allows them to track it on their phone.

3.16 Gantt Chart

The Gantt Chart depicts the progress of the project over time. The proposed methodology will be used for the project's requirements planning, user design, construction, and cutover phases. APPENDIX A contains the Gantt Chart.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter focuses on the overall process of implementing the Smart Blind Stick with Emergency Button system, testing, and the results obtained throughout the project system implementation process. The RAD methodology, which was discussed in the previous chapter, was used in the process sequence of system implementation and testing. This chapter will provide a detailed explanation of the system implementation method, obtained results, and testing technique used to ensure the project's objectives were met. Throughout the project system's implementation, programming languages such as C for Arduino IDE language were used in hardware setup. This chapter will also outline the project's constraints. The obtained results and discussion in this project system aid in future system planning and direction.

4.1.1 Development Environment

The Arduino IDE and the Blynk Application were used in the system's implementation. The Arduino IDE is a piece of software that allows to write code, upload code, and monitor sensor data via the serial monitor. The Arduino programming language was used to sketch the build code to interact with the NodeMCU ESP8266 microcontroller with the sensors connected, and the serial monitor was used to monitor the sensor data. Meanwhile, the Blynk Application was used in the development of a mobile application to track the location of blind people, receive alert notifications, and allow guardians to login.

The NodeMcu ESP8266 microcontroller board with WIFI was used for the Smart Blind Stick with Emergency Button, and the Arduino IDE was used to write the build code. Arduino is a free and open-source electronics platform with simple hardware and software that includes a text editor, an output area, a toolbar, and uploading and compiling menus. Its standard programming language is C, and it makes use of the GNU C compiler. The build code written in the Arduino IDE communicates with the NodeMcu ESP8266 microcontroller and the sensors connected. It allows to upload the assembled code into the NodeMcu ESP8266 microcontroller, which defines the hardware functions. The Arduino IDE interface is depicted in Figure 4.1.

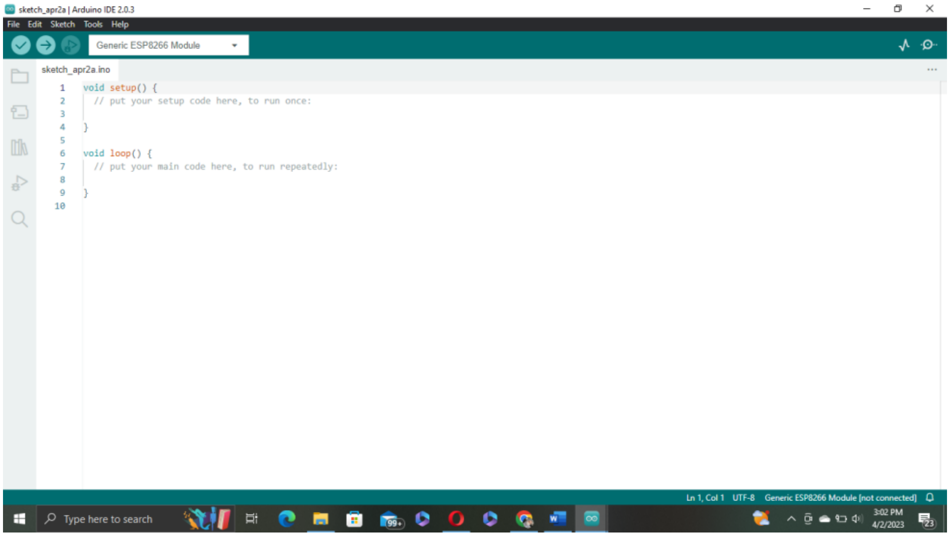


Figure 4.1: The Arduino IDE Software Interface

4.2 Mobile Application System

The guardians of the blind will be the primary users of this Smart Stick Application system. The goal of this system is to assist guardians in tracking the location of blind people and receiving alert notifications when blind people press the emergency button on their stick. The data will be displayed in the mobile application in longitude, latitude, speed, direction, satellite, and GPS maps for easy understanding by the guardian.

4.2.1 Login Interface

The Figure 4.2 below shows the login interface's function is to validate the user before allowing access to the Smart Stick application. The user must enter the valid username and password that the developer assigned to the user. Furthermore, the username and password entered by the user will be validated if the entered authentication details match the username and password. If the user's authentication details do not match, the user will be denied access to the system.

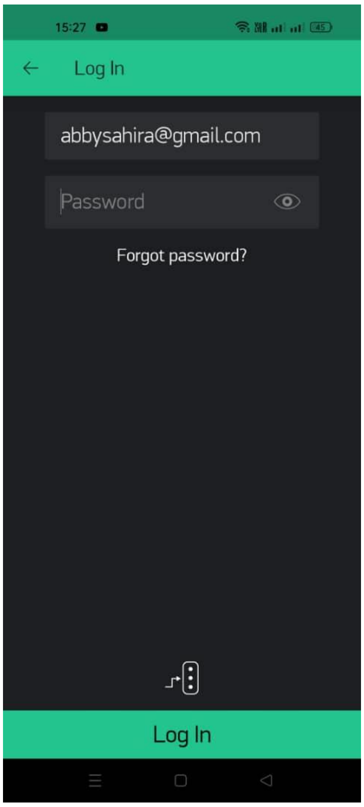


Figure 4.2: Login Interface

4.2.2 Forgot Page Interface

The user will be able to reset the password of the account in the forgot page interface based on the validation of the email address used when purchasing this Smart Blind Stick with Emergency system. The developer will then email the user instructions on how to reset the password for the account with the username that shows in Figure 4.3.

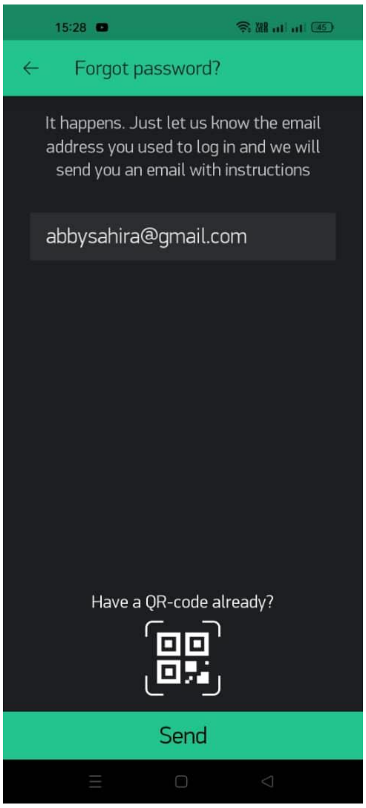


Figure 4.3: Forgot Page Interface

4.2.3 Home Interface

If the user successfully logs into the application, it will redirect the user to the home interface in Figure 4.4, where the user will be able to access application functions such as tracking the location and receiving alert notifications if the blind people press the emergency button on their stick. The entire system's function is to achieve the system's goal. Unless the user clicks the logout button, the system will remain logged in.

