Faculty of Electronic and Computer Engineering and Technology

DEVELOPMENT OF A SMART CANE USING ARDUINO MEGA FOR VISUALLY IMPAIRED

THIRACHINISWARY A/P MUNISWARAN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF A SMART CANE USING ARDUINO MEGA FOR VISUALLY IMPAIRED

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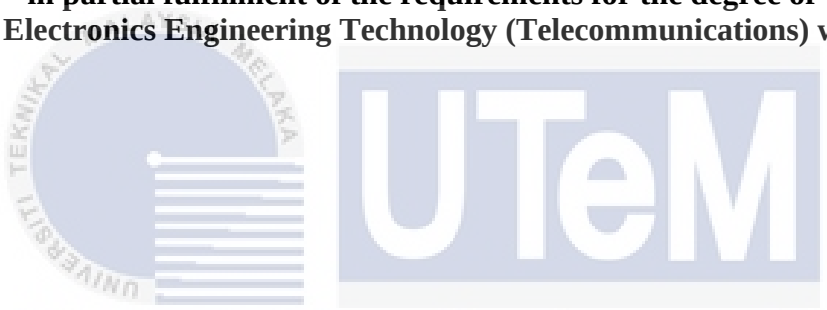
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours



Faculty of Electronic and Computer Engineering and Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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Disahkan oleh:

M. Thirachiniswary.

(TANDATANGAN PENULIS)

Alamat Tetap: Block 28-4-12A,Taman Sri Pinang,Jalan Sungai,10150,Georgerown,Pulau Pinang

Tarikh: 15.1.2024

DR. AKM ZAKIR HOSSAIN
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
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Student Name : THIRACHINISWARY A/P MUNISWARAN

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

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Supervisor Name : DR. A K M ZAKIR HOSSAIN

Date : 15.1.2024

DEDICATION

I extend this project report's dedication to my family and friends, with a special acknowledgment to my parents who instilled in me the valuable lesson that even seemingly challenging tasks can be accomplished through a step-by-step approach. Furthermore, I dedicate this work to my friends who played a crucial role in supporting and enabling me to complete the project. I am deeply grateful for the assistance and guidance received.

Additionally, I express my gratitude to my PSM Supervisor,

Dr. AKM Zakir Hossain, for his valuable advice that significantly contributed to the successful completion of my final year project.

ABSTRACT

In the modern generation of IoT (Internet of Things), the improvement of a smart cane and the use of Arduino Mega for visually impaired people are relatively relevant and timely. IoT technological know-how allows the integration of quite a number of devices and sensors, allowing for real-time data collection and analysis. By making use of IoT in the smart cane, it becomes viable to connect the device to the internet and leverage cloud-based offerings for enhanced functionality. Furthermore, the COVID-19 pandemic has brought large challenges for visually impaired individuals, as they frequently depend on contact and physical assistance for navigation. With social distancing measures in place, the desire for technological solutions that can help them navigate independently is even more pronounced. The smart cane, outfitted with IoT capabilities, addresses this difficulty by supplying a revolutionary and accessible device that can aid visually impaired people in a contactless manner. By incorporating IoT technology into the smart cane, it becomes possible to acquire valuable information on the user's surroundings, such as obstacle detection and location information. These statistics can be similarly analysed and utilised to enhance the performance and effectiveness of the smart cane, ensuring a more accurate and reliable navigation journey for visually impaired individuals. In summary, the development of a smart cane using Arduino Mega and IoT technology provides a promising solution to tackle the challenges faced by visually impaired individuals, in particular in the contemporary state of affairs where the necessity for contactless navigation aids is crucial.

ABSTRAK

Dalam generasi moden IoT (Internet of Things), penambahbaikan pada tongkat pintar dan penggunaan Arduino Mega bagi individu yang mengalami masalah penglihatan adalah relevan dan sesuai pada masa kini. Teknologi IoT membolehkan integrasi pelbagai peranti dan sensor, membolehkan pengumpulan dan analisis data secara waktu nyata. Dengan menggunakan IoT dalam tongkat pintar, adalah mungkin untuk menyambungkan peranti ke internet dan memanfaatkan perkhidmatan berasaskan awan untuk meningkatkan fungsi. Selain itu, pandemik COVID-19 telah membawa cabaran besar bagi individu yang mengalami masalah penglihatan, kerana mereka sering bergantung pada sentuhan dan bantuan fizikal untuk bergerak. Dengan langkah-langkah penjarakan sosial yang dilaksanakan, keinginan untuk penyelesaian teknologi yang dapat membantu mereka bergerak secara bebas menjadi lebih ketara. Tongkat pintar, dilengkapi dengan keupayaan IoT, menangani cabaran ini dengan menyediakan peranti yang inovatif dan mudah digunakan untuk membantu individu yang mengalami masalah penglihatan secara tanpa sentuhan. Dengan memasukkan teknologi IoT ke dalam tongkat pintar, adalah mungkin untuk mendapatkan maklumat berharga tentang persekitaran pengguna, seperti pengesanan halangan dan maklumat lokasi. Data ini boleh dianalisis dan digunakan untuk meningkatkan prestasi dan keberkesanan tongkat pintar, memastikan perjalanan navigasi yang lebih tepat dan boleh dipercayai untuk individu yang mengalami masalah penglihatan. Ringkasnya, pembangunan tongkat pintar menggunakan Arduino Mega dan teknologi IoT menyediakan penyelesaian yang menjanjikan untuk mengatasi cabaran yang dihadapi oleh individu yang mengalami masalah penglihatan, terutamanya dalam keadaan semasa di mana keperluan bagi bantuan navigasi tanpa sentuhan adalah penting.

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First, I extend my sincere appreciation to my supervisors, Dr. AKM Zakir Hossain from the Department of Electric & Electronic Engineering Technology at University Teknikal Malaysia Melaka, for his excellent guidance, valuable suggestions, and constructive criticism. His thoughtfulness, kindness, and support have played a pivotal role in ensuring the successful completion of this project, and I deeply respect all his contributions.

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CHAPTER 1

INTRODUCTION

1.1 Background

Blindness is defined as having or experiencing visual loss, which can have a significant impact on one's quality of life. Most of the data we gather with our environment comes by means of our eyesight. According to the World Health Organization, around 1 billion individuals suffer from vision impairment. A person with eyesight problems finds it difficult to navigate in an environment that heavily depends on eyesight [1].

According to JKM which manages OKU total of 576150 person with disability in Malaysia, which is 1.8% of Malaysia population. In Malaysia, not much over eighty percent of registered Oku are among those in the range of 15 and 64. Compared to the National Health and Morbidity Survey 2019, one out of every four individuals in Malaysia have physical challenges, with trouble seeing having the highest incidence at 14.9%. As a result, owing to limitations in abilities, you are more likely to be jobless. Some employers have a skewed notion of handicapped workers being less productive over time. In poor nations, between 80 and 90 percent of people with impairments of adulthood who are employed are jobless [2].

In the beginning of time, people with visual impairments navigated using various methods such as wooden sticks, assistance from others, and the employment of assistance dogs. However, we are subject to certain limits while utilizing them, such as relying on

others, barriers that cannot be identified accurately using a wooden stick since they must be recognized as items, and we cannot completely rely on dogs [3].

To solve the issue, an IOT-based smart walking cane was developed to help the visually impaired be safer and more cautious when moving around on their own. This walking cane is intended to help visually impaired persons grow increasingly dependent and at ease when walking. The fundamental walking stick is a completely mechanical device that detects static obstructions[4].Technology in the contemporary age, there has been a lot of study done on this, but most of it is quite expensive and difficult to utilize. So, this project is attempted to create a system that is simple to use, small, and cost effective[5]. This technology made use of ultrasonic reflection characteristics. Similarly, we combined more innovations such as audio feedback to develop a viable and trustworthy blind stick for blind and partially sighted people.

The goal of such a project is to empower persons with vision impairments to live independently in the world around us. The biggest percentage of people who have untreated impaired vision come from rural, impoverished countries. Strengthened the advancement of these areas would contribute to redressing this inequality. This technology allows youngsters to acquire an education, working-age individuals to get and hold a job, and elderly people to stay linked to their communities' economic and social fabric [6].

