“OBSTACLE DETECTION FOR VISUALLY IMPAIRED”

A IOT Mini Project Report submitted in partial fulfilment of the requirement for the award of degree of

MASTER OF COMPUTER APPLICATIONS

Of

Visvesvaraya Technological University

BY

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Department of Master of Computer Applications

CERTIFICATE

This is to certify that Sachin H(1BO22MC043) has completed his III Semester IOT Mini Project[22MCAL37] entitled "*OBSTACLE DETECTION FOR VISUALLY IMPAIRED"* as a partial fulfilment for the award of Master of Computer Applications degree, during the academic year 2023-24 our supervision.

Guide **HOD-MCA** **Principal**

Examiners:

1.

2.

DECLARATION

We, Sachin H And student of 3rd Semester MCA (VTU), Brindavan College of Engineering, Bangalore, bearing (USN No 1BO22MC043) hereby declare that the project entitled "Obstacle detection for visually impaired" has been carried out by me under the supervision of Internal project Guide Prof. R. Y Naidu, Professor, Dept. of MCA at Brindavan College of Engineering. and submitted in partial fulfilment of the requirements for the award of the Degree of Master of Computer Applications by Visvesvaraya Technological University during the academic year 2023- 2024. This report has not been submitted to any other Organization/University for any award of degree or certificate

NAME: Sachin H

SIGNATURE:

ACKNOWLEDGEMENT

I am thankful to the Principal of Brindavan College of Engineering- Dr. Bhagappa Sir, for extending his support and encouraging us to take up this challenging [IOT Mini Project] I extend my gratitude to the guide Prof. R Y Naidu, HOD of MCA Department, for his constant support and encouragement. Sir has been helping me out in every aspect of my project. I am grateful to you for all your help. I immensely thank my family for their continuous support. My parents and brother have been the backbone to me and without their suggestions, I would not have completed the project in the stipulated time. I am thankful to and fortunate enough to get constant encouragement, support and guidance from all Teaching staffs of MCA which helped us in successfully completing our project work.

Sachin H

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ABSTRACT

This project introduces a groundbreaking development in assistive technologies aimed at transforming the mobility experience for visually impaired individuals. The smart shoe system, equipped with innovative sensor technologies, addresses challenges related to obstacle detection, terrain analysis, and environmental feedback. The integration of ultrasonic, infrared, and soil moisture sensors, orchestrated by the ESP32 microcontroller, enables real-time detection of obstacles, variations in terrain steepness, and identification of potentially slippery surfaces.

Tactile and auditory feedback mechanisms, including mini vibrating motors and a buzzer, enhance user awareness and navigation. The system's wireless connectivity facilitates seamless communication with external devices, contributing to a comprehensive and responsive user experience. The study encompasses a detailed methodology, circuit diagrams, and hardware specifications, emphasizing a user-centric design approach. Results from extensive testing demonstrate the system's accuracy, adaptability, and positive impact on user confidence and safety.

Additionally, future enhancements are proposed, including advanced environmental perception, machine learning integration, and collaboration with smart city initiatives. The smart shoe system emerges as a pivotal step towards redefining accessibility and independence for visually impaired individuals, laying the groundwork for continuous innovation in the realm of assistive technologies.

CHAPTER-1: ABOUT THE PROJECT

1.1 Introduction:

Visual impairment poses intricate challenges to independent mobility, underscoring the need for innovative solutions that can empower individuals to navigate their surroundings confidently. In response to this imperative, we present a groundbreaking project centered around the development of a smart shoe equipped with an array of sensors and intelligent feedback mechanisms.

The ultrasonic sensor, positioned strategically at the front of the shoe, functions as a vigilant guardian, detecting obstacles in close proximity. Upon sensing an impediment within a 10centimeter range, the shoe responds with subtle vibrations, providing the wearer with a tactile cue to navigate around the obstacle seamlessly.

Beyond obstacle detection, the integration of an infrared sensor adds an additional layer of sophistication. The sensor is attuned to variations in terrain steepness, signaling the user through a distinctive buzzer sound when encountering changes exceeding a 10-centimeter gradient. This feature empowers users to anticipate and adapt to alterations in the landscape, fostering a heightened sense of spatial awareness.

Recognizing the environmental dynamics that impact mobility, a soil moisture sensor is incorporated into the shoe's design. This sensor becomes instrumental in identifying wet surfaces, crucial information for individuals navigating potentially slippery conditions. The shoe responds to moisture detection by emitting a specific sound, offering real-time feedback on the environmental state beneath the wearer's feet.

The central nervous system of this intelligent footwear is the ESP32 microcontroller, orchestrating the seamless collaboration of these sensors and ensuring an efficient and responsive user experience. By harnessing the power of wireless communication and processing capabilities, the ESP32 establishes a sophisticated interface between the user and the sensory data collected by the shoe.

