Faculty of Electronics and Computer Technology and Engineering

DEVELOPMENT OF SMART BLIND STICK USING GPS

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ABSTRACT

The smart blind stick using Global Positioning System (GPS) is an assistive device designed to enhance the mobility and independence of visually impaired individuals. Traditional blind sticks provide basic obstacle detection and aid in navigation, but it lacks an advanced features for precise location tracking and route guidance. This project aims to leverage GPS technology to develop a smart blind stick that can accurately determine the user's position and provide audio-based navigation instructions. The proposed system incorporates a GPS module to acquire real-time coordinates and a microcontroller to process the data. The device is designed to be lightweight, portable, and user-friendly. The software component involves developing a user interface that allows the user to input their destination or select pre-defined routes. The system then calculates the optimal path based on the GPS coordinates and provides step-by-step directions, which include distance and directional cues. To enhance the functionality, additional features such as obstacle detection using ultrasonic sensors or cameras can be integrated. These sensors can alert the user about potential obstacles in them path, further improving safety during navigation. The smart blind stick using GPS aims to offer a cost-effective and efficient solution for visually impaired individuals, enabling them to navigate unfamiliar environments with confidence. The success of this project will be evaluated through user testing, feedback collection, and comparisons with existing navigation aids.

ABSTRAK

Tongkat pintar bagi orang buta menggunakan teknologi Sistem kedudukan sejagat (GPS) merupakan satu projek tahun akhir yang bertujuan untuk meningkatkan mobiliti dan kemandirian individu yang mengalami masalah penglihatan. Tongkat buta tradisional hanya menyediakan pengesanan halangan asas dan bantuan dalam navigasi, tetapi kurang ciri-ciri canggih untuk penjejakan lokasi yang tepat dan panduan laluan. Projek ini bertujuan untuk memanfaatkan teknologi GPS untuk membangunkan tongkat pintar bagi orang buta yang dapat menentukan kedudukan pengguna dengan tepat dan menyediakan arahan navigasi berasaskan audio. Sistem yang dicadangkan melibatkan modul GPS untuk mendapatkan koordinat secara masa nyata dan mikropemproses untuk memproses data tersebut. Peranti direka dengan ringan, mudah alih, dan mesra pengguna. Komponen perisian melibatkan pembangunan antara muka pengguna yang membolehkan pengguna memasukkan destinasi mereka atau memilih laluan yang telah ditetapkan. Sistem kemudian mengira laluan yang optimum berdasarkan koordinat GPS dan menyediakan arahan langkah demi langkah, termasuk petunjuk jarak dan arah. Bagi meningkatkan fungsinya, ciri-ciri tambahan seperti pengesanan halangan menggunakan sensor ultrabunyi atau kamera boleh diintegrasikan. Sensor-sensor ini boleh memberi amaran kepada pengguna mengenai halangan yang mungkin berada di hadapan mereka, yang seterusnya meningkatkan keselamatan semasa navigasi. Tongkat pintar bagi orang buta bertujuan untuk menawarkan penyelesaian yang berkos efektif dan cekap kepada individu yang mengalami masalah penglihatan, membolehkan mereka bergerak dengan yakin dalam persekitaran yang tidak dikenali. Kejayaan projek ini akan dinilai melalui ujian pengguna, pengumpulan maklum balas, dan perbandingan dengan bantuan navigasi yang sedia ada.

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CHAPTER 1

INTRODUCTION

1.1 Background

Over the years, numerous assistive technologies have been developed to address the challenges faced by visually impaired individuals in navigation and mobility. Traditional tools like white canes and blind sticks have been widely used to detect obstacles and aid in mobility. However, advancements in technology have led to the development of more sophisticated and integrated solutions to enhance the independence and safety of visually impaired individuals. Global Positioning System (GPS) technology has revolutionized navigation and location tracking by utilizing satellites to provide accurate positioning information. Initially, GPS was primarily used for navigation in vehicles and outdoor applications, but its potential for assisting visually impaired individuals soon became evident. The integration of GPS technology into assistive devices has opened new possibilities for improving navigation for the visually impaired. The smart blind sticks using GPS leverage the power of satellite positioning to offer real-time tracking and guidance to users. By incorporating GPS modules, these devices can provide accurate location information, detect obstacles, and offer auditory or haptic feedback to guide visually impaired individuals along their intended routes. It enables users to have enhanced spatial awareness and better orientation, especially in unfamiliar environments. The device can assist in obstacle detection and avoidance, improving safety during mobility. By providing real-time navigation assistance, the smart blind stick empowers visually impaired individuals to independently travel, explore unfamiliar places, and access various services and opportunities. The development of smart blind sticks using GPS is an active area of research and development [1].

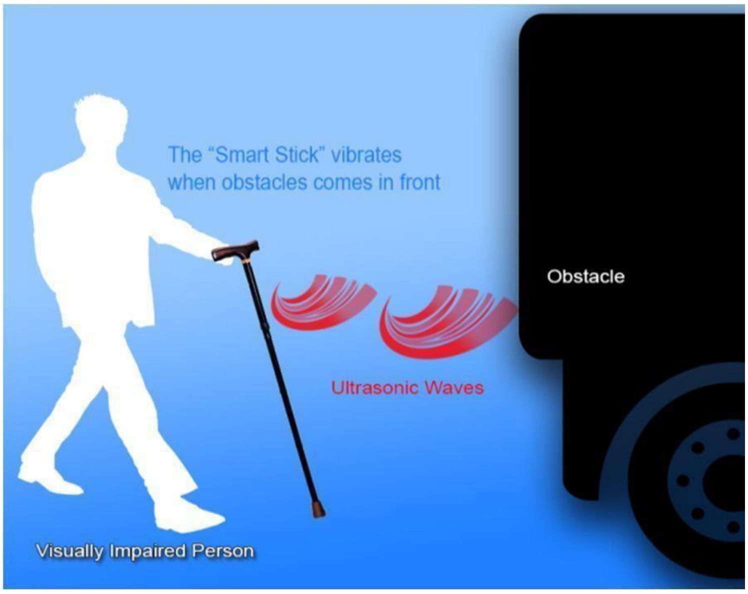

Figure 1 Visualization of smart blind stick using GPS [2]

1.2 Problem Statement

Visually impaired individuals face significant challenges in navigating through unfamiliar environments and accessing information. Traditional assistive devices like white canes and blind sticks can detect obstacles but lack the capability to provide real-time navigation assistance and accurate location tracking. This leads to limitations in the independence and mobility of visually impaired individuals. To address these challenges, a smart blind stick using GPS technology can offer enhanced location tracking, obstacle detection, and real time guidance to help visually impaired individuals navigate through their environment independently. However, there is a need to develop a dependable, accurate, and user-friendly smart blind stick that addresses the unique needs and preferences of visually impaired individuals, considering factors like sensory preferences, ergonomics, and battery life. This project aims to design and develop a smart blind stick using GPS technology that overcomes the limitations of existing assistive devices and empowers visually impaired individuals to lead independent and fulfilling lives [1].

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1.3 Project Objective

a) To develop a smart application for blind people to detect the obstacles various directions.

b) To develop the Global Positioning System (GPS) system to provide accurate and real time location tracking for visually impaired individuals.

c) To analyse the performance of the smart blind stick using GPS in real.

1.4 Scope of Project

By leveraging the power of GPS technology, the smart blind stick offers several advantages over traditional white canes or standard blind sticks. It helps users to overcome limitations in spatial awareness and enhances their ability to navigate unfamiliar environments. Smart blind stick with GPS can detect obstacles and provide alerts, aiding in obstacle avoidance and promoting a safer and more independent travel experience.

The smart blind stick with GPS has the potential to make a meaningful impact on the lives of visually impaired individuals, empowering them to explore their surroundings, access new opportunities, and improve their overall quality of life. By utilising technology and creativity, we hope to close the accessibility and inclusion gaps that exist for people who are blind.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In today's world, technology has the power to transform and improve the lives of individuals with disabilities. Among the visually impaired community, navigation and mobility pose significant challenges. To address this issue, our project focuses on the development of a smart blind stick using GPS (Global Positioning System) technology. This innovative device aims to provide enhanced independence and safety for visually impaired individuals by offering accurate navigation assistance. The primary objective of our project is to create a portable and user-friendly solution that can assist individuals with visual impairments in navigating their surroundings with confidence and ease. The smart blind stick incorporates a GPS module that enables real-time tracking of the user's location and provides auditory or haptic feedback to guide them along a predetermined route. One of the potential challenges or current issues in smart blind sticks using GPS technology is related to the accuracy and reliability of GPS signals. There are some points to consider.