1.2 Addressing Mobility Challenges for the Visually Impaired Through Smart Cane Technology

Mobility issues for the visually impaired are a major global concern, affecting the freedom and safety of millions of people worldwide. Navigating new surroundings can be especially difficult, increasing the danger of an accident and limiting access to needed services. To solve these difficulties, it is important to understand the requirements of visually impaired people who travel. The development of a smart cane using an Arduino Mega provides a possibility by combining technology to improve navigation and obstacle detection for visually impaired people. The smart cane empowers visually impaired individuals, promoting inclusivity and independence in navigating unfamiliar environments, reducing the risk of accidents, and improving overall quality of life.

1.3 Problem Statement

Struggling with visual impairment or blindness is merely one amongst the challenges that those with visual disabilities encounter daily. Blind persons are practically the same as most others, except that they cannot see. They confronted several problems daily, the most prevalent of which was accessing the information around them. A short look around illustrates how visual most of the data that exists in society is. Directions to a location, signs indicating the correct path, and barriers in the path are all examples of visual information that we encounter on a regular basis. Most data would be invisible to those who are blind or visually challenged, minimizing their right to liberty. because skill represents their own independence[7].

The key difficulties that visually impaired people have are finding and retaining a job. Employment is a completely other scenario whether you are visually impaired. Given the scarcity of glimpsed work and job situations, it is simple to understand how hiring a

lacking in vision individual may be considered as a problem for a company. The consequence is a significant influence those who are visually impairer's self-confidence and their mental wellness, while completely affecting their financial seclusion. Blind or low vision persons are unable to sustain themselves since they have few to no options[7].

Even if the issues may be addressed, one of the most serious issues in the blind world is mobility. Walking without sight increases the danger of falls and accidents due to the fact the walking stick they used might have issues whereas it was unable to cater an accurate result in front of barriers while walking. This IOT-based walking cane might assist visually impaired persons in overcoming challenges by offering safe and comfortable usage and enabling them to be more independent. This would empower their community and raise awareness of blind people today.

1.4 Project Objective

After examining the before-mentioned problems overview, the PSM lead's main objectives are as follows:

a) To design and simulate an IOT based smart walking cane.

b) To fabricate the prototype of the proposed IOT based smart walking cane.

c) To assess the outcome to existing trends.

1.5 Scope of Project

The goal of developing an IOT-based smart cane for visually impaired people utilizing Arduino Mega is to help vision-impaired people walk with greater self-esteem by providing information about their surroundings. In this project, users can navigate diligently and effectively by using precise verbal directions and an ultrasonic to detect obstacles, a temperature sensor to detect current temperature,sms notification to guardian on current location if there is an emergency and a voice module to provide voice over feedback[8]. Finally, the technology will help visually impaired persons and their caretakers feel far more comfortable and secure.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Smart canes for visually impaired individuals have been developed using advanced technologies like Arduino Mega. This literature review focuses on the background, facts, and theories related to the development of smart canes using Arduino Mega technology. Relevant research papers, journals, publications, and other sources will be examined to obtain crucial knowledge and insights, including previous projects using similar technologies and methodologies.

The focus of this literature review will be on the ideas of an environment friendly and dependable smart cane for visually impaired individuals. All acquired information will be summarized in the conclusion. Before begin the research work, a thorough literature study is vital to accumulate necessary records and insights. The sources of data will include prior dissertations, research papers, journals, publications, and the Internet.

This chapter will include a compilation and discussion of all pertinent topics associated to the development of a smart cane for visually impaired people using Arduino Mega technology. The trend of technological developments in smart cane technology is visible and explainable.

2.2 The History of Smart Cane

The records of smart walking sticks or canes for visually impaired people can be traced back to the early 20th century. In 1921, James Biggs, a blind photographer, invented the white cane. Initially, the white cane was meant to serve as a sign to alert drivers to the presence of visually impaired pedestrians [9]. Later, the white cane grew to become a recognized image of blindness and used to be used as a mobility aid.

In current years, technological developments have led to the improvement of smart walking sticks or canes. The electronic cane was once outfitted with an ultrasonic sensor that may want to detect obstacles and alert the user with the aid of a vibrating [10].

In the 21st century, smart walking sticks or canes have grown to be extra advance with the creation of IoT devices. Modern smart canes are outfitted with more than a few sensors, consisting of barrier detection sensors, and gyroscope sensors. These sensors permit the cane to provide real-time feedback to the user and assist them navigate through their environment more effectively and safely. Smart walking sticks or canes are additionally being developed with innovative aspects such as voice-enabled interfaces, smartphone connectivity, and haptic feedback. These aspects' goal to make the walking stick greater intuitive and user-friendly.

In conclusion, the history of smart walking sticks or canes for visually impaired people can be traced lower back to the invention of the white cane in 1921. With technological advancements, smart canes have turn out to be extra practical and efficient, providing real-time comments and revolutionary elements to aid visually impaired people in their mobility.

2.3 Usage of Smart Cane in 2023

Smart canes have end up an increasing number of popular and imperative tool for visually impaired people to navigate their environment with ease and safety. In 2023, it is anticipated that the utilization of smart canes will proceed to enlarge as new technological developments are made.

One foremost benefit of smart canes is the use of IoT technologies, which enable the cane to be linked to a community of different gadgets and services. This connectivity allows real-time location tracking, emergency alert systems, and customized navigation help based totally on the user's region and preferences [11].

Additionally, new, and revolutionary aspects are predicted to be delivered to smart canes in the coming years. Some of these aspects include haptic remarks structures that can alert the person to boundaries or adjustments in terrain, voice-enabled interfaces that can supply verbal directions or assistance, and superior sensors that can discover environmental elements such as temperature or humidity.

Furthermore, the use of smart canes is no longer limited to outdoor navigation. Many smart canes are now geared up with indoor navigation systems that can assist visually impaired people move round unfamiliar indoor environments such as purchasing centers or workplace buildings.

Essentially, the utilization of smart canes in 2023 is predicted to continue to develop as new technologies are developed, and greater visually impaired individuals obtain get right of entry to these beneficial tools.

2.4 Previous System and Existing Technologies in Malaysia

Smart canes for the visually impaired have been developed using a variety of technologies in Malaysia, consisting of RFID, GPS, and IoT.

Previously, GPS technology has been integrated into smart canes in Malaysia. GPS-enabled smart canes use a combination of GPS and Google Maps to supply real-time location data and turn-by-turn instructions to the user. This technology offers greater mobility and flexibility, as it does now not require physical infrastructure, and the vary is no longer limited.

Another technology that is turning into increasingly famous in Malaysia for smart canes is IoT. Smart canes geared up with IoT technologies are connected to a community of different devices and services, offering real-time region tracking, emergency alert systems, and personalized navigation help primarily based on the user's location and preferences. This technology approves for extra seamless integration with other smart devices and services, making it less complicated for visually impaired people to navigate their environment.

Summary, the use of extraordinary technologies in smart canes has advanced over time in Malaysia, the most frequent technological know-how used in the past, observed by using GPS- enabled smart canes and greater recently.

2.5 Related Previous Project

2.5.1 Smart Cane for Visually Impaired Based on Iot

The article "Smart Cane for Visually Impaired Based on IoT" by Chowdhury describes a smart cane designed for visually impaired individuals using Internet of Things (IoT) technology. The smart cane is designed to help human beings with imaginative and prescient impairments in their everyday lifestyles with the aid of giving features such as recognizing obstacles., object identification, and navigation. The system is outfitted with sensors that can realize barriers and alert the person thru vibrations, and it can also discover objects through picture processing and supply comments by way of a speaker. The navigation characteristic is applied using a GPS module and a mobile application that can provide turn-by-turn directions to the user.

The article highlights the significance of such assistive technologies in bettering the satisfactory of life for visually impaired individuals. The author emphasizes that the smart cane is designed to be low cost and user-friendly, with a easy interface and easy-to-understand feedback. The device's IoT skills enable it to connect to the web and supply remote monitoring and support, allowing household contributors or caregivers to track the user's place and monitor their safety.

