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Information Technology

Internet of Things

Third Eye for The Blind

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Introduction:

The community of people who are visually impaired has numerous obstacles that affect all facets of daily life. Mobility and spatial awareness are two of these difficulties that stand out as very important areas where creative solutions can have a big impact. For those who are visually impaired, moving around indoors, traversing busy streets, or navigating through unfamiliar areas can present significant challenges. These difficulties frequently result in a reliance on outside help, which reduces the person's independence and sense of autonomy.

In order to tackle these issues, our idea suggests creating a revolutionary tool called the "Third Eye." In contrast to conventional mobility aids, the Third Eye uses contemporary technology to give the user immediate input, enabling them to confidently and independently explore their environment.

With the help of an ESP8266 microprocessor and an ultrasonic sensor, the device can identify obstacles in the user's close area and instantly warn them of any potential dangers. This proactive approach not only improves safety but also helps visually impaired people feel independent and autonomous.

Literature Review:

Navigating through the world independently poses significant challenges for individuals with visual impairments. Over the years, researchers and technologists have endeavoured to develop assistive devices to mitigate these challenges and enhance mobility and autonomy for the visually impaired community. This literature review examines previous research efforts, technological advancements, and methodologies employed in addressing the navigation needs of individuals with visual impairments.

Historically, traditional aids such as white canes and guide dogs have been indispensable tools for individuals with visual impairments, offering tactile feedback and assistance in detecting obstacles and navigating unfamiliar environments. However, these aids have inherent limitations, particularly in indoor settings where the density of objects is higher. Negotiating indoor spaces poses unique challenges for individuals with visual impairments, as the proximity of furniture, walls, and other obstacles requires precise navigation and spatial awareness. In such environments, traditional aids may be less effective in providing comprehensive guidance and may necessitate alternative solutions to enhance indoor mobility and independence.

One prominent avenue of research has been the integration of electronic sensors and feedback systems into wearable devices. Ultrasonic sensors, in particular, have garnered attention for their ability to detect obstacles in the surrounding environment by emitting high-frequency sound waves and analysing their reflections. Several studies have explored the feasibility of using ultrasonic sensors in assistive navigation devices for the visually impaired, with promising results. Additionally, advancements in miniaturization and wearable technology have facilitated the development of compact and unobtrusive navigation aids that seamlessly integrate into the user's daily life. Wearable devices such as smart glasses and wristbands equipped with sensors and audio feedback systems have shown potential in providing real-time navigation assistance, route guidance, and obstacle detection.

Despite these advancements, challenges remain in the development and adoption of assistive navigation technologies for the visually impaired. Issues such as accuracy, reliability, affordability, and social acceptance pose significant barriers to widespread implementation. Addressing these challenges requires interdisciplinary collaboration, user feedback-driven design iterations, and continuous innovation in sensor technology, data processing algorithms, and assistive device form factors.

Methods to Solve Problem:

The proposed method offers a holistic approach to addressing the mobility challenges faced by visually impaired individuals through the seamless integration of hardware components and intelligent feedback mechanisms. By combining an ESP8266 microcontroller with an ultrasonic sensor, the system enables real-time monitoring of the user's surroundings, continuously measuring distances to detect potential obstacles. This proactive approach to obstacle detection allows the user to navigate their environment with greater confidence and safety, minimizing the risk of collisions or accidents.

Central to the effectiveness of the method is the feedback mechanism facilitated by the ESP8266 microcontroller. Upon detecting obstacles within a predefined range, the microcontroller interprets the sensor data and triggers feedback alerts to notify the user of potential barriers. The use of buzzers as part of the feedback process ensures that the alerts are both audible and immediate, providing the user with timely information to adjust their navigation path accordingly. By delivering actionable feedback in real-time, the method empowers visually impaired individuals to navigate their surroundings more effectively, promoting independence and autonomy in their daily lives.

Detailed Description of Used Equipment's:

- **Ultrasonic Sensor (HC-SR04):** This sensor monitors the time it takes for ultrasonic waves to bounce back from obstacles and produces ultrasonic waves in order to precisely compute distances. It also has crystal oscillators in it. It will perform the stabilization operation in the ultrasonic sensor.

