POLITEKNIK MALAYSIA
SULTAN SALAHUDDIN ABDUL AZIZ SHAH

KEMENTERIAN PENDIDIKAN TINGGI

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SMART SHOES FOR VISUALLY IMPAIRED PERSON

NAME	REGISTRATION NO
MAGDELYN JODIN MAJJIHIL	08DEU22F1020

JABATAN KEJURUTERAAN ELEKTRIK

DISEMBER 2024

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MAGDELYN JODIN MAJJIHIL	08DEU22F1020

This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

DISEMBER 2024

CONFIRMATION OF THE PROJECT

The project report titled "Smart Shoes for Visually Impaired Person" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

Checked by:

Supervisor’s name : WEE SOO LEE

Supervisor’s signature:

Date :12/11/2024

Verified by:

Project Coordinator name :

Signature of Coordinator :

Date :

"I acknowledge this work is my own work except the excerpts I have already explained to our source"

1. Signature :

Name : **MAGDELYN JODIN MAJJIHIL**

Registration Number : **08DEU22F1020**

Date :12/11/2024

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : SMART SHOES FOR ASSITS VISUALLY IMPAIRED PERSON

SESSION: JUNE 2020

1. I, **1.MAGDELYN JODIN MAJJIHIL (08DEU22F1020)**

   is a final year student of **Diploma in Electrical Engineering, Department of Electrical, Politeknik Sultan Salahuddin Abdul Aziz Shah**, which is located at **Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor**. (Hereinafter referred to as 'the Polytechnic').

2. I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering**to me.

Made and in truth that is recognized by;

a) **MAGDELYN JODIN MAJJIHIL**
(Identification card No: -030809-02-0354)

) .

....…………………………

)**MAGDELYN JODIN MAJJIHIL**

In front of me, Click here to enter text.(Click here to enter text.)) .....………………

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As a project supervisor, on the date:

ACKNOWLEDGEMENTS

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to (Name of your Organization Guide) for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards my parents & my supervisor for their kind co-operation and encouragement which help me in completion of this project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

ABSTRACT

Our eyes are invaluable, allowing us to experience the world fully. For those who are visually impaired, however, life is more challenging as they rely on traditional aids like canes, which often lead to accidental trips, falls, and restricted mobility. This project introduces Smart Shoes for visually impaired person by providing real-time obstacle detection and guidance. The primary goal is to enhance navigation, safety, and independence for visually impaired users. Using an Arduino Nano microcontroller, these shoes operate through an ultrasonic sensor and **a** vibration motor system. The Arduino processes data from the sensor and activates vibrations when an obstacle is near, alerting the wearer. Feedback from users highlights that the Smart Shoes improve awareness and reduce accident risks, fostering a sense of safety and confidence. This solution, incorporating ultrasonic sensing, Arduino processing, and vibration feedback, is user-friendly and promises to improve quality of life for visually impaired individuals.

Key Words: Arduino nano, Ultrasonic sensors, Vibration motor ,Smart Shoes for Visually Impaired person

ABSTRAK

Mata kita sangat berharga, membolehkan kita mengalami dunia sepenuhnya. Namun, bagi mereka yang mengalami masalah penglihatan, kehidupan menjadi lebih mencabar kerana mereka bergantung pada alat bantu tradisional seperti tongkat, yang sering menyebabkan tersandung, terjatuh, dan pergerakan yang terhad. Projek ini memperkenalkan Smart shoes for Visually Impaired Person dengan menyediakan pengesanan halangan dan panduan secara nyata. Matlamat utama projek ini adalah untuk meningkatkan navigasi, keselamatan, dan kebebasan bagi pengguna yang kurang penglihatan. Menggunakan mikrokontroler Arduino Nano, kasut ini beroperasi melalui sensor ultrasonik dan sistem motor getaran. Arduino memproses data daripada sensor dan mengaktifkan getaran apabila terdapat halangan berdekatan, memberikan amaran kepada pemakai. Maklum balas daripada pengguna menunjukkan bahawa Kasut Pintar ini meningkatkan kesedaran dan mengurangkan risiko kemalangan, sekaligus menyemai rasa keselamatan dan keyakinan. Penyelesaian ini, yang menggabungkan penderiaan ultrasonik, pemprosesan Arduino, dan maklum balas getaran, mesra pengguna dan menjanjikan peningkatan kualiti hidup bagi individu kurang penglihatan.

Kata Kunci: Arduino nano, Ultrasonic sensors, Vibration motor ,Smart Shoes to Assist Visually Impaired person

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LIST OF SYMBOLS

Category	Symbols
Punctuation	. , : ; " ' • ? ! ¿ ¡ – & ¯ _ \ / §
Business	@ # % ® © ™ CE ✓
Mathematics	+ – × ÷ ± = *
Bracket	( ) [ ] < > « »
Arrow	➡ ⬅ ⬆ ⬇ ↔ ⇄ ☞ ☜
Unit	$ ¢ € £ ¥ °
International	α β γ δ μ Ω ϕ ª º
Number	² ³ ₂ ₃ ¼ ½ ¾
Pictograph	★ ● ○ □ △ ♠ ♥ ♦ ♣ ♪ ✚ ❢ ♂ ♀
Electrical	⏚ ∼ ⎓ ⊣⊢ ⏻ ⊗ ▭ ⏊ ▣ ○ | ⊖ ⓘ ▽ ⊘ ϟ ▬ ◁
Others	🛇 ⚠ ⚠ ☠ ⊗ ☎ ✎ 🖶 ✉ 🖳 ✏ 🎬 ✿ ☃ ❦ 🎁 ❋

- Exclamation mark !
- Quotation mark "
- The number sign #
- Dollar sign $
- Percent sign %
- Ampersand &
- Apostrophe '
- Left parenthesis (
- Right parenthesis)
- Asterisk *
- Plus sign +
- Comma ,
- Hyphen -
- Period (full stop) .
- Slash (forward slash) /
- Colon :
- Semicolon ;
- Less-than sign <
- Equals sign =
- Greater-than sign >
- Question mark ?
- At symbol @
- Left square bracket [
- Backslash \
- Right square bracket]
- Caret ^
- Underscore _
- Grave accent `
- Left curly brace {
- Vertical bar |
- Right curly brace }
- Tilde ~
- Euro symbol €
- Pound sterling £
- Yen ¥
- Cent ¢
- Copyright ©
- Registered trademark ®
- Trademark ™
- Degree °

LIST OF ABBREVIATIONS

Abbreviation	Full Form
CBSLA	Columbia Broadcasting System Los Angeles
WHO	World Health Organization
IAPB	International Agency for the Prevention of Blindness
ICCES	International Conference on Computational & Experimental Engineering and Sciences
IOT	Internet of Thinking
LiDAR	Light Detection and Ranging

CHAPTER 1
INTRODUCTION

1.1 Introduction

A visually impaired person refers to those individuals whose ability to see or interpret visual information is less than that of the normal sighted persons. The level of visual impairment may vary from slight to severe and may cover a range of conditions like low vision, partial sight, or total blindness. People without vision are used to practicing other systems and means such as Braille to move about in their environment, communicating and doing daily activities. These can include the use of assistive devices such as the canes, guide dogs, brailles, screen readers, and magnifiers, as well as alterations to the environment and the usual routines which are put in place to support the person with visual impairment. Smart shoes for visually impaired person are footwear designed for visually impaired people to assist them in navigating their surroundings more safely and independently .These shoes typically incorporate sensors, like ultrasonic sensors(HC-SR04), that can detect obstacles in the wearer's path. When an obstacle is close, the shoes might alert the wearer through vibrations or sounds. The user can change their path and prevent collisions by wearing the smart shoes, which employ vibration or other sensory cues to indicate the presence of obstacles and their vicinity. The plan for this project has three main parts. First, two HC-SR04 detectors are put into the shoe. They are put in spots to find things that the person can't see. One is on top and the other is on the side. They work together to see things near the person or obstacle. Next, an Arduino NANO chip is used to control everything. It takes data from the detectors and compares it to a set distance. If the distance is wrong, it sends a signal to turn on things to help the person. Lastly, two small vibration motors and a buzzer are used to tell the person if there's a problem. The motors will vibrate to show something is close and the buzzer will makes a sound. This plan aims to help visually impaired person to navigate their path safely and reducing accidents due to fall

1.2 Background Research

Visually impaired individuals face significant challenges in daily mobility, with navigation in unfamiliar environments being particularly difficult. According to the World Health Organization (WHO), there are at least 2.2 billion people globally with a visual impairment. This includes, with 39 million people classified as blind, Low vision with 246 million people and near vision impairment around 826 million people. Due to this their facing many challenging life rather than normal person its include difficulty detecting obstacles, changes in terrain, and identifying landmarks or objects that might be in their path. Existing assistive devices such as cane which can leads to accidental trips, falls and limited mobility and independence. Therefore, Assistive technologies, such as smart devices, can significantly improve their quality of life by enhancing mobility and reducing the risk of accidents.

For this project, the primary components include the Arduino Nano, ultrasonic sensor, and vibration motor. The Arduino Nano acts as the brain of the system, processing data from the ultrasonic sensor and activating the vibration motor to notify the user of nearby obstacles. The ultrasonic sensor will detect objects within a certain range, sending signals to the Arduino, which in turn will trigger the vibration motor based on the proximity of the detected obstacle. This system is compact, cost-effective, and easily programmable, making it ideal for integration into a smart shoe designed to assist visually impaired individuals.

There have been various studies and prototypes focused on smart shoes and wearable technology for visually impaired individuals.For example at LOS ANGELES,USA (CBSLA) ,Computer scientists have already created a smart shoe that helps blind and visually impaired people avoid multiple obstacles .The shoes, called InnoMake, contain waterproof ultrasonic sensors attached at the tip of each shoe. Whenever it encounters obstacles, the sensors send vibrations or make noises to signal the wearer.

However, challenges remain in terms of sensor accuracy, particularly in detecting low-lying or smaller obstacles, as well as ensuring user adaptability and comfort. Despite these challenges, the potential for wearable devices, such as smart shoes, to enhance the safety and independence of visually impaired individuals is clear.

1.3 Problem Statement

Blind and visually impaired individuals often face significant challenges in navigating their environment independently and safely, relying on traditional assistive tools like white canes. While these tools provide some support, they have notable limitations that can lead to accidents and injuries, making it harder for individuals to move freely. The proper use of a white cane requires specific technique and training, which can be difficult for certain groups such as children, the elderly, or those who have recently lost their vision due to an accident, illness, or other circumstances. Furthermore, white canes are unable to detect changes in elevation, such as steps or curbs, which increases the likelihood of trips and falls. This project seeks to address these limitations by developing smart shoes designed to enhance mobility, providing more reliable navigation assistance, and reducing the risk of accidents, thereby empowering individuals with impaired vision to move with greater confidence and independence

1.4 Research Objectives

The main objective of this project is helps the vision impaired navigate their environment more easily and safe.