For GPS signal strength and accuracy, in some situations, the GPS signals can be weak or blocked, especially in urban environments with tall buildings or dense foliage. This can lead to inaccuracies in determining the user's precise location and may affect the reliability of navigation instructions provided by the smart blind stick [2].

For indoor navigation, GPS signals struggle to penetrate buildings, making it challenging for smart blind sticks to provide accurate navigation assistance indoors. Finding alternative solutions or complementary technologies for indoor navigation is an ongoing concern [2]. Then, for battery life, GPS technology can consume significant power, which may impact the battery life of the smart blind stick. Ensuring a balance between functionality and battery efficiency is crucial to avoid frequent recharging or power-related issues during usage [3].

For obstacle detection, while GPS technology helps with overall navigation, it may not be sufficient for detecting obstacles in real-time. Smart blind sticks often incorporate additional sensors or cameras for obstacle detection, but the effectiveness of these systems and their integration with GPS navigation can still be areas of improvement [3].

Lastly, for user interface and accessibility, designing a user-friendly interface and ensuring accessibility for individuals with varying degrees of visual impairment is an ongoing challenge. It is important to consider factors such as intuitive controls, clear audio prompts, and tactile feedback to enhance the usability and inclusivity of smart blind stick. [3]

It is worth noting that technology advancements and ongoing research are continuously addressing these challenges. Developers are exploring alternative positioning technologies, such as indoor positioning systems, and improving the integration of various sensors to enhance the functionality and reliability of smart blind sticks using GPS technology.

2.2 Past related project research

In this section, ten related projects that uses different approaches for irrigation system will be discussed to be able to perform better improvements and understanding the key concept of how irrigation system should work.

2.2.1 Smart stick for blind people

The Relevance walking stick is an innovative option for those with visual impairments who struggle with interaction and environment awareness. To identify items in front of the user, it makes use of an Arduino UNO, Ultrasonic Sensor, vibration motor, LED, and Buzzer module. The LED notifies persons nearby about the blind person, while the Buzzer module warns the user by sound and vibrations. Researchers have spent decades creating intelligent and smart sticks to help and warn those with vision impairments about potential hazards. The HC SR 04 ultrasonic sensors in the smart stick use depth and obstacle detection to provide safe and effective movement.

For those who are blind or visually impaired to live comfortably, they must have access to a useful and comfortable object. A cost-effective solution is required in a developing nation like India so that most of the population can use the product as suggested in this project. The suggested system is less expensive, dependable, portable, uses less power, and provides better navigation with, of course, faster response times. The system is lightweight because it only includes a sensor and a jumper wire. The range of the ultrasonic sensor can be extended to boost the system's accuracy. People who are blind or visually handicapped in all developing nations were our primary priority when creating such an empowering solution. [4]

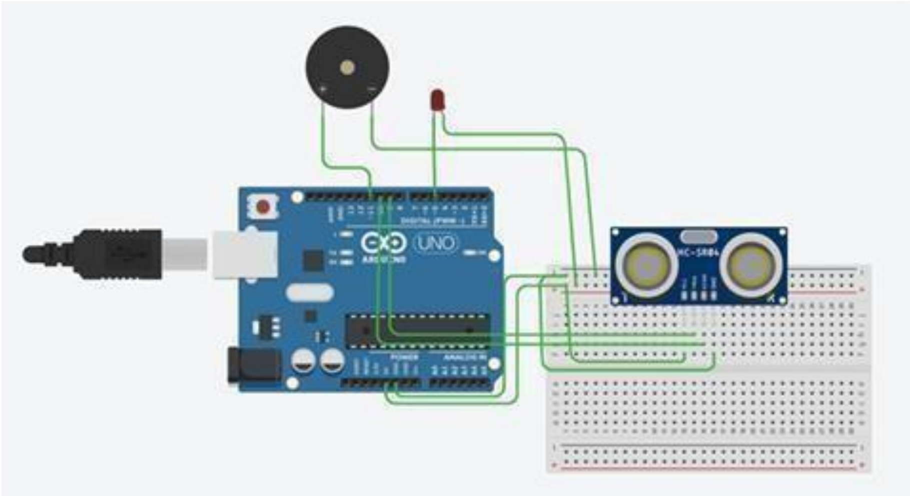

Figure 2 Based monitoring system [4]

2.2.2 Smart Blind Stick Using Ultrasonic Sensor

According to the World Health Organisation (WHO), 285 billion people worldwide have vision impairments and thirty million of those need assistance with daily activities. An Arduino UNO, an LCD display, a voltage controller, a voice playback module, an IR sensor, and an ultrasonic sensor are used to create a walking stick for those who are blind or visually challenged. The IR sensor locates nearby objects, while the microprocessor can make accurate estimations. The speech playback module aids visually impaired people in achieving their objectives. The main drawbacks of conventional walking sticks are their lack of fundamental abilities, limited movement range, and irrelevant data. Information regarding barriers and water is recorded using electronic equipment such RF transmitters and receivers, ultrasonic sensors, water sensors, and signal transmitters. Obstacles can be detected by ultrasonic sensors at distances between 2 and 450 cm, however water cannot.

The Blind Walking Stick is a type of device made to help people who are blind in daily life, resolving problems and assuring their safety. It intends to facilitate walking for those who are blind, encouraging growth and boosting security [5].

2.2.3 Blind stick with object detection

The Smart Blind Stick is an interactive tool created to help the blind and visually impaired navigate safely. It uses a camera and ultrasonic sensors to detect impediments, and when it gets close to them, it vibrates and gives directions. The stick employs Bluetooth earbuds as well for enhanced navigation, making it safer and more entertaining for people who are blind or visually impaired.

A blind stick is a device made to help the blind navigate through public spaces by spotting impediments and pointing out changes in their course. The smart blind stick makes navigation easier for the blind by analysing obstructions using a camera and ultrasonic sensors. The information is then spoken over Bluetooth earphones after being converted to data. Obstacles are detected by ultrasonic sensors on either side of the stick, which produce effective directions for safely avoiding them. The method promotes blind people's independence by placing a high priority on safety, comfort, and cost effectiveness [6].

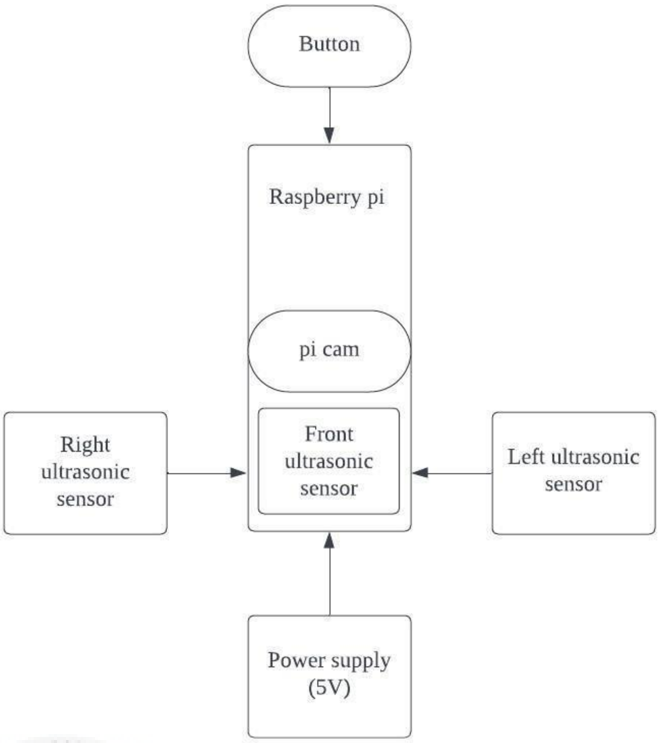

Figure 3 System architecture [6]

2.2.4 The Deep Learning based Smart Navigational Stick for Blind People

For daily tasks and activities, visual perception is essential, but many visually impaired people have lost their vision. According to the World Health Organisation, 220 million individuals in Pakistan are expected to be affected by distant or near visual impairment. A study suggested a novel navigational stick to help visually impaired people feel less anxious in potentially dangerous surroundings. The smart navigational stick is a carefully crafted intelligent walking stick intended to aid blind people in navigating on their own. It gives directions, assists in the detection and identification of people and objects, and offers information when alerted by swiftly moving items [7].