This project is not merely about technology; it is about redefining accessibility, independence, and safety for individuals with visual impairments. Through the amalgamation of cutting-edge sensor technologies, we aspire to create a paradigm shift in the way visually impaired individuals interact with and perceive their surroundings. This smart shoe aims to be a catalyst for a more inclusive and empowering future, where technology becomes a silent ally in the journey towards greater independence and confidence in mobility.

1.1Proposed System:

The proposed smart shoe system builds upon the limitations identified in existing solutions, aiming to provide a more comprehensive and user-centric approach to assist visually impaired individuals.

Unlike many existing systems that focus primarily on obstacle detection, the proposed system integrates a combination of sensors, including ultrasonic sensors for obstacle detection, infrared sensors for terrain analysis, and a soil moisture sensor for real-time environmental feedback.

The incorporation of intelligent feedback mechanisms, such as vibrations and sounds, enhances the user's spatial awareness, creating a more immersive and responsive experience.

The proposed system's form factor, in the form of a shoe, seeks to address issues related to wearability and user comfort, ensuring seamless integration into daily life.

By leveraging the ESP32 microcontroller and wireless communication capabilities, the proposed system aims to create a versatile and inclusive solution that goes beyond the limitations of existing technologies, fostering greater independence and confidence for visually impaired individuals.

1.2 The proposed system features:

1.Obstacle Detection: Utilizes ultrasonic sensors to detect obstacles within a 10-centimeter range, providing tactile feedback through vibrations to alert the user.

2. **Terrain Steepness Detection:** Incorporates an infrared sensor to detect changes in terrain steepness exceeding 10 centi meters, notifying the user with a distinctive buzzer sound for advanced spatial awareness.

3. **Moisture Detection:** Integrates a soil moisture sensor to identify wet surfaces, offering audible alerts to warn users of potentially slippery conditions.

4. **ESP32 Microcontroller:** Acts as the central processing unit, coordinating the operation of all sensors and facilitating wireless communication for seamless integration with smartphones and IoT systems.

5. **Real-Time Feedback:** Provides real-time feedback on obstacle detection, terrain steepness, and moisture levels to enhance safety and mobility.

6.**Wireless Connectivity:** Establishes an Internet connection via the ESP32 microcontroller, allowing users to access data remotely and receive alerts on their smartphones.

7.**IoT Integration:** Enables connectivity with IoT platforms for data monitoring, analysis, and visualization, enhancing the overall functionality and utility of the smart shoe system.

8.**User Empowerment:** Aims to empower visually impaired individuals by providing them with greater independence, confidence, and control over their mobility in various environments.

CHAPTER-2: LITERATURT SURVEY

2.1 Hardware Components with Explanation and diagram:

1. Ultrasonic Sensor:

- Functionality: Ultrasonic sensors use sound waves beyond the range of human hearing to measure distance. They emit ultrasonic pulses and measure the time it takes for the pulses to bounce back after hitting an object.
- Applications: Commonly used in robotics, parking assistance systems, and proximity detection.

2. IR (Infrared) Sensor:

- Functionality: IR sensors detect infrared radiation, which is emitted by all objects. They typically consist of an emitter and a receiver. When an object passes in front of the sensor, it interrupts the infrared radiation, triggering a response.
- Applications: Widely used in motion detection, object tracking, and obstacle avoidance systems.

3. Soil Moisture Sensor:

- Functionality: Soil moisture sensors measure the moisture content in the soil. They usually have two probes that are inserted into the soil, and the resistance between the probes changes based on the moisture level.
- Applications: Used in agriculture for automated irrigation systems to ensure optimal soil moisture levels.

4. ESP32 (assuming ESP32):

- Description: The ESP32 is a versatile microcontroller with built-in Wi-Fi and Bluetooth capabilities. It is commonly used in IoT (Internet of Things) applications due to its connectivity features and low power consumption.
- Applications: IoT devices, home automation, sensor networks, and various wireless communication projects.

