Smart shoe for visually impaired person

A mini project report
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in

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Certificate

This is to certify that the project report entitled "Smart Shoe for visually impaired person " is a bonafide record of the work done by **SHAHMA K (MEA20IT023)** *under our supervision and guidance. The report has been submitted in partial fulfillment of the requirement for award of the Minor Degree of* **Bachelor of Technology** *in* **Electronics and Communication Engineering** *from the APJ Abdul Kalam Kerala Technological University for the year 2023.*

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Abstract

The Smart Shoe, designed specifically for visually impaired individuals to enhance their mobility and independence. Visual impairment significantly impacts the daily lives of millions of people worldwide, restricting their ability to navigate their environment safely. The Smart Shoe incorporates advanced technologies and sensory feedback mechanisms to provide real-time assistance and improve spatial awareness for visually impaired individuals.

The Smart Shoe employs an array of sensors, including distance sensors, accelerometers, and gyroscopes, to collect real-time data about the user's surroundings and movement. These sensors enable the shoe to detect obstacles, changes in terrain, and provide accurate spatial information. The collected data is processed by an embedded microcontroller, which utilizes machine learning algorithms to interpret and analyze the sensory inputs.

List of Abbreviations

GPS	Global Positioning System
TX	Transmitting Pin
RX	Recieving Pin
IOT	Internet Of Things
PWM	Pulse Width Modulation

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CHAPTER 1

Introduction

Imagine a world where navigating the streets becomes effortless for visually impaired individuals. Introducing Smart Shoes, a revolutionary technology designed to empower and enhance the lives of the visually impaired community. With live tracking capabilities, these shoes aim to provide a safer and more independent mobility experience.

One of the key features of these Smart Shoes is live tracking. Using GPS technology, the shoes accurately pinpoint the wearer's location and provide continuous updates to a connected smartphone or wearable device. This live tracking feature ensures that visually impaired individuals can confidently navigate their surroundings, knowing they have a reliable and real-time source of information guiding their steps.

The Smart Shoes also incorporate obstacle detection sensors, allowing users to detect and avoid potential hazards in their path. These sensors utilize innovative technologies such as proximity sensors, infrared scanners, or depth perception cameras to provide immediate feedback to the wearer. This proactive obstacle detection system helps prevent accidents and enhances the user's overall safety.

This shoe will be enriched with various sensors with their numerous features which would help blind persons to make their way to destination. People with visually impaired faced most of the challenges in the environment. The long Hoover Cane used by them is not advantages while walking and travelling. Smart shoes is a smart footwear technology. It adopts smartphone applications to support tasks cannot be done with standard footwear. The uses shows vibrating of the smart phone to tell users when and where to turn to reach their destination via Google Maps or self-lacing. Using smart shoes for visually impaired people need not to be depending on others for mobility. The systems we have designed consist of sensors and vibrator for sensing the surrounding environment and giving feedback to the blind person. It is used as a safety device as well as navigation device. The electronic hardware will be fixed in shoes for users. User will wear the shoe and travel anywhere, and attached sensor will be sense obstacles near to the shoes alerts with the help of visually impaired people

FIGURE 1.1: Image of smart shoe

Smart shoes have emerged as innovative solutions to assist individuals in various aspects of their daily lives. One particularly valuable application is in aiding visually impaired individuals to navigate their surroundings independently and safely. In this introduction, we will explore the concept of a smart shoe equipped with an ultrasonic sensor, a buzzer, and an Arduino microcontroller, designed to provide real-time feedback and enhance the mobility of the visually impaired.

1.1 Need for Smart Shoes for the Visually Impaired:

For people with visual impairments, navigating unfamiliar environments can be challenging and potentially hazardous. Traditional aids like canes and guide dogs have limitations in detecting obstacles at lower body levels. A smart shoe with advanced sensor technology can complement these aids and provide additional information to help users avoid obstacles and navigate more confidently.

1.2 How the Smart Shoe Works:

As the user walks, the ultrasonic sensor continuously measures distances to objects in the shoe's vicinity. When an obstacle is detected within a predefined range, the Arduino triggers the buzzer to emit sound alerts. The user can interpret the sounds and adjust their path accordingly to avoid the obstacle. With this real-time feedback mechanism, the smart shoe empowers visually impaired individuals to move around with increased safety and confidence.

1.3 Benefits

Smart shoes with ultrasonic sensors, buzzers, and Arduino microcontrollers offer a practical and cost-effective solution for obstacle detection and navigation assistance. As technology continues to advance, there is room for further improvement, such as integrating additional sensors for more comprehensive environmental awareness or incorporating connectivity features to communicate with smartphones or other assistive devices.

CHAPTER 2

Background Information and Literature Review

Here's some background information on the key components and functionalities of smart shoes for visually impaired persons:

1.Sensor Technology: Smart shoes often employ a combination of sensors to gather data about the user's surroundings. These may include:

- Obstacle Detection Sensors: These sensors use ultrasonic or infrared technology to detect nearby objects and obstacles in the path of the wearer.

2. Connectivity and Live Tracking: Smart shoes can be connected to mobile devices or dedicated companion apps via Bluetooth or Wi-Fi. This connectivity enables live tracking and communication with other devices or individuals. Key features include:

- GPS Tracking: By integrating GPS technology, smart shoes can determine the wearer's location in real-time. This information can be shared with caregivers, family members, or emergency services, allowing for assistance or monitoring.
- Navigation Assistance: Using GPS data and mapping applications, smart shoes can provide turn-by-turn directions or auditory cues to guide the wearer along a predefined route.

3.Embedded Systems Programming: The Arduino Integrated Development Environment (IDE) is the primary software used for programming Arduino boards. It provides a code editor, compiler, and uploader for Arduino sketches (programs). The IDE is available for Windows, macOS, and Linux.

- Once the Arduino sketch is written, it can be compiled and uploaded to the Arduino board using the Arduino IDE

4.Communication and Data Processing: Smart shoes may require communication protocols and data processing capabilities. Programming languages used in these areas include:

- Python: Python is widely used for data processing tasks due to its extensive libraries for scientific computing and data analysis.

2.1 Literature Survey:

2.1.1 Comparison Table

AUTHOR	DESCRIPTION	LIMITATIONS
Kela, N., Pussegoda, K., Srinivasan, M. (2017)	Design of an obstacle detection system for visually impaired people using ultrasonic sensors. Journal of Assistive Technologies, sensor integration, and signal processing	1.Limited evaluation 2.Environmental limitations 3.Lack of long-term evaluation
Wang, Y., Wu, D., Liu, Y., Gao, Y. (2019).	This research introduces a smart shoe-based wearable system that combines sensors, a microcontroller, and a wireless communication module	1.Limited evaluation 2.Cost considerations 3.Navigation accuracy
Gomez, G., Ibanez, J., Alvarez, F., Gonzalez, J. (2019).	This paper proposes a footstep-based indoor localization technique using pressure sensors embedded in shoes. It discusses the algorithm design, localization accuracy, and user trials, highlighting the potential benefits for visually impaired individuals.	1.Dependency on infrastructure installation(such as pressure sensors or RFID tags) 2.cost

2.1.2 More literature surveys:

1. Smarts Assistive shoes for blind[1]: Ariba Khanam, Anuradha Dubey, Bhabya Mishra (2019) International Journal of Advance Research in Science and Engineering (IJASE) introduced the smart assistive shoes for blind people which will help them in their needed activities. The shoes will detect the nearby obstacles and simultaneously send a message to the receiver in audio and vibration form. The ultrasonic sensor detect the obstacles for blind people. The arduino microcontroller keeps the pulling the ultrasonic sensor and provide the

feedback via vibrator. This paper presents an idea dealing the problems faced by visually impaired individual through assistive device in form of shoes. The shoes will be detect the nearby obstacles and continuously send a message to the receiver in audio and vibration form. The ultrasonic sensor has been fully utilized on order to advance the mobility of the blind. Future work will be focused image acquired by using web camera and NI camera helps in identification of object as well as scans the entire instances for the presence of number objects in the path of the blind person.

2. Design and Developement of a Prototype Rehabilitative Shoes for the Blind[2]: Ziad O.AbuFaraj, Elie Jabbaur, Paul Ibrahim, Anthony Ghaoui (2018) Institute of Electrical and Electronics Engineers, Each shoes is mounted with three pairs of ultrasonic transducers placed on aspect of the toe cap so as to detect ground level obstacles of different heights as well as ground pits and holes. Additionally, design considerations mitigated the effects of ipsilalateral and contralateral foot swing, ground level detection, stair climbing and 5 descent as well as others impediment that might be perceived as obstacles. The corresponding tactile outputs are provided by three miniature sized vibrating motors embedded within the collar of the shoes. Each shoes is mounted with three pairs of ultrasonic transducers placed on aspect of the toe cap so as to detect g ground level obstacles of different heights as well as ground pits and holes. Instrumented with the smart shoes, underwent an entensive training session, whereby each sensor was independently triggered and the corresponding tactile output was acivited

3. Smart Shoes a Safe Future for the Blind[3]: Shlesha Khursade, Malavika Karunan, Ibtisam Sayyad, Saloni Mohanty (2016) International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), one such wearable system designed to provide directional information to the visually impaired. Now a day, android mobile is commonly used by everyone. With help of android application, wearable device is to be made to help in navigation path. Sensors attached with the hardware will sense obstacles and vibrators will vibrate for left and right turn through path. A buzzer will be used for alerting the user that obstacle is nearing blind. Android mobile is commonly used by everyone. With help of android application, wearable device is to be made to help in navigation path. Obstacles comes in contact with the sensors, the distance is calculated, from the sensor and the obstacles. If obstacles is in the predefined range of 15- 20 cm, it is detected and the buzzer starts beeping.