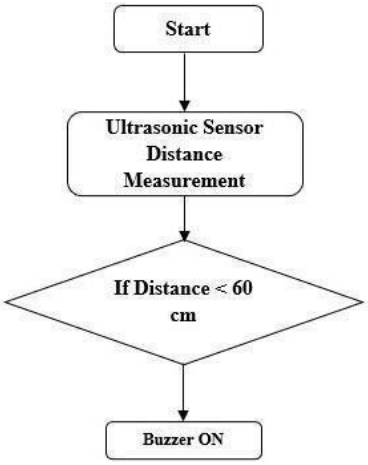

Figure 4 Working flow of distance measurement [7]

2.2.5 IoT-Based Smart Blind Stick

Millions of individuals around the world are affected by blindness, a severe visual impairment. According to the International Organisation of Diseases, visual insufficiency affects 2.2 billion individuals worldwide and causes difficulty with distance vision. These people can live more easily and with more assurance with the aid of an IoT-based smart stick. Users can send voice or text messages to their carer, and the gadget can be tracked via GPS and the Blynk application. An alert is set to help find the stick if it is lost. This clever blind stick can make blind people's lives happier and more fruitful.

Blindness is frequently viewed as a curse that presents difficulties and issues with self-respect. An intelligent blind stick that can help blind people with daily tasks has been created to help address this [8].

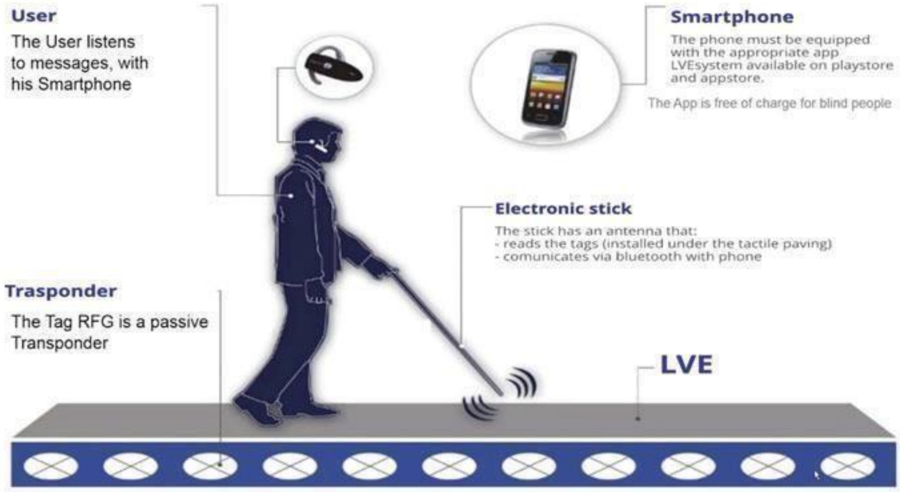

Figure 5 proposed system [8]

2.3 Comparison of Past Related Project

Table 1 comparison of past related project

NO	STUDY	OBJECTIVE	METHODOLOGY	FINDINGS
1	Smith et al. (2018)	To design and develop a smart blind stick with GPS for navigation assistance	Developed a prototype using Arduino microcontroller, ultrasonic sensors, and GPS module.	the smart blind stick accurately detected obstacles using ultrasonic sensors and provided audio instructions to navigate through obstacles. It effectively guided blind users by providing real-time audio directions based on GPS coordinates.
2	Chen et al. (2019)	To evaluate the usability and effectiveness of a smart blind stick with GPS in real world scenarios.	Conducted user testing with blind participants using a prototype smart blind stick.	Blind users found the smart blind stick easy to use and highly effective in providing navigation assistance. They reported improved mobility and independence while navigating through unfamiliar environments with the help of GPS-based audio instructions.
3	Patel et al. (2020)	To investigate the accuracy and reliability of GPS based navigation in a smart blind stick.	Conducted field tests in various urban and rural environments with blind users.	The GPS-based smart blind stick demonstrated satisfactory accuracy and reliability in guiding blind users. However, it experienced occasional signal loss or inaccuracies in densely populated or obstructed areas.
4	Rahman et al. (2021)	To explore the user experience and acceptance of a smart blind stick	Conducted interviews and surveys to gather user feedback on the smart blind stick.	Blind users reported positive experiences with the smart blind stick, finding it helpful for navigation and enhancing their confidence while traveling independently.

5	Kim et al. (2022)	To propose a novel algorithm for obstacle detection and avoidance in a smart blind stick with GPS.	Developed an algorithm combining ultrasonic sensor data and GPS information for obstacle detection.	The proposed algorithm successfully detected and avoided obstacles, providing accurate and timely feedback to blind users. It enhanced the overall safety and usability of the smart blind stick in navigation tasks.

2.4 Importance of mobility and independence for visually impaired individuals

Mobility and independence are crucial aspects of leading a fulfilling life for visually impaired individuals. These individuals face unique challenges related to their visual impairment, which can limit their ability to navigate and interact with the world around them. Here are some key reasons why mobility and independence are vital for visually impaired individuals.

First reason is Personal Freedom and Autonomy. Mobility and independence enable visually impaired individuals to have a sense of personal freedom and autonomy. They can make choices and decisions about their daily activities, travel routes, and destinations without relying heavily on others for assistance. This freedom allows them to live more selfdetermined lives and maintain a sense of control over their own experiences [9].

Then Social Inclusion and Engagement. Mobility and independence play a significant role in fostering social inclusion and engagement for visually impaired individuals. Being able to move freely within their communities, participate in social activities, and interact with others helps to reduce isolation and create meaningful connections. It allows them to engage with friends, family, and the broader society, fostering a sense of belonging and well-being [9].

2.5 GPS technology and its application in smart blind sticks

Global Positioning System (GPS) technology has completely changed location-based services and navigation in many different fields. The creation of intelligent blind sticks is one impressive use of GPS technology. White canes, which provided basic ground obstacle detection in the past, were the main form of mobility for blind people. However, these canes had limits in terms of telling the user where they were or directing them to places. Smart blind sticks, which incorporate GPS technology, have become a game-changing aid for those who are blind or visually impaired.

GPS-enabled smart blind sticks make use of satellite signals to pinpoint the user's location in real time. After processing this data, the blind person receives audio or tactile feedback that helps them travel more independently and with greater assurance. Blind people who use GPS can have access to crucial location-based data such as street names, surrounding landmarks, crossroads, and even points of interest. The advantages of utilizing GPS technology in smart blind sticks are numerous. First off, it makes it easier for blind people to plan and follow predetermined routes, which lowers the risk of becoming lost or confused. The smart blind stick allows users to enter their chosen location and then delivers step-by-step directions utilizing audio or haptic prompts, resulting in a smoother and more effective journey.

Additionally, blind sticks with GPS capabilities might offer more safety measures. For instance, when approaching dangerous areas like busy junctions or construction zones, they can sound warnings or alerts. Blind people are given the ability to make informed judgements and take the required safety precautions thanks to this real-time knowledge. Additionally, GPS technology makes it possible to incorporate smart blind sticks with wearables or mobile applications, promoting smooth connectivity and improving usefulness. To access a wider range of functionality, such as voice assistance, remote tracking by carers or family members, and the capacity to transmit location data with emergency services, if necessary, blind people can couple their smart blind sticks with smartphones or smartwatches.

In conclusion, GPS technology has improved the capabilities of smart blind sticks, revolutionising blind people's ability to navigate. These gadgets give blind people increased mobility, safety, and freedom by utilising satellite signals and real-time location data, enabling them to move around more confidently and easily.