More specifically the principle objective of this research are:

1. To assists the visually impaired person navigate their surrounding in an efficient

2. To develop a tool for minimizing trip and fall

3. To invent a tool to increase their independence, mobility, and safety.

1.5 Scope of Research

This project is focusing on developing an innovative solution to assist blind and visually impaired individuals by creating smart shoes that enhance navigation, reduce the risk of accidents, and promote independent movement. The primary goal is to address the limitations of traditional assistive tools such as white canes. Other than that, the emphasis is on integrating advanced sensor technologies such as ultrasonic sensors, into the smart shoes to detect obstacles, changes in elevation, and other environmental factors. This enables real-time feedback to guide users safely through their surroundings. Moreover, the main controller is using a microcontroller, such as an Arduino nano to process sensor inputs and control the response mechanisms of the smart shoes. The controller will manage the system's logic, ensuring that the shoes provide accurate and timely alerts to the user.

1.6 Project Significance

The significance of this project lies in its potential to greatly enhance the lives of blind and visually impaired individuals by providing a practical, innovative, and more reliable mobility solution. Traditional assistive tools, like white canes, have inherent limitations, often leading to accidents and restricting independence. By developing smart shoes equipped with advanced sensors, this project aims to overcome these challenges by offering real-time detection of obstacles, changes in terrain, and elevation variations. This not only reduces the risk of falls but also promotes safer and more confident navigation. The integration of real-time feedback mechanisms ensures that users can effectively respond to their environment, even in unfamiliar or complex settings. In doing so, the project empowers individuals with visual impairments, increasing their independence, mobility, and overall quality of life. Additionally, the success of this project could drive further advancements in assistive technologies, influencing the design of smarter, adaptive devices tailored to the evolving needs of visually impaired individuals.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Vision loss is predicted to increase by as much as 55 percent in the next 30 years, impacting some 600 million new people, according to the 'Vision Atlas' report by the International Agency for the Prevention of Blindness (IAPB,2024).As the number of people with vision impairments continues to grow, the need for effective assistive technologies becomes more critical. Addressing these challenges through innovative solutions, such as smart mobility aids, is essential for improving the quality of life and independence of visually impaired individuals worldwide

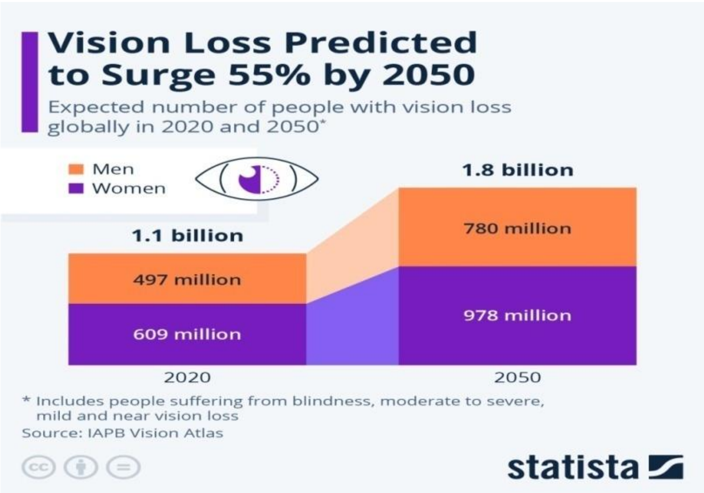

Figure 2.1: Statistic prediction of vision loss to surgery

2.2 Visually Impaired person Challenges in life

A visually impaired person is someone who experiences significant vision loss, ranging from partial vision to complete blindness, which cannot be fully corrected with glasses or medical treatment. This impairment can make it difficult for individuals to perform everyday tasks, such as reading, navigating their environment, or recognizing faces. Visually impaired individuals often rely on assistive tools like white canes, guide dogs, or advanced technologies to help them navigate and maintain independence in their daily lives. However, traditional white canes, are widely used by visually impaired individuals, but they come with several limitations and not safe (ICCES,2020).Furthermore, they fail to detect changes in terrain, such as steps or curbs, which can lead to accidents of fall .For example case ,Cleveland Gervais, 53, fell from the platform edge at Eden Park station in Bromley, south-east London, due to lack of tactile paving.The report by the Rail Accident Investigation Branch (RAIB,2020).

Recent advancements in assistive technologies have led to the development of wearable devices based on ultrasonic sensor, such as Eyeronman Vest by Eyeronman Technologies Introduced in 2020. It detects nearby obstacles and provides haptic feedback, creating a sense of spatial awareness for people with limited vision and also the weWalk smart cane launched in 2019, integrates ultrasonic sensors to detect obstacles above chest level and alerts users with vibrations. Based on these devices it shown the use of such sensors has shown promise in preliminary studies, suggesting that wearable mobility aids could significantly reduce accidents and promote greater independence.

By addressing the limitations of traditional aids and integrating modern technology, this project seeks to develop a new device of smart shoes for visually impaired person that capable of providing safer, more effective navigation support. Such innovations hold the potential to transform the landscape of assistive technology, ultimately fostering independence and improving the quality of life for visually impaired individuals.

2.2.1 Previous Research

Unfortunately, visually impaired individuals cannot cure their eyesight through medication alone. Surgery is required, but it is often costly and can take a significant amount of time to find a suitable donor. But there are varieties of similar devices to help and improve visually impaired person daily life to navigate the path safely on the market widely in the **Error! Reference source not found.**

Table 2. 1: Similar Devices to help visually impaired

Feature	 **WeWALK Smart Cane - https://wewalk.io/en/**	 **Sunu Band - https://www.aph.org/product/sunu-band/**
Sensor Technology	use ultrasonic sensors to detect obstacles	use ultrasonic sensors to detect obstacles
Haptic Feedback	vibrates to alert the user	vibrates to alert the user
Approval	Widely available in many countries, WeWALK is recognized as a certified assistive device.	FDA-registered as a Class I medical device in the United States, making it widely accepted as an assistive tool.

Both of these devices help visually impaired person navigate independently, but they can be quite expensive. The WeWalk is priced at approximately RM 2,300 to RM 2,500, while the Sunu Band costs around RM 1,300 to RM 1,500.

Due to these high costs, I came up with the idea of designing a new, more affordable device that is easy to wear and comfortable for users to take anywhere. This solution would be in the form of a **smart shoe**, by using the same components which is ultrasonic sensor and combining the benefits of mobility assistance with a practical, everyday wearable item.

2.3 Ultrasonic sensor

An ultrasonic sensor works by using sound waves to measure distance. It sends out high-frequency sound waves, which travel through the air until they hit an object. It play an important role in helping to compensate for or assist our eyesight .When the sound waves hit something, they bounce back to the sensor. The sensor has a receiver that detects the reflected sound waves. The time it takes for the waves to go to the object and come back is measured. By knowing how fast sound travels, the sensor can calculate how far away the object is. The shorter the time it takes for the sound to return, the closer the object is. Ultrasonic sensors are often used in robotics for obstacle avoidance, parking sensors in cars, and in other applications where measuring distance is important. They are useful because they don't need to touch the object to measure the distance and can give accurate results.

2.3.1 Microcontroller

A microcontroller (MCU) is a small, integrated chip that functions as the brain of an embedded system, combining a processor, memory, input/output ports, and peripherals into a single unit. It processes data from sensors, controls actuators, and executes program instructions, making it essential for tasks like controlling an obstacle-avoidance robot. Microcontrollers come in various types, such as Arduino, ESP32, and STM32, and are chosen based on factors like processing power, memory, I/O pins, and peripheral support, ensuring the system can efficiently handle tasks like sensor input processing, motor control, and communication.

2.3.2 Arduino

Arduino is an open-source electronics platform that combines easy-to-use hardware and software, designed for creating interactive projects. It consists of a microcontroller, typically an ATmega328 chip, and a development environment (Arduino IDE) that allows users to write and upload code to the board. Arduino boards feature input/output pins to connect sensors, motors, and other components, and support a wide range of pre-written libraries to simplify project development. Widely used for prototyping and learning electronics systems.

2.4 Literature review

This literature review examines various aspects of existing assistive technologies for visually impaired individuals, with a particular emphasis on obstacle detection methods such as ultrasonic sensors integrated into guide canes. Additionally, user experience studies will be explored to identify key factors in designing smart shoes that prioritize comfort, ease of use, and user preferences. By investigating current developments in smart shoes and wearable technologies, I aim to identify innovative ideas that could enhance the functionality of smart shoes. This research will provide a solid foundation for the development of smart shoes as a valuable assistive tool for visually impaired individuals. Through this review, I have gained valuable insights into the diverse approaches to assistive technology, which have further inspired and informed the design process for my project.

Table 2.2: Literature review of similar project

No	Title/Author	Objective	Method	Result
1	**Smart Assistive Shoes for Blind People**Ariba Khanam, Anuradha Dubey, Bhabya MishraDept. of Electronics and Communication Engineering, Gorakhpur, India	To overcome the difficulties in existing methods and provide a cost-effective and user-friendly system for blind navigation	Building smart shoes for the blind using sensors, feedback mechanisms, and Arduino for sensor testing. The ultrasonic sensor generates high-frequency sound waves and evaluates the echo received.	Smart assistive shoes are a promising development for aiding visually impaired individuals with navigation and obstacle detection. The shoes utilize sensors and feedback mechanisms to provide information about surroundings.
2	**Smart Shoe for the Blind**Dr. K. Venkata Rao, Mohammed Ameenulla Z, Damini K Devadiga, Deepa S Rao, Gauthami N.P	Objective 1: To detect obstacles in the path.Objective 2: To alert the user.Objective 3: To keep track of the user's location.Objective 4: To inform the guardian if the user falls.	To detect obstacles using an ultrasonic sensor and alert the user with a buzzer for obstacle avoidance.	Smart shoes help blind individuals navigate their surroundings safely, with ultrasonic sensors detecting obstacles and providing alerts through vibrations or sounds. Some shoes integrate with smartphones for enhanced navigation.
3	**Smart Shoe for Visually Impaired People**Dr. C. Sunitharam, B. Mithan Baskar, J. Vishnu	To create an Electronic Traveling Aid (ETA) to assist blind people in navigating clear paths.	Use of ultrasonic sensors and an ESP32 microcontroller to detect obstacles and notify the user via buzzers.	The smart shoes provide a effective method for blind people to detect obstacles in their path, using sensors to trigger alerts through

				vibrations or sounds.
4	**Smart Shoes for Obstacle Detection and Terrain Recognition for Blind People**Wang et al. (2019)	To develop a smart shoe system for obstacle detection and terrain classification.	Prototype development with pressure sensors, accelerometers, and machine learning algorithms for terrain recognition.	The system achieved high accuracy in detecting obstacles and classifying terrain types (e.g., grass, stairs), potentially enhancing awareness of the surrounding environment.
5	**A Wearable Navigation System for Visually Impaired People Using Smart Shoes and Indoor Positioning**Kim et al. (2021)	To integrate smart shoes with an indoor positioning system for navigation.	Prototype development with ultrasonic sensors, Bluetooth beacon infrastructure, and a smartphone app for navigation.	The system successfully provided turn-by-turn navigation indoors. Users reported increased confidence and efficiency in navigating unfamiliar environments.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

In order to realize this project as a product that ready to use with safety characteristic, a very comprehensive plan is undertaking. A step by step procedure is done so that the project can be completed in time. This include collecting data of user feedback, design the mechanical part, circuit design testing and verification.