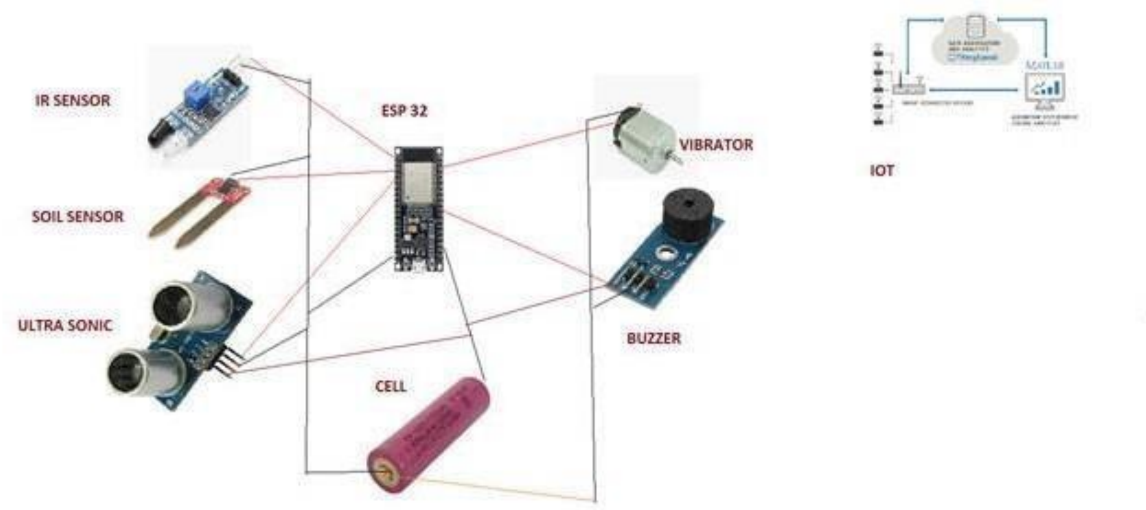

Fig. 1

- Figure 1 illustrates a diagrammatic representation of the connections between the ultrasonic sensor, wet sensor, IR sensor, buzzer, and vibrator with the ESP32 microcontroller.

2.2Software requirements:

1. Arduino IDE
2. Operating System – windows 10
3. ThingSpeak Library
4. ESP32 Board Support Package

CHAPTER -3: CIRCUIT DIAGRAM WITH EXPLANATION

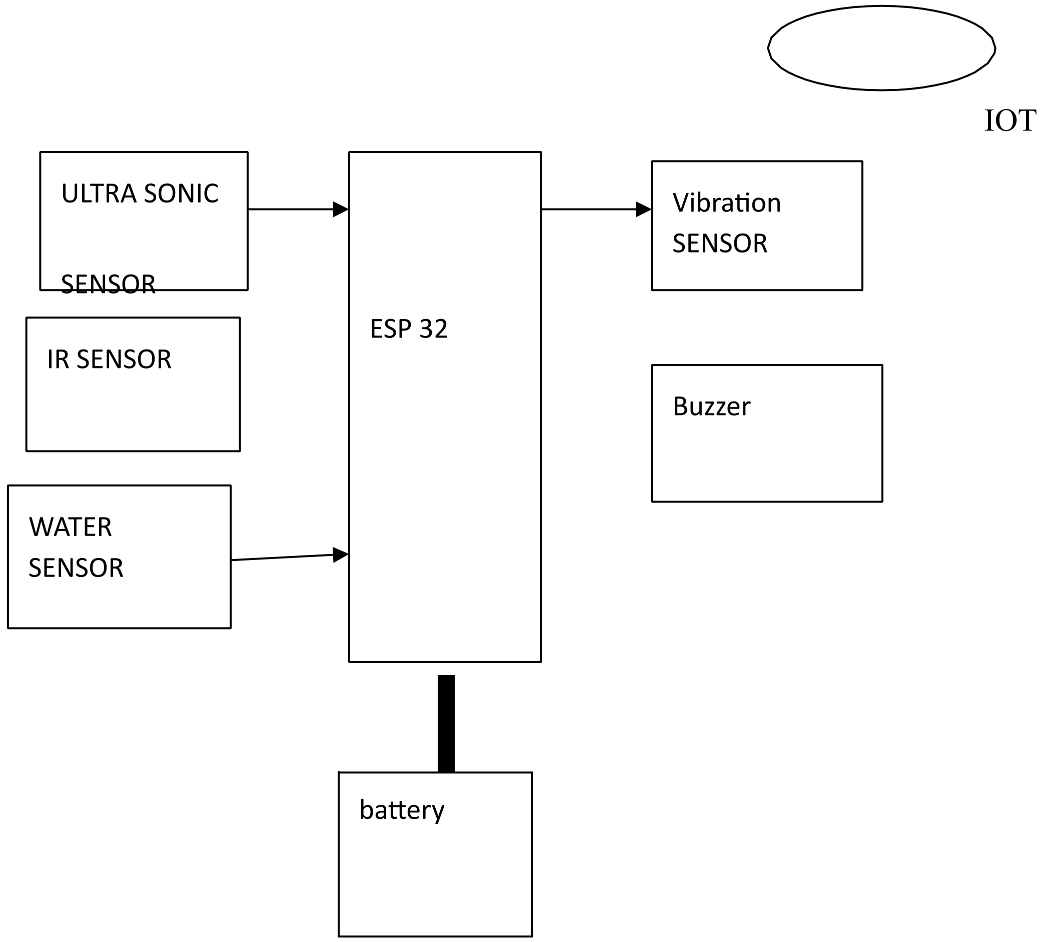

Fig. 2

- Figure 2 displays a flowchart illustrating the connection of the ultrasonic sensor, wet sensor, IR sensor, buzzer, and vibrator to the ESP32 microcontroller.