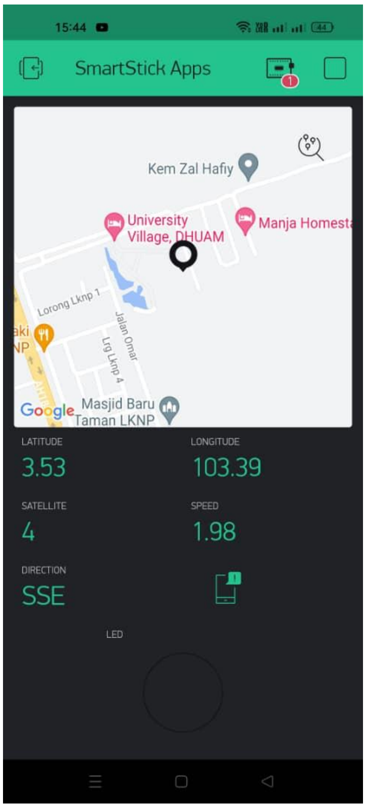


Figure 4.4: Home Interface

4.3 Hardware Implementation

The microcontroller is the primary piece of hardware in this system. It functions as a controller on an integrated circuit that is intended to perform a task. This system makes use of the Nodemcu esp8266 microcontroller board, which has 30 digital input/output pins. The features allow for the installation of two sensors, a push button, a buzzer, and a GPS module. Ultrasonic sensors and a water sensor are among the sensors. This microcontroller includes a Wi-Fi module that is used to exchange sensor data with the Blynk server. Using hardware such as a shield board, breadboard, male to male jumper wires, and male to female jumper wires, the sensors are then connected to the Nodemcu esp8266 microcontroller board. The hardware had to be installed first. The breadboard was wired with male-to-male jumper wires from the 5v (VIN) and GND (Ground) ports. The sensors and components are then connected to a breadboard to communicate with the microcontroller. The code was transferred to the Nodemcu esp8266 via USB. To debug, a computer connection and a serial monitor were used.

Figure 4.5 depicts the hardware, which includes sensors, a breadboard, a Nodemcu esp8266, and other components.

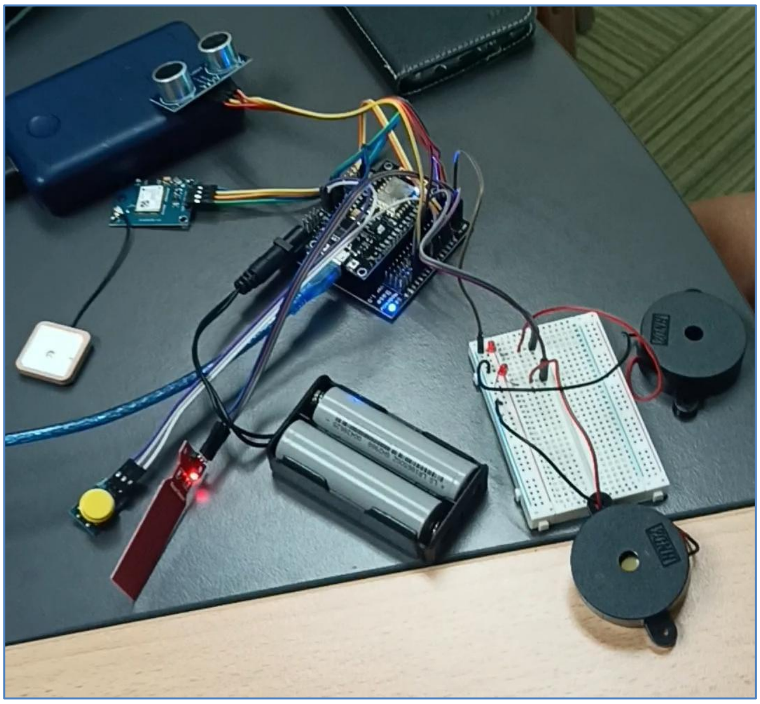


Figure 4.5: Smart Blind Stick with Emergency Button prototype

The ultrasonic sensor was used to detect any obstacles in the path of the stick. The jumper wire, buzzer and led are the components required to set up the ultrasonic sensor. Once the ultrasonic sensor detects any obstacles within in range 50 cm, the buzzer will be sound continuous and the led will be on. Figure 4.6 depicts the hardware configuration of the ultrasonic sensor and the NodeMCU ESP8266 microcontroller. The ultrasonic sensor is made up of four wires, which will be connected to ground, voltage, and pin numbers D6 and D7 on the nodemcu esp8266 board.

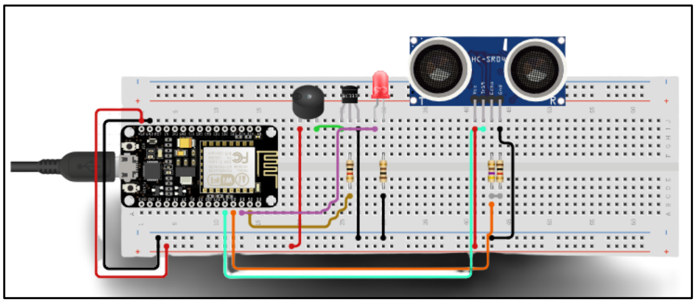


Figure 4.6: The diagram of ultrasonic sensor setup

If the ultrasonic sensor coding is not uploaded to the Arduino IDE after configuring the ultrasonic sensor and nodemcu esp8266 microcontroller, the ultrasonic sensor will not function. As a result, the code was uploaded to the Arduino IDE editor to ensure that the ultrasonic sensor worked properly. The code for the ultrasonic sensor that was uploaded to the Arduino IDE editor is shown below in Figure 4.7.

```
const int trigPin = 13;
const int echoPin = 12;

#define SOUND_VELOCITY 0.034
#define CM_TO_INCH 0.393701
#define LED 15 //untuk ultra D8 KELABU

long duration;
float distanceCm;
float distanceInch;
int val = 0;

void sensorRead()
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  // Calculate the distance
  distanceCm = duration * SOUND_VELOCITY / 2;
  // Convert to inches
  distanceInch = distanceCm * CM_TO_INCH;
```

```
long duration;

  Serial.print("Distance (cm): ");
  Serial.println(distanceCm);
  Serial.print("Distance (inch): ");
  Serial.println(distanceInch);

delay(500);
  if (distanceInch < 100) {
    digitalWrite(LED, HIGH);
  } else
  {
    digitalWrite(LED, LOW);
  }
}
void setup (){


  pinMode(trigPin, OUTPUT);  // Sets the trigPin as an Output
  pinMode(echoPin, INPUT);   // Sets the echoPin as an Input
  pinMode(LED, OUTPUT);
  pinMode(buzzer, OUTPUT);
}
void loop() {
  sensorRead();
}
```

