SMART BLIND STICK

A PROJECT REPORT

submitted By

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in partial fullfilment of the requirements for the award of the degree

of

Master of Computer Applications

Department of Computer Applications

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Declaration

I undersigned hereby declare that the project report titled **"SMART BLIND STICK"** submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Smt.Minu R Nath, Associate Professor. This submission represents my ideas in my words and where ideas or words of others have been included. I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity as directed in the ethics policy of the college and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and/or University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title.

Place : Trivandrum **Mubeena Nazar**

Date : 11/07/2022

DEPARTMENT OF COMPUTER APPLICATIONS

COLLEGE OF ENGINEERING
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CERTIFICATE

This is to certify that the report entitled **SMART BLIND STICK** submitted by **Mubeena Nazar** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by him under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor External Supervisor

Head of the Dept

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Abstract

Blindness refers to complete or nearly complete vision loss. Navigating from place to place is one of the biggest problems for the visually impaired, whether indoors or outdoors. They find it even more difficult to walk outdoors because of the adverse road conditions. To avoid consequences such as colliding with stable or moving obstacles, ascending or descending stairs, or slipping down wet terrain, they must be alert at all times. However, the traditional white cane they use only detects obstacles once they touch it. The goal of this project is to solve this issue.

The proposed solution employs the Internet of Things (IoT) paradigm to provide a medium between the blind and the environment. This project, intent to develop a "Smart Blind Stick", which increases the accessibility of blind person to move around by providing alerts about the staircase, potholes, water, fire and other obstacles that might occur on his path while travelling. The stick developed in this project uses algorithms to detect staircases, potholes, water, fire, and other obstacles within a given range close to the user. With the system, an emergency alert can be sent to the concerned person. Furthermore, the proposed system includes an app that allows users to locate the stick using a buzzer sound and configure its settings. The smart blind stick is user friendly, quick response, very low power consumption, lighter weight and is easy to hold by the user. It is designed in such a way that it will be easy to integrate many more functions like voice assistance, location tracking etc. in the near future.

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Chapter 1

Introduction

As we consider our lives in retrospect, it is without a doubt the gift of vision that we would cherish most. A person's vision allows them to see the world around them and assists us in navigating unfamiliar environments. With very limited powers of sight, visually impaired people have difficulty moving around and even fall in dangerous situations. The task of navigating from one place to another is among the biggest challenges faced by visually impaired people. To avoid consequences like collisions with moving or stable obstacles, slipping down wet terrain, and many others, they must always be alert. The traditional white cane they use only detects obstacles once they touch it. It is possible to solve this problem by developing smart assistance systems for blind people.

This project intent to develop a "Smart Blind Stick", which increases the accessibility of blind person to move around by providing alerts about the various obstacles using IoT. Aim of this project is to develop a user-friendly, reliable, and robust solution for seamless navigation through the use of the Internet of Things algorithms. It is an innovative device designed for people with visual impairments to benefit from refined navigation and advanced obstacle detection. With three ultrasonic sensors, a water sensor, a heat sensor, and a panic button, the blind stick is integrated with an ESP32 module and an android application. With the help of ultrasonic waves, three ultrasonic sensors detect obstacles ahead. Moisture content and heat are measured by a water sensor and heat sensor. ESP32 receives data from the sensor when obstacles are detected and alerts are sent accordingly. In case of emergency, panic switches can send alert messages to guardians. A lost stick can be found using an android app that controls the buzzer integrated in the stick. It is also possible to customize the settings of the smart stick, such as the

threshold at which the buzzer beeps, or the sound to be produced when it detects an obstacle. By customizing its assistant, blind people can use it more effectively. It can be operated both manually and automatically, is easy to maintain, cheap, and comfortable to operate. It requires training to help the user understand the information and react in real time to it, so it is not an effortless task to use this device with complete accuracy.

Chapter 2

Problem Definition and Motivation

Globally, around 40 million people are blind and another 250 million have some form of visual impairment, according to the World Health Organization.A human's ability to see is one of his most important senses for survival. Being able to see helps us feel connected to our surroundings. Those with impaired vision depend on other sources of dependency, like canes and other people. When they navigate a familiar area, such as the interior of a house, they memorize directions and obstacles on the way. However, the blind cannot always rely on their memories to navigate. In particular, when they are outdoors. People who are blind are not always offered assistance from others, so there is a need for devices, such as sticks, that can assist them in everyday activities. It is important that the stick be both cost-effective and efficient for it to be useful to all visually impaired individuals.