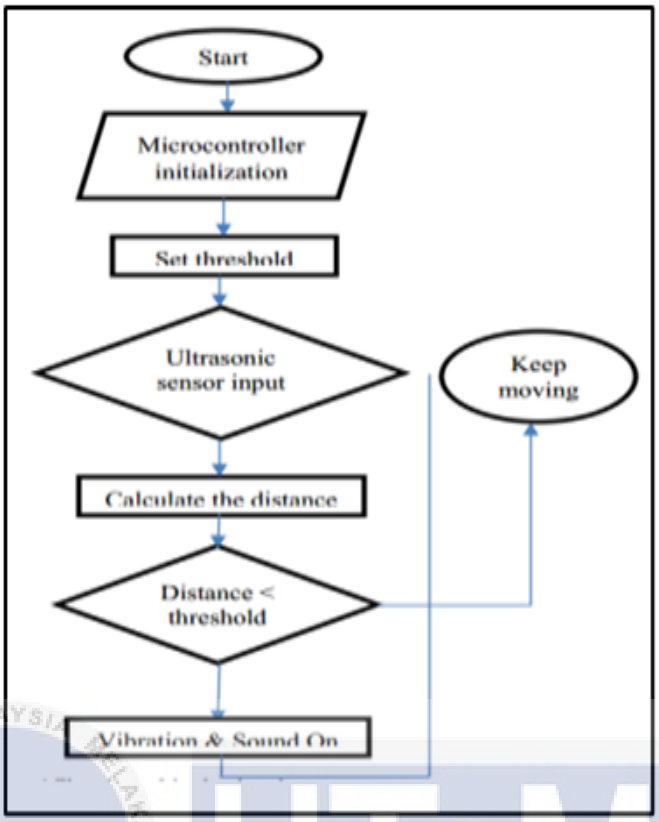

Figure 2.1 Flowchart of the developed system[12]

In summary, the article offers treasured insights into the manageable of IoT technology in developing progressive options to tackle the challenges faced by visually impaired individuals. The smart cane is a promising instance of how IoT can be leveraged to create assistive devices that improve accessibility and promote independence for persons with disabilities. However, extra research and improvement are wished to make sure that such devices are effective, reliable, and on hand to a wider audience.

2.5.2 Smart Walking Stick for the Visually Impaired using Node MCU ESP32

Smart devices for visually impaired people have grown in recognition in current years, with a quantity of new improvements being created to enhance their mobility and independence. One such system is the smart walking stick, which has been designed to assist visually impaired people in navigating their surroundings.

The article via Pugazhenthi et al. (2019) explores the improvement of a smart walking stick the usage of the Node MCU ESP32 microcontroller, which is a low-cost, high-performance microcontroller that can join to the web through Wi-Fi or Bluetooth.

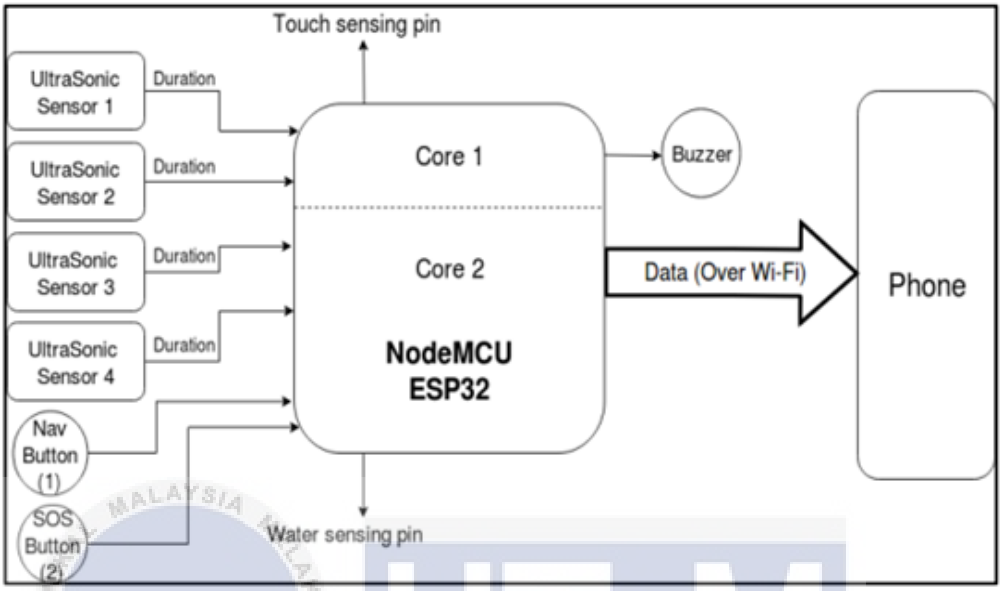

Figure 2.2 Block Diagram of Smart Walking Stick[4].

The smart walking stick developed by the authors is outfitted with several sensors, consisting of ultrasonic sensors, a temperature sensor, and a gyroscope, which assist to detect obstacles, adjustments in temperature, and modifications in direction. The system also includes a GPS module, which can be used to track the user's region and supply them with instructions thru a mobile application. The authors have also built-in an alert system into the device, which can provide users with auditory alerts when they are coming near an obstacle or when the battery level is low.

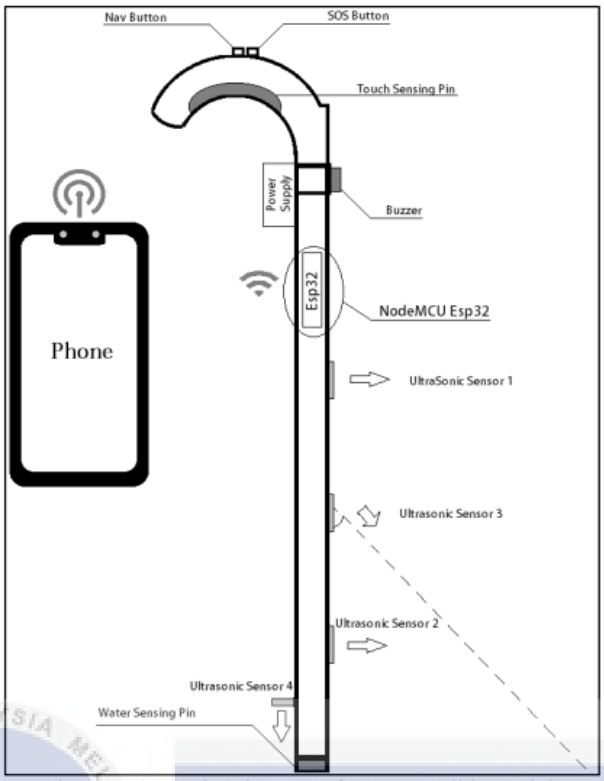

Figure 2.3 Schematic Diagram of Smart Walking Stick[4].

In conclusion, the article via Pugazhenthi et al. (2019) offers a well-designed and practical smart walking stick for visually impaired individuals. The use of the Node MCU microcontroller and various sensors provide the system with an excessive degree of functionality, and the integration of a GPS module and alert system enhance the user's experience. The authors have proven the achievable of low-cost microcontrollers and sensor technologies in developing assistive devices for persons with disabilities. This learns about affords a valuable contribution to the discipline of assistive technology and should serve as a foundation for further lookup and development in this area.

2.5.3 Iot Based Band for Blind Peoples Using ESP32 With GPS

The article "IoT primarily based Band for Blind Peoples using ESP32 with GPS" by Ratnaparkhi explores the development of a band that makes use of IoT technology to aid visually impaired individuals. The device is built using an ESP32 microcontroller, a GPS module, and a few different hardware components. The band is designed to provide real-time statistics to the user about their surroundings, such as their region and close by objects, using haptic feedback.

The writer outlines the aspects of the device, together with the ability to track the user's area using GPS and alert them of any obstacles within a certain range using ultrasonic sensors. Additionally, the band has a built-in microphone that can understand voice instructions and provide comments thru voice responses or haptic feedback. The author presents a designated clarification of the hardware and software used to build the band, which include the use of the Arduino IDE to software the ESP32 microcontroller. The article also offers the effects of experiments performed to consider the accuracy and effectiveness of the device.

In general, this study offers a promising solution for visually impaired individuals, as it presents a modern and effortless method to assistive technology. However, the article should benefit from similarly dialogue of workable barriers and challenges that may additionally occur in real-life situations.

In conclusion, the IoT-based band for visually impaired individuals introduced in this article offers solution for the independence and mobility of visually impaired. As assistive technology to evolve, in addition lookup and development of modern solutions like this will be necessary to improve the great of life of visually impaired individual[13].

