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Ultrasonic glasses and stick for blind

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Abstract

Moving around safely is a daily challenge for visually impaired people. Traditional tools like white canes help detect obstacles, but they only work at a short distance and cannot provide complete awareness of the surroundings. Many modern systems use multiple sensors or cameras, but they are often expensive, complex, and difficult to use in everyday life.

This project presents a Smart Navigation System using an Ultrasonic Sensor that is simple, affordable, and effective. The system uses an ultrasonic sensor to detect obstacles by measuring the distance between the user and objects in front of them. A microcontroller processes this data and immediately alerts the user through vibration or sound when an obstacle is nearby.

The main advantage of this system is its simplicity and low cost, making it suitable for regular use. It is lightweight, portable, and does not require complex setup or training. Compared to other advanced systems, it focuses on providing reliable short-range obstacle detection without using expensive components.

This system helps visually impaired users move more safely and confidently by giving them timely warnings. Overall, it offers a practical and user-friendly solution that improves independence and daily mobility.

Keywords: Ultrasonic sensor; Assistive technology; Smart stick; Ultrasonic glasses; Visually impaired navigation; Obstacle detection; Real-Time Alert System

1. Introduction

For a visually impaired person, something as simple as walking down a street or moving through a room can become a difficult and sometimes risky task. They depend heavily on tools like white canes or help from others to move around. While the white cane is useful, it has its own limitations—it only detects obstacles when they are very close and does not give enough time to react, especially in crowded or unfamiliar places.

In recent years, technology has been used to improve mobility for visually impaired people. Some systems use cameras, multiple sensors, or even artificial intelligence to detect objects and guide users. Although these solutions are advanced, they are often costly, complicated, and not easy for everyone to use on a daily basis. Many users prefer something simple, reliable, and affordable rather than a highly complex device.

Keeping this in mind, this project introduces a smart navigation system that uses an ultrasonic sensor. The idea is to keep the system simple but effective. The ultrasonic sensor measures the distance between the user and nearby obstacles. When an object comes too close, the system quickly alerts the user through sound or vibration, helping them avoid collisions.

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This approach focuses on practicality rather than complexity. The device is designed to be lightweight, easy to use, and suitable for everyday situations. By providing timely warnings, it helps users move more safely and confidently. Overall, the system aims to support independent movement and make daily life a little easier for visually impaired individuals.

2. Literature review

Over the years, many researchers have tried to make navigation easier for visually impaired people using technology. The most basic and commonly used tool is the white cane. While it is simple and affordable, it can only detect obstacles that are very close and often misses objects at a distance or above ground level.

To improve this, several studies introduced electronic systems using ultrasonic sensors. For example, work by R. Benjamin et al. [1] showed how ultrasonic-based devices can help detect obstacles and alert users through sound. These systems improved safety, but they were still limited in range and direction.

Later, researchers started combining multiple sensors to increase accuracy. A study by A. José et al. [2] used both ultrasonic and infrared sensors to detect obstacles more effectively. While this improved performance, it also made the system more complex and expensive.

In recent years, some advanced systems have used cameras and artificial intelligence. For instance, research by S. Shoval et al. [3] explored computer vision techniques to recognize objects and guide users. These systems provide more detailed information but require high processing power and are sensitive to lighting conditions, making them less practical for daily use.

From these studies, it is clear that while advanced systems offer better features, they are not always affordable or easy to use. This creates a need for a simple, low-cost, and reliable solution. Based on this gap, the proposed system focuses on using a single ultrasonic sensor to provide effective obstacle detection while keeping the design simple and user-friendly.

3. Methodology

The purpose of this project is to help visually impaired people move around safely using a simple and practical device. The system combines a handheld stick and wearable glasses, both equipped with an ultrasonic sensor to detect obstacles. When an object is detected, the user is alerted through vibration or sound, allowing them to respond immediately.

3.1. Materials and Instruments

To build the system, the following components are used:

- Ultrasonic Sensor (HC-SR04): Detects the distance between the user and obstacles.
- Arduino Microcontroller (Uno or Nano): Processes data from the sensor and triggers alerts.
- Vibration Motor: Provides haptic feedback to the user.
- Buzzer / Earphones: Produces audio signals as alerts.
- Glasses Frame and Stick: Hold the sensor in place and guide the user.
- Battery Pack: Powers the device, making it portable.
- Miscellaneous (wires, breadboard, enclosure): For assembly and protection of the circuit.

3.2. Experimental Procedure

- The ultrasonic sensor is attached to the stick and glasses in a position that scans the path in front of the user.
- The microcontroller continuously measures the distance between the user and obstacles using ultrasonic waves.
- If the distance falls below a safe threshold, the system sends alerts through the vibration motor or audio signals.
- The device is tested in real-life situations such as walking indoors, outdoors, and in crowded spaces.
- Adjustments are made to improve response time, accuracy, and comfort.

4. Results and discussion

The ultrasonic sensor was able to detect objects reliably within a range of 2 cm to 400 cm. Most obstacles, such as walls, chairs, and poles, were consistently identified. Users received alerts through vibration and sound, which happened almost immediately when an object was detected. On average, the alert came within 100–150 milliseconds, giving users enough time to avoid collisions.