The technology-controlled world in which people strive to live independently calls for the overcoming of these hurdles in the lives of blind people.Smart blind sticks are designed to alert the user of various obstacles through an alarm buzzer. Using a simple button on the stick, the blind person will be able to send alert message to their acquaintances. A software application allows acquaintances to make desired changes to the configuration settings. An optional remote control is provided if the stick is lost or misplaced, which, when pressed, triggers the stick to buzz.

2.1 Existing System

This socially relevant issue is currently addressed by a number of systems. With existing systems, such as canes, Through touching and poking, blind people can detect obstacles in their paths. Smart belts, rings, and canes are other alternatives to the above method, which can assist them by detecting obstacles,but their systems have a number of drawbacks.

2.1.1 Limitation of Existing System

- Limited availability of features
- Unable to customize the configurations
- Highly expensive.

2.2 Proposed System

The Smart Blind Stick is a new approach to designing and deploying a navigation system that provides a complete set of features for the visually impaired.On detecting various obstacles in front of them, such as objects, potholes, stairs, water, and fire, the system gives buzzer alerts to visually challenged people. Upon pressing the button, an emergency alert is sent to the person concerned. Additionally, the stick can be configured using an android application that can be used by acquaintances of the blind. It is also possible to lose the stick indoors. This problem is also addressed by this system.

2.2.1 Advantages of Proposed System

- This system can easily identify various obstacles that stand in its way.
- It can warn visually impaired people by giving them a buzzer alert.
- It can locate the lost stick by turning on the buzzer attached to it.
- With the push of a button, an emergency alert can be sent.
- The stick's configuration can be customized using an Android app.
- This is a highly portable,more accurate,less expensive and user-friendly system.

Chapter 3

Literature Review

Smart blind sticks are designed to enhance navigation for visually impaired people.The 'Smart Stick for Blind People' [1] proposed by N. Loganathan, K. Lakshmi and N. Chandrasekaran can identify all obstacles within a range of 4m in its path using an ultrasonic sensor installed in it and pass it on as buzzer sound to notify the user about hurdles on the way. An assistive remote with a buzzer button is provided in case a stick is misplaced. When pressed, the buzzer sounds.

A paper titled 'Smart Assistance For Visually Challenged People' [2] by J.Rebekah, K .Kanchanadevi, R .Parthasarathi and M .Ramya includes two sections, one is obstacle detection and another one is detecting users current location. Obstcale detection is done by ultrasonic sensors.The stick uses GPS and GSM to communicate the location of blind people.

'Multi-Functional Blind Stick for Visually Impaired People' [3] by Vanitha Kunta, Charitha Tuniki ,U. Sairam discussed the development of smart cane which uses an ultra-sonic sensor to detect obstacles and has a water sensor integrated which activates a distinct buzzer if it detects the same. A software application is also designed to let the acquaintances to change the phone numbers saved as emergency contact.

The other invention by Devashish Pradeep Khairnar,Rushikesh Balasaheb Karad and Apurva Kapse , on paper 'PARTHA: A Visually Impaired Assistance System' [4] includes a wearable glove to ensure the blind can navigate alone safely. The main component is an ultrasonic sensor to scan direction by emitting-reflecting waves and a GPS system for live location sharing.

A stick guide model was proposed by Sameer Grover, Aeysha Hassan and Kumar Yashaswi in the paper 'Smart Blind Stick' [5] , which have GPS and GSM which sends SMS along with location whenever the person needs help. It uses an ultra-sonic sensor and an infrared sensor for obstacle detection.

These papers have inspired the design of a Smart Blink Stick that detects obstacles and sends corresponding alerts along with an emergency message sending facility using all of the methods and techniques described in these articles.

Chapter 4

Requirement Analysis

4.1 Purpose

Aim of this project is to develop a Smart Blind Cane that combines technology with a traditional white cane to assist visually impaired people in navigating their way around.

4.2 Overall Description

The smart blind stick is developed to assist blind people to navigate safely and efficiently by providing them with appropriate alerts on obstacles in their way. Obstacles can include objects, staircases, potholes, water and fire. An emergency alert button is provided at the top of the stick. Additionally, a software application is designed to allow acquaintances of the blind to manage the configuration of the stick. It is also possible to lose the stick indoors. This problem is also addressed by this solution.