Figure 4.7: Ultrasonic sensor code

The water sensor used to detect water under the stick was then configured with the nodemcu esp8266 microcontroller. The jumper wire, buzzer and led are the components required to set up the water sensor. Once the water sensor detect water, the buzzer will be sound intermittent and the led will be on. The water sensor has a DC input range of 6V to 24V, which was used to power the nodemcu. Figure 4.8 depicts the hardware configuration of the water sensor and nodemcu esp8266 microcontroller. The water sensor also has three wires that connect to 6V-24V, 3V, and GND.

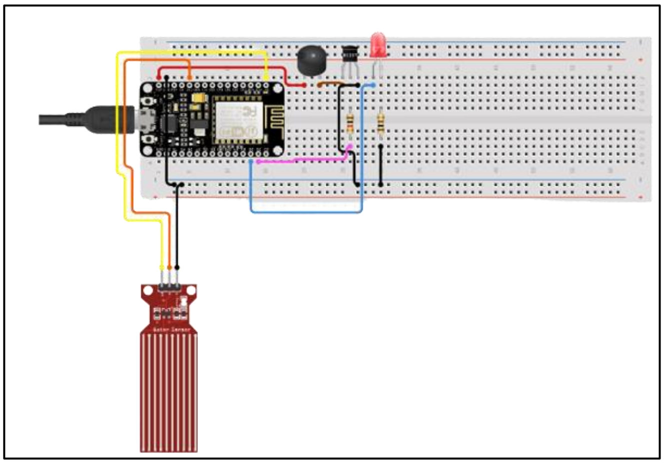


Figure 4.8: The diagram on the setup of water sensor

The code for the water sensor that was uploaded to the Arduino IDE is shown below in Figure .4.9.

```
#define buzzer 2
void Water()
{
  int s1=analogRead(A0);
  Serial.println(s1);
  delay(100);
  if(s1> 200 )
   {
    tone(buzzer,261);
    delay(200);
    noTone(buzzer);
    tone(buzzer,293);
    delay(200);
    noTone(buzzer);
   }
  else
   {
   digitalWrite(buzzer,LOW);
   }
}
Void setup(
  pinMode(LED, OUTPUT);
  pinMode(buzzer, OUTPUT);
}
Void loop()
{
 Water();
}
```

Figure 4.9: Water sensor code

Then, the GPS module was then installed. The blind people's location was tracked using the GPS module. Figure 4.10 depicts the hardware configuration of the GPS module and Nodemcu microcontroller. The GPS module is made up of four wires.

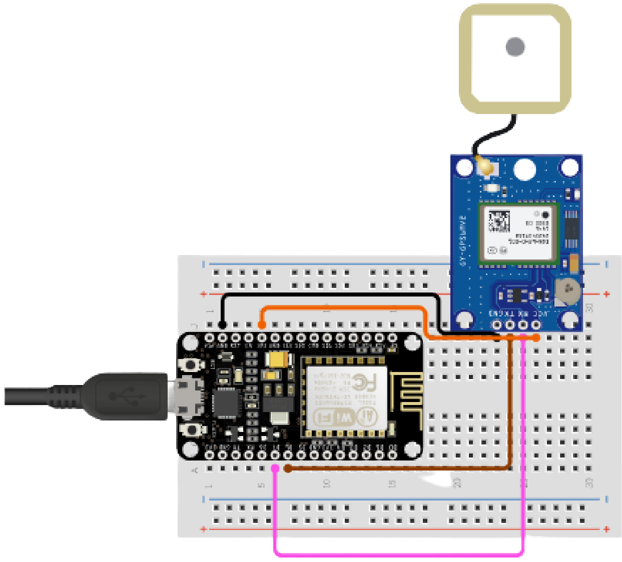


Figure 4.10: The diagram on the setup of gps module

The coding for the GPS module was sketched and uploaded to the Arduino IDE editor. The code for the GPS module that was uploaded to the Arduino IDE is shown below in Figure 4.11.

```
static const int RXPin = 4, TXPin = 5;
static const uint32_t GPSBaud = 9600;

TinyGPSPlus gps;
WidgetMap myMap(V0);

SoftwareSerial mygps(RXPin, TXPin);
BlynkTimer timer;

float latitude;     //Storing the Latitude
float longitude;    //Storing the Longitude
float velocity;     //Variable  to store the velocity
float sats;         //Variable to store no. of satellites response
String bearing;     //Variable to store orientation or direction of GPS
```

```
unsigned int move_index = 1;
void setup()
{
  Serial.begin(115200);
  Serial.println();

  mygps.begin(GPSBaud);
  Blynk.begin(auth, ssid, pass, IPAddress(139,59,224,74), 8080);
  timer.setInterval(5000L, checkGPS);

}
void checkGPS()
{
  if (gps.charsProcessed() < 10)
  {
    Serial.println(F("No GPS detected: check wiring."));
    Blynk.virtualWrite(V3, "GPS ERROR");
  }
}

void loop()
{
  while (mygps.available() > 0)
  {
    if (gps.encode(mygps.read()))
      displayInfo();
  }
  Blynk.run();
  timer.run();

void displayInfo()
{
  if (gps.location.isValid() )
  {
    sats = gps.satellites.value();       //get number of satellites
    latitude = (gps.location.lat());     //Storing the Lat. and Lon.
    longitude = (gps.location.lng());
    velocity = gps.speed.kmph();         //get velocity
    bearing = TinyGPSPlus::cardinal(gps.course.value());
    Serial.print("SATS:  ");
    Serial.println(sats);  // float to x decimal places
    Serial.print("LATITUDE:  ");
    Serial.println(latitude, 6);  // float to x decimal places
    Serial.print("LONGITUDE: ");
    Serial.println(longitude, 6);
    Serial.print("SPEED: ");
    Serial.print(velocity);
    Serial.println("kmph");
```

```
Serial.print("DIRECTION: ");
    Serial.println(bearing);

    Blynk.virtualWrite(V1, String(latitude, 6));
    Blynk.virtualWrite(V2, String(longitude, 6));
    Blynk.virtualWrite(V3, sats);
    Blynk.virtualWrite(V4, velocity);
    Blynk.virtualWrite(V5, bearing);
    myMap.location(move_index, latitude, longitude, "GPS_Location");
  }
  Serial.println();
}
```

Figure 4.11: GPS module code

Finally, the emergency button was being programmed. When blind people were in an emergency, they can use the emergency button. As a result, when the blind people press the button, the SmartStick app receives an alert notification. Figure 4.12 depicts the hardware configuration of the emergency button and Nodemcu esp8266 microcontroller. The emergency button is also made up of three wires.