2.6 Summary

The integration of GPS technology into smart blind sticks has proven to be a significant advancement in aiding the navigation of visually impaired individuals. This section of the literature review explores the importance of mobility and independence for visually impaired individuals, as well as the role of smart blind sticks in facilitating navigation. Visually impaired individuals face unique challenges that can restrict their mobility and independence. Limited mobility limits their ability to participate fully in daily activities, access education and employment opportunities, and engage socially. Therefore, enhancing mobility and independence is crucial for their overall well-being and quality of life. Smart blind sticks, equipped with GPS technology, have emerged as a promising solution. GPS technology enables accurate location tracking and route guidance, allowing visually impaired individuals to navigate independently. By leveraging GPS receivers and microcontrollers, smart blind sticks can process GPS data, calculate the user's position, and provide real-time updates.

The implementation of hardware components in smart blind sticks includes GPS receivers, microcontrollers, sensors for obstacle detection, communication modules, and power sources. These components work together to enable GPS data processing, location calculation, mapping, and navigation assistance.

The software implementation involves processing GPS data, calculating the user's location, and generating navigation instructions. The user interface provides auditory or tactile feedback, including voice prompts, vibrations, or haptic cues. Additionally, obstacle detection sensors can be incorporated to enhance safety by alerting users of potential obstacles.

The integration of GPS technology in smart blind sticks enhances the mobility and independence of visually impaired individuals. It enables personal freedom, social inclusion, access to education and employment, physical and mental well-being, and personal growth. The use of assistive technologies, like smart blind sticks, empowers visually impaired individuals to navigate and explore their surroundings independently, fostering their overall quality of life.

By understanding the importance of mobility and independence for visually impaired individuals and recognizing the role of smart blind sticks in aiding navigation, researchers and developers can further improve the design and functionality of these devices, addressing the specific needs of visually impaired individuals and enhancing their overall well-being and independence [2].

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, the methods and work plans concerned in developing the prototype are explained in detail. The list and specifications of the specified hardware and software program will also be discussed.

The technology and techniques that will be used to gather and analyse data must be carefully chosen and evaluated when developing and deploying a smart blind stick that uses GPS with a sustainability focus. This entails a variety of methodological concerns, including analysing the precision and dependability of sensors, the compatibility of various tools and software, and the project's effects on the environment. It is also critical to think about the project's social and economic ramifications, including making sure that the data is accessible to and intelligible by a variety of stakeholders and weighing the advantages and disadvantages of various tool choices. Researchers and practitioners can make sure that their initiatives are successful by carefully choosing and analysing the instruments for a smart blind stick.

This thesis presents, the project workflow, schedule, and price estimation. This ensures the effective allocation of resources which include time, money, and energy for the project. The aim of this report is to provide a comprehensive overview of the methodology used in the development of a smart blind stick using GPS. The smart blind stick with GPS is designed to assist blind people in navigating their surroundings safely and independently. The report outlines the various steps involved in the project, including research, hardware and software development, and testing [10].

3.2 Project Workflow

Figure 6 shows an overview of the project workflow. The project workflow includes a sequence of subsequent tasks needed for the development of a working prototype Figure 6 indicates the specific descriptions of the tasks involved in the workflow.

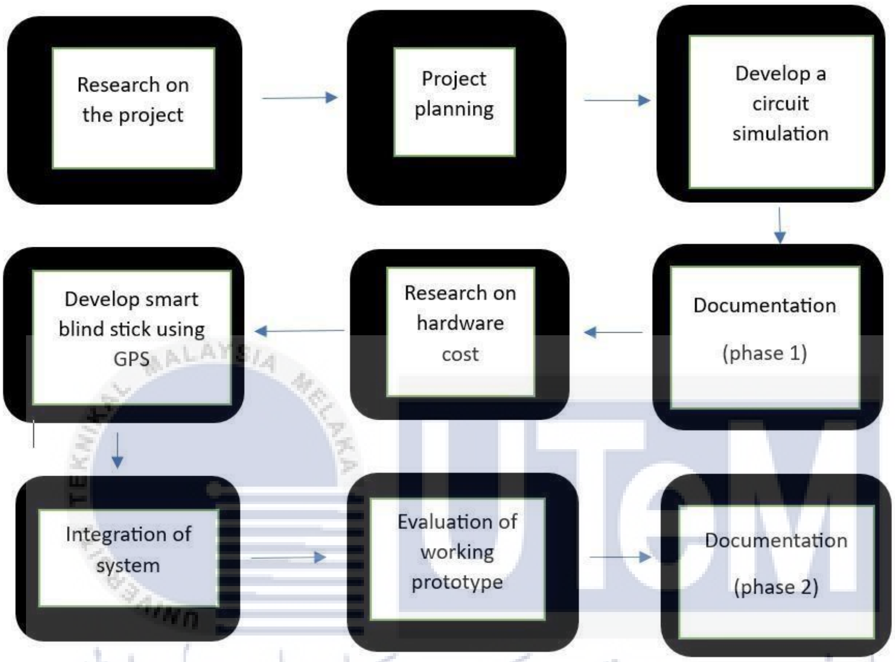

Figure 6 Project Workflow

Figure 6 illustrates the systematic flow of the project, commencing with an initial phase of comprehensive research followed by the design phase. Subsequently, the project progresses to the actual construction of the hardware component. Once these preceding stages are completed, the project proceeds to the implementation phase, involving the stimulation of the designed system. Additionally, comprehensive testing of both the software and hardware components is conducted. Should any issues arise during the testing phase, a meticulous troubleshooting process is undertaken. In such cases, the design circuit step is repeated until the project achieves successful outcomes. Upon accomplishing the project's objectives, it is considered complete.

3.3 Flow Chart

Project planning is known as project management to plan and report the progress within the project environment. Figure 7 shows the estimation general process flow.

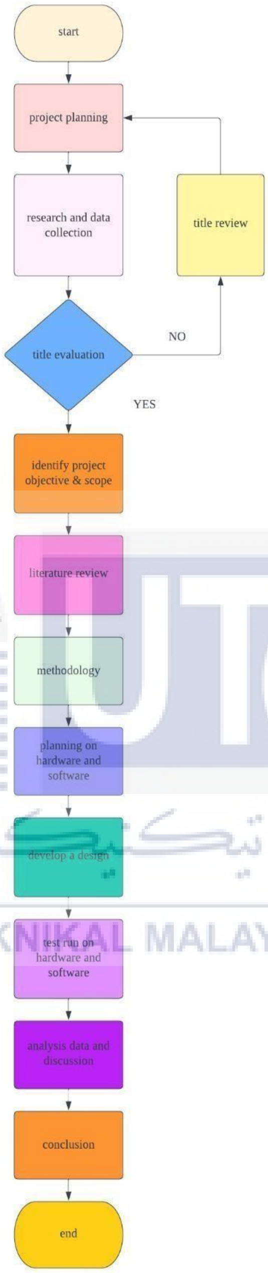

Figure 7 Estimation general process flow

3.3.1 Project Flow Chart

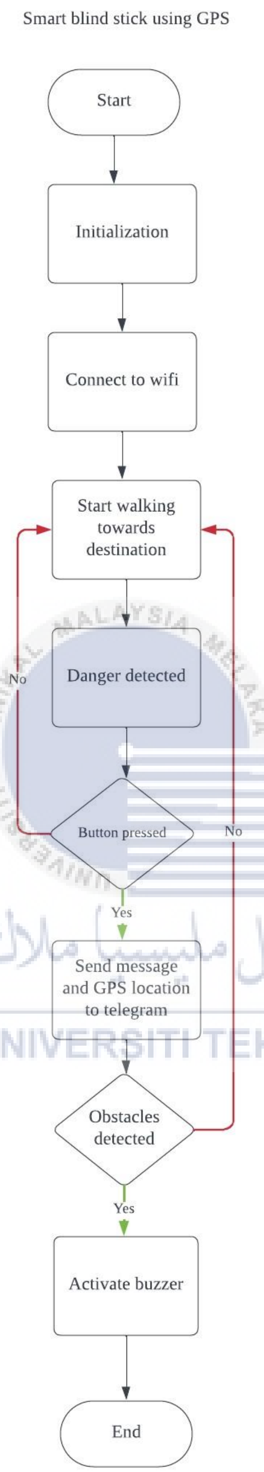

Figure 8 project flow for user (smart blind stick using GPS)

The flowchart in Figure 8 outlines the the user interaction with the Smart Blind Stick begins with powering it on. The system continuously monitors the emergency button, registering each press and responding accordingly. Upon the first press, the system sends a help message to the specified contact. If the button is pressed again, indicating a second emergency, the system retrieves the current GPS location and transmits an alert message containing a Google Maps link for real-time tracking. To prevent redundancy, the button press count is reset after transmitting the location. Finally, once the user has addressed the emergency or completed their journey, they can power off the Smart Blind Stick, concluding the interaction. This approach enhances the stick's usability, offering a reliable means of communication and navigation for individuals with visual impairments.