4.3 Software Requirements

- Internet Connection
- WINDOWS 7 or higher
- Arduino Software
- Android Studio

- Telegram

4.4 Hardware Requirements

- Computers with a Pentium 4 processor or higher
- Almost 100MB of free hard drive space
- 128MB of RAM or more
- Mobile Phone
- White cane
- ESP32 Module
- Ultrasonic Sensor
- Water Sensor
- Heat Sensor
- Press Button
- Jumper wires
- Buzzer

4.5 Functional Requirements

The smart cane assists the blind person in moving around the surroundings with confidence. The smart stick should provide the following functionalities

- It should be able to detect obstacles, staircase, potholes , heat, and water
- It should be able to warn the user on identifying any trouble.
- It should send an alert to the concerned person on pressing the emergency button
- It should provide the facility to change the settings on the smart stick on users' demand
- It should enable the buzzer to make a beep sound in order to find the lost stick.

4.6 Non Functional Requirements

4.6.1 Performance Requirements

- Automatic detection
- Obstacles detected quickly
- Fairly inexpensive
- Portable device
- Efficient and effective
- User friendly

4.7 Hardware Description

4.7.1 ESP32 Module

Microcontrollers in the ESP32 series are inexpensive, low-power, and include Bluetooth and Wi-Fi functionality. In addition to the ESP32 series' dual-core or single-core microprocessor, RF baluns, power amplifiers, low-noise receiver amplifiers, filters, and power management modules, the ESP32 series of boards use Tensilica Xtensa LX6 or LX7 microprocessors, or Tensilica Xtensa LX7 dual-core microprocessors. The ESP32 is designed and built by Espressif Systems in Shanghai, which uses TSMC's 40 nm technology. ESP8266 is its predecessor.

4.7.2 UltraSonic Sensor

By employing sound waves, an ultrasonic sensor can be utilised to calculate the distance to the target. It can calculate distance by working out the amount of time that has passed between these two events. Two ultrasonic sensors are mounted on the stick to identify various obstructions, including people, cars, stones, and walls in the outside world and furniture and walls inside, respectively. The suggested system makes use of an ultrasonic sensor with a theoretical measuring range of 2 cm to 450 cm, the HC-SR04.

4.7.3 Water Sensor

The sensor is made up of ten copper traces, five of which are power traces and five of which are sense traces.These traces are often not connected, but when submerged, water acts as a bridge. Together, the series of exposed parallel wires and a variable resistor function as a resistor. The resistance is inversely related to the water's height. By measuring the output voltage that the sensor generates in accordance with the resistance, we can ascertain the water level.

4.7.4 Heat Sensor

Smoke alarms use a variety of methods to sense minute airborne particles to identify fires. They sound the alert when they find these particles in excess of a predetermined threshold.

4.7.5 Press Button

For the user, it serves as an emergency signal that, when touched, can send a message to the relevant contacts in the event of an emergency.

4.7.6 Jumper wires

Copper and aluminum are the main components of this metal. Since electricity requires a medium through which it can travel easily, it allows an electric current to travel from one point to another.

4.7.7 Buzzer

Sound is often produced by this device. Triggering occurs when certain conditions are met.

4.8 Software Description

4.8.1 Android Studio

Android Studio is an Integrated Development Environment (IDE) that lets you develop Android apps while using IntelliJ IDEA's powerful code editor. In addition, it offers additional features to increase your productivity when developing Android apps.

4.8.2 Arduino Software

Open-source Arduino platforms are used to create electrical projects. Arduino allows you to write and upload computer code to a physical circuit board (also known as a microcontroller).Unlike most earlier programmable circuit boards, the Arduino does not require a separate piece of hardware (referred to as a programmer) to load new code onto the board; instead, you can use a USB cable. Furthermore, the Arduino IDE employs a condensed form of C++ that simplifies the learning process. Last but not least, Arduino offers a standard form factor that separates micro-functionality controllers.

Chapter 5

Design And Implementation

Blind people's lives can be made easier with the proposed system, which integrates the traditional white cane with the Internet of Things paradigm (IoT).

5.1 Overall Design

By using various sensors, the system warns the user of any safety risks in their path. A facility to send emergency alerts to the concerned person is also provided to the blind by the system. With the help of the android app, users can also customize the settings of the stick. The system is user-friendly, efficient, and low-cost.