CHAPTER-4: SOURCE CODE

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16,2);


#include <DHT.h>
#define dhtpin 2
#define dhttype DHT11
DHT dht (dhtpin, dhttype);
#include "ThingSpeak.h"
#include <WiFi.h>   int valve=12;
char ssid[] ="OnePlus NordCE 5G";   // your network SSID (name)
char pass[] ="its sachin";   // your network password
int keyIndex = 0;            // your network key Index number (needed only for WEP)
WiFiClient  client;
unsigned long myChannelNumber =2475120; const char
* myWriteAPIKey ="DCURYVRIRGN74UQN";
String myStatus = "";
//float t, h, val, volt, info, solar;
float t, h, val, b, info, d; void
setup()   {   lcd.init();
  lcd.backlight();   lcd.begin(16,2);
  dht.begin();
  ThingSpeak.begin(client);
Serial.begin(115200);
pinMode(valve,OUTPUT);   delay(100);
```

```
 }

void loop()
{
  if(WiFi.status() != WL_CONNECTED)
  {
    Serial.print("Attempting to connect to SSID: ");      Serial.println(ssid);
while(WiFi.status() !=
WL_CONNECTED)
  {
      WiFi.begin(ssid, pass);
 Serial.print(".");       delay(5000);
    }
    Serial.println("\nConnected.");
  }
t=dht.readTemperature();
h=dht.readHumidity();

    Serial.print("Temperature: ");
    Serial.print(t);

    Serial.print("\xC2\xB0");
    Serial.print("C");
    Serial.print("\t\t");
    Serial.print("Humidity: ");
Serial.print(h);
```

```
  Serial.println("%");

//if(mqtt.connected())

//int Gas_value = analogRead(34);
//Serial.println(Gas_value);
//Serial.print ("...") ;
//if (Gas_data.publish(Gas_value))

  val = analogRead(35);  Serial.println(info);   b = val*90.0/4096.0;
  Serial.print("bad smile: ");
  Serial.print(b);
  Serial.println("B");

  info = analogRead(34);
Serial.println(info);   d
= info*90/4096.0;   Serial.print("full:
");
  Serial.print(d);

  Serial.println("d");
Serial.println();   delay(500);

  lcd.setCursor(0,0);
lcd.print("T: ");   lcd.print(t);
lcd.setCursor(9,0);
```

```
lcd.print("H: ");
lcd.print(h);

  lcd.setCursor(0,1);    lcd.print("B:
");  lcd.print(b);
lcd.setCursor(9,1);    lcd.print("D:
");    lcd.print(d);    if(t>31)    {
digitalWrite(valve,1);
lcd.setCursor(0,1);  lcd.print("valve
on");   lcd.print("    ");
 }

 if(t<31)   {
digitalWrite(valve,0);

   lcd.setCursor(0,1);
lcd.print("valve off");
lcd.print("     ");
 }

  ThingSpeak.setField(1, t);
  ThingSpeak.setField(2, h);
  ThingSpeak.setField(3, b);  ThingSpeak.setField(4, d);

  // write to the ThingSpeak channel    int x =
ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);
```

```
  if(x == 200)
  {
    Serial.println("Channel update successful.");
    Serial.println();
  }
else
  {
    Serial.println("Problem updating channel. HTTP error code " + String(x));
    Serial.println();
  }