2.5.4 A Smart Cane Using GPS Device and GSM Module

The article " A Smart Cane Using GPS Device and GSM Module" by Maha Khalil Ibrahim and Nadia Mahmood Hussien researches ways to improve the mobility and safety of visually impaired people by incorporating GPS technology and a GSM module into a smart cane. The researchers address the urgent need for creative ways to aid the sight-impaired in independently navigating their environment.

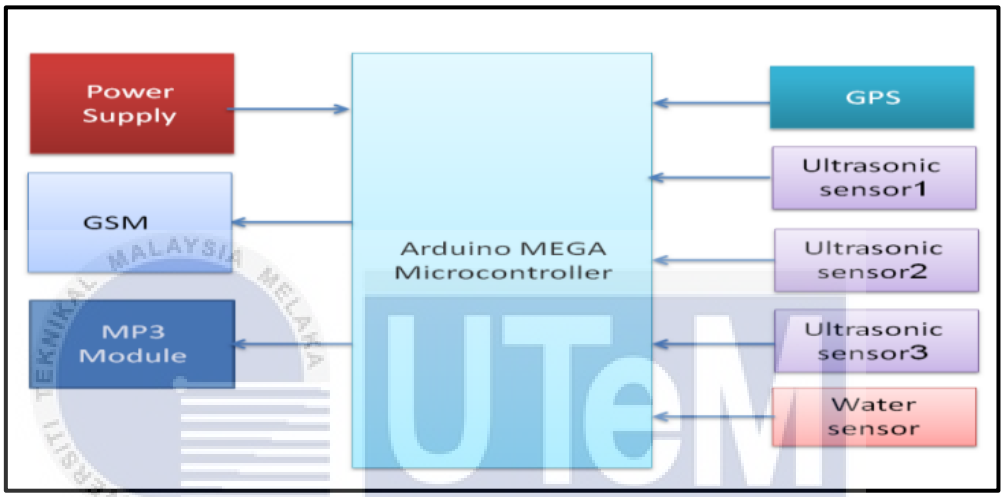

Figure 2.4 Block Diagram of the system[14].

The article's literature review is expected to go into existing research and advances linked to assistive technology for the visually impaired. It would most likely cover the difficulties that people with vision impairments encounter, as well as the limits of standard mobility aids. Previous study in this subject may have investigated the usage of GPS and GSM technology individually, identifying possible benefits while also recognizing certain problems.

Studies and initiatives that have used GPS devices and GSM modules in assistive devices may be cited to offer background for the creation of the smart cane mentioned in this article. The integration of GPS and GSM technologies in a cane might be positioned as a game-changing breakthrough that tackles the drawbacks of existing solutions, providing a

better and more complete tool for visually impaired people to navigate their environment with more autonomy.

In conclusion, the article's literature review likely analyses the research within the broader context of assistive technology for the visually impaired, illustrating the advancement of such devices and the unique difficulties they seek to solve. The smart cane's unique contribution, combining GPS and GSM technology, is expected to be highlighted as a potential achievement in this sector.

2.5.5 Obstacle Detection and Navigation for Blind Using Smart Blind Stick

The article "Obstacle Detection and Navigation for Blind Using Smart Blind Stick" by Chaitanya, M., Karthik, G., Prathyusha, K., and Leela, K.S. emerges focusing on the critical issue of improving the mobility and safety of visually impaired people using a smart blind stick. This article's literature review most likely investigates existing studies and technology targeted at aiding the blind in navigating their environment.

The literature review will most likely look at various techniques applied to smart blind sticks, such as ultrasonic sensors, infrared sensors, or computer vision techniques. It could emphasis the advantages and disadvantages of each device, describing how good they are at identifying obstacles and assisting with navigation. The gains achieved and lessons gained from previous designs may be seen in the growth of smart blind stick technology throughout time.

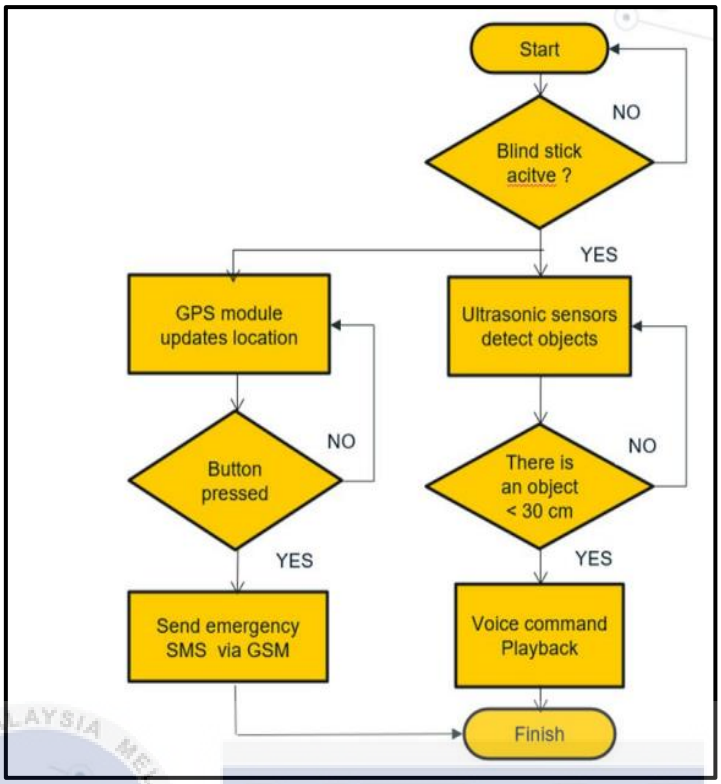

Figure 2.5 Flowchart of the system[5]

Furthermore, the review might cover research that examines the usefulness and acceptance of smart blind stick technology among visually impaired people. Understanding user comments and preferences is critical in the development of assistive technologies to ensure their usability and enjoyment. The paper intends to contribute to the current body of knowledge by situating their study within the framework of past research and presenting an innovative method for obstacle detection and navigation for the visually impaired using a smart blind stick.

In a nutshell, the article's literature analysis likely gives a complete overview of cutting-edge technology for aiding the blind, with an emphasis on obstacle detection and navigation. It serves to contextualize the suggested smart blind stick's relevance in overcoming the limits of existing solutions and furthering the field of assistive technology for the visually impaired.

2.6 Advantage and disadvantage of previous project

No	Reference	Advantages	Disadvantages	Components
1	[12]	1. Incorporates obstacle detection 2. GPS tracking 3. Enhanced safety	1. Obstacle detection algorithms has minimized false positives which require extensive development and testing 2. Development of this project has increased time and costs	• Ultrasonic sensor • GPS module • Arduino
2	[4]	1.Enables Wi-Fi connectivity for convenient data transmission	1. Power efficiency to extend battery life has involve trade-offs such as reducing system performance and functionality 2. Impact the overall user experience and limit the capabilities of the device.	• Node MCU ESP32 • Ultrasonic sensor • Buzzer
3	[13]	1. Utilizes GPS for location tracking 2. Improved mobility	1. Integration with other sensors effects functionality which lead to compatibility issues and technical complexities.	• ESP32 • GPS module • Vibrating motor • Battery
4	[14]	1.Enchanced Mobility 2. Provides real-time location updates through GSM communication.	1. Continuous use of GPS and GSM can drain the device's battery quickly. 2. Some visually impaired users may find it challenging to operate.	• GPS Device • GSM Module • Arduino Mega • Ultrasonic Sensor • Battery
5	[5]	1. Provides real-time feedback to users about their surroundings. 2. Designed to be easily usable for individuals with visual impairments.	1. Implementation of advanced sensors and technology can increase the overall cost. 2. External factors may affect sensor accuracy.	• Arduino UNO • Node MCU • Ultrasonic sensor • Buzzer

2.7 Summary

In conclusion, the literature reviewed above gives valuable insights into the improvement of smart canes for visually impaired individuals. Different authors from a variety of backgrounds have proposed special options to enhance the mobility and security of visually impaired human beings using technology. Through these literature studies, it has become clear that an IoT-based approach is one of the most promising options for developing an environment-friendly and high-quality smart cane. By making use of an Arduino Mega microcontroller, the smart cane project can contain elements such as obstacle detection, audio feedback, and location information. The project additionally has the benefit of being lightweight and easy to handle. In chapter 3, a detailed process of the hardware and software improvement of the smart cane using the Arduino Mega is provided. By incorporating trendy technology and progressive ideas, this project has the potential to revolutionize the lives of visually impaired individuals by offering them expanded independence and safety.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Assistive technologies have drastically expanded the lives of visually impaired humans by providing them with equipment to navigate and interact with the world. This chapter will offer a way for developing a smart cane with Arduino Mega, an IoT, to improve the functionality and use of ordinary canes for visually impaired people. This approach draws on past research in the realm of assistive devices for the visually handicapped while also making use of advances in IoT and sensor technologies.