5.2 System Design

To bridge the gap between the blind and the environment, the proposed solution utilises the Internet of Things (IoT) paradigm. There are three ultrasonic sensors in the system that detect objects, stairs, and potholes. Wet terrains and heat in the surroundings are detected using a water sensor and a fire sensor. A buzzer attached to the system provides warning. An emergency message is sent whenever the button is pressed. An android app developed allows the blind to configure settings such as the distance at which the buzzer beeps, the sound produced when an obstacle is detected, etc. With the app, the lost stick can be found by enabling the buzzer attached to it.

5.3 Methodology

With the proposed system, visually challenged people can navigate with ease using advanced technology. The blind stick is equipped with ultrasonic sensors, fire and water sensors, and a panic button. By using ultrasonic waves, the system detects obstacles ahead. ESP 32 receives data from the sensor when it senses obstacles. The ESP32 then processes this data and calculates if the obstacle is within the prescribed threshold limit. Unless the obstacle is extremely close to the limit, the circuit does nothing. Otherwise, it sends a warning in form of different buzzer sound for different obstacles. The most important feature of the system is that it allows the user to send alert message to the concerned person in case of any distress by simply pressing a button. In addition, the system includes an Android app that allows users to customize stick configurations.It also offers an advanced feature to assist blind people in finding their sticks if they forget where they kept them. In the app, pressing the remote button activates a buzzer on the stick, which helps the blind find it.

5.3.1 Use Case Diagram

This diagram gives a graphical depiction of a user's possible interactions with a system.

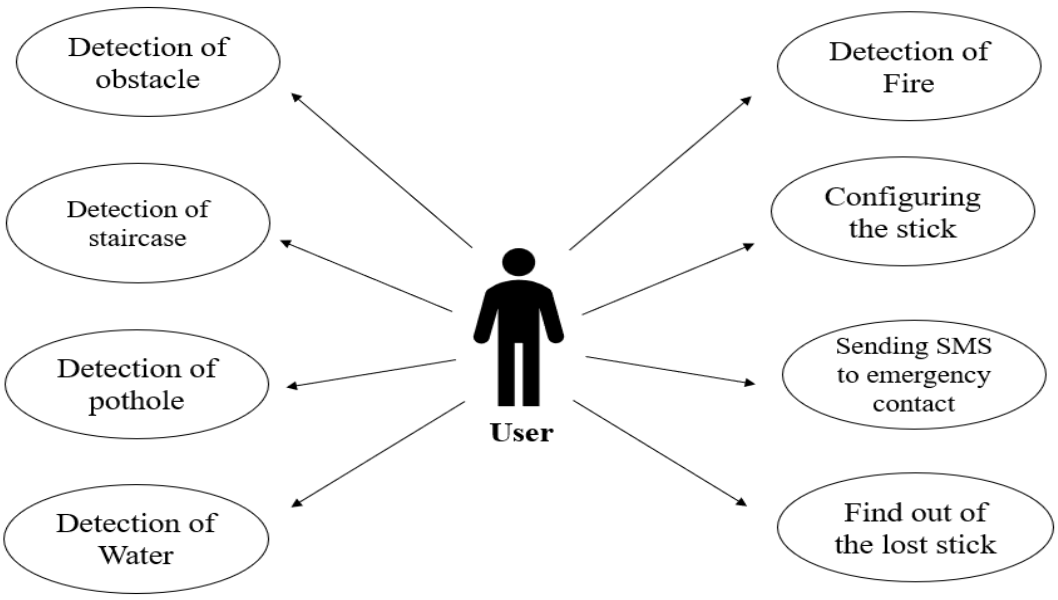


Figure 5.1: Use case diagram of the system

5.3.2 Flow Chart

This is a graphical representation of the algorithm for a better understanding of the code visually.