4. Li-Fi Based Smart Shoes for Blind[4]: Shanthi M, Madhu Meena M.K, Kadiravan R, Kowsalya R.J (2019) International Journal of Engineering Science and

Computing, Smart shoes that helps the visually impaired in navigation through voice commands which are conveyed light source in their path. The RFID reader detects all information stored on the tag, it is then analyzed and the data retrieved is transmitted to a control unit that translates the information into Braille code. The ultrasonic sensor is used for obstacle detection The IR sensor is used for detection of water in the path. The receiver receives this flicking light and converts it into electrical signal. The signal is then converted to binary data which recognized as audio signals. Thus navigation done using LiFi. This paper proposes a smart shoe that helps the visually impaired in navigation through voice commands which are conveyed through light sourced (Li-Fi) in their path. The Li-Fi module produces LED which transmit data to the shoe module. The Li-Fi receiver at the shoe detects this signal and the controller plays this data through the speaker.

5. Smart Navigational Shoes for the Blind Person[3]: Saylee Begampure, Renuka Deshmukh, Sheetal Chotaliya, Shubham Sirsat (2017) International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, Android is a working system created google for portable system. It depends on the linux bit and intended for touch screen, for example, cell phone and tablets. The system is implemented in shoes we used a battery for power supply. Bluetooth is used to get the location coordinate form mobile phone by using GPS setting from mobile. The shoes sync up with a Smartphone app that uses maps and vibrate to tell users when and where to turn to reach their destination. The control 7 unit gives vibration according to the route coordinates in shoes to indicates the blind person.With help of android application, wearable device is to be made to help in navigation path. The IR sensor is utilized for obstacle detection in the project that the obstacle is distinguished out and about then buzzer will turn ON.The shoes sync up with a Smartphone app that uses maps and vibrate to tell users when and where to turn to reach their destination. In future scope we will focused Bluetooth speaker, it's used to get the location coordinate from mobile phone by using GPS

6. Smart Assistive Shoes and Cane, Soul mate for the blind people[5]: Shubham Rastogi, Pankaj Sharma, Parth dhall, Rishav Agarwal, Shristhi Thakur (2020) International Journal of Advanced Research in Electronics and Communication Engineering, The technology proposed in the paper serves as a solution for visually impaired people. The smart shoes that alerts visually impaired people over obstacles coming between their ways and could help them in walking with less collision. IR sensor connected to the module and the voltage level depending upon the status of the IR sensor are transmitted to the microcontroller and as

per the data collected an appropriate alerting the blind person about the surroundings. The arduinolily controller receives the input from the above sensors, executes and decode it and again select the appropriate saved voice messages and command to the speaker. The smart shoes that alerts visually impaired people over obstacles coming between their ways and could help them in walking with less collision. A shoes that could communicate with the user through voice alert and pre-recorded message. The system has been used to receive data from the sensing devices, two connected to the shoe to detect objects at the 8 ground. Then, as per the information received by the micro controller, it provides an acoustic feedback to the user. In future, longitudinal research would be required to judge if the smart shoes would be able to augment their conventional way of mobility, thereby make them independent after prolonged used.

7. Smart Assistive Shoes and Cane-Solemates for the Blind People: S.D. Asha Mahesh, K. Raj Supriya, M.V.S.S., N.K. Pushpa Latha, P.Gowri, T.Sonia, B,Nani, (2019) Internationl Journal of Engineering Science and Computing This system is intended to provide overall measures object detection and send information related to blind people. This project aims at the development of an Electronic Travelling Aid (AID) to help the blind people to find obstacle free path. This ETA is fixed to the shoe. When the object is detected near to the shoe alerts them with the help of vibratory circuit and also in advancement with help of speakers or headphone that is voice command with help of android application. IR sensor which detects the presence of the obstacles in the direction and sends the command to the controller the detection of object in the direction. Smart shoes that alerts visually impaired people over obstacles coming between their ways and could help them in walking with less collision. When the object is detected near to the shoe alerts them with the help of vibratory circuit and also in advancement with help of speakers or headphone that is voice command with help of android application. After receiving the input form the shoe module via Bluetooth module, the arduinolily receives the input, decodes it and select the appropriate saved voice message and commands to the speaker which give indication to the user of the obstacles in the respective direction. In future, longitudinal research would be required to judge if the smart shoes would be able to augment their conventional way of mobility, thereby make them independent after prolonged used.

CHAPTER 3

Smart Shoe

Smart shoe is a revolutionary smart shoe system that empowers blind and visually impaired individuals to navigate their surroundings confidently and independently. By combining advanced sensors, haptic feedback, and intelligent navigation assistance, it enhances the user's spatial awareness and safety, ultimately promoting a more inclusive and accessible environment for the visually impaired community.

3.1 Object Detection Smart Shoe

Many blind people require travel aids to navigate in unknown environments. We present Smart Shoes project that enable the visually impaired users with mobility impairment to avoid obstacles. By leveraging existing robotics technologies, our system detects obstacles such as curbs, and staircases in the ground or even moving objects, and transmits obstacle information through haptic feedback (vibrations and beeps). Initial experiments show that our device enables human users to navigate safely in indoor and outdoor environments.

The smart shoe will help the Blind person to reach his destination independently. It is built using IoT Technology in which the shoe will be embedded with various sensors, Microcontroller and buzzers. The shoe warns the user by making noise with the buzzer when he/she walks in front of an obstacle. [**?**].

FIGURE 3.1: Object detection Smart Shoe

3.2 GPS Tracking Smart Shoe

Smart Shoe is a groundbreaking GPS tracking smart shoe designed specifically for blind and visually impaired individuals, aimed at revolutionizing their mobility, safety, and independence. By integrating advanced GPS technology into a comfortable and stylish shoe.This technology allows his family or friends who has access to his tracking know their location and thus help the blind people to know where they are.[?].

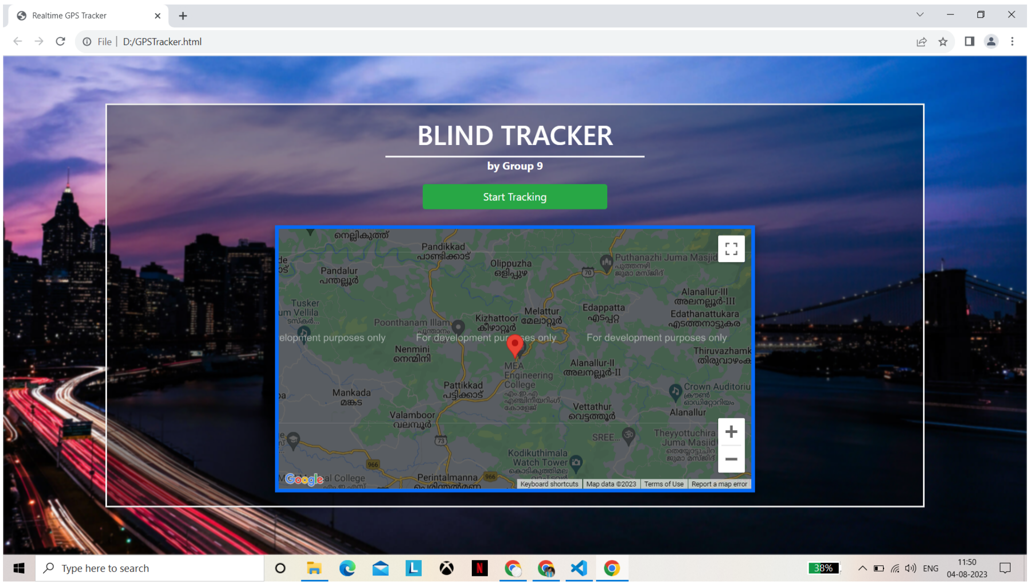

FIGURE 3.2: Before GPS Tracking

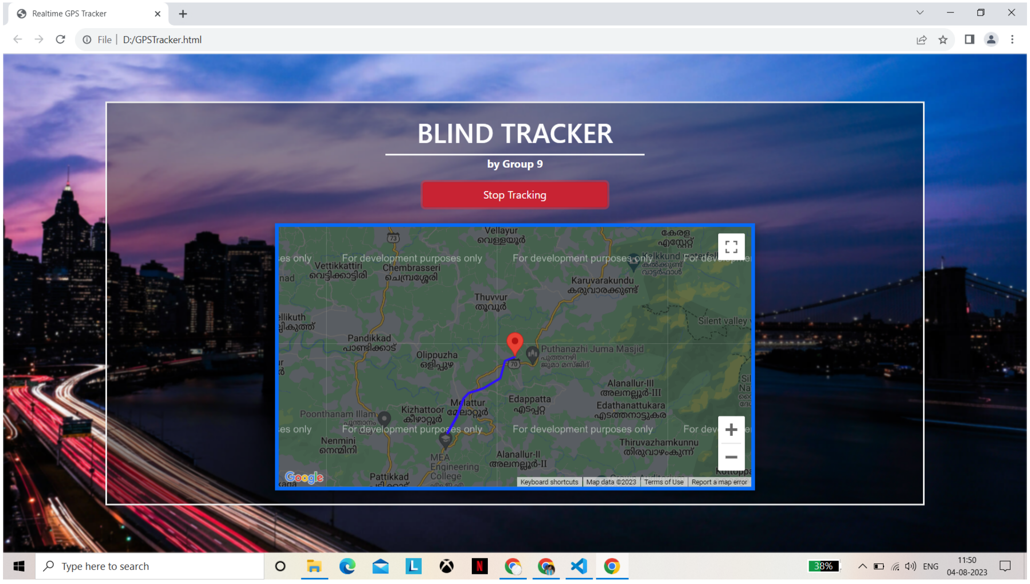

FIGURE 3.3: After GPS Tracking

3.3 Targeted Users

	User	Notes
User 1	Legally blind person	Complete blindness
User 2	Color blind person	Also called “dyschromatopsia”
User 3	Night blind person	

FIGURE 3.4: Table for targeted users

CHAPTER 4

System Design and Implementation

4.1 System design

Designing a smart shoe for the blind requires careful consideration of various factors, including safety, usability, and effectiveness. The goal is to create a shoe that can provide real-time feedback and navigation assistance to help blind individuals navigate their surroundings independently.