3.2 Project Design and Overview.

As mentioned in the previous chapter, the design utilizes an Arduino Nano as the main controller for managing the ultrasonic sensor, which detects obstacles to assist visually impaired individuals in navigating safely. The design of the controller circuit, based on the Arduino Nano, was initially created and tested using Proteus software for simulation. This allowed us to ensure the functionality and reliability of the system before moving to hardware implementation.

3.2.1 Block Diagram of the Project

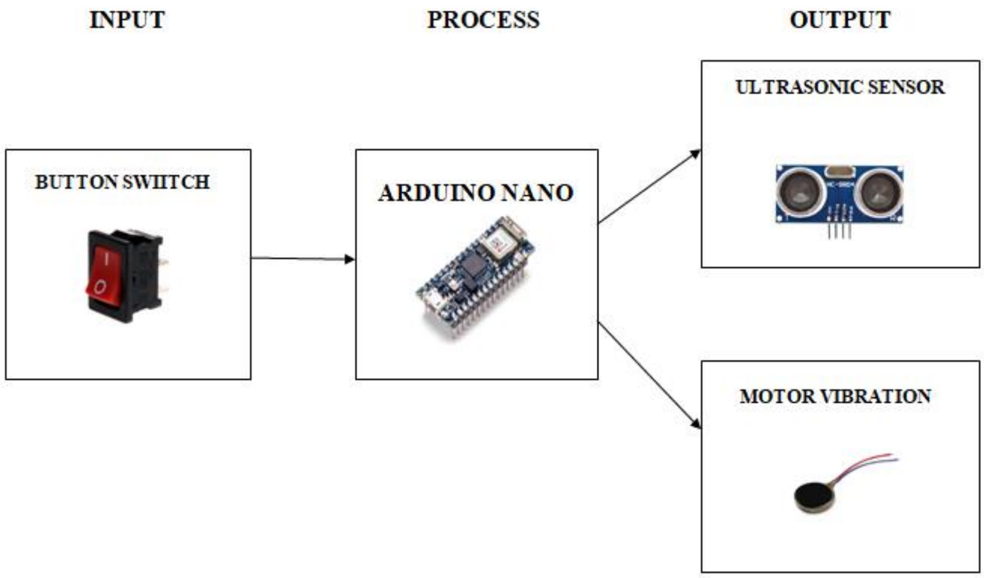

Figure 3.1: Block diagram of project

3.2.2 Flowchart of the Project

Figure 32 shows the circuit diagram of the whole system. It is shows that flowchart outlines of obstacle avoidance strategy with vibration motor for this project. It initiates by using its sensors to detect objects in its vicinity. Once an object is identified and receive the sensor will transmit the data and make the motor vibrate after the shoe calculates its distance. This distance is then compared to a predefined threshold. If the distance falls below the threshold, the robot activates its vibration and alerts to the user.

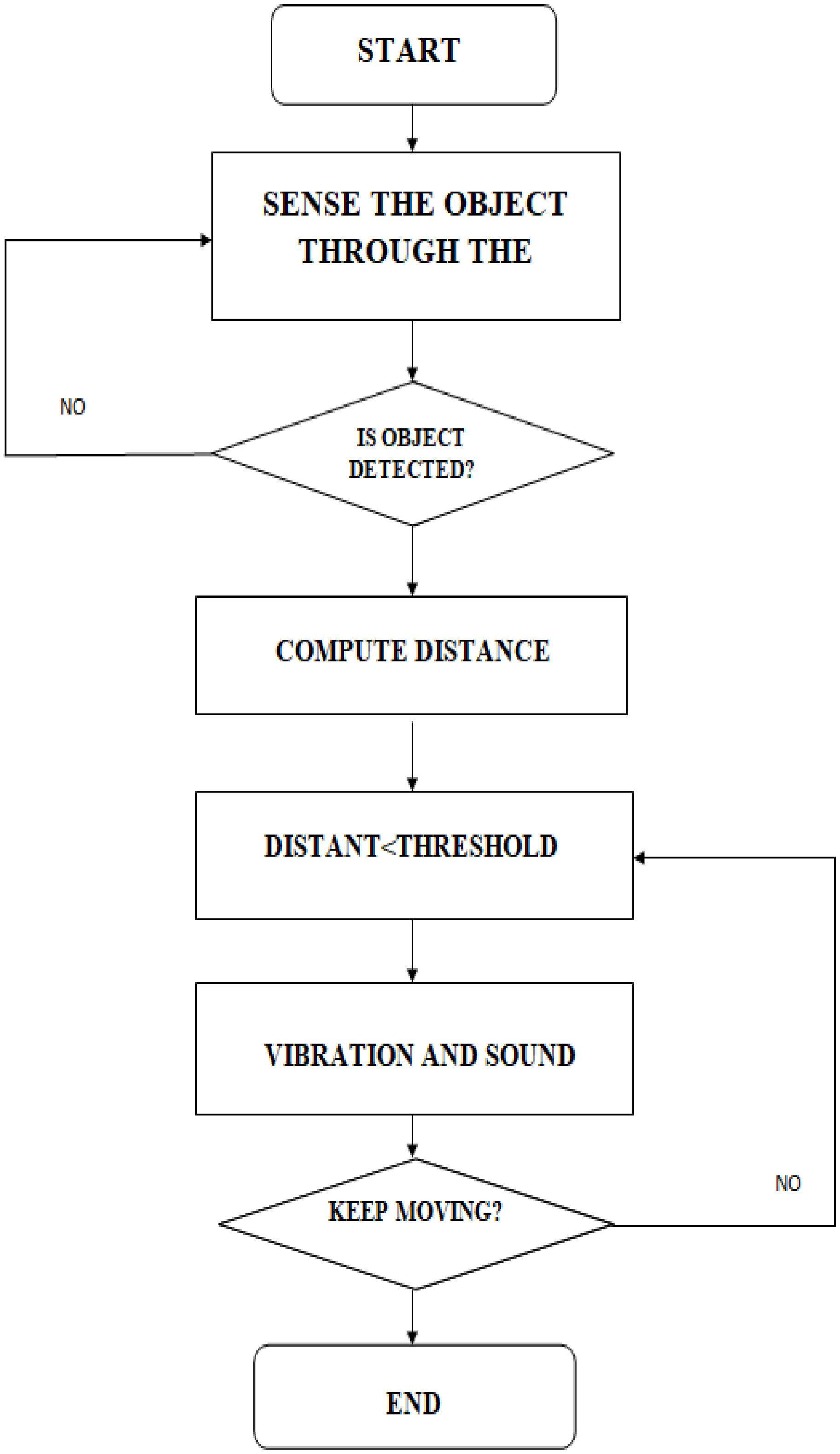

Figure 3.2: Flow chart of operation of the system

3.2.3 Project Description

As mentioned in the previous chapter, the design uses an Arduino Nano to control the ultrasonic sensor while navigating the surroundings. If the ultrasonic sensor detects objects or obstacles within 70 cm in front of the user, the motor will activate a vibration to alert the user, prompting them to be cautious and prepared. The motor will vibrate based on the proximity of the obstacle, with the intensity of the vibration varying depending on how close or far the obstacle is.

3.3 Project Hardware

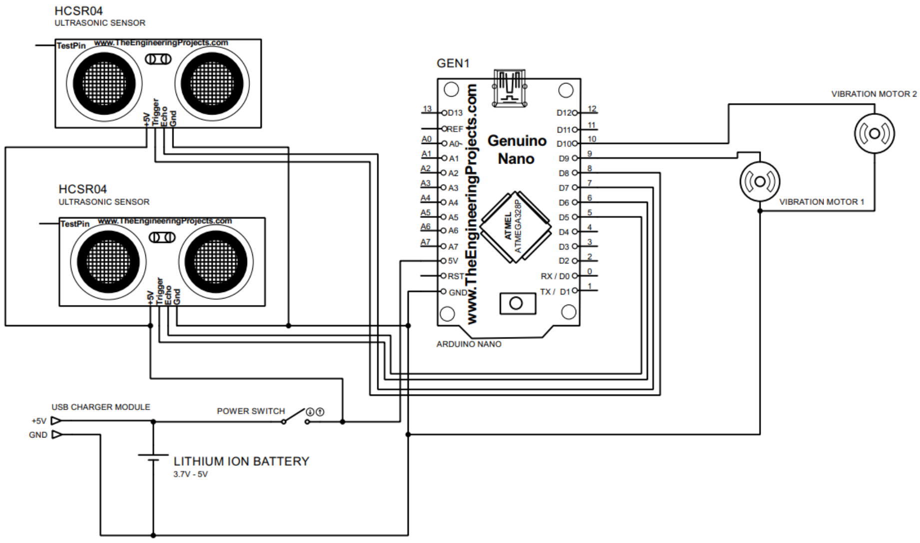

Figure 3.3: Schematic Circuit of the project

In this project the circuit diagram illustrates a system designed to detect obstacles using ultrasonic sensors and provide haptic feedback through vibration motors. The heart of the system is an Arduino Nano microcontroller, which serves as the central processing unit.

Two HC-SR04 ultrasonic sensors are connected to the Arduino, each with four pins: VCC for power, Trig for transmitting signals, Echo for receiving distance measurements, and GND for ground. Trig and Echo pins from ultrasonic sensor are connected to 8,7,6, and 5 pins to Arduino. The Arduino sends a trigger signal to the sensor, which emits an ultrasonic pulse. The sensor then measures the time it takes for the pulse to reflect off an object and return, calculating the distance to the object.

Based on the distance data received from the sensors, the Arduino code determines whether an obstacle is within a predefined range. If an obstacle is detected, the Arduino activates the vibration motors, which are connected to digital pins 9 and 10 on Arduino pins. The vibration motors provide tactile feedback to the user, alerting them to the presence of the obstacle.