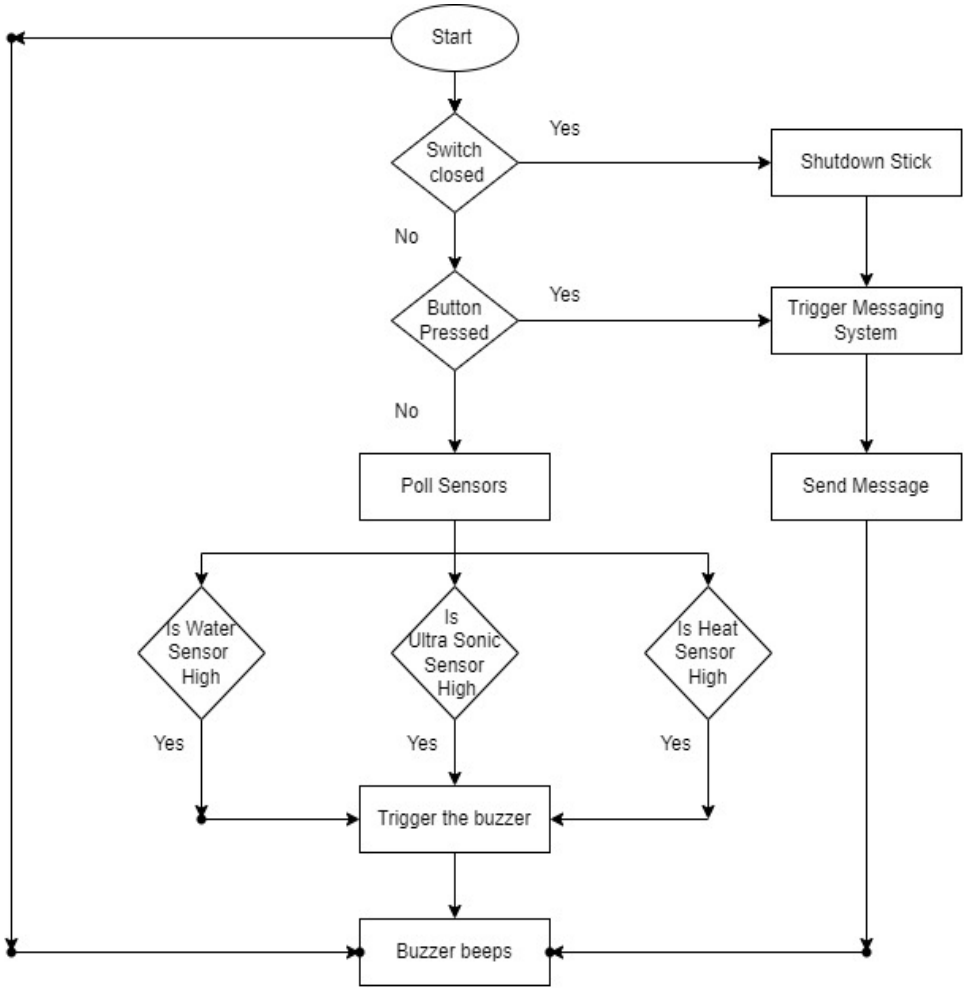


Figure 5.2: Flow chart of the system

5.3.3 Block Diagram

This illustration gives a functional overview of the system.

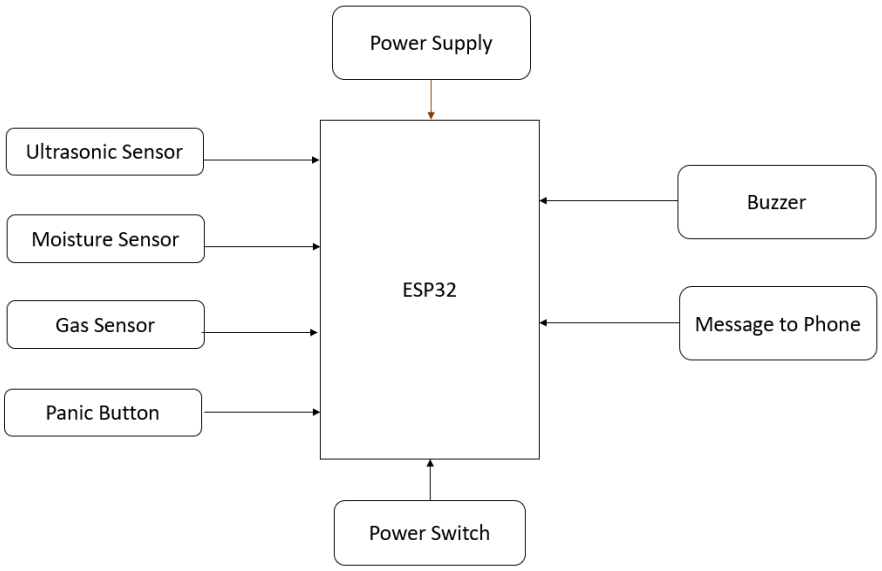


Figure 5.3: Block diagram of the system

5.3.4 Circuit Diagram

This illustration gives a functional overview of the system.