A data flow diagram (DFD) is a visual representation of how data flows within a system. In the context of object detection using Arduino, an ultrasonic sensor, and a GPS module, the DFD illustrates the movement and processing of data as it goes through various components of the system. Here's an explanation of the DFD for this scenario:

1.**Inputs**:

Ultrasonic Sensor Data (Distance):
The ultrasonic sensor detects distances from nearby objects and provides data to the Arduino board.

GPS Module Data (Location):
The GPS module calculates the current location coordinates (latitude and longitude) and sends the data to the Arduino.

2.**Arduino Board:**

Data Processing:
The Arduino board receives the ultrasonic sensor data and processes it to

calculate the distance from nearby objects. It also receives the GPS module data and processes it to extract the current location information.

3.**Object Detection Decision:**

Decision Logic:
Based on the processed ultrasonic sensor data, the Arduino determines if any nearby objects are within a predefined range (threshold distance) that could be considered as obstacles. Depending on the decision, the Arduino generates an output signal to indicate if an obstacle is detected.

4.**Outputs:**

Object Detection Signal:
If an obstacle is detected, the Arduino sends a signal to activate the haptic feedback system or any other warning mechanism in the smart shoe (not shown in this diagram).

GPS Location Data:
The Arduino may also pass the processed GPS location data to another component, such as a display or communication module, to provide real-time location updates (not shown in this diagram).

Haptic Feedback System:
If an obstacle is detected, the haptic feedback system in the smart shoe generates tactile cues (vibrations or pressure) to alert the user about the obstacle's presence and proximity.

Display/Communication Module:
The processed GPS location data may be used to show real-time location updates on a display or transmitted to a companion mobile app via communication modules (e.g., Bluetooth or Wi-Fi).

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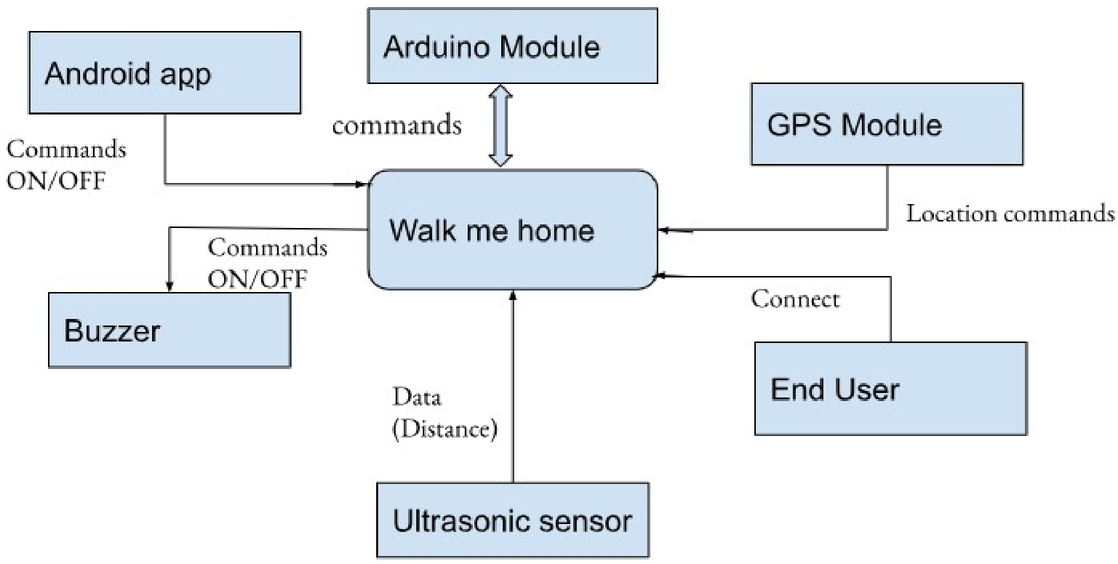


FIGURE 4.1: DFD

4.2 Implementation

The implementation of a smart shoe for the blind involves hardware design, software development, and integration of various components. Here's a step-by-step guide for implementing the system:

- Hardware Selection:

  Choose appropriate sensors (ultrasonic, GPS, IMU, pressure sensors), microcontroller, communication module, haptic feedback actuators, and power source based on the system design requirements.

- Hardware Integration:

  Assemble the selected hardware components onto the shoe in a compact and ergonomic manner.Ensure proper positioning and calibration of sensors for accurate data.

- Communication Module Integration:

  Set up the communication module to enable data transfer between the smart shoe and the companion mobile application.

- Haptic Feedback System Implementation:

  Develop software to control the haptic feedback actuators based on sensor inputs.Design distinct vibration patterns for different types of obstacles or navigation cues.

- Mobile Application Development:

  Create a mobile application that pairs with the smart shoe via the communication module.Develop a user-friendly interface for customization, navigation, and monitoring.Implement features like real-time navigation, obstacle detection alerts, and settings adjustment.

- Testing and Calibration:

  Conduct thorough testing of the smart shoe to validate its accuracy, responsiveness, and reliability.Calibrate sensors and feedback mechanisms to optimize performance.

- User Testing and Feedback:

  Engage visually impaired users to test the smart shoe in real-world scenarios.Gather feedback to identify potential improvements and address user concerns.

- Manufacturing and Quality Control:

  Once the prototype is refined and ready for production, set up the manufacturing process. Implement quality control measures to ensure consistent product performance

- Distribution and Launch:

  Plan the distribution strategy to make the smart shoe available to the intended user base. Launch the product and continue to gather feedback for further improvements.

4.2.1 Use case diagram

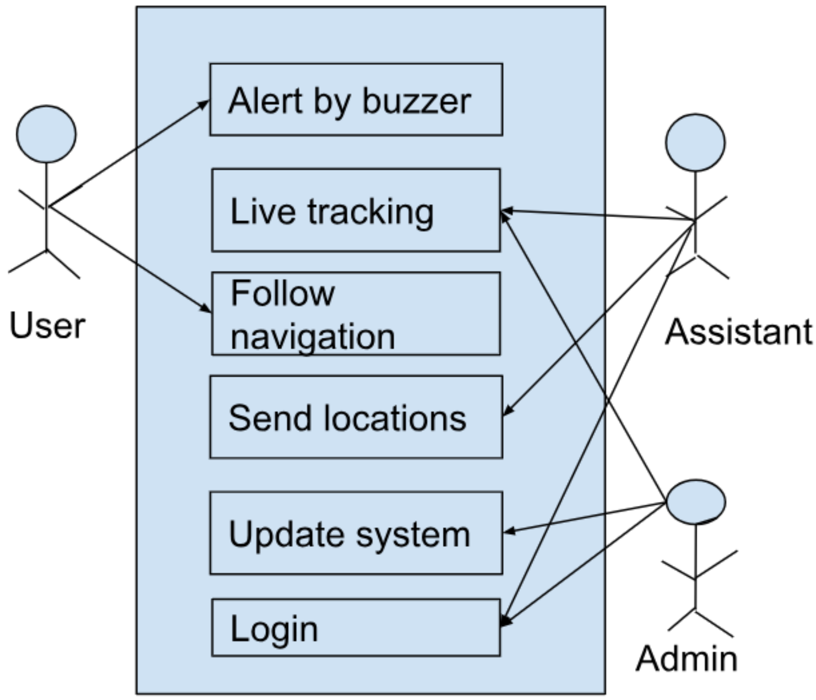


FIGURE 4.2: use case diagram

1.Actors:

- User
- Assistant
- Admin

2.Use Cases:

- Alert by buzzer

- Live tracking
- Follow navigation
- Send locations
- Update system
- Login

3.System Boundary: The system boundary encloses the smart shoe and its related use cases and interactions with the user,Assistant and admin

4.3 Algorithm

4.3.1 Algorithm for object detection:

1. Start
2. initialize the ultrasonic sensor,buzzer ,and other necessary components in the arduino setup function
3. Activate the ultra sonic sensor
4. Compare the measured distance with the threshold distance
5. If the distanced is less than the threshold, an object is detected within the warning range and buzzer will generate an audible alert to warn the user of the detected object
6. Else the user can step forward or continue their movement
7. stop

4.3.2 Algorithm for GPS tracking:

1. Start
2. Initialize the GPS receiver module in the smart shoe to start receiving signals from GPS satellites.
3. Continuously read location data from the GPS receiver at regular intervals .