A methodical method is used to plan the smart cane. This consists of developing standards primarily based on visually impaired people's needs, choosing applicable hardware factors such as Arduino Mega and sensors, and integrating them into the cane construction. The technique additionally consists of creating algorithms for record processing, producing warnings, and connecting to other devices. The resultant smart cane has the potential to extensively improve visually impaired people's freedom and safety. The cane can provide real-time feedback, assist with obstacle identification, and ease connectivity with other devices by utilizing IoT and sensor technologies.

In summary, the purpose of this chapter is to improve the functioning and use of regular canes for visually impaired people. This approach affords an attainable way to address the unique issues encountered by visually impaired humans in their everyday lives by integrating IoT and sensor technology, as well as actively incorporating customers during the improvement process.

3.2 Project Workflow

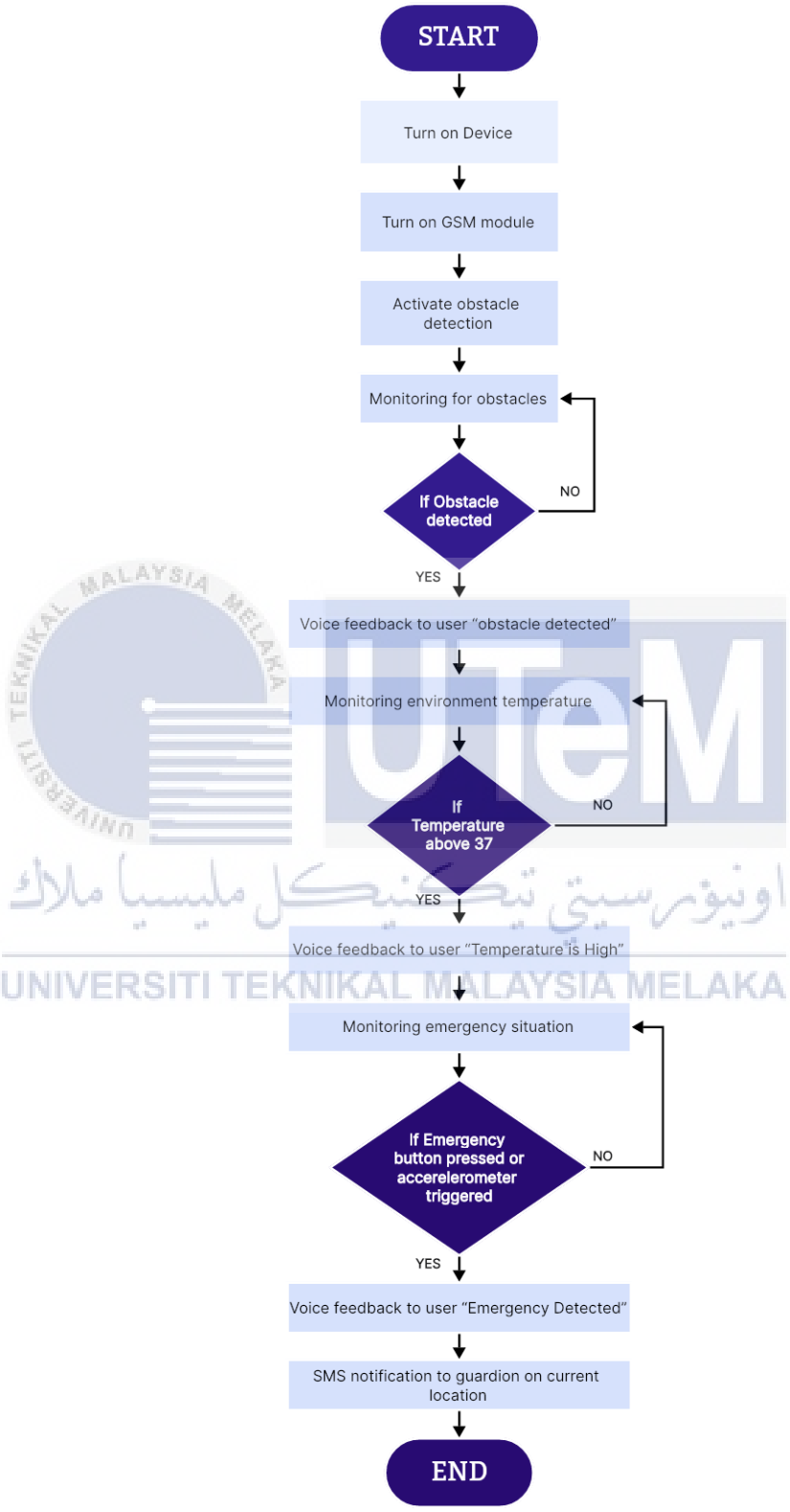

Figure 3.1 Project Flowchart

3.3 Hardware Specifications

Several hardware standards should be addressed whilst developing a clever cane for visually challenged people utilising Arduino Mega, Ultrasonic sensor,Temperature Sensor,GPS and GSM module,Voice Module and Arduino IDE. These hardware specifications provide a basis for developing a smart cane the use of Arduino Mega for visually impaired individuals. It is necessary to select aspects that meet the precise necessities of the project while thinking about factors such as power efficiency, durability, and person accessibility.

3.3.1 Mega2560 Pro ATMEGA2560

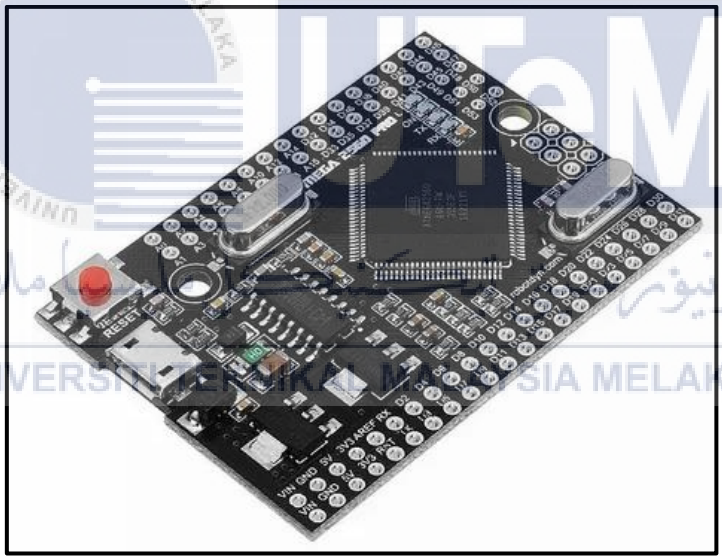

Figure 3.2 Pro ATMEGA2560[15]

The Mega2560 Pro ATMEGA2560 is an advanced and resource-intensive microcontroller board based on the ATmega2560 processor. It is a more advanced version of the famous Arduino Mega 2560, with increased capabilities and versatility for a wide range of applications. This board is still compatible with the Arduino Mega 2560, allowing it to be used by the Arduino community.

This board's ATMEGA2560 microcontroller has a high-performance 8-bit AVR architecture with 256 KB of Flash memory, 8 KB of RAM, and 4 KB of EEPROM. The Mega2560 Pro has several connection choices for connecting with various sensors, actuators, and communication modules, with 54 digital I/O pins, 16 analogue inputs, and many communication interfaces including UART, I2C, and SPI.

The Mega2560 Pro's smaller form size is one standout feature, making it ideal for applications with limited space. It also has a USB-to-serial converter for simple programming and computer connectivity. A USB connection or an additional source of power can be utilized for the board.

The Mega2560 Pro ATMEGA2560 is designed for flexibility and is an excellent solution for complicated applications needing many I/O pins and important computing capacity. It offers a reliable platform for modern electronics users, engineers, and professionals.

3.3.2 GPS Module

Figure 3.3 GPS Module[16]

The Global Positioning System (GPS) is a satellite navigation system. It transmits time and location information to a GPS receiver located on or near the earth's surface. GPS operates in all weather situations.

