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Smart Glasses for Obstacle Detection Using Ultrasonic Sensor

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Abstract - Visually impaired individuals often face difficulties in safe navigation due to the presence of unexpected obstacles in their surroundings. Traditional mobility aids such as white canes are effective only at ground level and provide limited information about obstacles at head height. This paper presents the design and implementation of a smart glasses system that uses an ultrasonic sensor to detect nearby obstacles and provide real-time audio alerts. The system is controlled by a compact microcontroller and powered by a rechargeable battery, making it lightweight and wearable. When an obstacle is detected within a predefined distance, an alert is generated through a buzzer to warn the user. Experimental observations indicate that the proposed system is reliable, cost-effective, and suitable for indoor navigation assistance.

Key Words: Smart Glasses, Ultrasonic Sensor, Obstacle Detection, Assistive Technology, Arduino, Wearable Device

1.INTRODUCTION

Visual impairment affects millions of people worldwide and significantly limits independent movement. Safe navigation in indoor and outdoor environments is one of the biggest challenges faced by visually impaired individuals. Obstacles such as walls, furniture, and moving objects can lead to accidents and injuries. Conventional aids like white canes help in detecting obstacles on the ground but are ineffective for detecting objects at upper body or head level. With the advancement of embedded systems and wearable electronics, smart assistive devices have gained attention. Smart glasses provide a hands-free solution by placing sensors at eye level, enabling early detection of obstacles.

This paper focuses on the development of a smart glasses system using an ultrasonic sensor and a microcontroller to detect obstacles in real time and alert the user using audio feedback.

2. Body of Paper

2.1 System Architecture

The proposed smart glasses system consists of an ultrasonic sensor, Arduino Mini microcontroller, buzzer, rechargeable battery, and a lightweight glasses frame. The ultrasonic sensor continuously scans the environment for obstacles, while the microcontroller processes the received signals.

2.2 Working Principle

The ultrasonic sensor operates based on the time-of-flight principle. It emits ultrasonic waves which reflect back after hitting an object. The time taken for the echo to return is measured and used to calculate the distance. If the calculated distance is less than 50 cm, the microcontroller activates the buzzer to alert the user.

2.3 Hardware Components

- **Ultrasonic Sensor:** Used to detect obstacles by measuring distance.
- **Arduino Mini:** Acts as the processing unit for sensor data.
- **Buzzer:** Provides an audio alert to the user.
- **Rechargeable Battery:** Supplies power to the system.
- **Glasses Frame:** Supports all components in a wearable form.

2.4 Software Implementation

The microcontroller is programmed using the Arduino IDE. The software continuously triggers the ultrasonic sensor, calculates distance, and compares it with a threshold value. The buzzer is activated when an obstacle is detected within the set range.

2.5 Experimental Results

The system was tested in indoor environments with stationary and moving obstacles. The smart glasses successfully detected objects within a range of 10 cm to 50 cm. The response time was quick, and the alert was generated instantly, allowing the user to react safely.

At the first occurrence of an acronym, spell it out followed by the acronym in parentheses, e.g., charge-coupled diode (CCD).

Table -1: Hardware Components Used

S. No.	Component Name	Specification / Description
1	Ultrasonic Sensor	HC-SR04, Range 2–400 cm
2	Microcontroller	Arduino Mini
3	Buzzer	5V Piezo Buzzer
4	Power Supply	Rechargeable Battery Pack (5V)
5	Glasses Frame	Lightweight Plastic Frame

Fig -1: Figure

3. CONCLUSIONS

This paper presents a simple and effective smart glasses system for obstacle detection. By using ultrasonic sensing and a compact microcontroller, the proposed device enhances navigation safety for visually impaired individuals. The system is lightweight, affordable, and easy to implement. Although the current design has limited range and functionality, it provides a strong foundation for future enhancements such as voice feedback and GPS-based navigation.

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