The entire system is powered by a lithium-ion battery, which can be charged using a USB charger module. A power switch allows the user to control the power supply to the circuit. The project was tested through experiments, as outlined in Table 3.1.In this experiment, the motor vibration gradually fades as the distance from the obstacle increases.**Error! Reference source not found.**

Table 3.1:Smart shoe experiment on real person

	Range	Distancesdetected	Discussions
Big Box	30	1-74sm	Motor stop vibrate around 72-74cm
Big stone	30	1-74cm	Motor stop vibrate around 72-73cm
Small Box	30	1-73cm	Motor stop vibrate around 72-73cm
Small flower vase	30	1.70cm	Motor stop vibrate around 67-70cm
Small stone	30	1-73cm	Motor stop vibrate around 72-73cm

3.4 Project Software

The software development for the smart shoe project involved the use of **Proteus** and **Arduino IDE** as the primary tools. These platforms were essential in ensuring the successful integration and functionality of the hardware and software components. Proteus was primarily used for circuit simulation and design. It allowed for virtual testing of the interactions between the microcontroller, ultrasonic sensor, and vibration motor. This simulation phase was crucial in detecting and correcting potential errors in the circuit design before proceeding to the physical assembly. By visualizing how the components would interact in a real-world scenario, Proteus saved time and resources, ensuring a more streamlined development process.

The Arduino IDE, on the other hand, was utilized for programming the microcontroller, which serves as the brain of the smart shoe system. Through the IDE, code was written, compiled, and uploaded to control the system's functionality. The primary tasks implemented in the code included reading data from the ultrasonic sensor to detect obstacles, processing this data to assess the risk of collision, and activating the vibration motor to provide haptic feedback to the user. The IDE's built-in libraries, such as those for ultrasonic sensors, and tools like the Serial Monitor for debugging, facilitated efficient development and testing. Additionally, optimization techniques were applied to the code to ensure the system operated in real-time, delivering immediate feedback to the user.

The workflow began with circuit design and simulation in Proteus to validate the hardware's functionality. Once the design was confirmed to be robust, the Arduino IDE was used to develop and deploy the control logic, seamlessly integrating the software with the hardware. Despite some challenges, such as ensuring real-time response and debugging sensor-motor communication, these were effectively addressed through iterative testing in both tools.

The combined use of Proteus and Arduino IDE proved to be a reliable approach for the project. Proteus ensured the hardware was error-free, while Arduino IDE enabled the implementation of an efficient and functional control system. Together, these tools contributed to the successful development of the smart shoe, making it a practical and effective solution for assisting visually impaired individuals in navigating their environment safely.

Figure 3.4: Application Software

3.4.1 Schematic Circuit

Error! Reference source not found.shows the overall circuit diagram of this project.The schematic diagram show two HC-SR04 ultrasonic sensors, an Arduino Nano microcontroller, two vibration motors, a lithium-ion battery, and a USB charger module. The ultrasonic sensors are used to detect obstacles by sending out ultrasonic pulses and measuring the time it takes for the echoes to return. Each sensor's **Trig** and **Echo** pins are connected to specific digital pins on the Arduino Nano, allowing it to send and receive distance data. The Arduino Nano processes this data to determine the proximity of nearby objects. When an obstacle is detected within a specified range, the Nano activates the vibration motors connected to its digital output pins, providing tactile feedback to alert the user. The entire system is powered by a lithium-ion battery, which can be recharged via the USB charger module. A power switch is also included, enabling the user to easily turn the device on and off as needed.

3.4.2 Description of Arduino nano

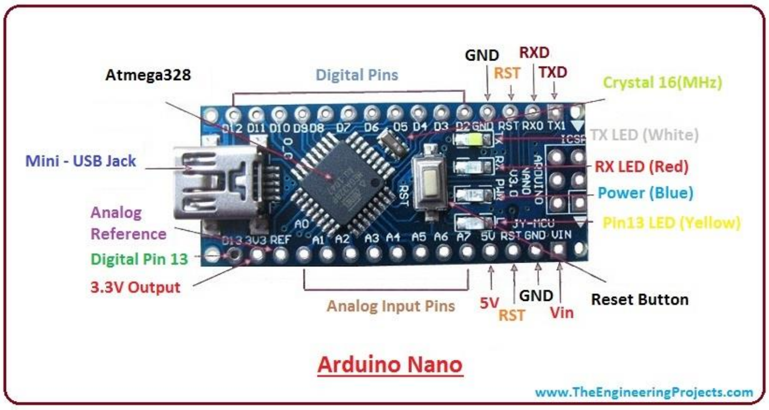

Figure 3.5 Arduino nano

The Arduino Nano is a compact, microcontroller board based on the ATmega328P chip. It serves as the brain of the system, controlling the functions of all other components. The Nano receives input signals from the ultrasonic sensors, processes the data, and determines whether an obstacle is close enough to trigger an alert. It is ideal for wearable projects due to its small size, low power consumption, and ease of programming.

3.4.2.1 Description of Ultrasonic sensor

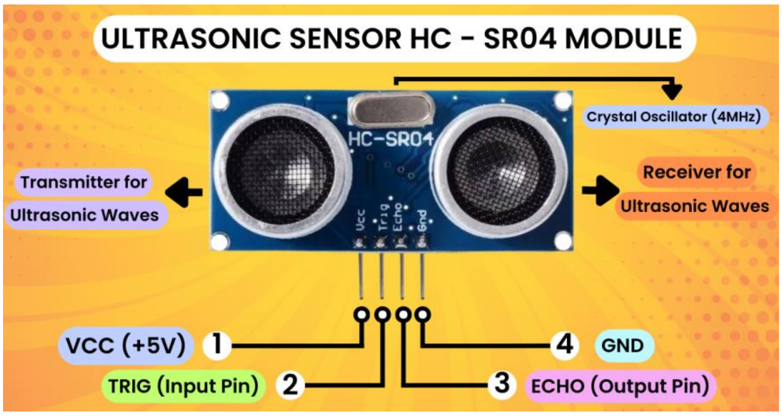

Figure 3.6: Ultrasonic sensor

These ultrasonic sensors detect obstacles by emitting high-frequency sound waves and measuring the time it takes for the echoes to return after bouncing off an object. Each sensor has four pins: VCC, Trig, Echo, and GND. The Trig pin sends the ultrasonic pulse, while the Echo pin receives the returning sound wave. The distance to an obstacle is calculated based on the time delay between sending and receiving the pulse. The sensors are highly accurate for short distances, making them suitable for detecting objects in close proximity to the user.

3.4.2.2 Description of Motor vibration

Figure 3.7: Motor vibration

The vibration motors provide haptic feedback to the user when an obstacle is detected. Controlled by the Arduino Nano, they vibrate to alert the user when an object is within a specified range. These motors are small and low power, making them ideal for wearable devices. By providing tactile feedback, the vibration motors ensure that the user can be alerted without needing to rely on visual or auditory cues, which is especially beneficial for visually impaired users.

3.4.3 Methodology of the Project

The methodology for this project is designed to develop a smart shoe system aimed at assisting visually impaired individuals in navigating their environment. This system will integrate various sensors and feedback mechanisms to enhance mobility and safety. The approach is divided into several stages, each critical to the successful completion of the project. The following sections outline the steps taken to design, develop, and test the smart shoes.

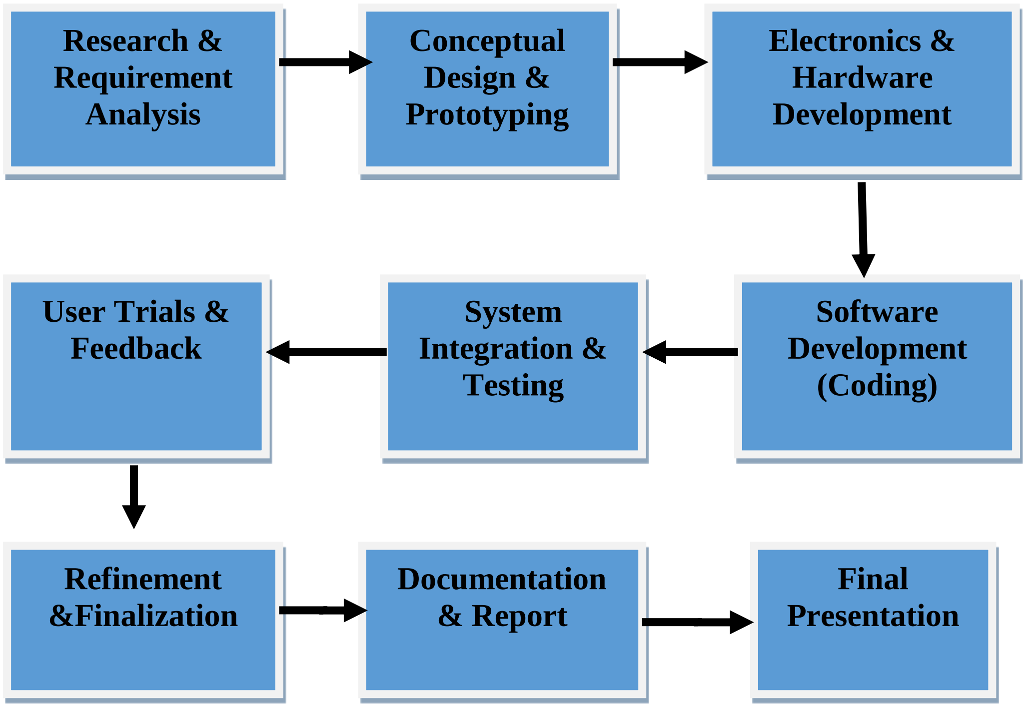

Figure3.8: Block diagram of the project flow

1. Research and Requirement Analysis

The initial phase of this project focuses on understanding the specific needs of visually impaired users, particularly with regard to mobility, obstacle avoidance, and safety. The objective is to gather comprehensive insights into the challenges faced by visually impaired individuals in different environments. Primary data will be collected through surveys and interviews with visually impaired users, allowing for the identification of key problems that need addressing, such as the difficulty of detecting obstacles and navigating unfamiliar spaces. Additionally, a thorough review of existing assistive technologies and smart footwear solutions will be conducted to identify gaps in the current market and inform the design process. The features prioritized for inclusion in the smart shoes will be based on user feedback, ensuring that the final product meets the needs of the target demographic. These features may include obstacle detection, real-time navigation assistance, and emergency alert systems.

2. Conceptual Design and Prototyping

Following the research phase, the conceptual design of the smart shoes will be developed. The primary objective of this stage is to create a functional prototype that is both effective and comfortable for long-term use. The design process will consider factors such as the ergonomics of the shoe, material selection, and the integration of sensors. The shoe must be lightweight and durable while housing the necessary electronic components. Ultrasonic sensors will be integrated on top and front and left and right side of the shoes for detecting obstacles, while vibration motors or haptic feedback systems will provide real-time alerts to the user based on proximity to objects.. An Arduino or similar microcontroller-based system will be used to process sensor data and trigger feedback responses. The prototype will be tested for comfort, fit, and practicality in real-world scenarios.