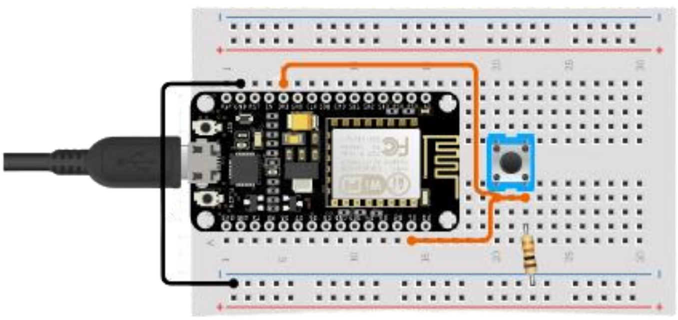


Figure 4.12: The diagram on the setup emergency button

The sketches for the emergency button were then uploaded to the Arduino IDE editor. The code for the emergency button that was uploaded in the Arduino IDE is shown below in Figure 4.13.

```
#define noti_buttonpin 14
WidgetLED notiled(V6);
void notifyme()
{
  if (digitalRead(noti_buttonpin) == HIGH)
  {
    delay(200);
    Serial.println("Help Me");
    Serial.println("Send noti to phone");
    Blynk.notify("Danger! Help Me!");
    notiled.on();
  }

  else
  {
    delay(200);
    Serial.println("No Request");
    notiled.off();
  }
}

void setup()
{
  Serial.begin(115200);
  Serial.println();
  pinMode(noti_buttonpin,INPUT);

}

void loop()
{

  Blynk.run();
  timer.run();
  notifyme();

}
```

Figure 4.13: Emergency button code

4.4 Prototype of Smart Blind Stick with Emergency Button

Figure 4.14 below shows the prototype of the Smart Blind Stick with Emergency Button.

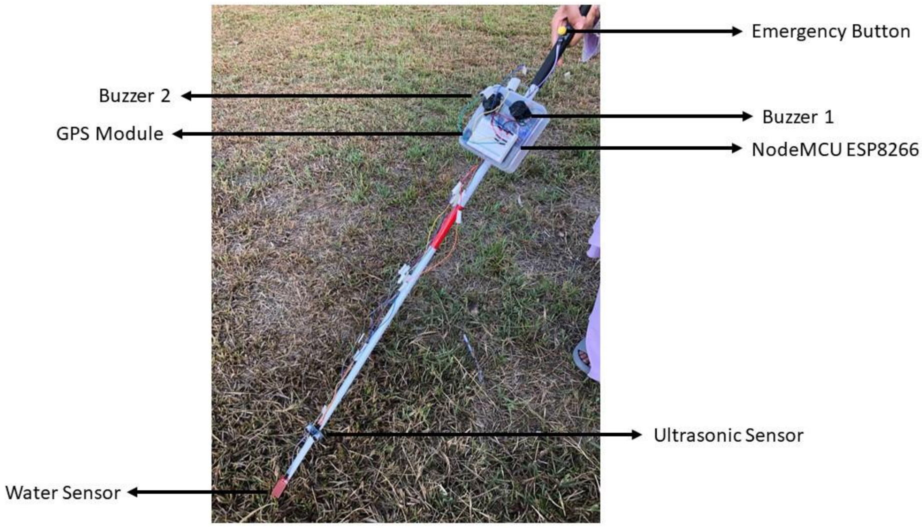


Figure 4.14: Prototype of Smart Stick with Emergency Button

4.5 Blynk Application

The Blynk application was used to save the user's information from the mobile application, such as the username, and password. The Blynk application also used the NodeMCU ESP8266 microcontroller to store the location of blind people. The communication between the Blynk application and the NodeMCU ESP8266 was established using an internet connection and the proper setup configuration. The real-time location from the stick's GPS module was used to store the longitude, latitude, satellite, speed, and direction on the SmartStick application.

4.5.1 Blynk Connection

The data retrieval from the Blynk server was required for the function login and data display on the interface. As a result, before performing data retrieval, the first step is to connect to the Blynk server. The Blynk connection is written in C. The code in Figure 4.15 below depicts the Blynk connect function. The Blynk function takes the authentication token's address, the ssid, and the password. The Blynk.begin() function is used to validate the database connection.