4. Update the current geolocation of the smart shoe based on the acquired GPS data.
5. Store the GPS data locally on the smart shoe for buffering in case of temporarily loss of connectivity,transmit the GPS data over a wireless connection.
6. Display the real time location of the smart shoe on a user interface.
7. Analyze the GPS data to provide insights into the user's movements,activity, and trends.
8. Stop

4.4 Flowchart

4.4.1 Flowchart for object detection:

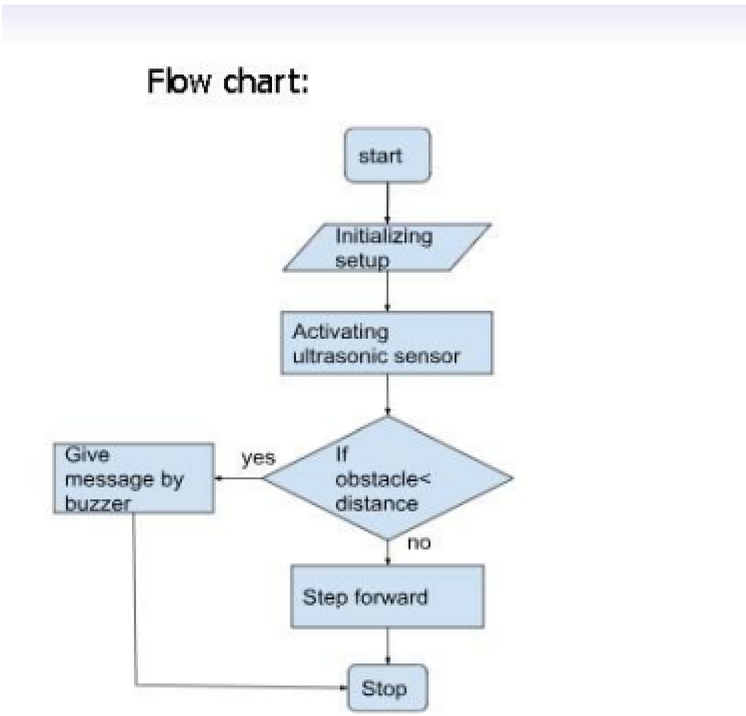


Figure 4.3: object detection flowchart

4.4.2 Flowchart for GPS tracking

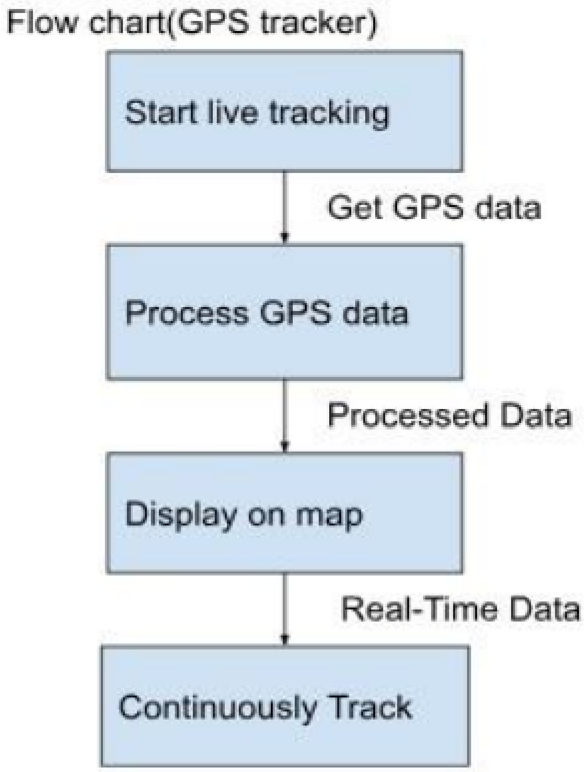


FIGURE 4.4: GPS tracking flowchart

CHAPTER 5

Experimental Validation and Result

Mobility is one of the main problems encountered by the blind in their life, this smart shoes helps to overcome the issues faced by them.The purpose of this technology is to improve the daily lives of visually impaired individuals, offering them greater autonomy in navigating their environment, reducing the risk of accidents, and increasing their confidence and mobility. By incorporating object detection and GPS tracking into a wearable device like a shoe, this smart solution can provide real-time assistance and critical information, making it a valuable tool for the blind community.

5.1 Component Selection

The hardware components included the following:

- Shoe
- Arduino
- Raspberry Pi 2
- Buzzer
- Ultrasonic Sensor
- GPS neo 6 module
- Battery

The software components include the following:

- Python

- HTML
- CSS
- Arduino IDE

5.2 Hardware Components

5.2.1 Shoe

FIGURE 5.1: Shoe

Shoe Design

Every product needs a complete design with exact measurement before it can be fabricated. The design plays a fundamental role in this project. Therefore, prior to the design process, a few criteria were considered. For this shoe, we designed the shoe dimensions and the main components, which allowed the shoe to fit all other components needed to make a smart shoe.

Material selection is a core step in the process of designing any physical object. The systematic selection of the best material for the given application begins with the properties and costs of candidate materials. Selecting the appropriate material is one of the keys that lead to success.The shoe must be water resistant and dust resistant so that it will not affect the other electric components in shoe.

Shoe Fabrication

Shoe fabrication involves the process of transforming raw materials into a finished shoe product. It is a multi-step manufacturing process that requires precision, skill, and attention to detail. The fabrication process can vary depending on the type of shoe being produced, but the general steps involved are as follows:

1. Design and Pattern Making: The shoe fabrication process begins with the design phase. Shoe designers create sketches and digital renderings of the shoe's appearance and features. Once the design is finalized, pattern makers develop detailed patterns for each shoe component, such as the upper, sole, and insole. These patterns serve as a blueprint for cutting the materials.

2. Material Selection and Cutting: High-quality materials are selected for the shoe, including leather, synthetic fabrics, rubber, foam, and various other components. The materials are carefully inspected for defects before cutting. Automated cutting machines or skilled craftsmen then cut the materials according to the patterns.

3. Stitching and Assembly: The cut pieces are then assembled together using various techniques like stitching, gluing, or molding. For leather shoes, skilled craftsmen often use sewing machines to stitch the upper pieces together. Synthetic shoes may use heat sealing or adhesives to bond the materials.

4. Lasting: Lasting is the process of pulling the upper over a foot-shaped form called a last, which gives the shoe its final shape. The lasting process can be done manually or using specialized machines. It ensures that the shoe maintains its desired shape and fit.

5. Soling: The next step is attaching the sole to the shoe. Depending on the shoe type, different methods may be used, such as cementing, stitching, or molding. The sole can be made of rubber, foam, or other materials, depending on the shoe's purpose.

6. Finishing: After the shoe components are assembled, they undergo finishing touches. This includes trimming excess material, buffing, polishing, and adding any final embellishments or branding elements.
7. Quality Control: Before the shoes are ready for the further process to make it as a smart shoe, they undergo a thorough quality control process. Each pair is inspected to ensure it meets the required standards for appearance, fit, comfort, and durability.

Throughout the fabrication process, manufacturers follow strict quality standards and guidelines to ensure that each pair of shoes meets the brand's reputation for comfort, style, and performance. The collaboration between skilled artisans and advanced machinery results in the creation of footwear that satisfies consumer needs and preferences.

5.2.2 Arduino

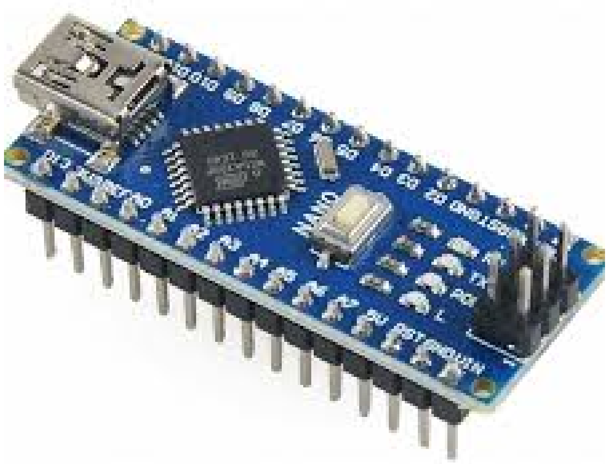


Figure 5.2: Arduino Nano

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - wet sensor - and turn it into an output. The board is equipped with sets of digital and analog input/output (I/O) pins shown in Figure 5.1 that may be interfaced to various expansion boards (shields) and other circuits. The Arduino Nano is a compact and versatile microcontroller board based on the ATmega328P microcontroller. It is part of the Arduino family of development boards and shares many similarities with the Arduino Uno but in a smaller form factor. The Nano is designed to be used for various electronics projects and prototyping applications.