GPS operates using a technique known as trilateration. Trilateration is a method of determining your position that is entirely reliant on the intersection of spheres. When a receiver receives a signal from one of the satellites, it estimates its distance from the satellite tv for pc by envisioning a 3-dimensional sphere with the satellite tv for pc in the middle. Once the receiver completed the identical thing with three more GPS satellites, it will proceed to find the intersection point of the three spheres in order to compute its location. Trilateration receives data from satellites to output region information and is used to calculate location, velocity, and elevation.

GPS is a powerful and dependable tool for companies in a variety of sectors. Surveyors, scientists, pilots, boat captains, first responders, and mining and agricultural employees are just a few of the people that use GPS on a daily basis for work. They use GPS data to prepare accurate surveys and maps, to take precise time measurements, to follow a function or position, and to navigate[16].

3.3.3 DHT22 sensor

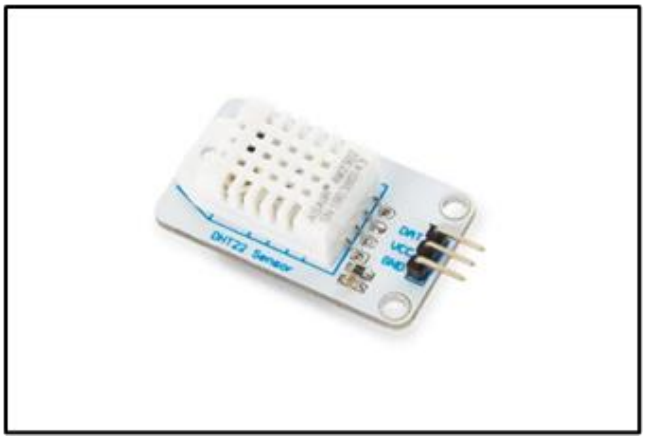

Figure 3.4 DHT22 Temperature Sensor[17]

The DHT22 sensor has a capacitive humidity detecting component as well as a thermistor for measuring temperature. It has an accuracy of 0.5 degrees Celsius and can measure temperatures ranging from -40 to 80 degrees Celsius (-40 to 176 degrees Fahrenheit). In humidity, it can measure between 0 and 100% with an accuracy of 2-5%.

The sensor interfaces with the host device thru a straightforward 1-wire protocol that requires solely a single digital input/output pin to ship and get hold of data. It commonly sends records in binary format, which the host device should analyses to acquire temperature and humidity values in human-readable format[17].

3.3.4 Ultrasonic Distance Sensor - HC-SR04

Figure 3.5 Ultrasonic Sensor[18]

The HC-SR04 Ultrasonic Distance Sensor is a widely used sensor that utilizes ultrasonic sound waves to determine the distance between the sensor and an object. It consists of two main components: an ultrasonic transmitter and an ultrasonic receiver. The transmitter emits quick pulses of ultrasonic waves which propagate thru the air and are detected by using the receiver.

The sensor operates at a frequency of around 40 kHz and can measure distances accurately within a vary of 2 cm to 400 cm. To use the sensor, a microcontroller sends a trigger sign to initiate the ultrasonic pulse and the sensor measures the time it takes for the echo signal to return, permitting the microcontroller to calculate the distance based totally on the velocity of sound.

The HC-SR04 sensor is widely available, affordable, and well suited with several microcontrollers and improvement platforms. Its simplicity and reliability make it a famous preference for projects involving distance sensing and object detection in robotics, automation, and IoT software application[18].

3.3.5 GSM Module

Figure 3.6 GSM Module[19]

The GSM (Global System for Mobile Communications) module is an essential component of modern communication systems, allowing devices to connect to cellular networks for data transfer and voice communication. The SIM800L GSM module is one such example.

The SIM800L is a small GSM module that includes all of the hardware required for cellular connectivity. It works on a 2G network, making it suited for applications that do not require 3G or 4G connection.

The SIM800L module, which has a SIM card slot, allows devices to connect to the GSM network and use services such as SMS (Short Message Service) and GPRS for data transmission. Users may interact with the module using the AT command set to execute a variety of tasks, including as sending and receiving messages, making phone calls, and accessing internet services via GPRS.

It is frequently used in applications requiring cellular connectivity, such as vehicle tracking, remote monitoring, and IoT devices.

3.3.6 Audio Voice Module

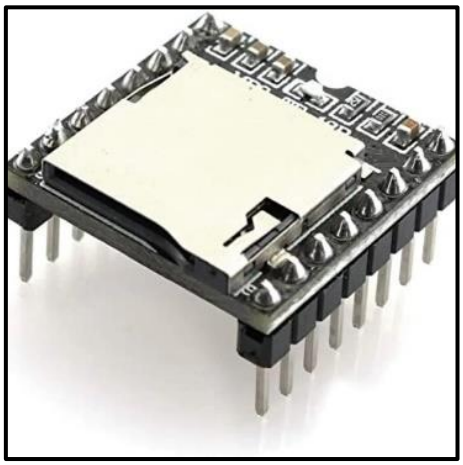

Figure 3.7 Audio Voice Module[20]

The Audio Voice Module is a flexible audio playback module developed for use with Arduino and other microcontroller applications. It is commonly used to play MP3 files from a TF (TransFlash) card or U Disc. This little module, sometimes known as the GM DFPlayer Mini, is used in applications that require audio playback.

The audio voice module , which has an inbuilt micro SD card reader, supports TF cards, also known as micro SD cards. This function allows users to store MP3 audio files on the card and play them back flawlessly through the module. It also supports U Disc connection, allowing you to play music files directly from a USB flash drive.

The Audio Voice Module is compatible with Arduino and can be easily controlled using serial communication. It features a range of commands, including play, pause, volume control, and track selection, making it suitable for various applications such as DIY music players, sound effects in robotics, and interactive projects.

With its compact size and straightforward integration capabilities, the audio voice module is a popular choice for electronics enthusiasts and hobbyists looking to incorporate audio playback functionality into their projects.

3.3.7 Accerelerometer

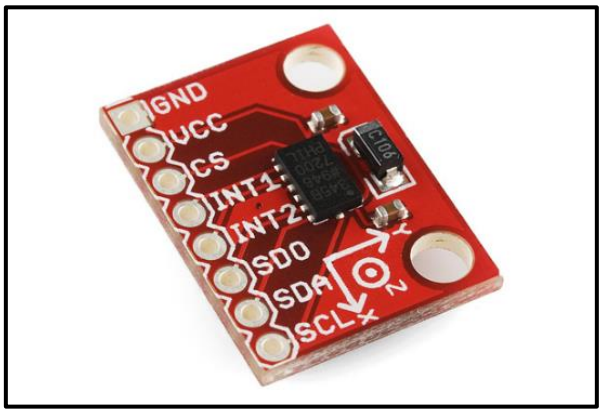

Figure 3.8 Accerelerometer[21]

An accelerometer is a key sensor used in electronic devices to measure acceleration, giving essential data for applications such as motion sensing, orientation detection, and impact analysis. The ADXL345 accelerometer is one example of such a sensor.

Analogue Devices' ADXL345 accelerometer is a compact, low-power three-axis accelerometer with good resolution (up to 13 bits) and a broad measuring range. It works on the idea of sensing capacitance changes induced by acceleration. This accelerometer has customisable data output rates and ranges, making it appropriate for a wide range of applications requiring reliable acceleration measurements.

This accelerometer is commonly used in motion-enabled gaming, camera image stabilisation, and impact detection in industrial equipment. Because of its small size, low power consumption, and adaptability, it is a preferred option in the design and development of systems that require precise acceleration measurements.

3.4 Software Configuration

3.4.1 Arduino ide

Figure 3.9 Arduino IDE[22]

The Arduino IDE is a well-known software program improvement environment that is used to programmed Arduino microcontrollers that It has an easy-to-use interface and an elevated code language, making it appropriate for each beginner and professional coders. Users can also use the IDE to write, build, and add code to Arduino boards, permitting them to assemble a variety of electrical projects[22].