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

BlynkTimer timer;
char auth[] = "dPY_O9EJY-OdyUVOs97txjtlsDw-9llK";          // Auth Token in the
Blynk App.
char ssid[] = "mila";                                  //  WiFi credentials.
char pass[] = "erinmila";
Blynk.begin(auth, ssid, pass, IPAddress(139,59,224,74), 8080);
```

Figure 4.15: Blynk connect function code

4.6 Testing and Discussion

This section will go over all the project data in terms of testing and discussion, it consists of hardware and software testing to ensure that the sensors, and mobile applications are on track to achieve the system's goal. The type of object detected by the ultrasonic sensor and water sensor will influence the result on the stick. The most intriguing observation was that the stick is also affordable for them. This stick can provide the user with quick output The necessary equipment and materials. The hardware prototype, mobile application, and internet connection will be used for testing. The system was subjected to the User Acceptance Test for overall testing.

4.6.1 Alert on SmartStick Application

When blind people press the emergency button on their stick, the alert notification shown in Figure 4.16 is generated. As a result, the system generated an alert notification to the guardian of the blind people. When the guardian clicks the notification, he or she will be taken to the SmartStick homepage which is the page that allow guardian to track the location of the blind people, as shown in Figure 4.17.

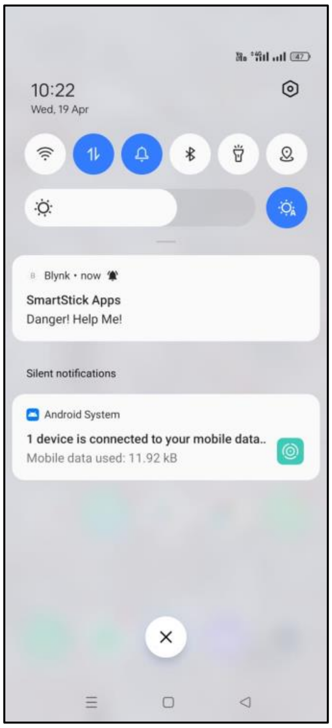


Figure 4.16: Notification Alert on SmartStick Apps

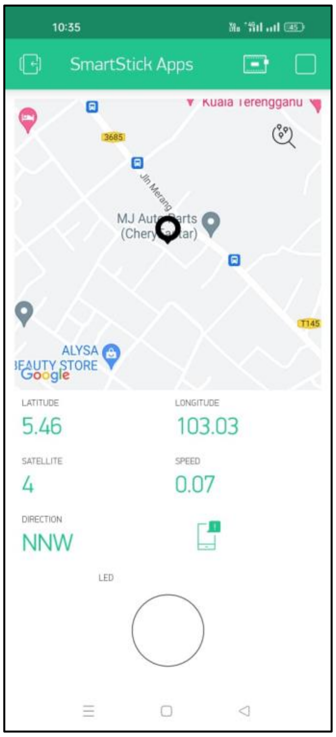


Figure 4.17: Location Interface of Blind People

4.6.2 Result on Ultrasonic Sensor Detection

Table 4.1 depicts the condition of the buzzer when the ultrasonic sensor begins to detect an object at a specific distance. To begin, as shown in the table, the ultrasonic sensor begins to provide output to the buzzer with sound to beep continuously at a distance 50 cm and below. Second, the buzzer will stop at 50 cm and above.

Distance / **Output**	**< 20 cm**	**30 cm**	**< 50 cm**	**60 cm**	**75 cm**
Beeping/Not Beeping	Beeping	Beeping	Beeping	Not Beeping	Not Beeping

Table 4.1: Result on Ultrasonic Sensor Detection

Figure 4.18 show the testing of ultrasonic sensor. The system was tested on a road with obstacles in front of blind people. The buzzer beeps with a high beep when the range is less than 50 cm, alerting blind people to the presence of an obstacle in front of them.

Figure 4.18: Testing of Ultrasonic Sensor Detection

4.6.3 Result on Water Sensor Detection

Table 4.2 shows the state of the buzzer when the water sensor detects water. To begin, as shown in the table, the water sensor begins to provide output to the buzzer with an intermittent beep when it detects any water below the stick.

Condition / Output	With Water	No Water
Beeping/Not Beeping	Beeping	Not Beeping

Table 4.2: Result on Water Sensor Detection

Figure 4.19 shows the testing of water sensor. The system was tested on a road with puddle of water under the blind's stick. When the water sensor detects the presence of water, the buzzer emits a low beep, alerting the blind to the presence of water.

Figure 4.19: Testing of Water Sensor Detection

4.7 Conclusion

The implementation of this system began with hardware, with all the required components placed together in the breadboard with the Nodemcu ESP8266, followed by the development of the mobile application. After configuring the hardware and the mobile application with basic compose code to run both, the connection to the Blynk server was established. The sensors and connection to the Nodemcu were connected using jumper cables, which eliminated the need for soldiering. The combined sensor code was uploaded into the Nodemcu using the Arduino Ide, and the mobile application was configured and installed. The Blynk server was simple to set up to connect the Nodemcu to the mobile application. The testing was done to ensure that the emergency button works properly when blind people press the button on their stick and an alert notification is sent to their guardian via the SmartStick app. Then, the ultrasonic sensors and water sensor were then tested to ensure that they were working properly. The testing was done to ensure that the Nodemcu could transmit the output via buzzer sound when the ultrasonic sensor detected a distance of 50 cm or less, and that the water sensor would sound if there was any water below the stick. Finally, the Smart Stick with Emergency Button includes a feature that allows the guardian to track the location of the blind people using the real-time location by using the GPS module on the blind's stick.

CHAPTER 5

CONCLUSION

5.1 Introduction