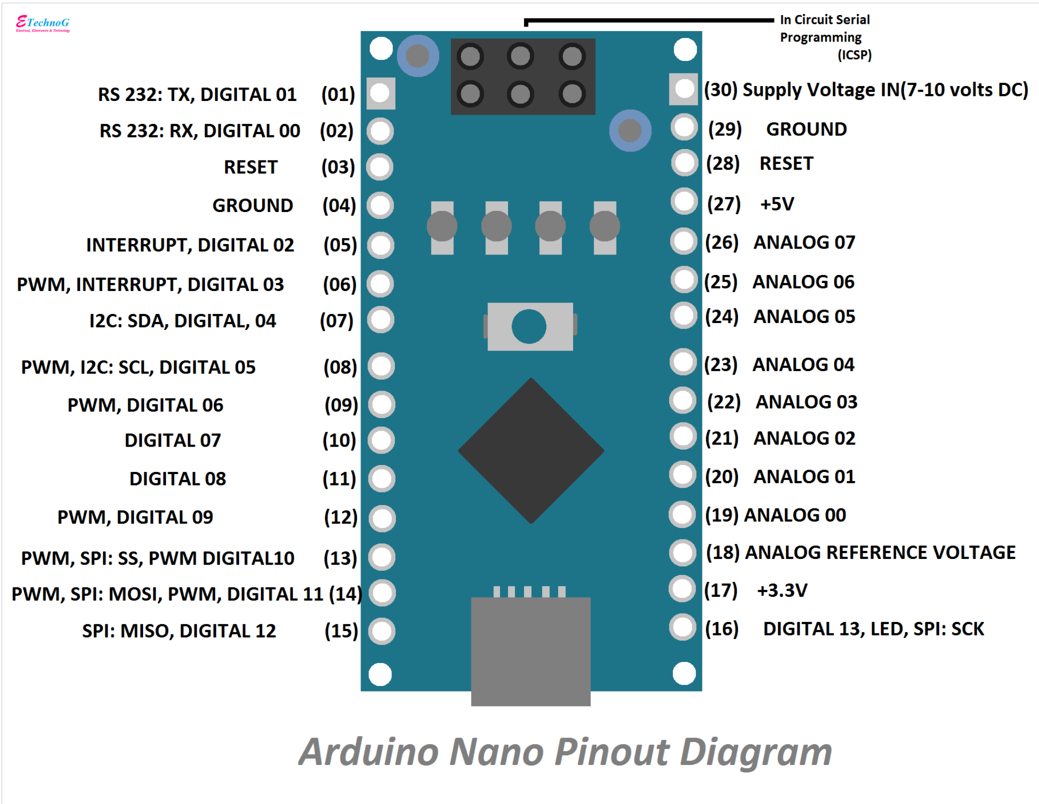


FIGURE 5.3: Arduino Nano Pin Diagram

Explanation about Pinout Diagram:

1. Digital Pins (D0-D13): These pins are used for general-purpose digital input and output operations. You can use them to read digital sensors, control actuators, or communicate with other digital devices.

2. TX (Transmit) and RX (Receive): These pins are used for serial communication. They are connected to the USB-to-Serial converter on the Arduino Nano, allowing you to communicate with your computer or other serial devices.

3. RST (Reset): This pin is used to reset the microcontroller. You can connect a momentary push-button between this pin and the ground to manually reset the Arduino.

4. VCC and GND: These pins provide the power supply to the Arduino Nano. VCC (Voltage Common Collector) is connected to the positive supply voltage (usually 5V), while GND (Ground) is connected to the ground reference.

5. AREF (Analog Reference): This pin allows you to set an external reference voltage for analog-to-digital conversions.

6. Analog Pins (A0-A7): These pins are used for analog input. They can read analog voltages from sensors and other devices. Note that some of the digital pins (D0-D13) can also be used as analog input pins.

5.2.3 Raspberry Pi 2

Raspberry pi is a single computer board with credit card size, that can be used for many tasks that your computer does, like games, word processing, spreadsheets and also to play HD video. Raspberry Pi has a dedicated camera input port that allows users to record HD video and high-resolution photos. Using Python and specific libraries written for the Pi, users can create tools that take photos and video, and analyze them in real-time or save them for later processing.Here we used Raspberry pi 2.The Raspberry Pi 2 is a single-board computer developed by the Raspberry Pi Foundation. It is the second generation of the Raspberry Pi series, succeeding the original Raspberry Pi Model B. The Raspberry Pi 2 was released in February 2015 and brought significant improvements over its predecessor. Here's an explanation of the Raspberry Pi 2:

1. Processor: The Raspberry Pi 2 is powered by a Broadcom BCM2836 system-on-chip (SoC). It features a quad-core ARM Cortex-A7 CPU running at 900 MHz. The quad-core CPU provides a considerable performance boost compared to the single-core processor of the original Raspberry Pi.

2. RAM: The Raspberry Pi 2 comes with 1GB of LPDDR2 RAM. This increase in memory capacity improves multitasking and allows the board to handle more complex applications and processes.

3. Storage: Like its predecessor, the Raspberry Pi 2 relies on a microSD card for primary storage. The microSD card is used to store the operating system and user data.

4. GPIO Pins: The Raspberry Pi 2 features 40 GPIO (General Purpose Input/Output) pins, just like the original model. These pins allow the Raspberry Pi to interface with various electronic components and sensors, making it an excellent platform for physical computing and DIY electronics projects.

5. Video Output: The Raspberry Pi 2 supports HDMI video output, allowing users to connect it to a monitor or TV for display. It is capable of outputting video at

resolutions up to 1080p, making it suitable for media playback and other graphical applications.

6. Audio Output: The board has a 3.5mm audio jack for audio output, enabling users to connect speakers or headphones for sound playback.
7. USB Ports: The Raspberry Pi 2 features four USB 2.0 ports, allowing users to connect various USB devices like keyboards, mice, Wi-Fi dongles, or external storage.
8. Ethernet: Unlike the original Raspberry Pi Model B, which had a 100 Mbps Ethernet interface, the Raspberry Pi 2 comes with a 10/100 Mbps Ethernet port, enabling faster network connectivity.
9. Operating System: The Raspberry Pi 2 supports various operating systems, including Raspbian (a Debian-based OS optimized for Raspberry Pi), Ubuntu, Windows 10 IoT Core, and more. Users can choose an operating system based on their specific requirements.
10. Compatibility: While the Raspberry Pi 2 brought significant improvements in performance, it maintains compatibility with most of the hardware and software developed for the original Raspberry Pi Model B. This allows users to upgrade to the newer model without facing major compatibility issues.

The Raspberry Pi 2 is widely used for a variety of projects, such as home automation, robotics, media centers, IoT applications, and educational purposes. Its affordable price, small form factor, and versatility have made it a popular choice among hobbyists, students, and developers for learning, experimentation, and building innovative projects.

FIGURE 5.4: Raspberry Pi 2

5.2.4 Buzzer

A Buzzer is an audio signalling device. There are many types of buzzer and here 5V passive Buzzer is used, which is used to create the sound and it may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. The passive buzzer is an electromagnetic squeaker used to generate sound signals of different frequencies. It requires an AC signal to make a sound, where a changing input signal produces the sound, rather than producing a tone automatically. To use this 5v buzzer, connect one pin to ground and the other to a microcontroller programmed to output a square wave or a timer IC.

FIGURE 5.5: Buzzer

5.2.5 Ultrasonic Sensor

FIGURE 5.6: Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = $\frac{1}{2}$ T x C.

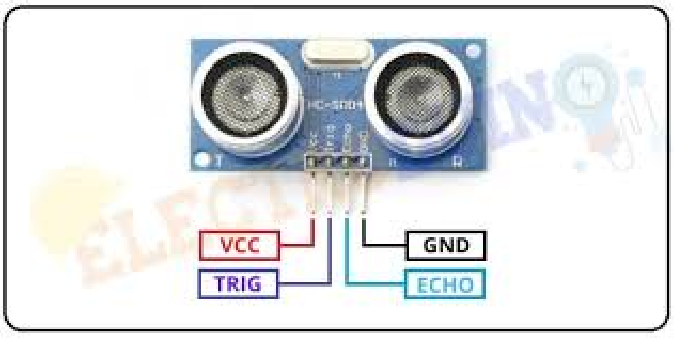


FIGURE 5.7: Ultrasonic Sensor

The pinout explanation:

1. VCC: This is the power supply pin for the ultrasonic sensor. It requires a voltage supply of typically 5V to operate correctly. Connect this pin to the 5V pin of your microcontroller or power supply.

2. Trig (Trigger): The Trig pin is used to trigger the ultrasonic sensor to send out a short burst of ultrasonic waves. To initiate a measurement, you need to send a short pulse (usually 10 microseconds) to this pin from your microcontroller.

3. Echo: The Echo pin is used to receive the ultrasonic waves that bounce back after hitting an object. When the reflected waves are detected, the Echo pin outputs a pulse whose duration is proportional to the time taken for the ultrasonic waves to travel back. The length of this pulse is directly related to the distance between the sensor and the object.

4. GND (Ground): This is the ground (0V) connection for the ultrasonic sensor. Connect this pin to the ground pin of your microcontroller or power supply.

Ultrasonic sensors like HC-SR04 are straightforward to use. To obtain distance measurements, you simply need to trigger the sensor by setting the Trig pin high for a short period (10 microseconds), then measure the duration of the pulse output on the Echo pin. By converting the pulse duration to distance using the speed of sound in air, you can calculate the distance between the sensor and the object.

5.2.6 GPS Neo 6 Module

The GPS Neo-6 module is a compact and cost-effective Global Positioning System (GPS) module developed by u-blox. It is widely used in various applications to provide accurate positioning and navigation data. The Neo-6 module is part of the u-blox 6 series and offers reliable and precise GPS capabilities. Here are some key features and details about the GPS Neo-6 module:

1. GPS Technology: The Neo-6 module utilizes GPS technology, which is a satellite-based navigation system that provides global positioning and timing information. It receives signals from multiple GPS satellites and calculates its position on Earth based on the signals' time of arrival.

2. u-blox 6 Series: The Neo-6 module is part of the u-blox 6 series of GPS modules, which are known for their high performance, low power consumption, and quick time to first fix (TTFF). The series supports various satellite systems, including GPS, GLONASS, and Galileo, for improved accuracy and reliability.

3. Interfaces: The Neo-6 module typically features UART (Serial) and I2C interfaces for communication with external devices, such as microcontrollers or computers. The UART interface is commonly used for simple and straightforward communication with the module.

4. NMEA Output: The module provides navigation data in the form of NMEA (National Marine Electronics Association) sentences through the UART interface. NMEA sentences contain information like latitude, longitude, altitude, time, speed, and more.

5. Position Accuracy: The Neo-6 module offers good position accuracy, usually within a few meters. The accuracy can be further improved with the use of external antennas and optimizing the module's configuration.