3. Electronics and Hardware Development

In this phase, the focus will shift to the development and integration of the electronics required for the smart shoes. The primary goal is to assemble the sensors, microcontroller, and feedback mechanisms into a compact system that fits comfortably on top of the shoe. Lightweight components such as ultrasonic sensors, vibration motors, and an Arduino Nano microcontroller will be selected to minimize weight and size while maintaining functionality. A small, rechargeable battery (e.g., Li-Po) will be used to power the system, ensuring the smart shoes are portable and energy-efficient. The system's wiring and components will be integrated into a custom-designed circuit board to ensure compactness and reliability. The challenge at this stage is to fit all necessary components into the shoe without compromising comfort or aesthetics. The shoe's design will ensure that the electronics are securely housed and that the overall product remains functional and practical for daily use.

4. Software Development

The software development stage involves programming the microcontroller to process the data from the sensors and provide real-time feedback to the user. The core task is to develop algorithms to handle ultrasonic sensor inputs, allowing the system to detect obstacles and trigger appropriate feedback, such as vibration alerts, when obstacles are in close proximity. The system will be tested for responsiveness and accuracy, with refinements made based on initial test results.

5. System Integration and Testing

After the hardware and software components are developed, the next step is system integration. The goal is to combine the hardware and software into a fully functional prototype. This involves ensuring that all components, such as sensors, microcontroller, and feedback systems, work seamlessly together. Initial testing will be conducted in a controlled environment, such as an obstacle course, to evaluate the system's performance in detecting obstacles and providing timely feedback. Test like response time, obstacle detection accuracy, and feedback effectiveness, will be measured. During testing, data will be gathered with user experience, and feedback used to make adjustments and improvements. This stage will also involve identifying and resolving any issues related to component compatibility or software bugs.

6. User Trials and Feedback Collection

Upon successful integration and testing of the system, user trials will be conducted to validate the system's usability in real-world settings. These trials will involve visually impaired participants navigating through both controlled and uncontrolled environments, such as indoor spaces, outdoor areas, and urban or rural settings. The goal is to assess the system's performance in various conditions and gather both qualitative and quantitative data on its effectiveness. User feedback will be collected to evaluate comfort, ease of navigation, and the effectiveness of the feedback mechanisms. This phase will also help identify any remaining issues with the system, such as excessive vibration or inadequate obstacle detection, which will be addressed in the subsequent refinement stage.

7. Refinement and Finalization

Based on the data collected during user trials, the design and functionality of the smart shoes will be refined. Adjustments will be made to the software, such as improving the accuracy of obstacle detection algorithms or fine-tuning the intensity and frequency of feedback. The physical design of the shoe will also be optimized for better comfort and durability. The system will undergo further testing to ensure that all components work reliably over extended periods of use. Once the refinements have been made and the system is deemed fully functional, the smart shoes will be finalized for production. This phase will also include the final testing of battery life, sensor durability, and overall system reliability.

8. Documentation and Report Writing

The final stage of the project will involve the documentation of the entire process, from research and design to testing and finalization. A detailed report will be written to describe the methodology, design choices, and results of the project. The report will also include an analysis of the challenges encountered during development and the solutions implemented to overcome them. In addition to the final report, a user manual will be created to guide users on how to operate the smart shoes, including instructions for charging, troubleshooting, and system maintenance. This documentation will serve as both a record of the project and a resource for future users or developers.

9. Final Presentation

The project will culminate in a final presentation to stakeholders, which may include academic supervisor or lectures and industry professionals. The presentation will include a demonstration of the smart shoes, showcasing their functionality, such as obstacle detection, feedback mechanisms, and navigation assistance. The presentation will also highlight the key features of the system, discussing the design choices, user feedback, and the potential impact of the smart shoes on the mobility and safety of visually impaired individuals. Any recommendations for future improvements will be shared based on feedback from users and stakeholders.

3.4.4 Gantt chart of Project

TITLE: SMART SHOE FOR VISUALLY IMPAIRED PERSON

GANTT CHART: PROJECT PLANNING THROUGH THE SEMESTER 4 AND 5

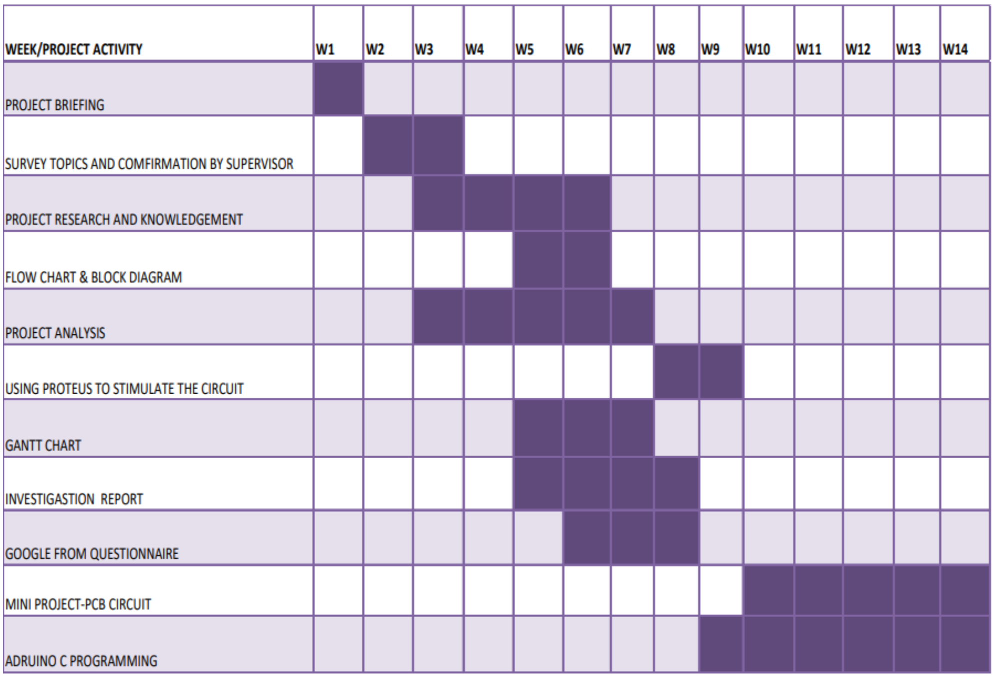

Figure 3.9: Gantt chart during semester 4

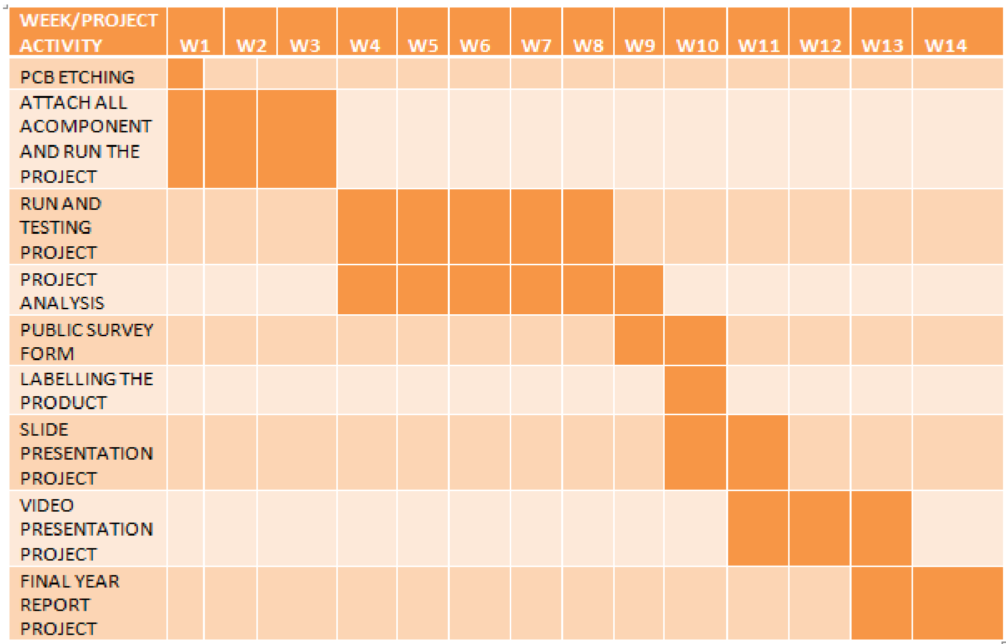

Figure 3.10: Gantt chart during semester 5

3.4.5 Budget of the Project

This project involves the cost of purchasing components and materials throughout its implementation. Components involving cost are hardware Arduino, alkaline battery 9v, ultrasonic sensor, Buzzer, wires jumper, shoes and other materials. All of these components are purchased through online purchase methods to make it easier as well as save on costs.The overall gross budget estimate in the implementation of this project is RM 230.40

Table 3.2: List of Components and Materials

No.	**Component and materials**	**The unit price**	**Quantity**	**Total**
1	Arduino nano set	Rm 30.00	2	Rm 60.00
2	Lithium ion battery 9v	Rm 4.20	2	Rm 8.40
3	Button swicth	Rm 3.00	2	Rm 6.00
4	Ultrasonic sensor (HS-SR04)	Rm 12.00	4	Rm 48.00
5	A pair of shoes	Rm 40.00	1	Rm 40.00
6	Wires	Rm 5.00	-	Rm 5.00
7	Soldering Iron set	Rm 35.00	-	Rm 35.00
8	Vibration Motor	Rm 5.00	4	Rm 20.00
9	Clear casing per pieces	Rm 2.00	4	Rm 8.00
			TOTAL:	**Rm 230.40**