Blindness and visual impairment are major public health issues worldwide. Though they do not directly cause death, they have a significant impact on the quality of life of affected individuals and communities because they cause disability that lasts a lifetime. To improve the existing stick and help blind people walk more safely, the Smart Blind Stick with Emergency Button could be an ideal solution for users, who are blind people and their guardians. The Smart Stick detects obstacles in front of blind people as well as the water below the stick by utilizing the NodeMCU esp8266 module to transmit the readings of the sensors and the buzzer will sound with different sounds to differentiate between the obstacles and water. The implementation of the Smart Stick system was proposed in this paper. The system was built by connecting multiple sensors to the NodeMCU esp8266 and programming the NodeMCU esp8266 and mobile application. This system used ultrasonic sensors to detect any obstacles in front of blind people within 50 cm and water sensors to detect water. This project includes an emergency button to assist blind people in an emergency. If blind people are in an emergency, they can push the button and an alert notification will be sent to their guardian by Blynk application. So that their guardian is aware by receiving the alert notification. The guardian can also track the location of blind people 24 hours a day. The data was read and sent to the NodeMCU esp8266 microcontroller for transformation into readable data for transmission to the Blynk database. The Blynk application uses data from the database to send an alert notification to the Blynk application when blind people press the button on their stick and allow their guardians to monitor blind people's location.

5.2 Constraints

There are several constraints exist during the system implementation process. The constraints include hardware, time, cost, and technical constraints.

5.2.1 Hardware Constraints

The implementation of the GPS module was an extremely difficult process due to the difficulty in receiving a timestamp from each of the visible satellites, as well as data on where in the sky each one is located, so that "GPS ERROR" will appear in the Blynk application. The NodeMCU microcontroller was short-circuited due to a voltage supply imbalance during the programming process, and the NodeMCU esp8266 could not be used for programming again. Even though all hardware constraints were encountered, all hardware was able to be replaced and the voltage supply was corrected before the proposal submission deadline.

5.2.2 Time Constraints

The system was able to be fully implemented before the deadline, but several improvements could have been made to the system. Because the mobile application used Blynk Application with simple required functions, more functions could be implemented, which will be discussed in the future work below. Due to the time constraint that was applicable in the implementation of the system for improvement, the improvement was added to the discussion of the system's future work.

5.2.3 Cost Constraints

The hardware required for this system was costly for the student, and the repeated purchase of hardware such as a microcontroller and a GPS module due to previous replacement had increased the expenses to complete this system.

5.2.4 Technical Constraints

As the Internet of Things and mobile applications were new concepts to learn in order to implement this system. The burden of research and learning the programming language for Arduino, Blynk Application, and the setup of the NodeMCU esp8266 with the sensors had increased due to a lack of knowledge. There were many failures from the beginning until the system was completed in code implementation, but the system was completed after the tiresome of research and learning about the concept and implementation process of the Smart Blind Stick with Emergency Button.

5.3 Future Work

The application of future work was critical for improving the system's robustness and functionality. A few functions were reduced in this system, which can be added in future work to make it more efficient. The improvement of the system will be prioritized in this future work. Even though the system can detect obstacles and water, monitor the location of blind people, and allow blind people to press an emergency button, there are a few improvements that could be implemented in the system's future work.

The system lacks an on/off switch, so it is always on, which can quickly drain the battery of the sticks. In the future, they can add a function that allows the system to turn on by simply holding the handle or upper stick. As a result, it will save the stick's battery.

Aside from that, the buzzer in this system is constantly beeping. The people around the users will feel uneasy while they use this stick. So that, in the future, they could upgrade the design by wearing headphones or earphones. As a result, only users can hear the buzzer as navigation.

As the mobile application was built with Blynk, they can upgrade it by creating their own application. As a result, the mobile application could be used to connect multiple guardians under a single system to be observed by a smart application at the same time. This method allows multiple guardians to track the location of blind people. Aside from that, if multiple guardians can monitor the guardians, it will be safer if anything happens to the blind people if one of the guardians is not alert or does not recognise the alert notification. As a result, this function is extremely useful for blind people to ensure their safety.