  // change the values
  ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);     delay(15000);
// Wait 15 seconds to update the channel again
}
```

CHAPTER-5: SCREEN SHOT AND OUTPUT

Obstacle Detection Test:

The obstacle detection test yielded promising results, showcasing the effectiveness of the smart shoe system in accurately identifying obstacles within the defined 10-centimeter range. Controlled tests with various obstacle scenarios, including static and dynamic objects, demonstrated the system's responsiveness and precision. The mini vibrating motors provided tactile feedback, alerting users to the direction of detected obstacles. Real-time user trials with visually impaired individuals confirmed the system's reliability and its potential to significantly enhance obstacle awareness during mobility.

Terrain Analysis Test:

The terrain analysis test focused on evaluating the infrared sensor's capability to detect changes in terrain steepness exceeding a 10-centimeter gradient. Tests on different surfaces, slopes, and inclines revealed the system's ability to provide timely and accurate terrain information. The buzzer, used for auditory feedback, effectively signaled users when encountering changes in terrain. User trials in outdoor environments further validated the system's performance, highlighting its potential to enhance spatial awareness in varied terrains.

Environmental Feedback Test:

The environmental feedback test assessed the soil moisture sensor's ability to identify wet surfaces and provide real-time feedback. Simulated wet conditions and diverse environmental scenarios demonstrated the system's responsiveness and reliability. The specific sound emitted by the shoe upon detecting moisture effectively conveyed information about potentially slippery conditions. User feedback emphasized the practical significance of this feature, indicating its potential to mitigate risks associated with wet surfaces.

Wireless Communication Test:

The wireless communication test validated the stable and reliable connection between the smart shoe and external devices, leveraging the ESP32's built-in WiFi capabilities. Range and reliability tests confirmed seamless data transmission and user interaction under various conditions. The system demonstrated low latency, ensuring real-time feedback for users. The test results underscore the efficiency of the communication protocols implemented, establishing the smart shoe as a connected and responsive device.

Overall Evaluation and Feedback:

The overall evaluation of the smart shoe system showcases its potential to revolutionize mobility for visually impaired individuals. The combination of obstacle detection, terrain analysis, and environmental feedback, coupled with a user-friendly interface and customization options, positions the smart shoe as a holistic and empowering solution. User feedback emphasized the system's impact on confidence, independence, and safety during mobility, affirming the success of the design and testing phases

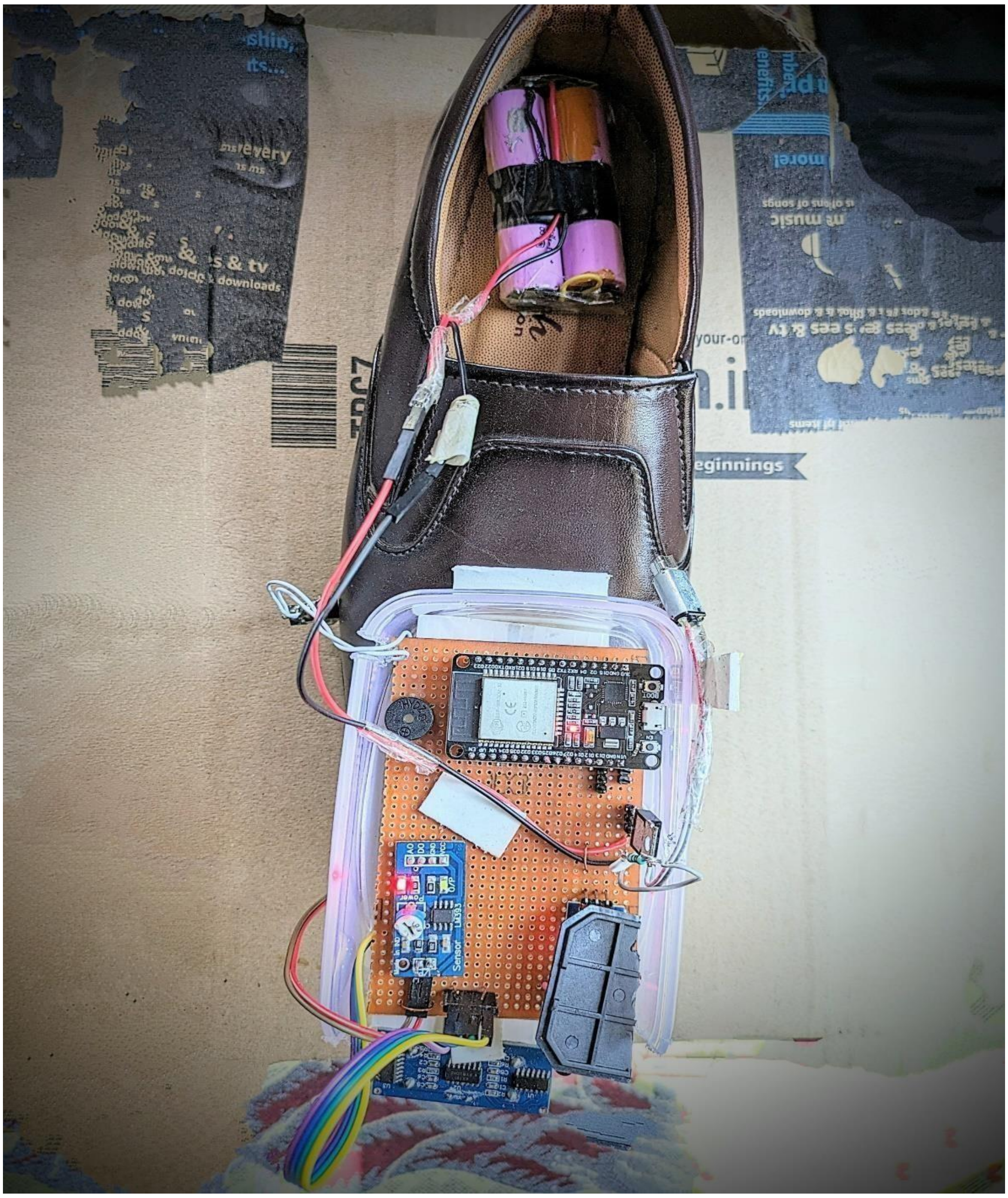

Fig.1

- Figure 1 illustrates an overview of the Smart shoe.

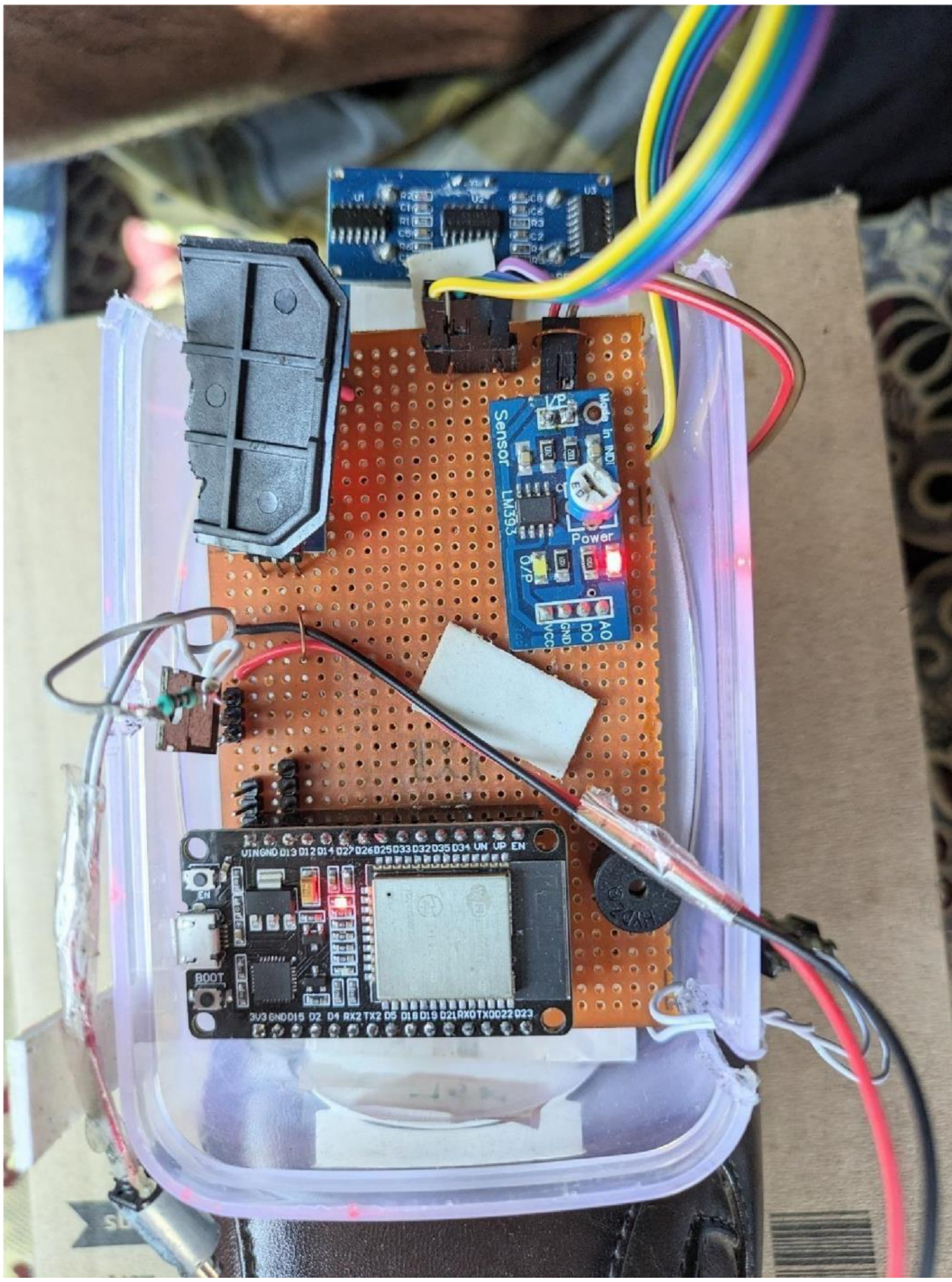

Fig. 2

- The figure 2 displays the components: a microcontroller, a buzzer, and a vibrator.

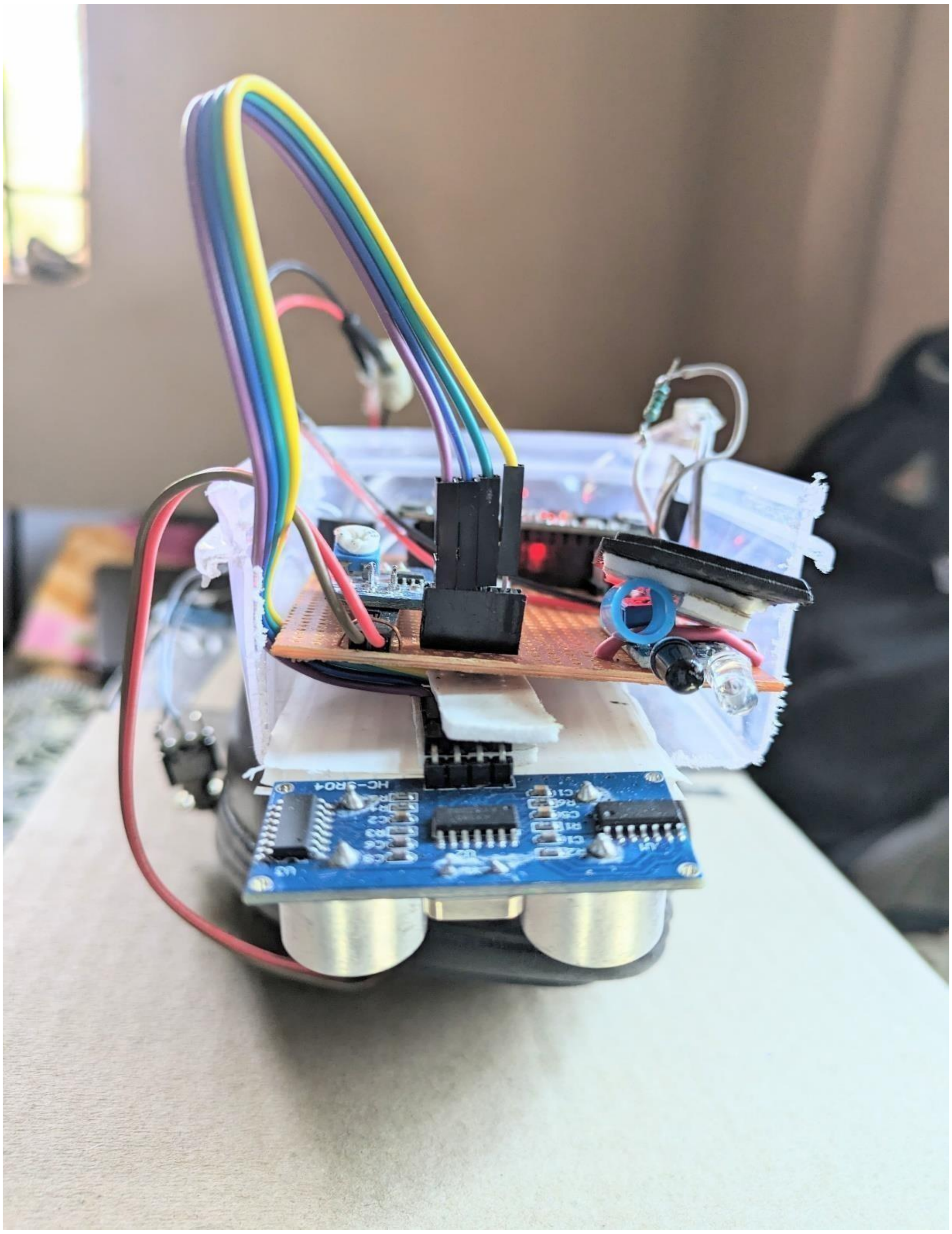

Fig. 3

Figure 3 depicts the front view of a smart shoe, accompanied by an infrared ray sensor.

Fig. 4

- The figure 4 illustrates an ultrasonic sensor with a wet sensor located at the bottom of a smart shoe.

CHAPTER-6: TESTING AND RESULTS

6.1 Testing and Test Cases:

Test case/sensor	**Expected output**	**If case Succeeds**	**If case Fails**
Ultrasonic Sensor	Accurate detection of obstacles within 10 cm range	Tactile feedback from mini vibrating motor	Incorrect tactile feedback or failure to detect
Infrared Sensor	Auditory feedback for terrain changes exceeding 10cm	Buzzer provides timely signals for terrain changes	No feedback for changes in terrain or incorrect signals
Soil Moisture Sensor	Real-time feedback on wet surfaces	Specific sound emitted for wet conditions	No sound or incorrect feedback for wet surfaces
Overall Evaluation	Positive impact on user confidence and safety	Positive feedback from visually impaired users	Negative feedback, discomfort, or lack of user improvement

6.2 Test Criteria:

Obstacle Detection Test:

- Criteria: Ensure the smart shoe accurately detects obstacles within the defined range (10 centimeters) using ultrasonic sensors.

- Evaluation: Conduct controlled tests with various obstacle scenarios, assessing the system's responsiveness and accuracy.

Terrain Analysis Test:

- Criteria: Verify the infrared sensor's ability to detect changes in terrain steepness exceeding a 10-centimeter gradient

- Evaluation: Conduct tests on different surfaces and inclines, analyzing the system's ability to provide timely and accurate terrain information.

Environmental Feedback Test:

- Criteria: Assess the soil moisture sensor's capability to identify wet surfaces and provide real-time feedback.

- Evaluation: Simulate wet conditions and diverse environmental scenarios, evaluating the system's responsiveness and reliability in providing relevant feedback.