3.5 Prototype Development and Etching

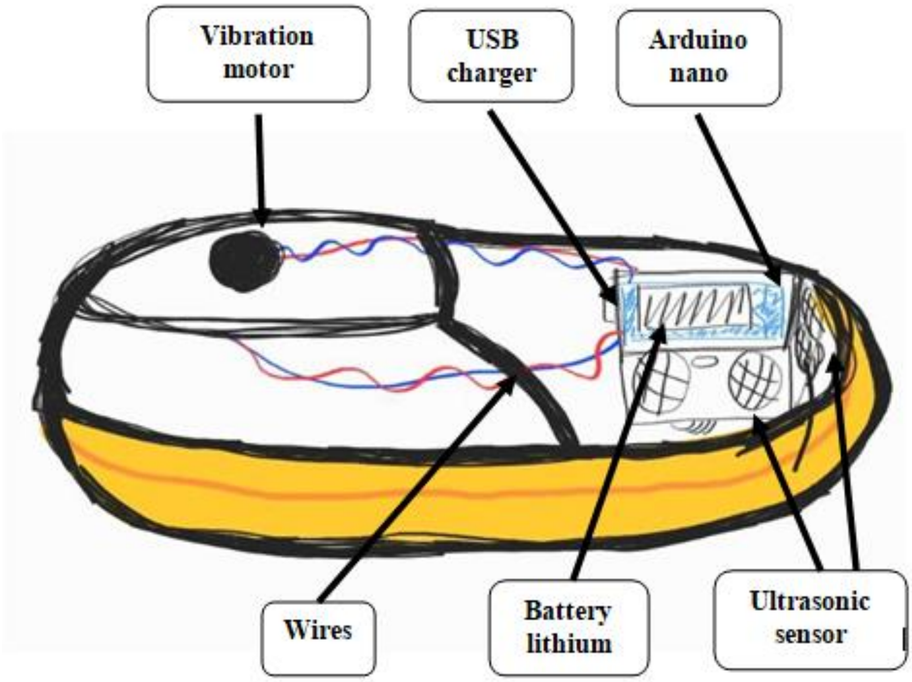

Figure 3.11: Right side view prototype smart shoes

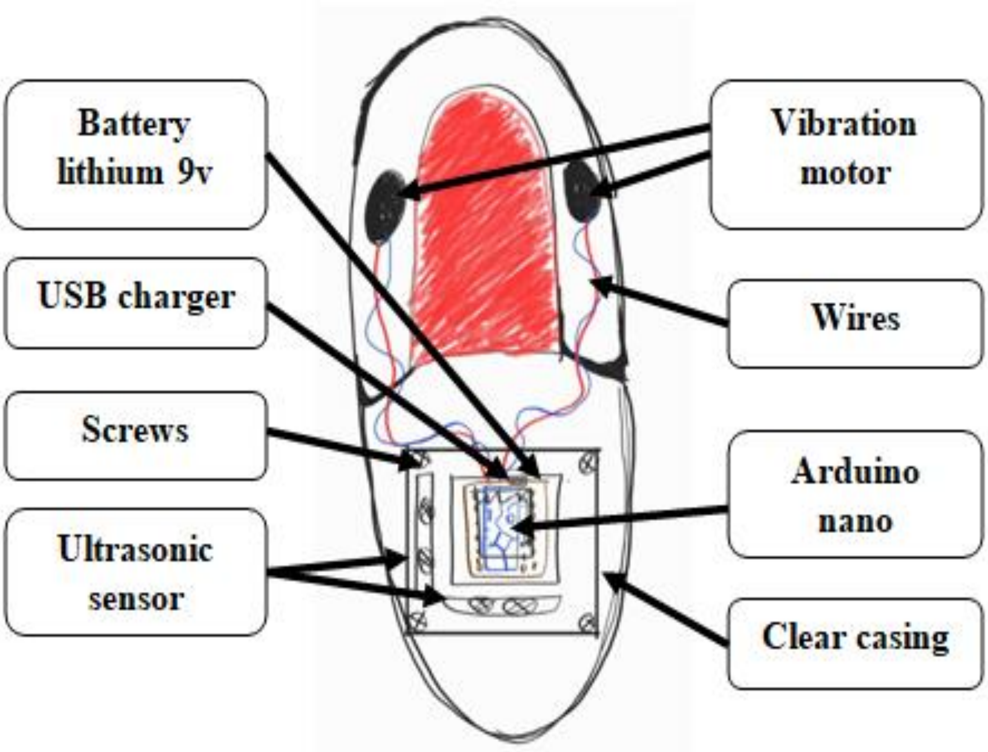

Figure 3.12: Top view of prototype smart shoe

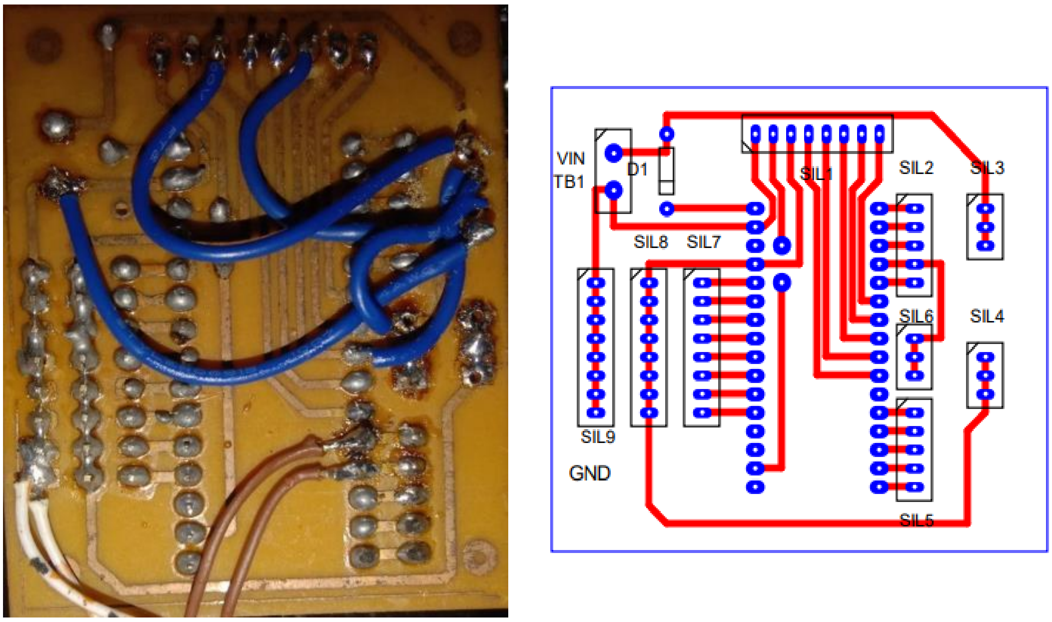

Figure 3.11: Right side view prototype smart shoes

3.5.1 Mechanical Design/Product Layout

The mechanical design or product layout illustrated in Figure 3.4.2 showcases the product's appearance, detailing both front and side views, as shown in Figure 3.4.2. This design is focused on the implementation of smart shoes for visually impaired individuals. The shoes are equipped with sensors strategically placed on the front, right and left which resemble two "eyes" providing obstacle detection capabilities. The ultrasonic sensor allowing the shoes to detect obstacles ahead and aid the user in navigating safely. The layout and arrangement are crucial for optimizing the sensors' field of view to detect obstacles at a range appropriate for real-time navigation assistance. This design ensures functionality without compromising the aesthetic look of the shoes, aiming to maintain a conventional appearance while incorporating advanced technology for enhanced mobility and safety

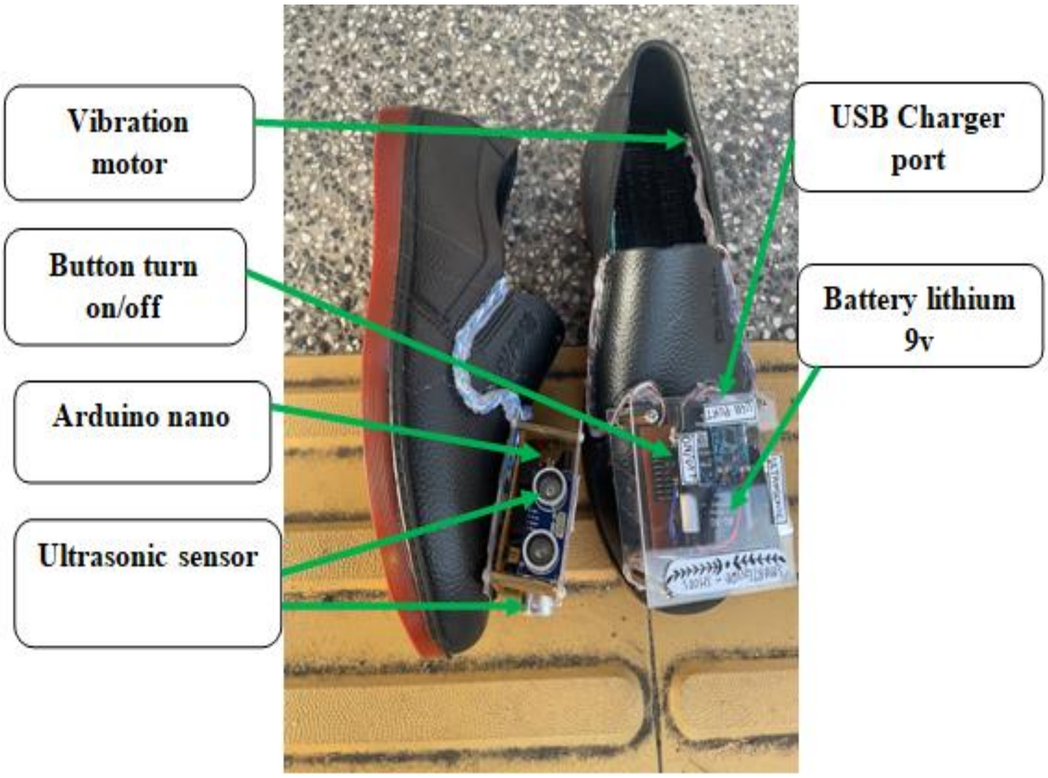

Figure 3.14: Front view and side view design

3.6 Sustainability Element in The Design Concept

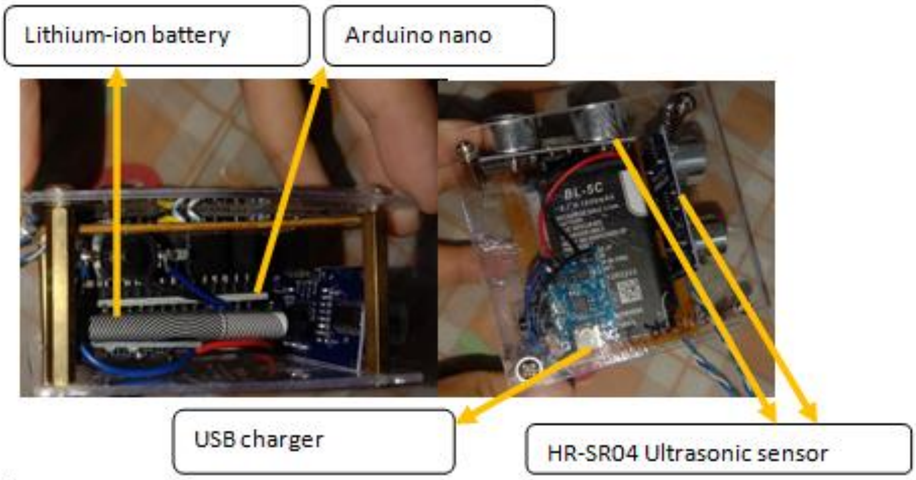

Figure 3.15: Product design concept

Energy Efficiency: The device uses a lithium-ion battery, which is rechargeable and energy-efficient. Lithium-ion batteries have a long life cycle and can hold a charge for extended periods, reducing the need for frequent battery replacements and minimizing electronic waste. The use of rechargeable batteries also makes the system more sustainable by lowering dependency on single-use batteries, which contribute to landfill waste and pollution.