Finally, the project is only applicable to blind people who can still use their ears to hear the buzzer as navigation. To solve this issue, the smart stick should include a vibrator for navigation. Vibrator is integrated so that presence of obstacle is directly sensed by the blind person.

REFERENCES

Binti Rosman, N. (n.d.). *SMART STICK WITH GPS NAVIGATION AND SENSOR DETECTION*.

Bishop, O. (2008). Using the Ultrasonic Sensor. *Programming Lego Mindstorms NXT*, 81–85. https://doi.org/10.1016/B978-1-59749-278-2.00008-1

Bourne, R. R. A., Steinmetz, J. D., Saylan, M., Mersha, A. M., Weldemariam, A. H., Wondmeneh, T. G., Sreeramareddy, C. T., Pinheiro, M., Yaseri, M., Yu, C., Zastrozhin, M. S., Zastrozhina, A., Zhang, Z. J., Zimsen, S. R. M., Yonemoto, N., Tsegaye, G. W., Vu, G. T., Vongpradith, A., Renzaho, A. M. N., … Vos, T. (2021). Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: The Right to Sight: An analysis for the Global Burden of Disease Study. *The Lancet Global Health*, *9*(2), e144–e160. https://doi.org/10.1016/S2214-109X(20)30489-7

Chandra, R. A., Fadlilah, U., Wibowo, P., Tegar, F., Saputra, N., Sulasyono, R. R., Muhammadiyah, U., & Surakarta, S. (2022). *Blind People Stick Tracking using Android Smartphone and GPS Technology* (Vol. 8, Issue 1).

Gend, M., Pathan, S., Shedge, C., & Potdar, Prof. D. P. (2021). Smart Ultrasonic Walking Stick for Visually Impaired People. *International Journal of Advanced Research in Science, Communication and Technology*, 680–687. https://doi.org/10.48175/IJARSCT-1460

Jabatan Kebajikan Masyarakat. (n.d.). Retrieved November 29, 2022, from https://www.jkm.gov.my/jkm/index.php?r=portal/full&id=ZUFHVTB1NnJWM0EreGtwNC9Vb1hvdz09

Murali, S., Shrivatsan, R., Sreenivas, V., Vijjappu, S., Gladwin, S. J., & Rajavel, R. (2017). Smart walking cane for the visually challenged. *IEEE Region 10 Humanitarian Technology Conference 2016, R10-HTC 2016 - Proceedings*. https://doi.org/10.1109/R10-HTC.2016.7906791

Natarajan, V., Yogeshwaran, M., & Canessane, A. (2022a). IoT based Smart Stick with Automated Obstacle Detector for Blind People. *2022 6th International Conference on Trends in Electronics and Informatics, ICOEI 2022 - Proceedings*, 536–540. https://doi.org/10.1109/ICOEI53556.2022.9777174

Natarajan, V., Yogeshwaran, M., & Canessane, A. (2022b). IoT based Smart Stick with Automated Obstacle Detector for Blind People. *2022 6th International Conference on Trends in Electronics and Informatics, ICOEI 2022 - Proceedings*, 536–540. https://doi.org/10.1109/ICOEI53556.2022.9777174

RAD Model - Phases, Advantages & Disadvantages | ArtOfTesting. (n.d.). Retrieved November 29, 2022, from https://artoftesting.com/rad-model

Riazi, A., Riazi, F., Yoosfi, R., & Bahmeei, F. (2016). Outdoor difficulties experienced by a group of visually impaired Iranian people. *Journal of Current Ophthalmology*, *28*(2), 85. https://doi.org/10.1016/J.JOCO.2016.04.002

Romadhon, A. S., & Husein, A. K. (2020). Smart Stick for the Blind Using Arduino. *Journal of Physics: Conference Series*, *1569*(3). https://doi.org/10.1088/1742-6596/1569/3/032088

SDLC - Agile Model. (n.d.). Retrieved November 29, 2022, from https://www.tutorialspoint.com/sdlc/sdlc_agile_model.htm

Singh, A., Mallikarjuna, B., Murtuza, M., & Tiwari, V. (2021). Design and Implementation of Superstick for Blind People using Internet of Things. *Proceedings - 2021 3rd International Conference on Advances in Computing, Communication Control and Networking, ICAC3N 2021*, 691–695. https://doi.org/10.1109/ICAC3N53548.2021.9725786

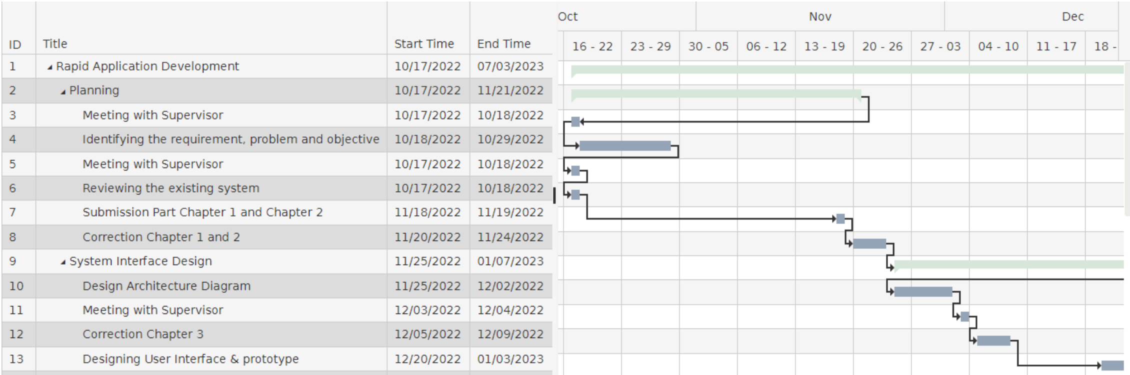
SVS College of Engineering, & Institute of Electrical and Electronics Engineers. (n.d.). *Proceedings of the 2018 International Conference on Current Trends towards Converging Technologies : 01-03, March 2018*.

Ultrasonic Sensor-Aided Intelligent Walking Stick for Visually Impaired | Request PDF. (n.d.). Retrieved November 29, 2022, from https://www.researchgate.net/publication/328880510_Ultrasonic_Sensor-Aided_Intelligent_Walking_Stick_for_Visually_Impaired

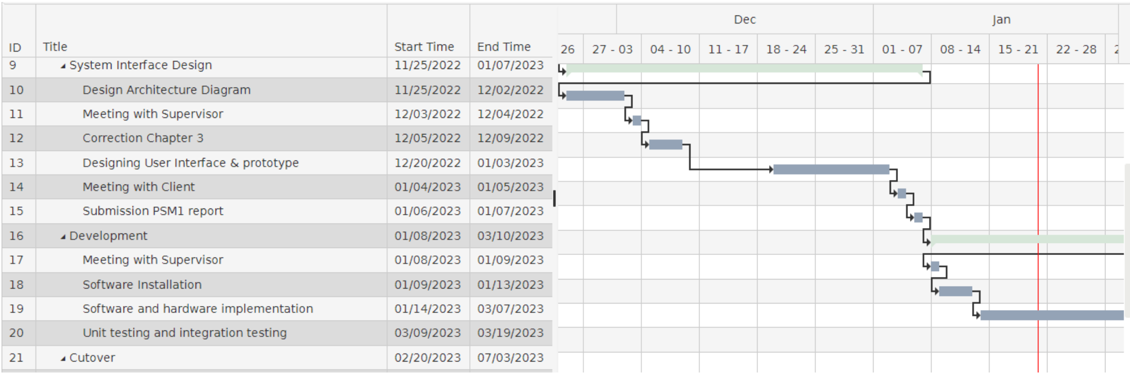
Waterfall vs RAD vs Agile: Difference | What Method Is the Best? (n.d.). Retrieved November 29, 2022, from https://kissflow.com/application-development/rad/rad-waterfall-agile-which-one-is-best-for-you/

APPENDIX A

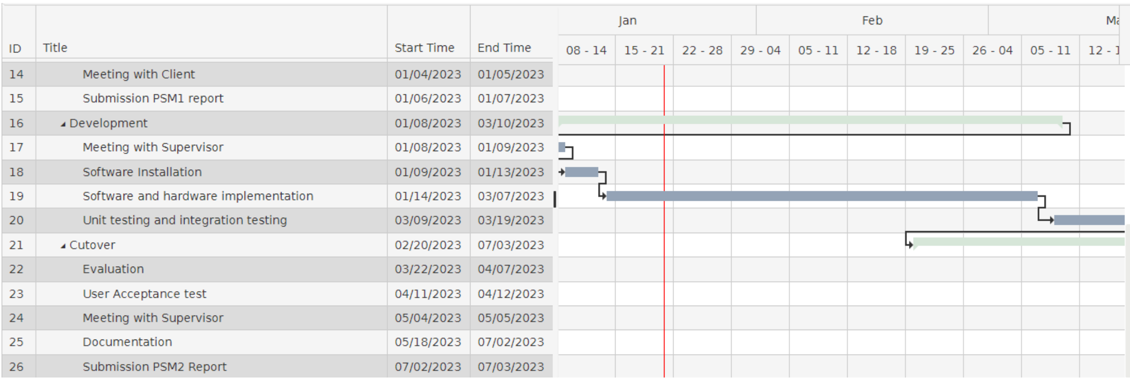
GANTT CHART



ID	Title	Start Time	End Time
1	Rapid Application Development	10/17/2022	07/03/2023
2	Planning	10/17/2022	11/21/2022
3	Meeting with Supervisor	10/17/2022	10/18/2022
4	Identifying the requirement, problem and objective	10/18/2022	10/29/2022
5	Meeting with Supervisor	10/17/2022	10/18/2022
6	Reviewing the existing system	10/17/2022	10/18/2022
7	Submission Part Chapter 1 and Chapter 2	11/18/2022	11/19/2022
8	Correction Chapter 1 and 2	11/20/2022	11/24/2022
9	System Interface Design	11/25/2022	01/07/2023
10	Design Architecture Diagram	11/25/2022	12/02/2022