  The HC-SR04 Ultrasonic Range Sensor Features:
  - *Input Voltage: 5V*
  - *Current Draw: 20mA (Max)*
  - *Digital Output: 5V (High)*
  - *Digital Output: 0V (Low)*
  - *Working Temperature: -15°C to 70°C*
  - *Sensing Angle: 30° Cone*
  - *Angle of Effect: 15° Cone*
  - *Ultrasonic Frequency: 40kHz*
  - *Range: 2cm - 400cm*
  - *Dimensions*
    - *Length: 43mm*
    - *Width: 20mm*
    - *Height (with transmitters): 15mm*

Figure 1: Ultrasonic Sensor

- **ESP8266 Microcontroller:** Often utilized in Internet of Things projects, the ESP8266 is a low-cost, Wi-Fi enabled microcontroller. It will interpret sensor data and generate feedback, acting as the Third Eye device's central processing unit.

Figure 2:ESP8266

Figure 3: Breadboard

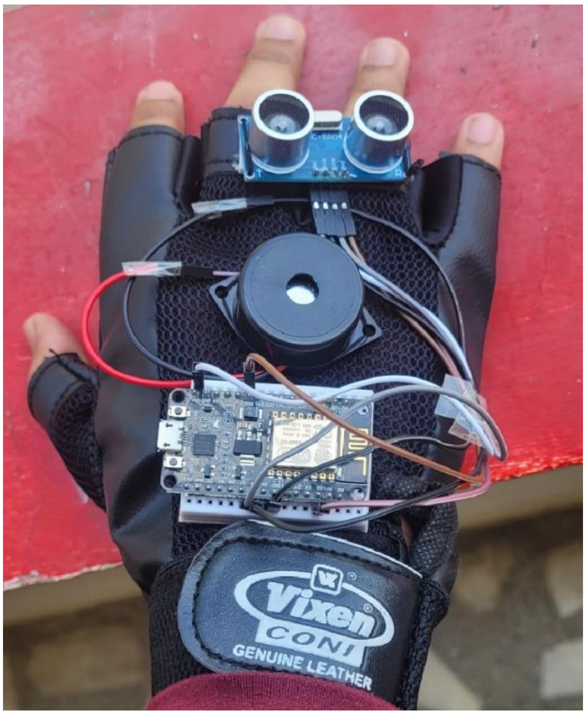
Figure 4:Buzzer

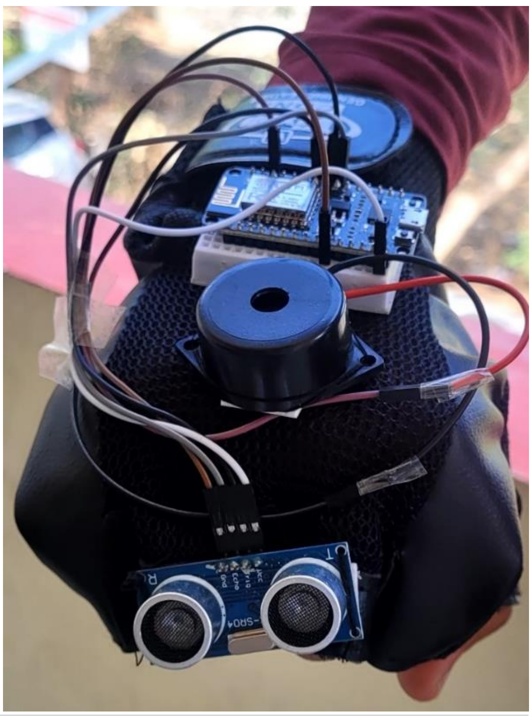
- **Breadboard**: During the development stage, the inclusion of a small breadboard proves to be indispensable for prototyping and connecting components effectively. A breadboard serves as a versatile platform for arranging and testing electronic circuits without the need for soldering, allowing for quick and easy adjustments to the circuit layout.

- **Gloves:** The user will be able to interact conveniently and hands-free by attaching the device to their gloves.