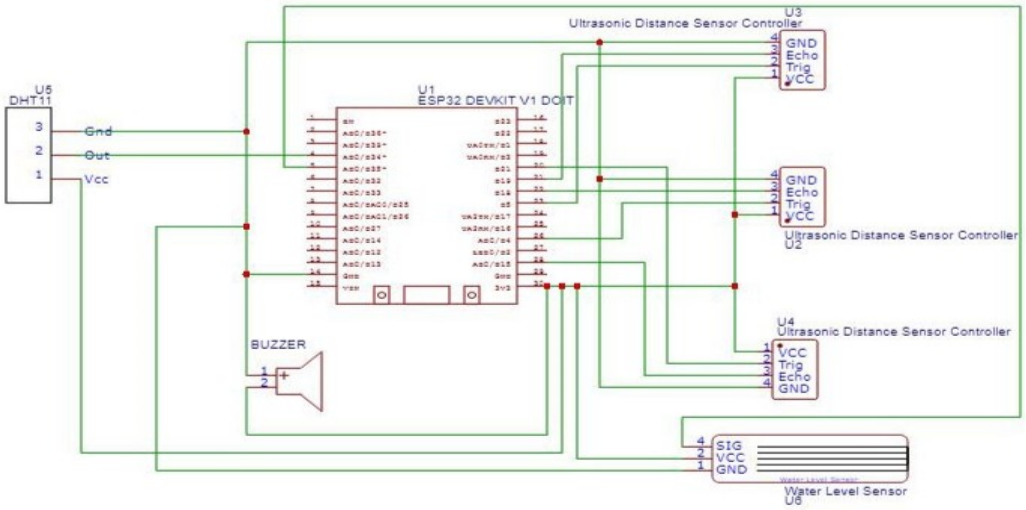
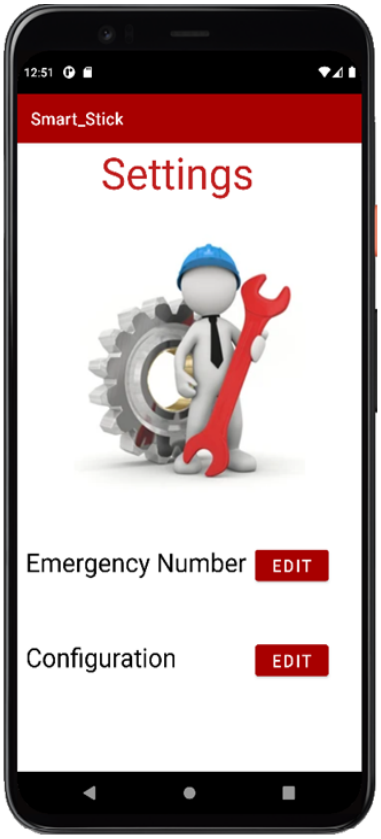
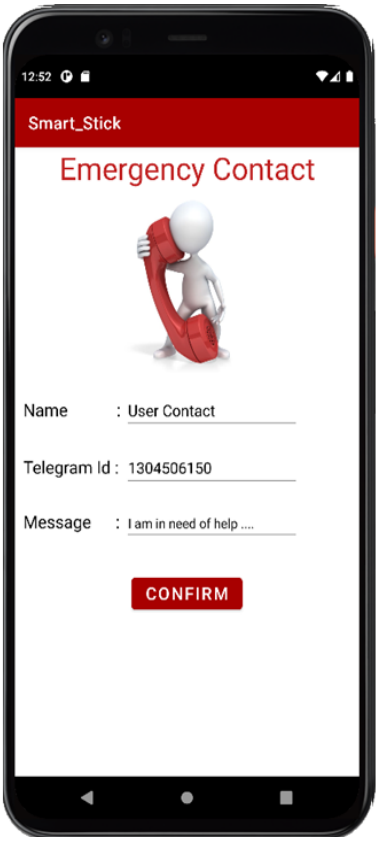