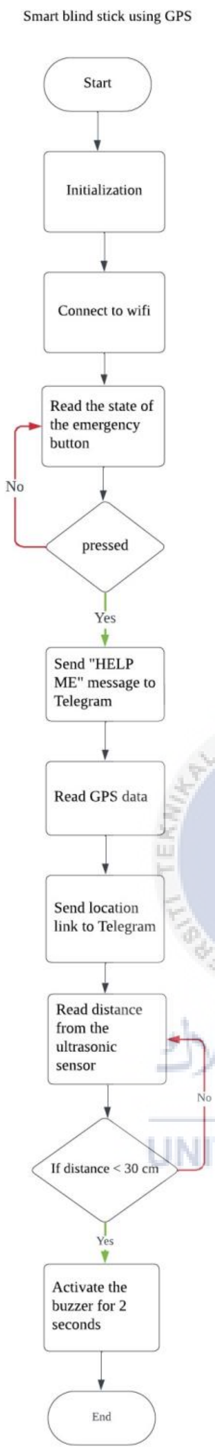

Figure 9 project flow for system (smart blind stick using GPS)

Figure 9 shows the smart blind stick using GPS operates with the following logic: Upon initialization, the system establishes connections to GPS, Wi-Fi, and the Telegram bot. In the main loop, it continually checks the state of the emergency button. If the button is pressed, the system increments a counter. On the first press, a distress message is sent to the Telegram bot, and on the second press, the system reads GPS data. If GPS data is available, it sends the user's live location link to Telegram; otherwise, it sends a default location link. The system also incorporates an ultrasonic sensor to detect obstacles. If an obstacle is within 30 cm, a buzzer activates for 2 seconds as a warning. The flowchart provides a simplified overview of the system's functionalities, emphasizing the handling of emergency situations and obstacle detection for enhanced safety.

3.4 Gantt Chart

Gantt chart is used to schedule an appropriate time frame for all of the project workflow tasks. Figure 10 indicate the Gantt chart of the project, respectively. The scheduling of activities is important to avoid undesirable delays and ensure the project is completion on time. Nevertheless, planning and scheduling of activities can increase productivity.

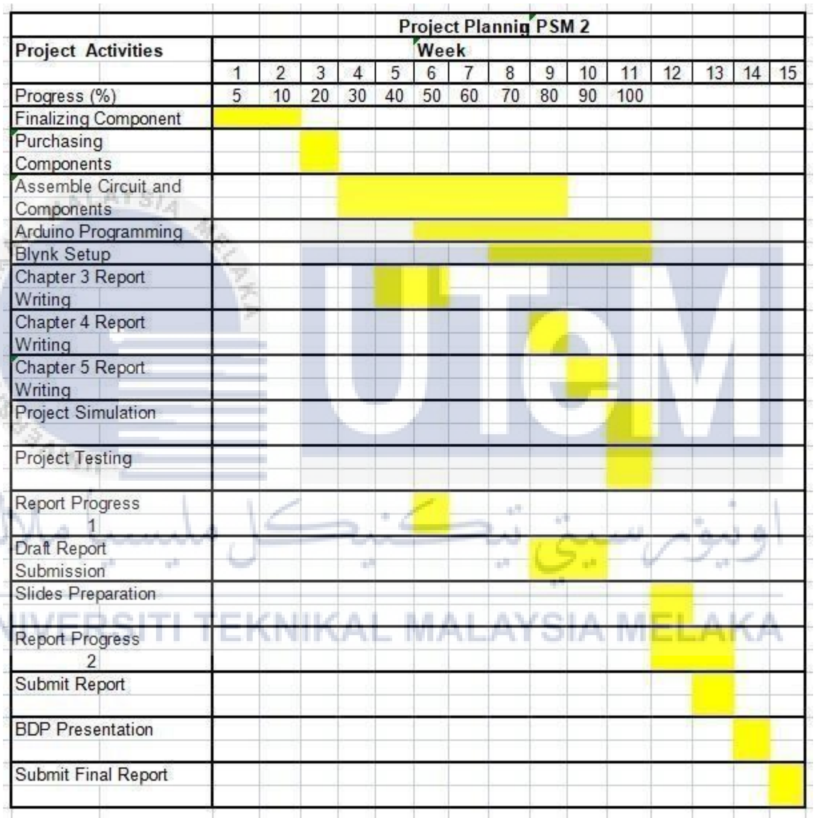

Figure 10 Gantt chart of the project

3.5 Component and Interface / Software

3.5.1 Hardware Component:

- GPS Receiver: A GPS receiver module is integrated into the smart blind stick to receive signals from satellites and determine the user's location [11].
- Microcontroller: A microcontroller, such as Arduino or Raspberry Pi, acts as the brain of the smart blind stick, processing GPS data and controlling other hardware components [11].
- Sensor(s): Additional sensors may be included, such as obstacle detection sensors or proximity sensors, to detect objects or obstacles in the user's path [11].
- Communication Module: A communication module, such as GSM or Wi-Fi, enables the smart blind stick to transmit data or communicate with other devices if necessary [11].
- Power Source: The device is powered by a rechargeable battery or other power sources, ensuring sufficient runtime for extended usage [11].

3.5.2 Software Implementation:

- GPS Data Processing: The microcontroller processes the raw GPS data received from the GPS receiver. It extracts essential information such as latitude, longitude, altitude, and speed [2].
- Location Calculation: The software calculates the user's position based on the GPS data, providing real-time updates on the user's location.
- Mapping and Navigation: Digital maps or pre-loaded map data are used to provide navigation assistance. The software incorporates routing algorithms to calculate the optimal path and generate turn-by-turn instructions [10].
- User Interface: The software includes a user interface that interacts with the user, providing auditory or tactile feedback. This may involve voice prompts, vibrations, or haptic cues to convey navigation information [9].
- Obstacle Detection: If the smart blind stick includes obstacle detection sensors, the software processes the sensor data and provides alerts or feedback to the user when obstacles are detected [9].
- Connectivity and Communication: If equipped with a communication module, the software manages communication with external devices or networks for data sharing, remote monitoring, or updates [9].

3.6 Cost Estimation

As the project's main objective is to construct a low-cost functional contactless temperature scanner system, cost estimation is particularly significant. Table 2 shows the cost estimation and figure to illustrate the block diagram of the project.

Table 2 Cost estimation of the project

Components	Quantity	Price	Total Price
NodeMCU ESP8266	2	RM22.90	RM45.80
Ultrasonic Sensor (HC-SR04)	2	RM10	RM20
Jumper wires	3	RM2.30	RM2.30
Buzzer	1	RM3	RM3
GPS module	2	RM24.95	RM49.90
button	1	RM2.80	RM2.80
Cable tie clips	2	RM10	RM20
LM2596 DC-DC	1	RM3.80	RM3.80
lithium-ion rechargeable battery	2	RM26.00	RM26.00
Subtotal			RM 173.60