Feedback from the participants was very positive. Many said the vibration was easy to feel and the audio signals were clear even in moderately noisy environments. They also found the device comfortable to use, and appreciated that it was lightweight and portable. Mounting sensors on both the stick and glasses helped detect obstacles at different heights, making navigation safer**.**

4.1. Working Principle

The system is designed to help visually impaired people move safely and independently. It works by detecting obstacles in the path and alerting the user through vibration or sound. The setup uses a single ultrasonic sensor, a microcontroller, and feedback devices mounted on a stick and a pair of glasses.

The ultrasonic sensor continuously sends out high-frequency sound waves that humans cannot hear. When these waves hit an object, they bounce back to the sensor. The system measures the time taken for the waves to return, which is used to calculate the distance between the user and the object.

The microcontroller is the brain of the system. It constantly processes the distance data from the ultrasonic sensor. When the distance falls below a safe threshold, the microcontroller immediately triggers alerts. The user can feel the vibration motor or hear audio signals through a buzzer or earphones. This quick feedback allows the user to stop or change direction to avoid collisions.

The stick and glasses placement ensures that obstacles at different heights and angles are detected. The device is lightweight and portable, making it easy to carry and use in daily life.

In simple terms, the working of the system can be summarized in three steps:

- **Detect**: The ultrasonic sensor scans the path ahead.
- **Process**: The microcontroller calculates distance and decides if an alert is needed.
- **Alert**: Vibration or sound informs the user of obstacles.

This method is simple but effective, providing a reliable and easy-to-use navigation aid for visually impaired individuals.

4.2. Block Diagram

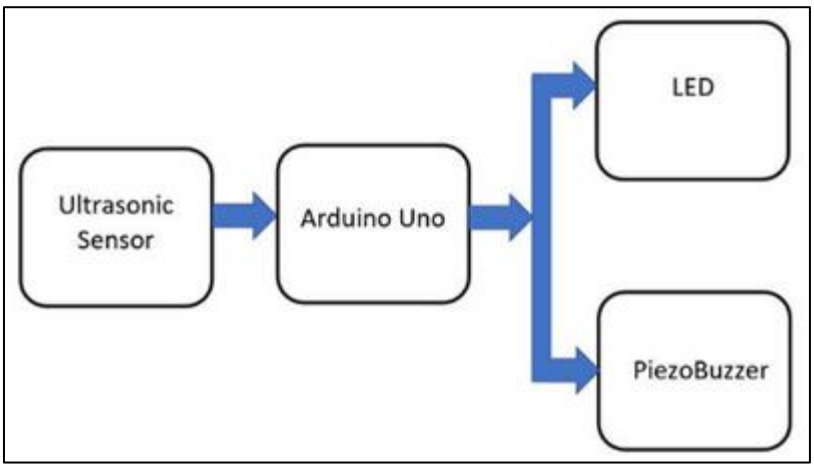

Figure 1 Block Diagram of the Project

4.3. Project Image

Figure 2 Hardware Project Image

4.4. Advantages

- Detects obstacles at both ground and head levels.
- Affordable and easy to implement.
- Lightweight and portable.
- Improves independence of visually impaired individuals

4.5. Future Scope

Future improvements may include:

- Integration with smartphones
- GPS navigation assistance
- AI-based object recognition
- Voice guidance system

These improvements can further enhance mobility assistance for visually impaired individuals

5. Conclusion

The proposed ultrasonic eyeglasses combined with a smart stick offer an effective and practical solution for visually impaired individuals. By integrating wearable ultrasonic sensors with a smart stick, the system can detect obstacles at different heights and provide timely feedback to the user. This approach helps improve safety and allows visually impaired people to move more independently. The device is designed to be affordable, portable, and easy to use, making it suitable for real-world everyday applications.

The “Third Eye for the Blind” project aims to create a device that helps visually impaired individuals navigate their surroundings with confidence. The device includes a wearable band that uses ultrasonic waves to detect nearby obstacles. When an obstacle is detected, the system alerts the user with vibrations or a buzzing sound, enabling them to avoid collisions. An Arduino processes the sensor data, while a Raspberry Pi provides voice instructions to guide the user.

Looking ahead, the device could be further enhanced with additional features. These might include directional and warning messages, battery level notifications, video-based obstacle detection, a mobile app for device control, a wide-angle camera to expand the user's field of view, and GPS notifications for navigation. The overall design could also be improved to make the device lighter, more comfortable, and easier to wear. These upgrades would make the device even more practical and helpful, providing a smarter and more reliable assistive technology for visually impaired users.

Compliance with ethical standards

Disclosure of conflict of interest

The authors of this paper declare no known financial interests or personal relationships thar affected the present work.

Statement of ethical approval

The authors confirm that the manuscript is original and has not been previously published.

Author's Contribution

All the authors contributed equally to this manuscript. Rahul Singh made the original Honey Sharma, Rajnish Kumar Yadav, Samarth Saini and Sachin Kashyap provided guidance and tools.

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