6. Time To First Fix (TTFF): The Neo-6 module can achieve a fast time to first fix, which is the time it takes to acquire enough satellite signals to calculate its initial position. TTFF is essential for applications that require quick and reliable positioning data.

7. Power Consumption: The module is designed to be energy-efficient, making it suitable for battery-powered devices and applications that require low power consumption.

8. Antenna: The Neo-6 module requires an external GPS antenna to receive satellite signals. The choice of the antenna can influence the module's performance, especially in challenging environments with poor signal reception.

9. Applications: The GPS Neo-6 module finds applications in various fields, including navigation systems, vehicle tracking, asset tracking, drones, robotics, geocaching, and many other projects that require accurate position information.

In here we used it for tracking the blind person.

Figure 5.8: GPS Neo 6 Module

5.2.7 Battery

In this project we used lithium battery.A lithium battery is a type of rechargeable battery that uses lithium ions as the main component of its electrochemistry. Lithium batteries are widely used in various portable electronic devices, such as smartphones, laptops, tablets, cameras, power banks, and electric vehicles, due to their high energy density and long-lasting performance. Here are some key characteristics and features of lithium batteries:

1. Lithium-Ion Chemistry: Lithium batteries operate based on lithium-ion chemistry. The battery consists of positive and negative electrodes made of different materials, typically lithium cobalt oxide ($LiCoO2$) for the positive electrode (cathode) and carbon for the negative electrode (anode). Lithium ions move between the electrodes during charge and discharge cycles.

2. Rechargeable: Lithium batteries are rechargeable, which means they can be recharged and used multiple times. The ability to recharge the battery makes it a more cost-effective and environmentally friendly choice compared to single-use disposable batteries.

3. High Energy Density: Lithium batteries have a high energy density, meaning they can store a large amount of energy in a relatively small and lightweight package. This high energy density is a key reason why lithium batteries are favored for portable electronic devices.

4. Low Self-Discharge Rate: Lithium batteries have a low self-discharge rate, which means they retain their charge for a more extended period when not in use. This feature makes them suitable for devices that may not be used frequently but need to be ready for use at any time.

5. Fast Charging and Discharging: Lithium batteries can be charged and discharged relatively quickly compared to other battery types, allowing for faster charging times and more efficient energy delivery.

6. No Memory Effect: Lithium batteries do not suffer from the memory effect, which is a phenomenon that reduces the battery's capacity over time due to incomplete charge and discharge cycles. This means you can recharge a lithium battery at any time without having to wait for it to be fully depleted.

7. Safety Considerations: While lithium batteries are generally safe, they can be sensitive to certain conditions that may lead to overheating or even fire in rare

cases. Proper handling, charging, and storage procedures are essential to ensure safety when using lithium batteries.

8. Variety of Types: There are different types of lithium batteries, including lithium-ion (Li-ion), lithium-polymer (LiPo), and lithium iron phosphate (LiFePO4) batteries. Each type has specific characteristics and applications.

9. Environmental Impact: Recycling lithium batteries is important to minimize environmental impact. Proper disposal and recycling processes help recover valuable materials and prevent harmful substances from entering the environment.

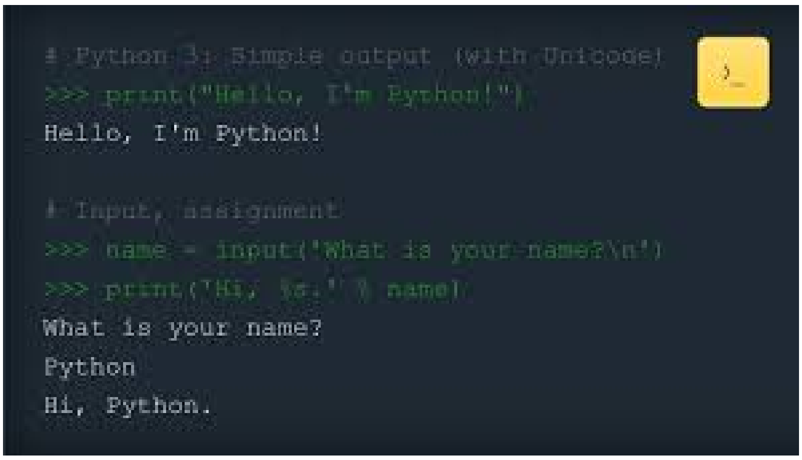
FIGURE 5.9: Lithium Battery

5.3 Software Components

5.3.1 Python

It is an open-source library used for building image processing model. It makes use of machine learning with built-in functions and can perform complex operations on images with just a few functions. It works with numpy arrays and is a fairly simple library even for those who are new to python.

Python is a high-level, interpreted programming language known for its simplicity, readability, and versatility. Guido van Rossum developed Python in the late 1980s, and it has since grown to become one of the most popular programming languages worldwide. Python's design philosophy emphasizes code readability, with a clean and concise syntax that allows programmers to express ideas in fewer lines of code compared to other languages. Its extensive standard library and vast community of developers contribute to the rich ecosystem of third-party libraries, making Python suitable for a wide range of applications, including web development, data analysis, artificial intelligence, automation, scientific computing, and more. Python's ease of use and rapid development capabilities make it an excellent choice for beginners and experienced developers alike, fostering a collaborative and inclusive programming community. With its widespread adoption in various industries and a strong focus on code readability and maintainability, Python continues to shape the landscape of modern programming and stands as a powerful tool for solving complex problems efficiently and elegantly.



5.3.2 HTML

HTML (Hypertext Markup Language) is the standard markup language used for creating and structuring content on the web. Developed in the early 1990s, HTML forms the foundation of every webpage you see on the internet. It consists of various tags that define the structure, layout, and elements of a webpage. Each HTML tag represents different elements like headings, paragraphs, images, links, forms, tables, and more. By combining these tags, developers can create visually appealing and interactive websites. HTML is not a programming language, but rather a markup language, as it focuses on presenting content rather than defining logic. It works in conjunction with CSS (Cascading Style Sheets) and JavaScript, allowing for a separation of concerns and enabling web developers to create dynamic and responsive webpages. With continuous updates and evolving standards, HTML remains a vital tool for web development, playing a significant role in delivering information and services to users across the digital landscape.

FIGURE 5.10: Coding interface of HTML

HTML, being a markup language, follows a tree-like structure with elements nested within each other. It is designed to be platform-independent, allowing webpages to be accessed and displayed consistently on various devices and browsers. HTML documents start with a doctype declaration to indicate the version of HTML being used. The ¡html¿ tag represents the root element of the page, enclosing the ¡head¿ and ¡body¿ sections.

In the ¡head¿ section, developers specify metadata, such as the title, character encoding, and links to external resources like CSS and JavaScript files. The ¡body¿ section contains the visible content of the webpage, including text, images, multimedia, and interactive elements.

HTML uses semantic tags like ¡header¿, ¡nav¿, ¡main¿, ¡article¿, ¡section¿, and ¡footer¿ to provide structure and meaning to the content, improving accessibility and search engine optimization. Additionally, hyperlinks are created using the ¡a¿ tag, allowing users to navigate between pages and websites seamlessly.

Web forms are an essential part of HTML, enabling users to input data through various form elements such as ¡input¿, ¡textarea¿, ¡select¿, and ¡button¿. Form submissions can be processed on the server using server-side programming languages like PHP, Python, or JavaScript.

As the backbone of the web, HTML continuously evolves with new versions, features, and standards. The latest version, HTML5, introduced significant improvements, including native multimedia support, canvas for graphics rendering, and support for modern APIs like geolocation and web storage.

In summary, HTML is the fundamental language that underpins web development. Its simplicity, compatibility, and continuous evolution make it an essential tool for building visually appealing, interactive, and accessible websites that cater to a global audience. When combined with CSS and JavaScript, HTML empowers developers to create engaging and dynamic web experiences that deliver valuable content and services to users across the digital world.

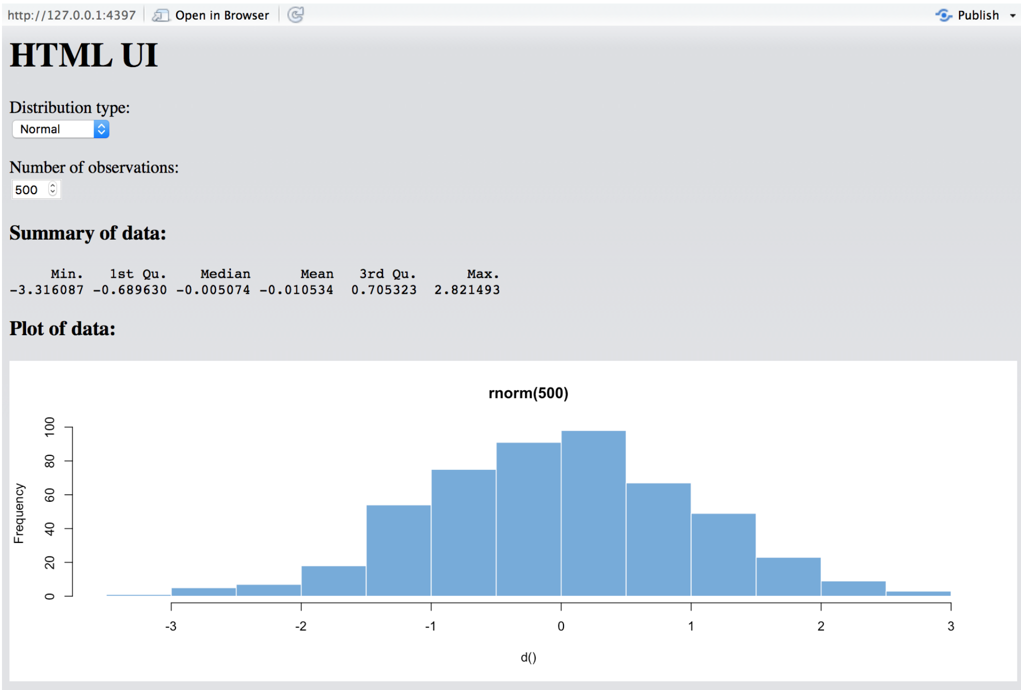


FIGURE 5.11: HTML UI

5.3.3 CSS

CSS (Cascading Style Sheets) is a crucial component of web development that complements HTML by defining the visual presentation and layout of webpages. Developed in the late 1990s, CSS provides a separation of concerns, allowing developers to control the appearance of HTML elements independently from the content itself. By using CSS, web designers can apply styles such as colors, fonts, margins, padding, and positioning to create visually appealing and consistent designs across webpages. CSS operates with a rule-based structure, where each rule consists of a selector that targets HTML elements and a set of properties and values that define how those elements should be styled. Additionally, CSS supports responsive web design, enabling websites to adapt to different screen sizes and devices. This flexibility and versatility make CSS an essential tool for creating modern and user-friendly websites that deliver an immersive and enjoyable user experience. As the web continues to evolve, CSS evolves with it, introducing new features and capabilities to accommodate the demands of contemporary web design and development.