Compact and Lightweight Design: The compact nature of the design minimizes material usage, making the device lighter and easier to transport. The design also makes it more suitable as a wearable device, which make the user comfortable and reduces the chances of the product being discarded due to impracticality.

Low Power Components: The components chosen, such as the Arduino Nano and HC-SR04 ultrasonic sensors, are known for their low power consumption. By using efficient microcontrollers and sensors, the design minimizes energy usage, extending battery life and reducing the environmental impact of frequent charging

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the interpretation of results and analysis of the data collected from the public respondent of development and testing of the smart shoe designed to assist visually impaired person. The findings of this study are examined in relation to the objectives of the project and compared with results from previous research highlighted in the literature review. By evaluating the performance and effectiveness of the smart shoe, this chapter aims to demonstrate its potential impact in enhancing mobility, safety, and independence for visually impaired users.

4.2 Results and Analysis

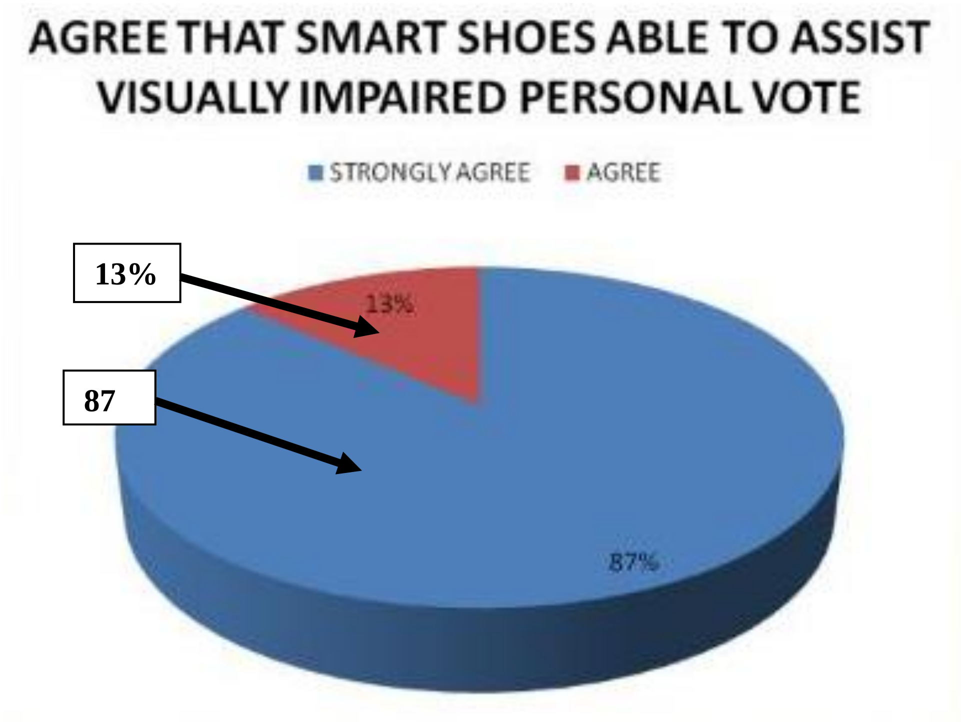

Figure 4.1 : Pie Chart of Smart Shoes Able to Assist Visually Impaired Person

Figure 4.1 illustrates a pie chart showcasing the feedback on whether smart shoes are capable of assisting visually impaired individuals. The results reveal that a significant majority, 87% of respondents, strongly agree with the effectiveness of smart shoes in aiding visually impaired persons. Meanwhile, 13% of respondents agree with the statement, although with less conviction. These findings indicate a high level of confidence in the potential of smart shoes to enhance the mobility, independence, and safety of visually impaired individuals.

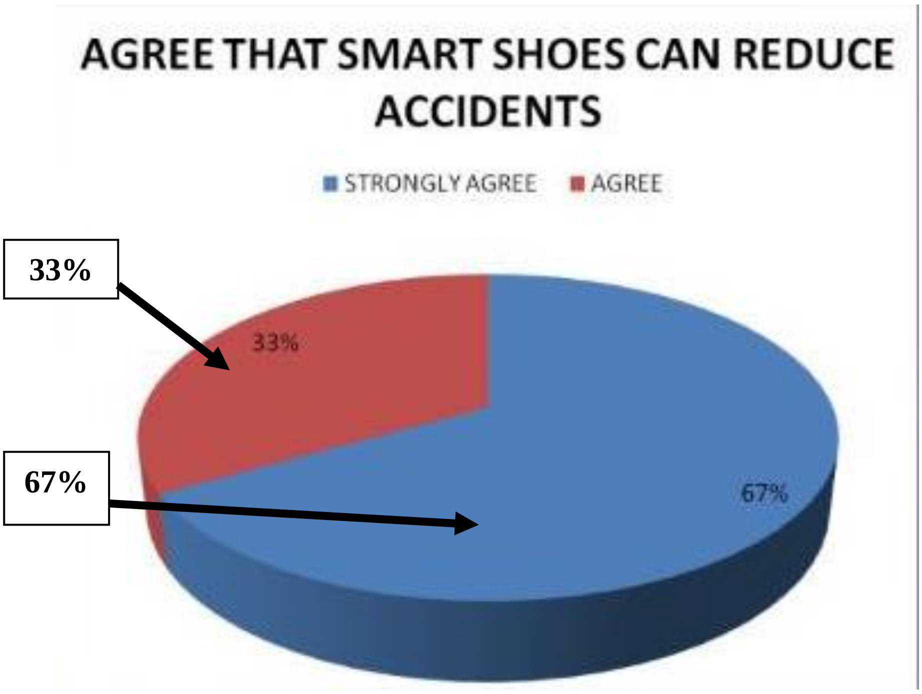

Figure 4.2: Pie Chart of Smart Shoes Can Reduce Accidents

Figure 4.2 illustrates a pie chart showcasing the feedback on whether smart shoes can reduce accidents. The results reveal that a significant majority, 67% of respondents, strongly agrees with the effectiveness of smart shoes can reduce accidents. Meanwhile, 33% of respondents agree with the statement.

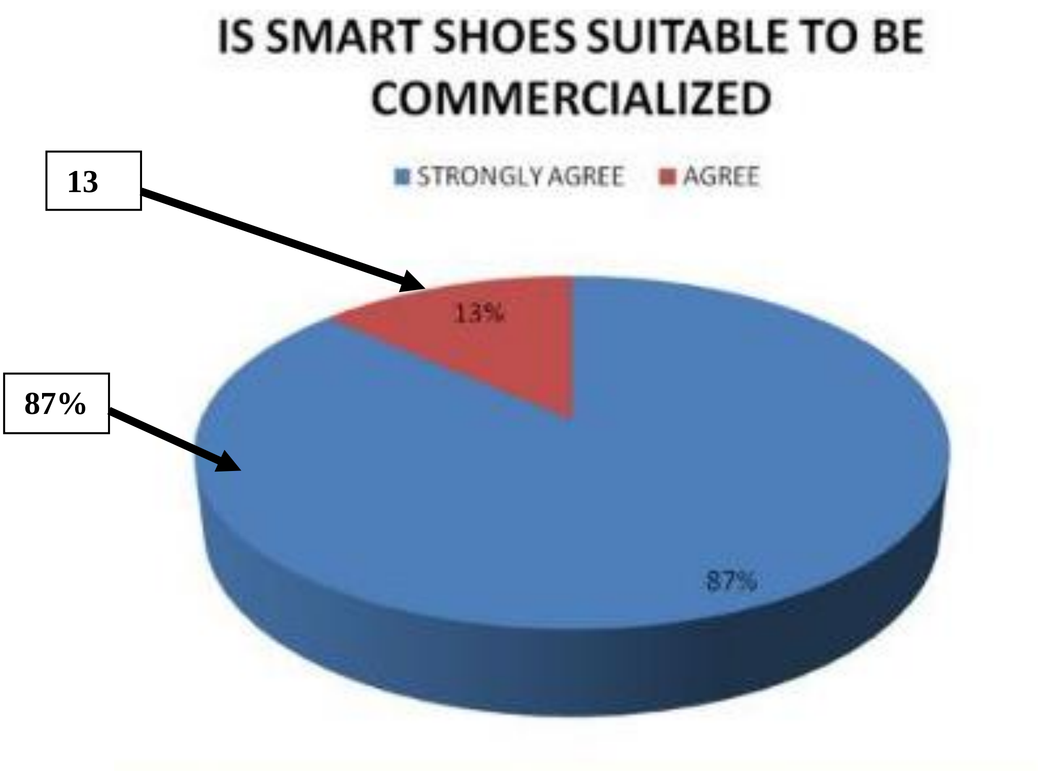

Figure 4.3: Pie Chart of Smart Shoes Suitable to Be Commercialized

Figure 4.3 illustrates a pie chart showcasing the feedback on whether smart shoes to be commercialized. The results reveal that a significant majority, 87% of respondents, strongly agree with the effectiveness of smart shoes in aiding visually impaired persons. Meanwhile, 13% of respondents agree with the statement.

As part of this project, I conducted a survey to gather public opinions. According to Chart 1, which addresses whether "Smart Shoes Can Assist Visually Impaired person," 87% of respondents strongly agreed, and 13% agreed. Similarly, in Chart 3, which considers the "Suitability of Smart Shoes for Commercial Use," the results show that 87% strongly agreed, and 13% agreed. In Chart 2, which explores whether “Smart Shoes Can Reduce Accidents,” 67% of respondents strongly agreed, while 33% agreed? Overall, the survey results indicate broad agreement that these smart shoes can offer significant benefits to visually impaired individuals.