Figure 5.4: Circuit diagram of the system

5.3.5 Screenshots of User interface





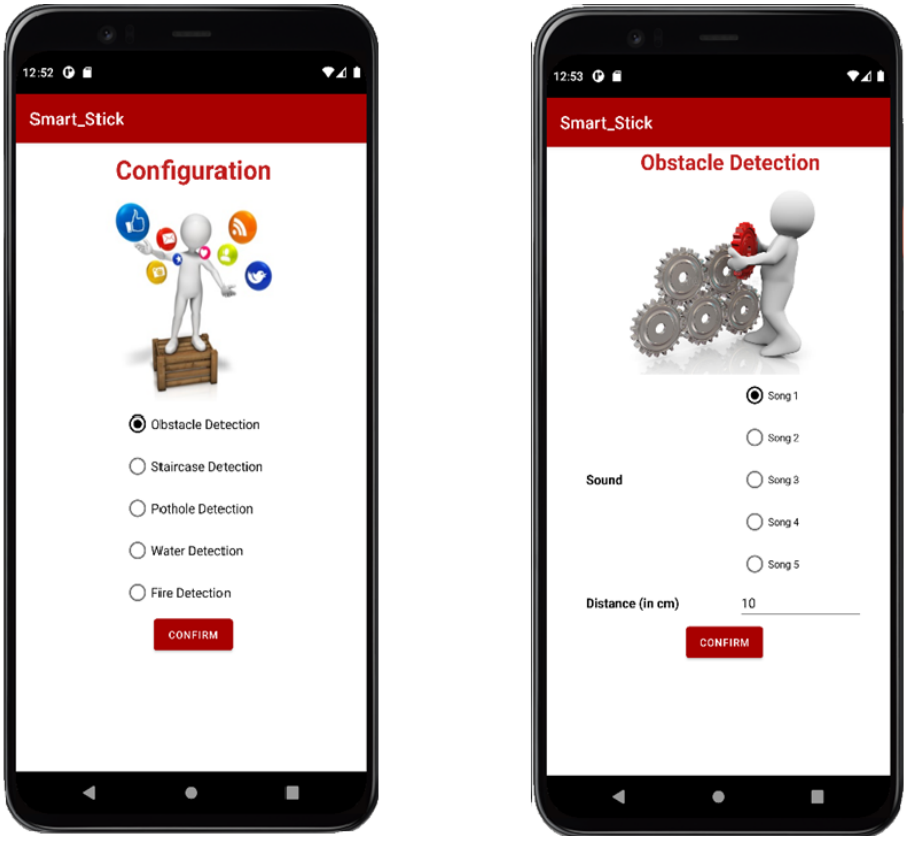


Figure 5.5: Screenshot of the android app

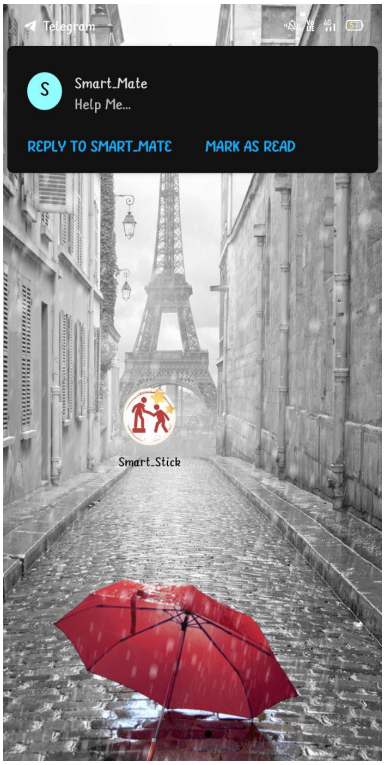


Figure 5.6: Screenshot of telegram alert

5.3.6 Prototype of Smart Blind Stick

Figure 5.7: Prototype of the system

5.4 Implementation

A variety of advanced technologies are available to assist visually challenged people in navigating the world. The blind stick contains three ultrasonic sensors, two fire sensors, and a panic button. Distance is calculated by measuring the delay between two successive waves sent and received by ultrasonic sensors. Moisture content is determined by measuring the conductivity of the water sensor. The heat sensor calculates heat intensity based on the particles in the surrounding area. After receiving this data, the ESP32 processes it and calculates whether the obstacle is within the threshold.Upon identifying different obstacles, it sends a buzzer notification. By pressing a button, the ESP32 module will send an alert message to the guardian of the blind person via telegram in case of distress. It provides additional support in the form of an Android app that makes it possible to configure the above mentioned settings of the Smart Blind Stick, such as the phone number saved as an emergency contact, the buzzer sound to be made, and the distance at which the buzzer makes a beeping sound. Users can activate the buzzer within the stick using the Android app to locate it if it is lost.