11	Meeting with Supervisor	12/03/2022	12/04/2022
12	Correction Chapter 3	12/05/2022	12/09/2022
13	Designing User Interface & prototype	12/20/2022	01/03/2023



ID	Title	Start Time	End Time
9	System Interface Design	11/25/2022	01/07/2023
10	Design Architecture Diagram	11/25/2022	12/02/2022
11	Meeting with Supervisor	12/03/2022	12/04/2022
12	Correction Chapter 3	12/05/2022	12/09/2022
13	Designing User Interface & prototype	12/20/2022	01/03/2023
14	Meeting with Client	01/04/2023	01/05/2023
15	Submission PSM1 report	01/06/2023	01/07/2023
16	Development	01/08/2023	03/10/2023
17	Meeting with Supervisor	01/08/2023	01/09/2023
18	Software Installation	01/09/2023	01/13/2023
19	Software and hardware implementation	01/14/2023	03/07/2023
20	Unit testing and integration testing	03/09/2023	03/19/2023
21	Cutover	02/20/2023	07/03/2023



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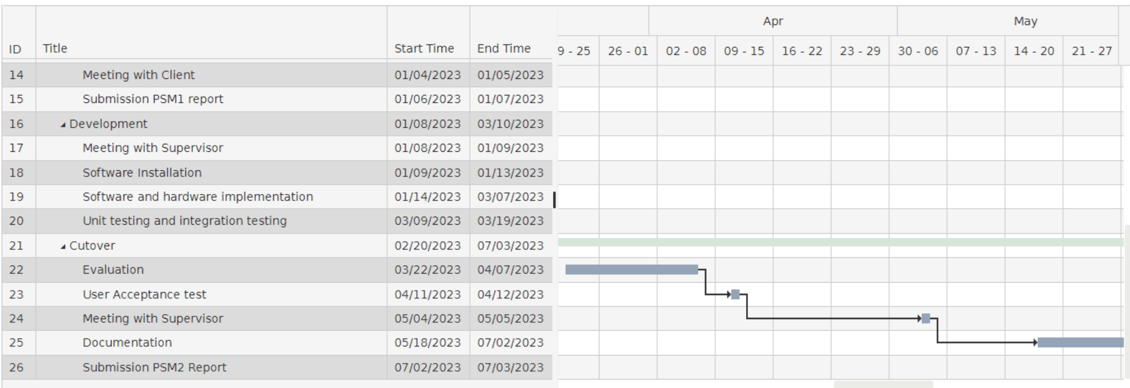
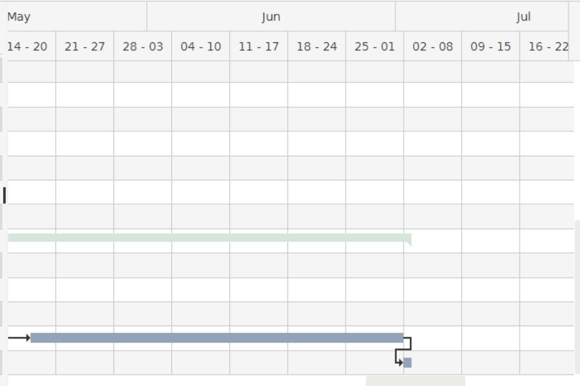
14	Meeting with Client	01/04/2023	01/05/2023
15	Submission PSM1 report	01/06/2023	01/07/2023
16	Development	01/08/2023	03/10/2023
17	Meeting with Supervisor	01/08/2023	01/09/2023
18	Software Installation	01/09/2023	01/13/2023
19	Software and hardware implementation	01/14/2023	03/07/2023
20	Unit testing and integration testing	03/09/2023	03/19/2023
21	Cutover	02/20/2023	07/03/2023
22	Evaluation	03/22/2023	04/07/2023
23	User Acceptance test	04/11/2023	04/12/2023
24	Meeting with Supervisor	05/04/2023	05/05/2023
25	Documentation	05/18/2023	07/02/2023
26	Submission PSM2 Report	07/02/2023	07/03/2023



ID	Title	Start Time	End Time
14	Meeting with Client	01/04/2023	01/05/2023
15	Submission PSM1 report	01/06/2023	01/07/2023
16	Development	01/08/2023	03/10/2023
17	Meeting with Supervisor	01/08/2023	01/09/2023
18	Software Installation	01/09/2023	01/13/2023
19	Software and hardware implementation	01/14/2023	03/07/2023
20	Unit testing and integration testing	03/09/2023	03/19/2023
21	Cutover	02/20/2023	07/03/2023
22	Evaluation	03/22/2023	04/07/2023
23	User Acceptance test	04/11/2023	04/12/2023
24	Meeting with Supervisor	05/04/2023	05/05/2023
25	Documentation	05/18/2023	07/02/2023
26	Submission PSM2 Report	07/02/2023	07/03/2023

ID	Title	Start Time	End Time
14	Meeting with Client	01/04/2023	01/05/2023
15	Submission PSM1 report	01/06/2023	01/07/2023
16	◢ Development	01/08/2023	03/10/2023
17	Meeting with Supervisor	01/08/2023	01/09/2023
18	Software Installation	01/09/2023	01/13/2023
19	Software and hardware implementation	01/14/2023	03/07/2023
20	Unit testing and integration testing	03/09/2023	03/19/2023
21	◢ Cutover	02/20/2023	07/03/2023
22	Evaluation	03/22/2023	04/07/2023
23	User Acceptance test	04/11/2023	04/12/2023
24	Meeting with Supervisor	05/04/2023	05/05/2023
25	Documentation	05/18/2023	07/02/2023
26	Submission PSM2 Report	07/02/2023	07/03/2023



APPENDIX B
USER ACCEPTANCE TEST (UAT)

1.0 Testing Report

The user acceptance test of the Smart Blind Stick with Emergency Button system is documented in this section. Each module is tested to ensure that the system is sufficient and meets the requirements. The approval of this testing means that the system has been thoroughly tested and is ready for system implementation. The discovered flaws have been addressed.

1.1 Mobile Application Testing Plan

Table 1.0: Mobile Application Testing

Test Care	Test Data	Expected Result	Actual Result	Pass/Fail	Comment
Login with correct username and password	Username: abbysahira@gmail.com Password: maker	Login successful and redirect to the Blynk Apps	Login successfully and redirect to homepage	Pass	-
Login with incorrect username and password	Username: abbysahira Password: 123456	Login unsuccessful and error message pops up and returns login page	Login unsuccessfully and error message pop-up	Pass	-
When tracking	Null	Display the location of blind person	Display the location of blind people	Pass	-
When view alert notification	Null	Display the message of notification	Display the alert notification	Pass	-

1.2 Sensors, Hardware, and Database Connecting Testing Plan

Table 1.2: Sensor, Hardware, and Database Connection Testing

Test Care	Test Data	Expected Result	Actual Result	Pass/Fail	Comment
When stick power on	Null	The system is active and can be used	The system is active and can be used	Pass	-
Ultrasonic sensors within range 50 cm	Walking by the sensor	Detect obstacles	Detect obstacles within in range 50 cm	Pass	-
Water sensors	Walking by the sensor	Detect water surface	Detect the water	Pass	-
Buzzer	Notify the obstacles and wet surface area	Buzzer triggered	Buzzer will beep when ultrasonic sensor detects any obstacles in range 50cm and detect the water	Pass	-
Emergency button	Press the emergency button	Send alert notification to the guardian	Alert notification will be sent to the Blynk Apps	Pass	-
GPS	Null	Display the location of the blind person	Location will be appeared in Blynk Apps	Pass	-

1.3 System Approval

Table 1.3: System Testing Approval

	Name	**Date**
Verified by:  ____________________ Developer	JAMILA SAHIRA BINTI JUNAIDDI	19 MAY 2023
Approved by: ____________________ Supervisor	DR. NOR SYAHIDATUL NADIAH BINTI ISMAIL	