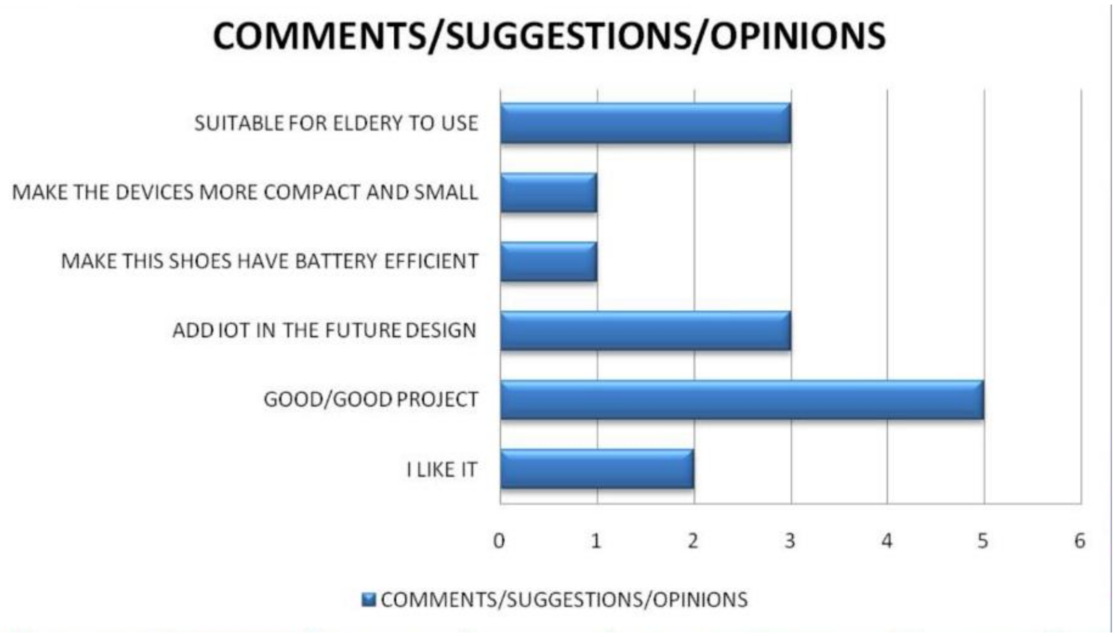

Figure 4.4: Comments and suggestion from Public Respondent

In figure 4.4, we have a summary of the feedback collected from participants regarding the smart shoes project. The most common suggestion was that the shoes are need IOT(internet of thinking) in this project. Overall, the feedback reflects strong support for the concept and offers valuable insights for improving the design and considering its potential marketability for both elderly and visually impaired users.

4.3 Feedback User

Figure 4.5: First experience of user using Smart Shoes

For a visually impaired person using smart shoes for the first time, the experience could feel empowering. As they walk, the shoes provide vibrations or sounds to alert them of obstacles in their path, such as curbs or objects. At first, they may feel cautious but gradually become more confident, using the feedback to navigate safely and independently. The shoes help reduce the risk of trips and falls, giving the user more freedom and confidence to move around without needing assistance. Over time, they will likely become more comfortable relying on the smart shoes during daily activities.

4.4 Discussion

The smart shoes project for visually impaired persons aims to enhance mobility and safety by incorporating advanced navigation assistance features. The design process focused on integrating technology in a way that would be both functional and comfortable, given the need to fit sensors, feedback systems, and a power source within a standard shoe design. Key components like ultrasonic sensors for obstacle detection, a microcontroller for processing data, and vibration motors for haptic feedback were selected based on size, weight, and power efficiency. Ensuring the system’s real-time response was essential for providing timely feedback, enabling users to detect obstacles and respond quickly.

During testing, trials conducted in controlled environments revealed the system's ability to detect various obstacle types and trigger feedback effectively, although adjustments were necessary to improve sensor accuracy and feedback timing. User trials provided crucial insights into the device's comfort and usability, leading to design refinements such as optimizing vibration intensity and adjusting sensor placement. Feedback from visually impaired participants underscored the value of the device in navigating challenging environments and avoiding hazards. However, battery life and component durability also emerged as considerations for long-term usability.

Overall, the smart shoes successfully demonstrate a viable solution for visually impaired users, offering greater independence and confidence in navigation. Future improvements could involve refining the form factor, enhancing battery efficiency, and potentially adding features like GPS or IOT (Internet of Think) for further navigation support. This project highlights the potential of wearable technology in assistive applications, contributing positively to the quality of life for visually impaired person.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The smart shoe project for assists visually impaired person aims to enhance their mobility and safety by providing a simple, effective, and wearable navigation aid. By integrating an ultrasonic sensor, Arduino Nano, and vibration motor, the system can detect obstacles in the user's path and provide tactile feedback, alerting them to potential hazards. The compact and lightweight design ensures that the device is non-intrusive, easy to use, and suitable for daily wear.

This project addresses key challenges faced by visually impaired individuals, such as navigating unfamiliar environments and avoiding obstacles, by offering a cost-effective and practical solution. The use of readily available and affordable components makes this device accessible to a wider audience.

While challenges such as power consumption, sensor accuracy, and user adaptability must be considered, the proposed smart shoe system has the potential to significantly improve the independence and quality of life for visually impaired individuals. By leveraging simple yet powerful technologies, this project contributes to the development of assistive devices that bridge the gap between functionality and affordability.

5.2 Recommendations

To enhance the functionality and expand the potential applications of the smart shoe for visually impaired individuals, several improvements can be recommended. One key area for future development is, incorporating advanced sensing technologies such as infrared or LiDAR could further improve accuracy and reliability, especially in detecting smaller or more complex obstacles that may be challenging for ultrasonic sensors alone.

Power efficiency is another crucial aspect to address. Extending the battery life and making the device more practical for daily use. Other than that, a user-friendly interface, such as an on/off switch or adjustable sensitivity settings, would enhance adaptability and convenience for users, ensuring that the system meets individual preferences.

Incorporating Internet of Things (IoT) capabilities into the future design of the smart shoe would bring significant advantages. By enabling the device to connect to a smart phone or cloud-based application, real-time data on the user's environment could be shared and analyzed. This could allow for features such as GPS navigation, remote monitoring by caregivers, and integration with other smart assistive devices. For instance, IoT integration could enable the shoe to provide audible navigation cues via a smart phone app or alert caregivers in case of emergencies, such as falls. Additionally, data collected from the device could be used for long-term analysis to improve user mobility patterns and further refine the system's performance.

Lastly, conducting user testing with visually impaired individuals is essential for gathering valuable feedback on comfort, effectiveness, and usability. This feedback would guide future iterations of the design, ensuring that the device remains user-centered and impactful. By addressing these recommendations, the smart shoe can evolve into a highly reliable, efficient, and innovative assistive device that not only enhances mobility and safety but also embraces the potential of IoT to further improve the quality of life for visually impaired individuals.

5.3 Suggestions for future work

Future improvements to the smart shoe can focus on adding more features and enhancing its usability. One idea is to include additional sensors like infrared, LiDAR, or cameras to improve obstacle detection. These sensors can help identify smaller or hard-to-detect objects, making the shoe more reliable in different environments.

Another area to explore is adding Internet of Things (IoT) features. By connecting the shoe to a smartphone or cloud app, it could provide GPS navigation, send emergency alerts, or allow caregivers to monitor the user’s safety remotely. IoT integration could also enable advanced features like audible guidance or data tracking to improve the system over time.

Improving battery life is also important. Using low-power components, optimizing the code, or exploring renewable energy sources like solar panels or kinetic energy could make the device last longer between charges.

Lastly, the shoe’s design can be made more comfortable and lightweight by using better materials and ensuring the components are neatly integrated. User testing is essential to get feedback from visually impaired individuals and make changes based on their needs. These improvements can help make the smart shoe more practical, reliable, and helpful in daily life.

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APPENDICES

APPENDIX A- DATA SHEET

1. **Ultrasonic Sensor (HC-SR04)**

- **Features**: Distance measurement from 2cm to 400cm with ±1cm accuracy
- **Operating Voltage**: 5V
- **Datasheet Link**: https://www.alldatasheet.com/view.jsp?Searchword=Sr04%20datasheet&gad_source=1&gclid=CjwKCAiA3Na5BhAZEiwAzrfagEPK94NqY37unOb6ua7s42ofxQei7Ge7KQQ_F9kQuml69hhjbAZz2xoCmBAQAvD_BwE

2. Microcontroller (Arduino Uno)

- **Features**: 14 digital I/O pins, PWM support, 5V input
- **Datasheet Link**: https://www.alldatasheet.com/view.jsp?Searchword=ARDUINO%20NANO

3. **Vibration Motor (for Feedback)**

- **Features**: 3V to 5V operating voltage, used for tactile feedback
- **Datasheet Link**: https://www.alldatasheet.com/view.jsp?Searchword=MOTOR%20VIBRATION

4. **Battery (Li-Po Battery)**

- **Features**: Rechargeable, 3.7V, varies by capacity (mAh)
- **Datasheet Link**: https://www.alldatasheet.com/view.jsp?Searchword=LI-PO%20BATTERY

APPENDIX B- PROGRAMMING

```
#define echoPin1 6

#define trigPin2 5

#define echoPin2 4

#define Vib1 8

#define Vib2 9


int PWM=130;

int Tm=0;

int Alarm=0;


void setup(void)

{

pinMode(trigPin1, OUTPUT);

pinMode(echoPin1, INPUT);

pinMode(trigPin2, OUTPUT);

pinMode(echoPin2, INPUT);

pinMode(Vib1,OUTPUT);

pinMode(Vib2,OUTPUT);


Serial.begin(9600);

}

void loop(void)

{

 long duration1x, duration2x, duration3x, distance3, duration4x, distance4, duration5x,
distance5;
```

```
delayMicroseconds(10); // Added this line
digitalWrite(trigPin1, LOW);
  duration1x = pulseIn(echoPin1, HIGH);
  distance1 = ((duration1x/2) / 29.1); //* 0.26;
  //inch=distance1*0.393701;

digitalWrite(trigPin2, LOW);  // Added this line
delayMicroseconds(2); // Added this line
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10); // Added this line
digitalWrite(trigPin2, LOW);
  duration2x = pulseIn(echoPin2, HIGH);
  distance2 = ((duration2x/2) / 29.1); //* 0.26;
  //inch=distance1*0.393701;

Serial.print(distance1,2);
Serial.print("\t");
Serial.println(distance2,2);

if (distance1>40 && distance1<150){
digitalWrite(Vib1,HIGH);

delay(distance1);
digitalWrite(Vib1,LOW);

delay(distance1);
}
if (distance1>0 && distance1<=40){
```

```
delay(50);
}

if (distance2>40 && distance2<150){
digitalWrite(Vib2,HIGH);

delay(distance2);
digitalWrite(Vib2,LOW);

delay(distance2);
}
if (distance2>0 && distance2<=40){
digitalWrite(Vib2,HIGH);

delay(50);
digitalWrite(Vib2,LOW);
delay(50);
}
}
```

APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE

1. Operation and Usage

- **Step 1**: Power on the device using the switch.
- **Step 2**: Wear the shoes and ensure sensors are positioned correctly for optimal detection.
- **Step 3**: The device will automatically detect obstacles within its range and alert the user via vibrations or sound.
- **Step 4**: Recharge the battery as needed after usage.

2. Maintenance Guidelines

- Regularly check the sensors and clean them to avoid dust accumulation.
- Inspect wiring connections to ensure durability and safety.
- Recharge the battery as per usage to maintain optimal performance.

3. Troubleshooting

Issue	Possible Cause	Solution
No feedback from the system	Battery is drained	Recharge the battery.
Inconsistent obstacle alerts	Sensors are misaligned	Reposition the sensors properly.
Vibration feedback not working	Loose wiring to the motor	Secure the wiring connections.

4. Safety Measures

- Avoid exposing the device to water or moisture.
- Ensure the battery is disconnected during prolonged storage.
- Use the device only for its intended purpose.