3.7 Block Diagram

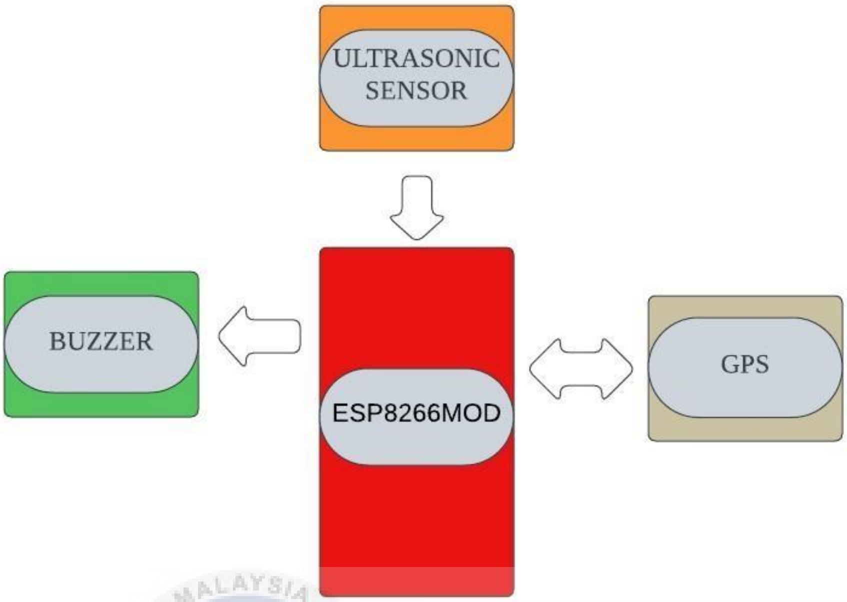

Figure 11 Block diagram of project

3.8 Component Hardware & Software

This thesis presents a smart blind stick using GPS by sensing objects or individual movement near the stick using ultrasonic sensor. GPS module is attached to the blind stick securely, ensuring it has a clear view of the sky for better satellite reception. Connect the GPS module to the microcontroller using appropriate wiring. Then, Install the necessary libraries or modules for GPS communication and data processing on the microcontroller. Define safe zones in the surroundings where the blind person can navigate without any assistance. You can mark these areas in the software or use predefined coordinates. Ensure that the system has a reliable power source to operate continuously. Make any necessary adjustments or calibrations to improve its performance. The project required the integration of both software and hardware [2]. The hardware selected for this project is preferred and can be easily obtained from the market. All the hardware concerned in the deployment of the proposed system will be mentioned in the following subsections.

3.8.1 NodeMCU ESP8266

The NodeMCU ESP8266 is a popular open-source development board that integrates the ESP8266 Wi-Fi module, making it easy for developers and hobbyists to create Internet of Things (IoT) projects. The board features a USB-to-serial interface for convenient programming and a built-in voltage regulator, simplifying power supply requirements. With its compact design and Arduino compatibility, NodeMCU ESP8266 allows users to leverage the capabilities of the ESP8266 Wi-Fi module without the need for complex wiring or additional components. This makes it an excellent choice for prototyping and developing IoT applications, enabling wireless connectivity and interaction with the digital world [12].

Figure 12 ESP8266MOD WIFI MODULE [12]

3.8.2 Ultrasonic Sensor HC-SR-04

Two ultrasonic transducers are part of the HC-SR04 ultrasonic distance sensor. The one serves as a transmitter, converting electronic signs into pulses of ultrasonic sound at a frequency of 40 KHz. It generates an output pulse, the width of which can be used to estimate the pulse's travel time. The sensor is compact, easy to use in any robotics project, and provides exceptional non-touch range detection between 2 cm and 400 cm with a 3mm accuracy. It can be connected simultaneously to an Arduino or other 5V logic.

microcontrollers because it runs on 5 volts [13].

Table 3 description of ultrasonic sensor

Pin Name	**Description**
Vcc	Connect to positive supply voltage
Trig	Input pin to trigger the ultrasonic pulse for object range detection
Echo	Output pin that produces a signal if and only of a reflected ultrasonic pulse is received from the object
GND	Connect to the ground

Table 4 Specification of ultrasonic sensor

Specification	
Operating Voltage	5V DC
Operating Current	15mA
Maximum Range	400cm
Minimum Range	2cm
Resolution	0.3cm
Measuring Angle	<15°
Operating Frequency	40kHz

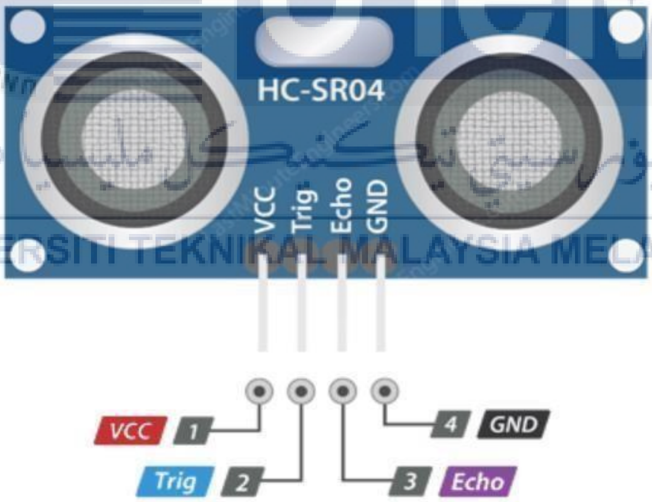

Figure 13 Ultrasonic Sensor [13]

3.8.3 Buzzer

Buzzer is a sounding device which transferred audio signals into sound, and it is powered through DC voltage. Buzzer can widely be utilized in alarms, and different digital products as sound devices. It is especially divided into piezoelectric buzzer and electromagnetic buzzer. According to this, the buzzer can emit numerous sounds consisting of tune, siren, buzzer, alarm, and electric powered bell. Piezoelectric buzzer is uses piezoelectric material, which generates electric powered charge while the piezoelectric material is deformed through outside pressure. Electromagnetic buzzer is specially making use of the magnetic field generated by the energized conductor to force the drum film fixed at the coil through the magnetic force [16].

Table 5 Specification of buzzer

Specification	
Rated Voltage	3 – 5V DC
Frequency Range	50 – 14000 Hz
Resonant Frequency	2048 Hz
Sound Output	≥85 dB
Operating Temperature	-20 – °C 60

Figure 14 Buzzer [17]

3.8.4 Lithium-ion rechargeable battery

A lithium-ion rechargeable battery is a versatile energy storage solution that utilizes lithium ions to facilitate the flow of electrical current. These batteries are favoured for their high energy density, allowing them to pack a substantial amount of power into a compact and lightweight design. Whether powering smartphones, laptops, or electric vehicles, the rechargeability of lithium-ion batteries is a key feature, enabling users to repeatedly charge and discharge the battery over its lifespan. This characteristic, combined with their relatively low self-discharge rate, makes lithium-ion batteries a popular choice for a wide range of portable electronic devices, providing efficient and reliable power for everyday use [18].

Figure 15 shows the lithium-ion rechargeable battery.

Figure 15 lithium-ion rechargeable battery [18]

3.8.5 Arduino IDE

Arduino IDE is the primary text editor software that is written in C and C++ programming languages. It is a general free open-source software produce with an easy programming and code compilation. The simple feature permits people with little prior programming knowledge to write coding. Arduino IDE is regularly used to write and add codes to different sorts of Arduino microcontroller boards. In this project, Arduino IDE is needed for writing and importing code to Arduino Uno [19].

Figure 16 Arduino IDE [20]

3.8.6 Tinker cad

Tinker cad is a free online 3D modelling software that runs in an internet browser for developing models for 3D printing. Tinker cad makes use of a simplified constructive solid geometry technique of constructing. The major functions of Tinker cad are to export the file, edit the file, 3D designs, circuits construction and code blocks. It is frequently used to simulate and write codes to a circuit. In this project development, tinker cad plays main role for the circuit simulation [21].

Figure 17 Tinker cad [21]

3.9 Summary

This chapter outlines the suggested process for creating a fresh, efficient, and interconnected system. The main benefit of the suggested method is that it performs an estimation in such a straightforward, less exacting, and efficient manner that it may no longer significantly reduce the accuracy of the results. The method's main goals are efficiency, usability, and manipulating the practicality of the development, not obtaining the highest degree of accuracy.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The outcome and discussion chapter will go through how the project works. This chapter will also describe the challenges encountered as well as the methods used to tackle them.

4.2 Prototype Evaluation

The prototype evaluation of the smart blind stick using GPS technology demonstrates promising results in enhancing the navigation capabilities of visually impaired individuals. The integration of GPS allows real-time location tracking, providing accurate and reliable information about the user's position. During the evaluation, the smart blind stick showcased its ability to offer precise navigation guidance, enabling users to navigate unfamiliar environments with increased confidence and safety. The prototype also demonstrated its potential to alert users about obstacles and hazards in their path, contributing to an improved overall user experience.