3.5 Summary

The "Development of a Smart Cane Using Arduino Mega for Visually Impaired" project utilises Arduino Mega along with an ultrasonic sensor, voice feedback, GSM and GPS modules, and a temperature sensor to create a complete solution for visually impaired individuals. The smart cane contains obstacle detection through the ultrasonic sensor, alerting users of possible obstacles in their path. Voice feedback enhances the user experience by way of delivering real-time auditory instructions. Furthermore, GPS enables the cane to detect its precise geographical locations, while GSM facilitates communication by transferring this position information over cellular networks to a central system or a chosen contact., enabling non-stop enhancement of the smart cane's functionality and

performance. Through hardware implementation, software programme development, and rigorous testing, the project aims to increase the mobility and independence of visually impaired humans while leveraging IoT technologies. In conclusion, the "Development of a Smart Cane Using Arduino Mega for Visually Impaired" project provides a promising assistive system that empowers visually impaired individuals with enhanced navigation capabilities, obstacle detection, and access to necessary data in their surroundings.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The findings and outcomes of the Smart Cane project, which used Arduino Mega to assist the visually impaired, are presented and discussed in this part. Furthermore, the project's execution and design will be described to offer a full knowledge of its progress and performance. The chapter presents an overview of the advancements made possible by the use of obstacle recognition, real-time audio guiding, and emergency warning. This chapter sets the scenario for assessing the Smart Cane's efficency and success in meeting the special demands of the visually impaired population. At the end of this chapter, provide a discussion on the project's outcome.

4.2 Hardware Development

The Arduino Mega acts as the project's main microcontroller, acting as the "brain" that connects with multiple components for internal hardware development. The system is connected to a battery for activation to power it up.

For connectivity, the RX (Receive) pin on the GSM module is connected to pin 2 on the Arduino, while the TX (Transmit) pin is attached to number 3. The ultrasonic sensor is connected to pin 9 as the trigger pin and pin 10 as the echo pin. The DHT11 sensor connects to the Arduino via pin 7. The analogue pin A1 on the Arduino is used to interact with an accelerometer. A buzzer is precisely attached to the Arduino's digital pin 4. Meanwhile, the RX pin of the MP3 player is connected to Arduino pin 19 (RX1), while the TX pin is connected to Arduino pin 18 (TX1).

This overall system, which is operated by the Arduino Mega, shows its capabilities by effectively monitoring environmental conditions, giving audio feedback via the MP3 player, and allow communication over the GSM network.

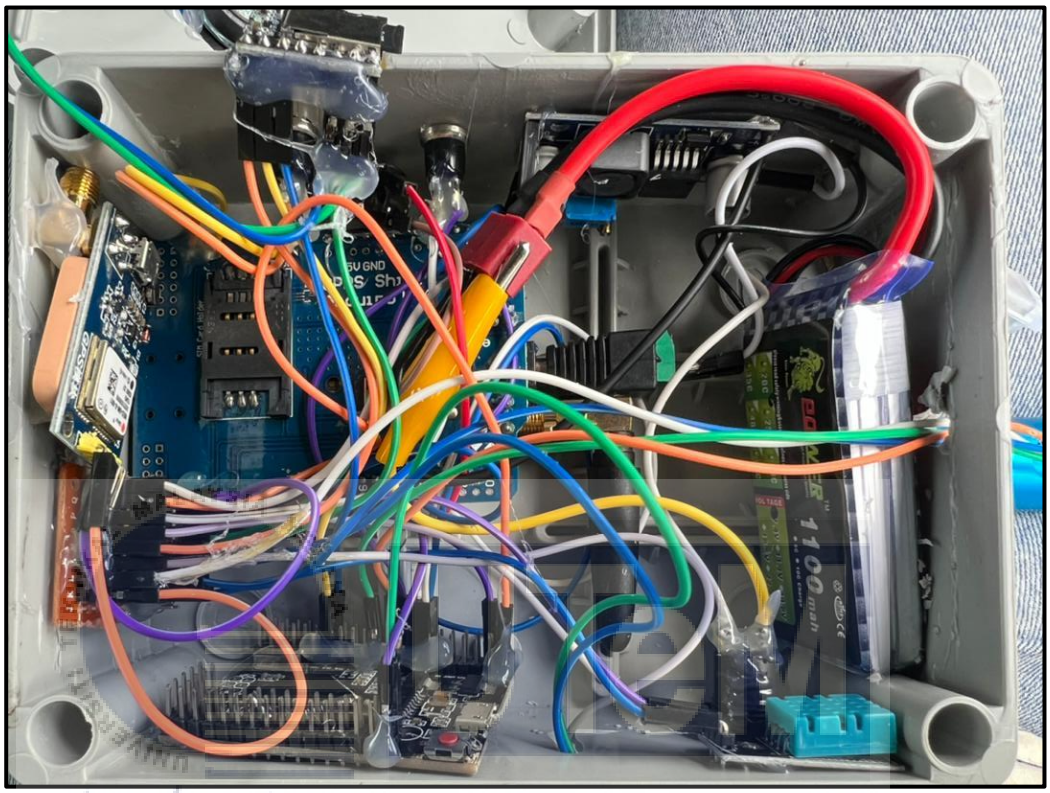

Figure 4.1 Complete Circuit Development

4.3 Prototype Development

4.3.1 Smart Cane Audio Feedback

This smart cane audio feedback facilitated by a speaker. It is set up to send out obstacle warnings, temperature alerts, and emergency notifications.To maximise the system's mobility and compactness, every piece of hardware was essentially combined into a single box.

Figure 4.2 Smart Cane Audio Feedback Speaker

4.4 Emergency SMS Notifications

During an emergency, the GSM module delivers SMS messages, which can be activated by the accelerometer sensing an impact or by a user-initiated button press. The system includes a cancellation mechanism to avoid excessive anxiety caused by false alerts. This feature enables users to cancel the emergency notification within 10 seconds of it being activated, providing a safety net, and lowering the probability of accidentally notifications.

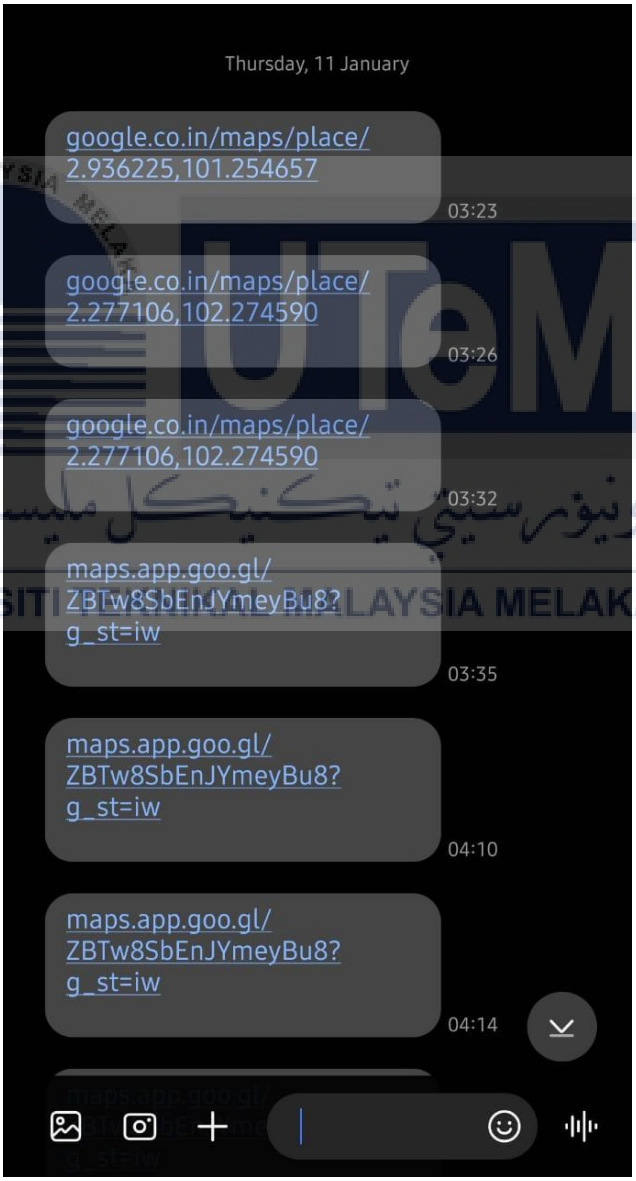

Figure 4.3 Smart Cane SMS notication

4.5 Discussion

The primary goal of this project was to develop an IoT smart cane that empowers visually impaired individuals by providing real-time obstacle detection, orientation tracking, and emergency assistance. The demand for such a technology arises from the struggles that visually impaired people have in navigating their surroundings on their own. This smart cane, with its efficient obstacle recognition and smart features, seeks to improve users' mobility, safety, and overall quality of life.