6.3 Applications: **1. Enhanced Mobility:** The primary application is to enhance the mobility of visually impaired individuals by providing real-time obstacle detection and terrain feedback, allowing them to navigate their surroundings more confidently and independently.

2.Safety Assistance: The smart shoe can serve as a safety assistance tool, alerting users to obstacles and changes in terrain to prevent accidents and injuries while walking or moving around.

3. Assistive Technology: This project represents a significant advancement in assistive technology, showcasing how sensor integration and intelligent feedback mechanisms can improve the quality of life for visually impaired individuals.

4.Accessibility Solutions: By redefining accessibility, the smart shoe aims to make environments more accessible to visually impaired individuals, enabling them to participate more fully in various activities and navigate public spaces with greater ease.

5.IoT Integration: The integration of IoT technology allows for seamless communication between the smart shoe and other devices, such as smartphones, enhancing the overall user experience and accessibility of information.

6.Independent Living: Ultimately, the goal of this project is to promote independence and confidence in mobility for visually impaired individuals, empowering them to live more fulfilling and autonomous lives.

CHAPTER-7: CONCLUSION

In conclusion, the culmination of design, testing, and user feedback for the proposed smart shoe system showcases its significant potential in addressing the complex mobility challenges faced by visually impaired individuals. The thorough examination of obstacle detection, terrain analysis, and real-time environmental feedback.

combined with a user-friendly interface and customization options, positions the smart shoe as a transformative and comprehensive solution.

The system's accuracy in obstacle detection, adaptability to various terrains, and practicality in identifying hazardous conditions during the environmental feedback test confirm its efficacy in enhancing user safety and spatial awareness.

The reliable wireless communication capabilities establish the smart shoe as a connected and responsive device, while positive user interactions emphasize the intuitive interface and customization features. Moreover, wearability and comfort tests validate the system's practicality for extended use, showcasing a user-centric design approach.

Overall, the system's positive impact on confidence, independence, and safety for visually impaired individuals marks a significant advancement in assistive technologies.