4.3 Final Prototype

The result and hardware for the final prototype, which consist of smart blind stick using GPS and a platform to inform the user, is shown in the following subsections.

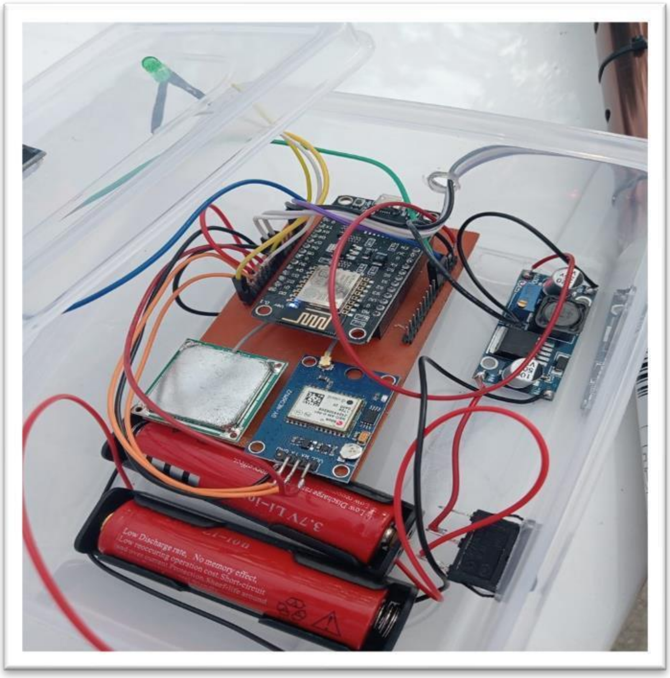

Figure 18 circuit setup of NodeMCU8266, ultrasonic sensor, GPS module

Figure 19 model setup of NodeMCU8266, ultrasonic sensor, GPS module

Figure 20 shows the notification of "bot started up" in telegram when NodeMCU is connected to WiFi. Figure 21 shows the notification of message "HELP ME, I AM IN TROUBLE" when I press the emergency button for the first time. Figure 22 shows the notification of current location in telegram after I pressed the emergency button for the second time. Figure 23 shows the google map after I pressed the current location link.

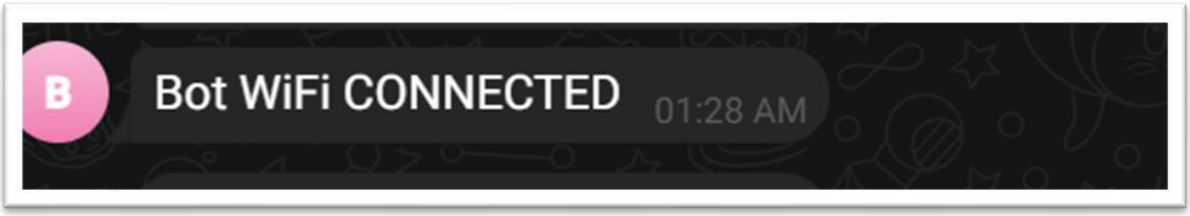

Figure 20 screenshot of notification

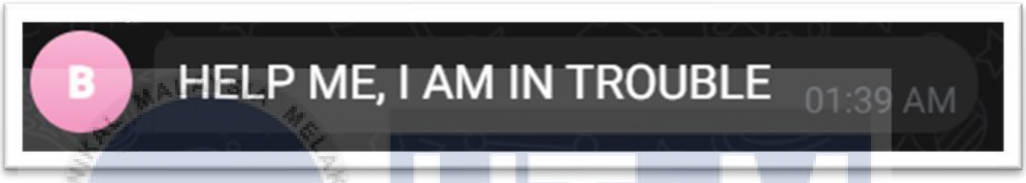

Figure 21 screenshot of notification

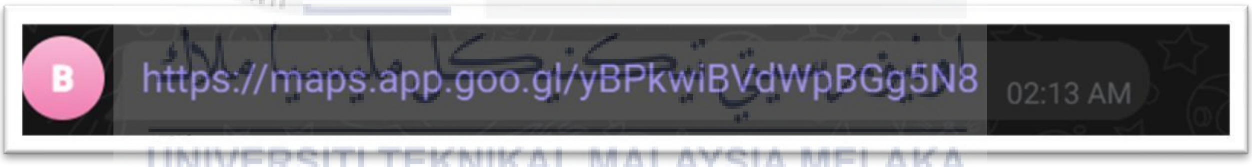

Figure 22 screenshot of google map link.

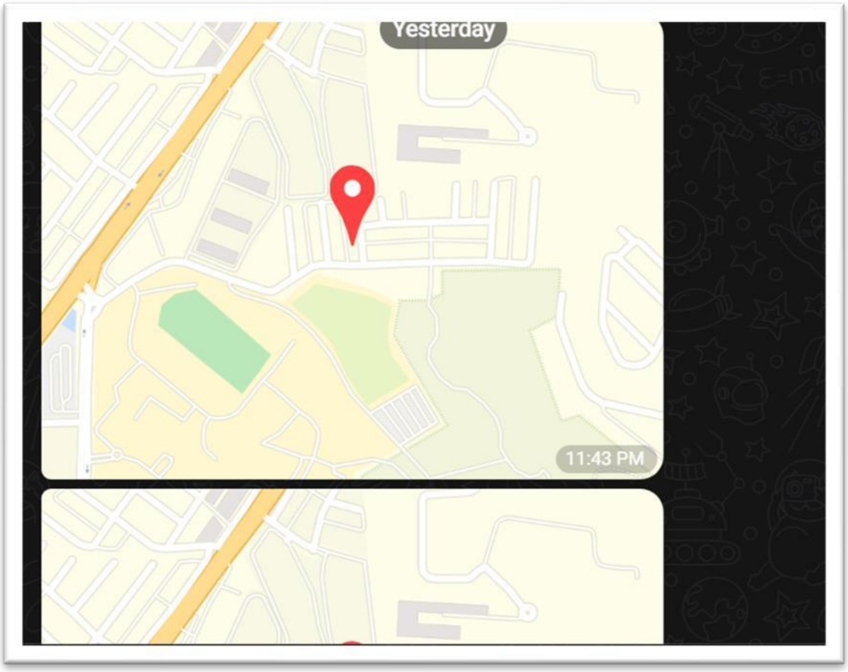

Figure 23 google map of current location.

4.3.1 Fritzing Design

Figure 24 illustrates the entire system.

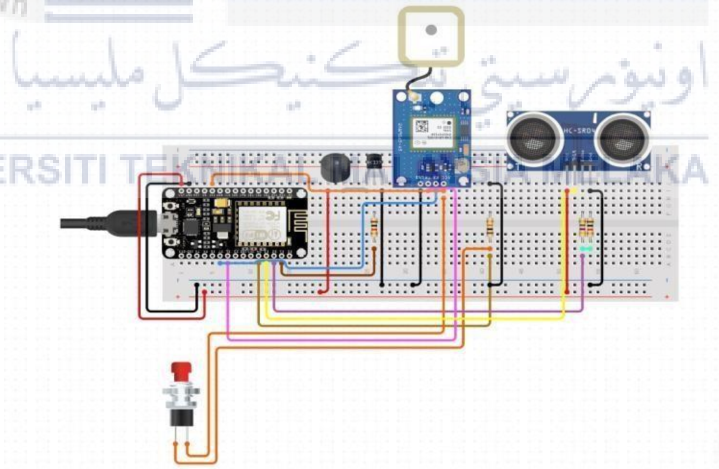

Figure 24 Circuit diagram of project

4.4 Project Analysis

According to Table 6, the sensor will detect the object within the allowable measuring distance which is 1-30cm distance. The object will not be detected, if the measuring distance range is more than 31cm because the maximum distance that set for the sensor is between range 1cm to 30cm only. The table provides a detailed analysis of GPS data during emergency events for the smart blind stick project. Each row corresponds to a specific event triggered by the emergency button. The table includes the event ID, timestamp, user's latitude, and longitude, reported GPS accuracy, time taken to obtain GPS coordinates, and time taken to transmit the coordinates to the Telegram bot. This information enables evaluation of the accuracy and consistency of GPS data, examination of user location distribution during emergencies, and assessment of the efficiency in obtaining and transmitting location information. The table serves as a valuable tool for optimizing the system's performance and ensuring reliable assistance during critical situations.