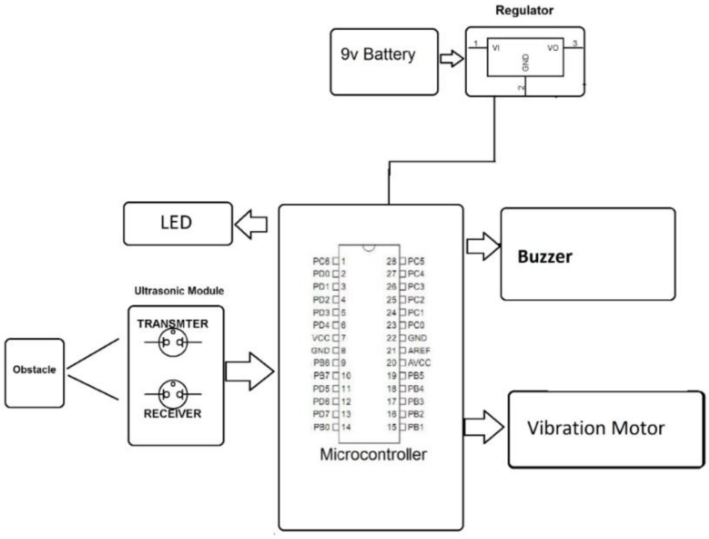
- **Buzzer:** A buzzer can be mechanical, electromechanical, or piezoelectric in nature. It resembles an electrical device that produces sound waves for the channel. It is a device that produces sound by converting audio signals into sound signals.

Project Picture:





Block Diagram:



Code And Simulation Motivation:

Code:

```
#define trigPin D5
#define echoPin D6
#define buzzer D2

long duration;
int distance;

void setup () {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzer, OUTPUT);
  Serial.begin(9600);
}

void loop () {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);

  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);

  distance = duration*0.034/2;
  if(distance <= 30) digitalWrite(buzzer, HIGH);
  else digitalWrite(buzzer, LOW);
```

```
  Serial.print("Distance: ");
  Serial.println(distance);
  delay(1000);

}
```

Simulation Motivation: Before physical implementation, simulating the device in a virtual environment allows for testing the functionality of the code and refining the algorithms to ensure optimal performance.

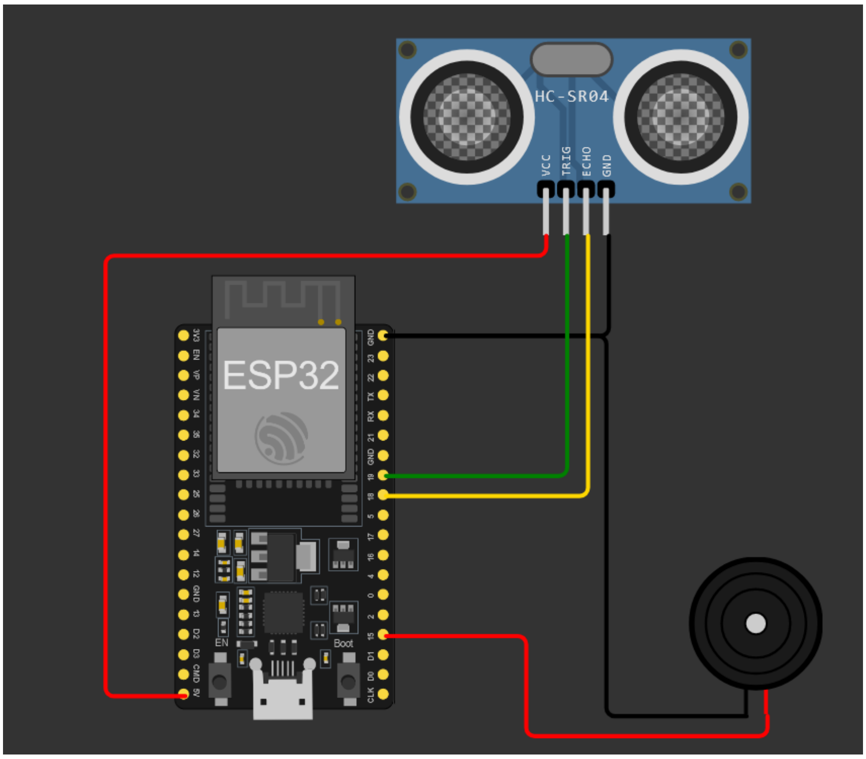


Figure 6: Simulation Diagram

Range Accuracy Test:

To evaluate the range accuracy of the system, a series of tests were conducted in various indoor and outdoor environments. The tests aimed to assess the device's ability to detect obstacles at different distances and angles, simulating real-world navigation scenarios encountered by visually impaired individuals.

Setup:

- The "Third Eye for the Blind" device was worn by a test subject in a controlled environment.
- A set of obstacles of varying sizes and materials were placed at predetermined distances from the test subject.
- The distance between the device and each obstacle was measured using a tape measure to serve as the ground truth for comparison.

Procedure:

- The test subject walked towards each obstacle while wearing the device, relying on its feedback signals to detect and avoid obstacles.
- The device emitted ultrasonic waves and analysed their reflections to estimate the distance to obstacles.
- The test subject noted the point at which they received feedback indicating the presence of an obstacle.
- The measured distances between the device and obstacles were recorded for analysis.

Results:

S. No.	Actual Distance (centimetres)	Detected Distance (centimetres)	Deviation (centimetres)
1	25	25	0
2	50	49	-1
3	75	76	1
4	100	101	1
5	150	153	3
6	200	196	-4

Note: Negative deviation indicates that the detected distance was shorter than the actual distance, while positive deviation indicates that the detected distance was longer than the actual distance.

Analysis:

- The system demonstrates consistent accuracy in estimating distances to obstacles across various distances.
- Small errors observed in the test results are expected due to the inherent limitations of human perception and the introduction of human error during the testing process.
- Despite these minor discrepancies, the system's overall performance in obstacle detection remains reliable, enhancing navigation assistance for visually impaired individuals in real-world environments.

Application:

1. **Navigation:** The "Third Eye" gadget aids visually impaired individuals in navigating both outdoor and indoor environments. Outdoors, it uses an ultrasonic sensor and ESP8266 microcontroller to detect obstacles like parked cars and signposts, enabling independent navigation. Similarly, indoors, it detects obstacles such as furniture and walls, allowing users to move freely and avoid collisions in places like offices and malls. Whether outdoors or indoors, the Third Eye enhances autonomy, providing a seamless navigation experience.

2. **Public Transit Accessibility:** The Third Eye gadget enhances accessibility for visually impaired individuals when using public transit systems. By alerting users to obstacles such as turnstiles, ticket machines, or crowded platforms, the device facilitates seamless navigation through transit stations and vehicles, reducing reliance on assistance from others and promoting independent travel.

3. **Customizable Feedback:** The Third Eye gadget can be customized to provide feedback tailored to the user's preferences and needs. For example, users can adjust the intensity or frequency of feedback alerts, choose between auditory or tactile feedback options, or configure personalized alerts for specific types of obstacles. This flexibility ensures that the device can accommodate a diverse range of users and environments.

4. **Applications with Minor Alterations:**
- **Smartphone Integration**: By incorporating Bluetooth or Wi-Fi connectivity, the Third Eye gadget can be paired with a smartphone to provide additional functionalities such as GPS navigation, voice assistance, or remote monitoring by caregivers.
- **Environmental Sensing:** With the addition of environmental sensors such as temperature or humidity sensors, the Third Eye gadget can provide users with information about their surroundings beyond obstacle detection, enhancing situational awareness and safety.
- **Localization and Mapping**: By incorporating localization technologies such as GPS or inertial navigation systems, the Third Eye gadget can offer advanced features such as route planning, landmark recognition, or indoor mapping, further enhancing navigation capabilities for visually impaired users.

Overall, the Third Eye gadget represents a versatile and adaptable solution for enhancing mobility and independence for visually impaired individuals in a variety of settings, with the potential for further customization and expansion through minor alterations and additional functionalities.

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