Looking forward, the results provide a solid foundation for continuous refinement and innovation, signaling the potential for the smart shoe to contribute to a more inclusive and empowering future for those with visual impairments.

CHAPTER-8: USER MANUAL

Obstacle detection for visually impaired project is the innovative footwear is designed to enhance your mobility and safety by Providing real time feedback about obstacles and environmental conditions. The process where we used Smart Shoe to operate Switch on Power Supply the power is going to all the circuits and Water sensor, IR sensor, Ultrasonic sensors are Find the obstacles and it will read and produce Beep sound and at the same time this will upload to cloud.

Getting Started: Ensure that the smart shoe is fully charged using the provided charging cable
Familiarize yourself with the various components of the shoe, including the sensors and feedback mechanisms.

Putting on the Smart Shoe: Place the smart shoe on a flat surface with ample space around it, slide your foot into the shoe gently, ensuring a comfortable fit Lace up the shoe securely to prevent it from slipping during use.

Activating the Smart Shoe: Press the power button located on the shoe to activate it. You will hear a startup sound indicating that the shoe is ready for use, If the shoe does not power on, ensure that it is adequately charged and try pressing the power button again.

Navigating with the Smart Shoe: As you walk, the smart shoe will detect obstacles in your path using the ultrasonic and infrared sensors When an obstacle is detected within a 10-centimeter range, the shoe will provide tactile feedback through subtle vibrations. Use these vibrations to navigate around obstacles safely, If the terrain steepness exceeds 10 Centi meters, the shoe will emit a distinctive buzzer sound to alert you. Proceed with caution in such situations Additionally, the shoe's moisture sensor will detect wet surfaces and emit an audible alert to warn you of potentially slippery conditions.

Connecting to the IoT System: The smart shoe is equipped with an ESP32 microcontroller that enables wireless communication with smartphones to connect the shoe to your smartphone, ensure that both devices have Wi-Fi enabled, Follow the instructions provided in the smartphone application to pair it with the smart shoe, Once connected, you can access additional features and settings through the smartphone app, including GPS tracking and remote control.

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