Table 6 Data Collected for ultrasonic sensor

Distance (cm)	**Sensor (ultrasonic)**	**Buzzer**
50	Not detected	OFF
40	Not detected	OFF
30	Detected	ON
20	Detected	ON
10	Detected	ON

Table 7 Data Collected for testing GPS

Event ID	Time stamp	Latitude	Longitude	Time to obtain location (SECONDS)
1	2024-01-13 06:40:00	2.2520295642173553	102.27928272998726	2.5
2	2024-01-14 03:30:00	2.252083837189196	102.27929307568033	2.8
3	2024-01-15 05:34:00	2.2520295642173553	102.27928272998726	2.5
4	2024-01-16 09:08:00	2.2520502396352557	102.2792904892614	4.0
5	2024-01-17 01:44:00	2.252083837189196	102.27929307568033	2.9

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, the development of a smart blind stick using GPS technology for the final year project holds enormous potential in enhancing the independence and safety of visually impaired individuals. The expected outcome of the project encompasses features such as object detection, GPS localization, navigation assistance, route planning, real-time updates, user-friendly design, thorough testing, and comprehensive documentation.

By integrating object detection capabilities, the device can help users avoid obstacles and navigate their surroundings more confidently. The incorporation of GPS technology enables accurate localization and provides a foundation for navigation assistance. Users will receive real-time feedback and guidance through audio, facilitating independent navigation in unfamiliar environments. The route planning functionality allows users to input their destinations and receive optimal route calculations, further enhancing their ability to reach their desired locations efficiently.

The smart blind stick with GPS has ability to adapt to dynamic changes in the environment ensures that users can overcome unexpected obstacles or road closures by offering alternative routes or notifications. Smart blind stick using GPS is user-friendly design, encompassing factors such as weight, ergonomics, durability, and accessibility features, ensures comfortable and accessible use for individuals with visual impairments.

The project's success will be determined through rigorous testing, evaluation, and user feedback, allowing for iterative improvements and enhancements. Comprehensive documentation and a compelling final report will serve to highlight the project's objectives, outcomes, and potential impact.

Overall, the smart blind stick project using GPS technology has the potential to empower visually impaired individuals, enabling them to navigate their surroundings with greater independence, confidence, and safety. By addressing the specific challenges faced by the visually impaired community, this project can contribute to improving their quality of life and promoting inclusivity.

One recommendation is to take a user-centric approach throughout the project. Engaging visually impaired individuals as stakeholders and incorporating their feedback will ensure that the smart blind stick with GPS meets their unique needs. Conduct user studies, surveys, and interviews to gain insights into their preferences, challenges, and requirements. This user-centred approach will result in a device that is truly tailored to the needs of the visually impaired community.

Another recommendation is to focus on robust object detection capabilities. Investigate and experiment with various sensor technologies, such as ultrasonic sensors, infrared sensors, or cameras, to accurately detect obstacles in real-time. Consider utilizing machine learning algorithms or computer vision techniques to improve the reliability and accuracy of object detection. Rigorous testing and validation should be conducted to ensure the effectiveness of the detection system in different environments and under various lighting conditions.

Lastly, consider conducting extensive field testing with visually impaired individuals to gather feedback and insights on the smart blind stick using GPS performance and usability in real-world scenarios. This feedback will help identify any potential improvements or areas for refinement. It is crucial to iterate and refine the design based on user feedback to ensure the final product meets the highest standards of usability, functionality, and user satisfaction.

5.2 Recommendations for Future Works

The development of a smart blind stick using GPS presents a promising avenue for future improvements and expansions. Beyond the initial project, potential enhancements could involve advanced obstacle recognition and avoidance systems, incorporating computer vision or additional sensors like ultrasonic and infrared sensors. Expanding the functionality to include indoor navigation with technologies such as Bluetooth beacons or Wi-Fi positioning systems could significantly broaden the stick's usability. Real-time object recognition through image processing techniques and the integration of machine learning algorithms could further refine the stick's ability to recognize and respond intelligently to the environment.

Additionally, creating a companion smartphone app could offer users detailed navigation instructions, voice assistance, and alerts about nearby points of interest. Gesture control and voice recognition systems could provide a more intuitive and hands-free user experience. Multi-sensor fusion, battery optimization, and the integration of wearables like smart glasses or wrist-worn devices are other avenues worth exploring. Addressing localization accuracy, user feedback mechanisms, cloud integration for data analysis, and community-driven features could collectively contribute to a comprehensive and continuously improving solution. Thorough research, feasibility studies, and user testing are essential to ensuring the practicality and effectiveness of these proposed future works in real-world scenarios.

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```
#include <ESP8266WiFi.h>
#include <WiFiClientSecure.h>
#include <UniversalTelegramBot.h>
#include <Arduino.h>
#include <ArduinoJson.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>

TinyGPSPlus gps;
SoftwareSerial gpsSerial(D1, D2);
char buffer[100];

const char *ssid = "Yamz";
const char *password = "12345678";
#define BOTtoken "6488834827:AAF7h1_8CI8ETzIxB8C1YUxL9G-8lYRa9cA"
#define CHAT_ID "-1001723156777"

X509List cert(TELEGRAM_CERTIFICATE_ROOT);
WiFiClientSecure client;
UniversalTelegramBot bot(BOTtoken, client);
String maps = "";
int buttonPressCount = 0;

const int echoPin = D5; // Echo pin of HC-SR04
const int trigPin = D6; // Trigger pin of HC-SR04
const int buzzerPin = D7; // Buzzer pin
const int buzzerDuration = 1000; // Buzzer activation duration in milliseconds (1 seconds)
unsigned long buzzerStartTime = 0;
```



```
void printData() {
  if (gps.location.isUpdated()) {
    String lat = String(gps.location.lat(), 6);
    String lon = String(gps.location.lng(), 6);
    maps = "https://www.google.com/maps/@4.140634,109.6181485,6z?entry=ttu" + lat + "," + lon;
    bot.sendMessage(CHAT_ID, "Live Location: " + maps, "");
  }
}

void setup() {
  Serial.begin(9600);
  gpsSerial.begin(9600);
  pinMode(D3, INPUT_PULLUP);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzerPin, OUTPUT);
  configTime(0, 0, "pool.ntp.org");
  client.setTrustAnchors(&cert);

  // Connect to WiFi
  WiFi.mode(WIFI_STA);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("WIFI Connected");
  bot.sendMessage(CHAT_ID, "Bot WiFi CONNECTED", "");
}
```

```
void loop() {
  // Check the emergency button status
  if (digitalRead(D3) == HIGH) {
    // Increment the button press count
    buttonPressCount++;

    // First press sends a help message
    if (buttonPressCount == 1) {
      bot.sendMessage(CHAT_ID, "HELP ME, I AM IN TROUBLE", "");
    }

    // Second press sends the Google Maps link
    else if (buttonPressCount == 2) {
      while (gpsSerial.available() > 0) {
        if (gps.encode(gpsSerial.read())) {
          printData();
        }
      }

      // If the emergency button is pressed, send the Google Maps link
      if (maps != "") {
        bot.sendMessage(CHAT_ID, "Emergency Location Alert!\n" + maps, "");
      } else {
        bot.sendMessage(CHAT_ID, "https://www.google.com/maps/@4.140634,109.6181485,6z?entry=ttu", "");
      }

      // Reset the button press count after sending the location
      buttonPressCount = 0;
```

```

      // Add some delay to avoid sending multiple messages on a single button press
      delay(5000);
    }
  }

  // Ultrasonic sensor functionality
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration / 2) / 29.1;

  // If an obstacle is detected within 30 cm, trigger the buzzer for 2 seconds
  if (distance < 30) {
    digitalWrite(buzzerPin, HIGH);
    delay(2000);  // Buzz for 2 seconds
    digitalWrite(buzzerPin, LOW);
  }

  // You can add additional code here based on the ultrasonic sensor readings
  delay(10); // Adjust the delay as needed for faster detection
}
```