CSS (Cascading Style Sheets) plays a pivotal role in shaping the visual identity of web content, allowing web developers to enhance the aesthetics and user experience of websites. With CSS, design elements like colors, typography, layout, and animations are easily customized and applied consistently across multiple pages. CSS follows a "cascading" principle, where styles can be inherited from parent elements and overridden by more specific rules, enabling developers to efficiently manage the presentation of complex web structures.

Beyond traditional styling, CSS empowers developers to create responsive designs that adapt gracefully to various devices, screen sizes, and orientations. Media queries enable the application of different styles based on device characteristics, ensuring optimal viewing experiences on desktops, tablets, smartphones, and beyond. The ability to create fluid layouts and flexible designs allows modern websites to reach a wider audience and cater to the preferences of diverse users.

CSS can also work in tandem with JavaScript, enabling interactive and dynamic experiences. Through CSS animations and transitions, web designers can introduce subtle effects, improving usability and user engagement. Moreover, CSS frameworks and preprocessor tools offer enhanced productivity, standardization, and code reusability, facilitating rapid development and maintenance of complex web projects.

As web technologies continue to evolve, CSS evolves with them, incorporating new features and standards to meet the demands of cutting-edge design trends and user expectations. The ongoing refinement of CSS ensures that it remains a powerful and indispensable tool for web development, providing web designers with the means to create visually stunning, accessible, and user-centric websites that leave a lasting impact on visitors.

5.3.4 Arduino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.' The Arduino IDE will appear as:

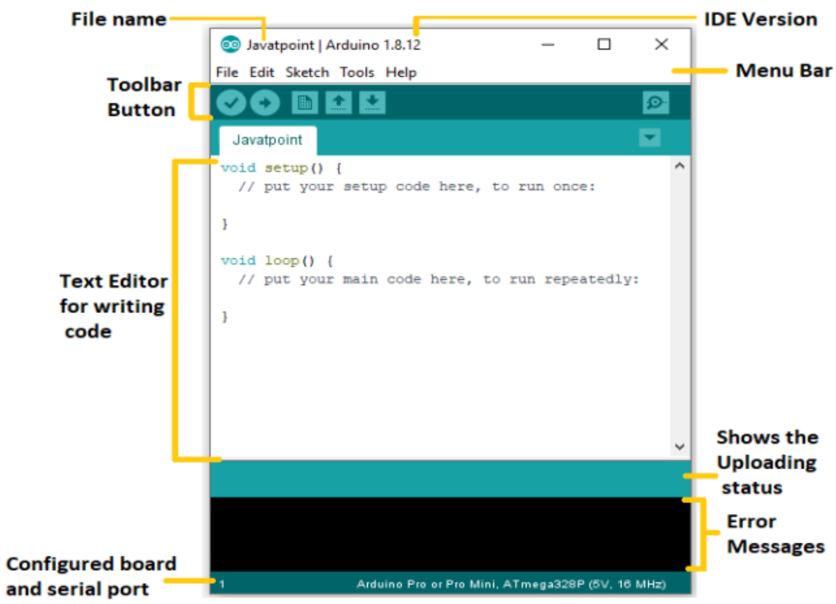


FIGURE 5.12: Arduino IDE Interface

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone -

children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems.

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms.
- Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Writing Sketches: Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.[**?**]

5.4 Result:

The smart shoe for the blinds using Arduino, ultrasonic sensor, and buzzer is a helpful project aimed at assisting visually impaired individuals in navigating their surroundings with increased safety and independence. The primary goal of this project is to create a shoe that can detect obstacles in the user's path and provide feedback through a buzzer to alert them about potential obstructions

5.4.1 Functionality:

1.Sensing

The ultrasonic sensor continuously measures the distance between the shoe and nearby obstacles

2.Distance Calculation:

Arduino processes the data received from the ultrasonic sensor and calculates the distance to the nearest obstacle.

3.Alert System:

Based on the distance calculated, the Arduino triggers the buzzer to emit different sound patterns. For example:

Constant tone: No obstacle detected, safe to move forward.
Increasing pitch: An obstacle is getting closer.
Decreasing pitch: The distance to the obstacle is increasing.

4.User Interface:

The smart shoe may include buttons or switches to adjust the sensitivity of the sensor or control the alert system.

5.Shoe Integration:

The components, including the Arduino, ultrasonic sensor, and buzzer, are properly integrated into the shoe in a comfortable and non-obtrusive manner.

5.4.2 Discussions:

The project of developing a smart shoe for visually impaired individuals with object detection and GPS tracking is a commendable and innovative idea with the potential to greatly enhance the safety and independence of visually impaired individuals. Here are some discussions about this project

- **Safety and Independence:**

One of the key benefits of this project is that it empowers visually impaired individuals to navigate their surroundings with increased safety and independence.

- **Integration and User Experience:**

A crucial aspect of this project is the seamless integration of various components into the shoe. Ensuring that the object detection system, GPS module, microcontroller, and feedback mechanisms work together flawlessly while maintaining user comfort is essential for a successful implementation.

- **Accuracy and Reliability:**

The accuracy of the object detection system and GPS tracking is critical for providing reliable information to users. False positives or inaccurate obstacle detection could lead to confusion and potentially unsafe situations.

- **Power Management:**

Efficient power management is crucial to extend battery life and avoid frequent recharging. The project should focus on optimizing power consumption to ensure that the smart shoe can be used for extended periods without interruption.

- **Cost and Accessibility:**

While the project offers significant benefits, its success also depends on its accessibility to a wider audience. Keeping the overall cost of the smart shoe affordable and manageable for visually impaired individuals is vital.

- **Customization and Personalization:**

Different visually impaired individuals may have varying needs and preferences.

- **Collaboration and Feedback:**

Engaging with visually impaired individuals and organizations working with the visually impaired community is crucial to understand their specific needs and challenges.

5.4.3 Final prototype:

Figure 5.13: prototype

5.4.4 Programming in Aurdino IDE:

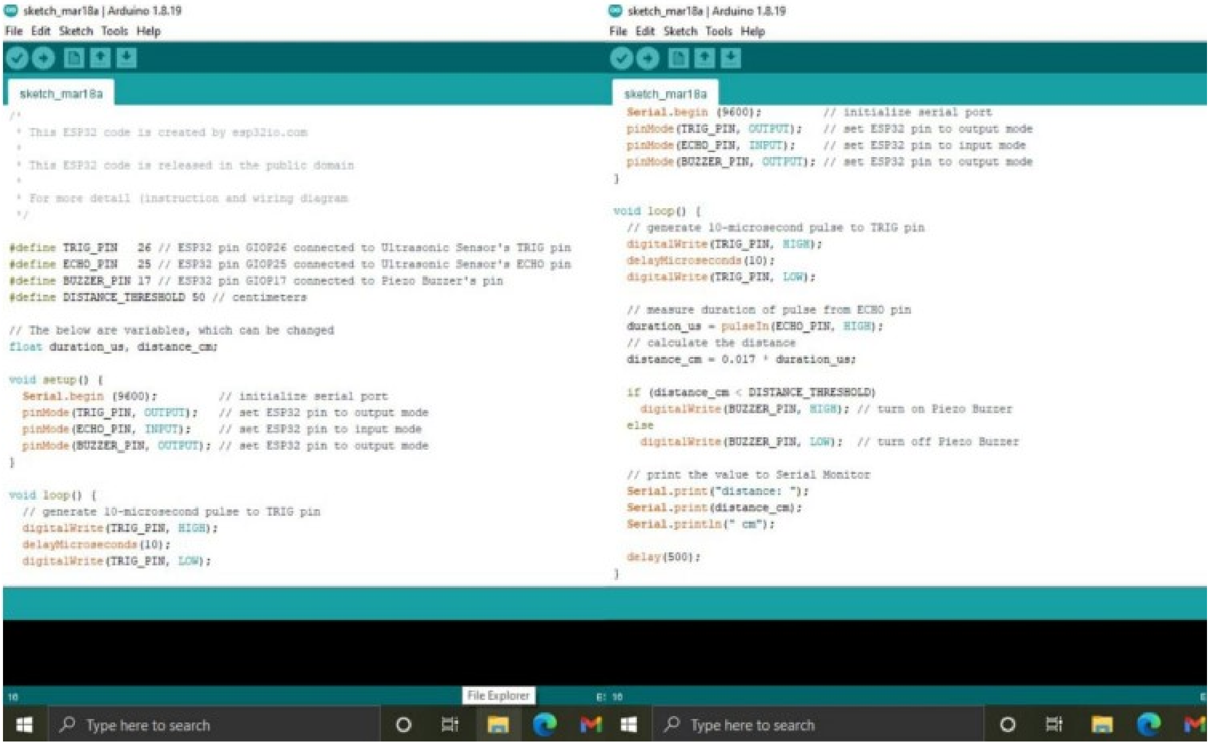


FIGURE 5.14: program in Ide

CHAPTER 6

Conclusion and Future Scope

6.1 Conclusion

The smart shoe with object detection and GPS tracking specifically designed for blind people represents a groundbreaking advancement in assistive technology. By integrating object detection sensors, the shoe empowers the visually impaired with a heightened awareness of their surroundings, detecting obstacles and potential hazards in real-time. This crucial feature enhances their mobility and safety, allowing them to navigate confidently and independently, both indoors and outdoors.