From the title's idea to completion, the project's development process took six months. A thorough search was undertaken to find previous projects with comparable aims, and the project was tackled with the goal of maximizing efficiency by utilizing simple components. A prototype was built using components such as the Arduino Mega microcontroller, ultrasonic sensor, accelerometer, voice module, and GPS and GSM modules. Throughout the development, various challenges were encountered, including the need to find suitable coding solutions and address errors through extensive debugging steps. Adjustments to the initial concept were made due to the incompatibility of certain components. However, leveraging the availability of integrated modules and components streamlined the project, reducing complexity and costs.

Figure 4.4 Smart Cane Prototype

The outcomes and testing of the smart cane prototype's studies show that it is successful in obstacle detection, orientation tracking, and emergency alert functionality. The technology has demonstrated encouraging outcomes in terms of increasing the safety and mobility of visually impaired users.

Finally, this Internet of Things-based smart cane project emphasizes the potential for technological innovation to address real-world difficulties encountered by visually impaired people. The use of simply available and integrated components improves the practicality as well as effectiveness of the suggested solution. Based on user input and changing technology, future iterations may investigate more features and enhancements.

4.6 Summary

The project development stage was an accomplishment, as it resulted in the development of a functioning and user-friendly IoT-based smart walking cane utilising Arduino Mega. The system's integration functions as a vital tool for improving the safety and mobility of visually impaired people. With the assistance of this technology, users' guardians can now have fewer concerns about their users. In the next chapter,the challenges and potential future improvements were discussed.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The development of a smart cane for the vision impaired using Arduino Mega is an innovative and creative solution to promote mobility and independence. This project aims to empower visually impaired people by providing them with a reliable tool that improves their visual perception, navigation ability, and overall quality of life.

Despite obstacles such as power consumption optimisation and user interface convenience, incremental adjustments have led to a stable and user-centric solution. This process underscores the commitment to addressing real-world challenges and ensuring that the Smart Cane meets the specific needs and preferences of visually impaired users.

This project's importance extends beyond its immediate uses. The Smart Cane not only acts as a practical aid for visually impaired people, but it also sets the framework for future advances in assistive technology. This awareness places the project as a catalyst for ongoing innovations with the potential to further empower and enhance the lives of people with visual impairments. In summary, the Smart Cane represents a step towards a more inclusive and technologically sophisticated future, not merely a solution for today.

5.2 Future Works

For future improvements, the accuracy of the smart cane's obstacle detection system could be enhanced as follows:

i. Integration with Smart Home Devices.

ii. Incorporating artificial intelligence algorithms and computer vision technology into the obstacle detection system.

iii. Power Management Optimization:

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APPENDICES

Appendix 1 Coding for the system

```
#include <SoftwareSerial.h>
   #include <TinyGPS.h>//library for gps
   SoftwareSerial SIM900A(2,3);

#define trigPin1 9
#define echoPin1 10

#include "Arduino.h"
#include "SoftwareSerial.h"
#include "DFRobotDFPlayerMini.h"

DFRobotDFPlayerMini myDFPlayer;
void printDetail(uint8_t type, int value);

long duration, distance, Sensor1;
int buzzer = 4;
int count;
String textForSMS;
int toggle_emg = 0;
int toggle_temp = 0;
long lat,lon;
   TinyGPS gps; // create gps object

int suis;
String lat1,lat2,lon1,lon2,coordinate;

#include <dht.h>
dht DHT;
#define DHT11_PIN 7

#include <math.h>

const int z_out = A1; /* connect z_out of module to A3 of UNO board */


void setup() {
  // put your setup code here, to run once:
pinMode(A0,OUTPUT);
Serial1.begin(9600);//mp3
Serial.begin(9600);
  SIM900A.begin(9600); //  GSM
  pinMode(trigPin1, OUTPUT);
pinMode(echoPin1, INPUT);
```

```
pinMode(buzzer,OUTPUT);

  Serial.println(F("DFRobot DFPlayer Mini Demo"));
  Serial.println(F("Initializing DFPlayer ... (May take 3~5 seconds)"));

  if (!myDFPlayer.begin(Serial1)) {  //Use softwareSerial to communicate with mp3.
    Serial.println(F("Unable to begin:"));
    Serial.println(F("1.Please recheck the connection!"));
    Serial.println(F("2.Please insert the SD card!"));
    while(true);
  }
  Serial.println(F("DFPlayer Mini online."));

  myDFPlayer.volume(30);  //Set volume value. From 0 to 30
}

void loop() {

      suis = digitalRead(A0);
      long data_lat1 = lat/1000000;
      long data_lat2 = lat%1000000;

      long data_lon1 = lon/1000000;
      long data_lon2 = lon%1000000;


      lat1 = String(data_lat1);
      lat2 = String(data_lat2);
      lon1 = String(data_lon1);
      lon2 = String(data_lon2);

      coordinate = lat1 + "." + lat2 + "," + lon1 + "." + lon2;
      //coordinate = lon2;

      Serial.print("Real Coordinate: ");
      Serial.println(coordinate);




       while(Serial1.available()){ // check for gps data
      if(gps.encode(Serial1.read())){ // encode gps data
       gps.get_position(&lat,&lon); // get latitude and longitude
       // display position

       Serial.print("Position: ");
       Serial.print("coordinaat ");
```

```
        Serial.print(lat/1000000);
        Serial.print(".");
        Serial.print(lat%1000000);
        Serial.print(" ");// print latitude to serialmonitor
        Serial.print(", ");
        Serial.print(lon/1000000);
        Serial.print(".");
        Serial.println(lon%1000000);// print longitude to serialmonitor

    }

}

  int chk = DHT.read11(DHT11_PIN);


  Serial.print("Temp: ");
  Serial.println(DHT.temperature);
  //Serial.print("Humidity: ");
 // Serial.println(DHT.humidity);

  SonarSensor(trigPin1, echoPin1);
  Sensor1 = distance;

  Serial.print("Distance 1: ");
  Serial.print(Sensor1);
  Serial.println("cm");


  //textForSMS = "google.co.in/maps/place/2.277106,102.274590";
  textForSMS = "maps.app.goo.gl/ZBTw8SbEnJYmeyBu8?g_st=iw";
  //textForSMS = coordinate;
  Serial.print("Defined Text: ");
  Serial.println(textForSMS);

    int x_adc_value, y_adc_value, z_adc_value;
  double x_g_value, y_g_value, z_g_value;


  z_adc_value = analogRead(z_out); /* Digital value of voltage on z_out pin */

  Serial.print("z = ");
  Serial.println(z_adc_value);

  while(suis == 1 || z_adc_value > 500)
  {

   if(toggle_emg == 0)
   {
    myDFPlayer.play(3);
```

```
 delay(2000);
 toggle_emg = 1;
}


 digitalWrite(buzzer,HIGH);
 delay(1000);
 count++;
 Serial.print("Count: ");
 Serial.println(count);


 int quit = digitalRead(A0);
 if(quit == 1)
 {
  digitalWrite(buzzer,LOW);
  count = 0;
  delay(3000);
  return;
 }

 if(count == 10)
 {
  SendMessage(textForSMS);
  digitalWrite(buzzer,LOW);
  count = 0;
  return;
 }

}

if(DHT.temperature >= 37 && toggle_temp == 0)
{
 myDFPlayer.play(2);
 toggle_temp = 1;
 delay(1500);

}

if(DHT.temperature < 37)
{
 toggle_temp = 0;
}

if(Sensor1 < 50)
{
 myDFPlayer.play(1);
 delay(1500);
}
```

```
  delay(50);
  toggle_emg = 0;


}


 void SendMessage(String message)
{

  SIM900A.println("AT+CMGF=1\r");    //Sets the GSM Module in Text Mode
  delay(1000);
  SIM900A.println("AT + CMGS = \"+60163825578\""); //Mobile phone number to send
message
  delay(1000);
  SIM900A.println(message);// Messsage content
  delay(100);
  SIM900A.println((char)26);// ASCII code of CTRL+Z
  delay(1000);
  SIM900A.println("AT+CMGD=1,4");//delete previous message

}



void SonarSensor(int trigPin,int echoPin)
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 29.1;

}
```