Chapter 6

Testing

Testing involves running a program to find errors and missing operations, as well as comprehensive verification to make sure the user requirements are met and the goals are reached. A comprehensive testing methodology is used for each module in the test plan. All three types of testing are defined in the test plan, including unit, integration, and system testing. After the project development cycle is complete, the user should find that all their criteria have been met or exceeded. Any modification, addition, or deletion to the requirements document, functional specification, or design specification must be documented and tested to the best of the test team's abilities given the remaining time frame.

6.1 Unit Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Obstacle detection	Successfully detected	Same as expected	pass
2	Staircase detection	Successfully detected	Same as expected	pass
3	Pothole detection	Successfully detected	Same as expected	pass
4	Water detection	Successfully detected	Same as expected	pass
5	Fire detection	Successfully detected	Same as expected	pass
6	Alert Message	Successfully send	Same as expected	pass
7	Configuration using app	Successfully configured	Same as expected	pass
8	Buzzer to find stick	Successfully beeped	Same as expected	pass

Table 6.1: Unit test cases and results

6.2 Integration Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Placing all the components in stick	Successfully integrated	Same as expected	pass
2	Developing the android app	Successfully developed the app	Same as expected	pass
3	Connecting android app and IoT devices together	Successfully connected	Same as expected	pass

Table 6.2: Integration cases and result

6.3 System Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Identifying various obstacles and provides warning	Successfully identified	Same as expected	pass
2	Sending alerts in case of emergencies	Successfully send	Same as expected	pass
3	Customizing settings using android app	Successfully modified	Same as expected	pass
4	Customizing settings using android app	Successfully found	Same as expected	pass

Table 6.3: System test cases and results

It was shown in the above test results that the developed system has successfully identified multiple obstacles such as objects, potholes, stairs, water, and fire. The different sensors which performed these tasks are successfully integrated onto the stick as well as a panic button to be used in emergency situations. The Android app developed successfully made desired adjustments to the stick configurations. The functionality to locate lost sticks again has been implemented successfully. Those results demonstrate that the system passed each of the above-mentioned tests.

Chapter 7

Results and Discussion

The aim of this project is to make the traditional blind stick smarter using IOT. System functionality is observed to be as expected.The primary objective is to support the blind people by offering various detection methods and an emergency alert message sending system, along with an app to customize the setting of this smart stick. Currently, there is no single system that provides all these features. This low-cost system is more effective than the expensive one that is currently in use.

7.1 Advantages

- The gadget will make it easier for people who are blind to walk anywhere they want with additional assistance.
- It will detect the obstacle coming in the way of blind people.
- Moreover, it can easily detect the moisture and temperature in the surroundings and will give the command to the blind person.
- The most important feature will be the panic button on the gadget; whenever the blind person is stuck or in an emergency, an emergency message be sent to the predefined person.
- The app provided for customizing configurations ensures an additional level of support.
- When the stick goes missing, the buzzer provides an alarming sound to help locate it.
- The gadget will be portable.

7.2 Disadvantages

- The stick always needs to be connected to the Internet
- There is a requirement of prior training of the blind person in order to use the device.
- The device cannot recognize and classify objects.
- The device cannot differentiate between person or object; it will simply sense it is an obstacle.

Chapter 8

Conclusion

In this project, I employ the Internet of Things (IoT) paradigm is used to facilitate communication between blind people and the environment.Here, I intend to develop a "Smart Blind Stick", which increases the accessibility of a blind person to move around by providing various alerts. The stick developed in this project uses algorithms to detect potholes, staircases, water, fire, and other obstacles within a range close to the user. It also has the facility to send a message to a concerned person in case of emergency on a button press and a buzzer is used to find the lost cane. The android app provided can help to customize the configuration.With this system users will enjoy the user-friendly interface, quick response, low power consumption, lighter weight, and ease of holding the smart blind stick.

Chapter 9

Future Scope

The proposed system can be updated in the future by removing some of the limitations in the current model as well as some extra features also can be implemented.Integrating GPS module to send location of the stick on pressing emergency button and in order to reach the desired destination, it can be used to find the shortest path and the longest path based on real-time coordination on Google Maps.Modifying the app to work with voice assistance. Video recording once emergency alarm gets triggered.The integrated set of hardware can be powered by solar panels instead of batteries. If one's functionality is compromised, a smart stick can communicate with a nearby smart stick (or mobile device, PC) to utilize that stick's functionality. Assuring direct access to police or official authorities during a crisis.

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