The GPS tracking capability of the smart shoe further extends its functionality, enabling blind users to access precise location information and efficiently plan their journeys. With accurate navigation assistance, they can explore new places, travel with greater ease, and even find their way back home confidently.

This innovative combination of object detection and GPS tracking transforms the lives of visually impaired individuals, providing them with an unprecedented level of autonomy and freedom. The smart shoe represents a remarkable step forward in creating an inclusive society, where technology bridges the gap and empowers individuals of all abilities to participate fully in various aspects of life.

As we continue to embrace and advance assistive technologies, the smart shoe for the blind exemplifies the potential of innovation in making positive, meaningful impacts on the lives of people with disabilities. It not only promotes accessibility but also nurtures a sense of empowerment, fostering a world that values diversity and inclusivity. With ongoing advancements in technology, the future holds even more possibilities for transformative solutions that cater to the unique needs and aspirations of every individual, making the world a more inclusive and compassionate place for all.

6.2 Future Scope

The future scope of smart shoes for blind people holds tremendous potential for further advancements and innovations. As technology continues to evolve, we can expect to see the following developments and enhancements:

1. Improved Object Detection: Future smart shoes may feature even more advanced object detection systems using cutting-edge sensor technologies like LiDAR (Light Detection and Ranging) or advanced computer vision algorithms. This would enable the shoes to detect and identify a broader range of obstacles, providing more detailed information to users.

2. Seamless Integration with Smart Devices: Smart shoes may become seamlessly integrated with other smart devices, such as smartphones or smartwatches, creating a holistic and interconnected assistive system. This integration could allow for more personalized notifications, route planning, and sharing of location information with caregivers or loved ones.

3. Artificial Intelligence (AI) Assistance: The incorporation of AI into smart shoes could lead to more intelligent and context-aware assistance for blind users. AI algorithms could learn and adapt to the user's preferences and habits, providing customized support tailored to their individual needs and preferences.

4. Haptic Feedback: Future smart shoes may integrate haptic feedback mechanisms to provide tactile cues to the user. Haptic feedback can help users interpret the surrounding environment better by conveying information about terrain changes, road crossings, and other essential details through vibrations or gentle taps on the foot.

5. Connectivity and Data Sharing: Enhanced connectivity features could enable smart shoes to communicate with other smart infrastructure in urban environments, such as smart traffic lights and public transportation systems. This connectivity would further streamline navigation and improve accessibility for blind individuals.

6. Energy Harvesting and Efficiency: Innovations in energy harvesting technologies could lead to self-powering smart shoes, reducing the reliance on external charging sources. Energy-efficient components and designs could also extend the battery life, making the shoes more practical for daily use.

7. Multimodal Interaction: Future smart shoes might incorporate multiple modes of interaction, such as voice commands or gesture recognition, in addition to the

existing tactile and auditory feedback. This multimodal approach would offer users more options for interacting with the device.

8. Community and Social Features: Smart shoes could foster a sense of community and social interaction among blind users. Features like location sharing with friends, local points of interest, or community-based navigation assistance could enhance the social aspect of navigation for blind individuals.

9. Integration with Navigation Apps and Services: Integration with popular navigation apps and services could further enhance the functionality of smart shoes. Users could access familiar interfaces, route guidance, and points of interest from their favorite navigation platforms directly through their smart shoes.

10. Augmented Reality (AR) integration: overlaying digital information and virtual objects onto the user's real-world environment. By leveraging sensors and cameras in the shoes, AR technology enhances the user's perception of their surroundings. For blind people, AR integration can provide real-time navigation cues, object identification, and contextual information. For example, AR can project navigation arrows or verbal directions directly onto the ground, guiding the user along the safest route. Additionally, AR can identify nearby objects, such as doors or obstacles, and provide audio or tactile feedback to alert the user. The combination of AR and smart shoes holds immense potential in empowering blind individuals to navigate independently and confidently in complex environments, making their daily lives safer and more accessible.

REFERENCES

[1] L. Nguyen, H. M. La, J. Sanchez, and T. Vu, “A smart shoe for building a real-time 3d map,” vol. 71, pp. 2–12, 11 2016.

[2] Z. O. Abu-Faraj, E. Jabbour, P. Ibrahim, and A. Ghaoui, “Design and development of a prototype rehabilitative shoes and spectacles for the blind,” 10 2012.

[3] M. C. Domingo, “An overview of the internet of things for people with disabilities,” *Journal of Network and Computer Applications*, vol. 35, pp. 584–596, 03 2012.

[4] M. Dobbins, H. Husson, K. DeCorby, and R. L. LaRocca, “School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18,” *Cochrane Database of Systematic Reviews*, 02 2013.

[5] L. M. Alcott, “Hospital sketches,” *Zea Books*, 07 2021.

Appendix

The objective is to develop a smart shoe.

6.3 Code For Arduino Nano

```
#define trigPin 11
#define echoPin 3
#define led 13
#define led2 10
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
/* Create object named bt of the class SoftwareSerial */
SoftwareSerial GPS_SoftSerial(A3, A4);/* (Rx, Tx) */
/* Create an object named gps of the class TinyGPSPlus */
TinyGPSPlus gps;


volatile float minutes, seconds;
volatile int degree, secs, mins;


const int buzzerPin = 9;


void setup()


Serial.begin(9600);
GPS_SoftSerial.begin(9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
```

```
pinMode(led, OUTPUT);
pinMode(led2, OUTPUT);
pinMode(buzzerPin, OUTPUT);

void loop()
long duration, distance;
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance=(duration/2)/29.1;
if (distance ¡= 10)
Serial.println(distance);
digitalWrite(buzzerPin, HIGH);
//delay(1000);



else
digitalWrite(buzzerPin, LOW);



smartDelay(1000); /* Generate precise delay of 1ms */
unsigned long start;
double lat_val, lng_val, alt_m_val;
uint8_t hr_val, min_val, sec_val;
bool loc_valid, alt_valid, time_valid;
lat_val = gps.location.lat(); /* Get latitude data */
loc_valid = gps.location.isValid(); /* Check if valid location data is available */
lng_val = gps.location.lng(); /* Get longtitude data */
alt_m_val = gps.altitude.meters(); /* Get altitude data in meters */
alt_valid = gps.altitude.isValid(); /* Check if valid altitude data is available */
hr_val = gps.time.hour(); /* Get hour */
min_val = gps.time.minute(); /* Get minutes */
sec_val = gps.time.second(); /* Get seconds */
time_valid = gps.time.isValid(); /* Check if valid time data is available */
if (!loc_valid)
```

```
Serial.print(”Latitude : ”);
Serial.println(”*****”);
Serial.print(”Longitude : ”);
Serial.println(”*****”);

else

DegMinSec(lat_val);
Serial.print(”Latitude in Decimal Degrees : ”);
Serial.println(lat_val, 6);
Serial.print(”Latitude in Degrees Minutes Seconds : ”);
Serial.print(degree);
Serial.print(””);
Serial.print(mins);
Serial.print(””);
Serial.println(secs);
DegMinSec(lng_val); /* Convert the decimal degree value into degrees minutes seconds
form */
Serial.print(”Longitude in Decimal Degrees : ”);
Serial.println(lng_val, 6);
Serial.print(”Longitude in Degrees Minutes Seconds : ”);
Serial.print(degree);
Serial.print(””);
Serial.print(mins);
Serial.print(””);
Serial.println(secs);

if (!alt_valid)

Serial.print(”Altitude : ”);
Serial.println(”*****”);

else

Serial.print(”Altitude : ”);
Serial.println(alt_m_val, 6);

if (!time_valid)
```

```
Serial.print("Time : ");
Serial.println("*****");

else

char time_string[32];
sprintf(time_string, "Time :
Serial.print(time_string);




static void smartDelay(unsigned long ms)

unsigned long start = millis();
do

while (GPS_SoftSerial.available())
/* Encode data read from GPS while data is available on serial port */
gps.encode(GPS_SoftSerial.read());
/* Encode basically is used to parse the string received by the GPS and to store it in a
buffer so that information can be extracted from it *

while (millis() - start ¡ ms);



void DegMinSec( double tot_val) /* Convert data in decimal degrees into degrees
minutes seconds form */

degree = (int)tot_val;
minutes = tot_val - degree;
seconds = 60 * minutes;
minutes = (int)seconds;
mins = (int)minutes;
seconds = seconds - minutes;
seconds = 60 * seconds;
secs = (int)seconds;
```