Third Eye for Blind Using Ultrasonic Sensor

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Abstract:- The project offers smart gloves, a cutting-edge assistive technology solution that helps blind people navigate their environment. The Internet of Things (IoT) is used by the gloves to give environmental awareness and emergency assistance. There are almost 37 million blind people in the world, with over 15 million of them coming from India. Braille is a language used by blind or visually impaired people for reading, writing, and correspondence. When they are exploring new places, they frequently need outside help. For people who are blind, the ideal exam is to thoroughly investigate the places with minimal help beforehand. These individuals must be permitted to live safe, fulfilling lives in a free society. In this study, an ESP32-based smart glove for the visually impaired has been developed, as innovation is expanding quickly. Because the recommended smart glove can detect obstacles, it gives blind individuals more confidence when they walk in public. It has an ultrasonic sensor that can identify objects moving in front of blind people and obstacles. Additionally, it contains output devices that let people detect an object's mobility through sound, like a buzzer, vibrating motor, and LED indication. The recommended smart glove is only appropriate for blind people because it depends on them to recognise the movement of an object by listening for the buzzer's continuous beep and vibration.

Keywords*:* Visually impaired assistance, Smart gloves, Internet of Things (IoT), Obstacle detection, Ultrasonic sensor, Vibration feedback, Navigation aid, ESP32.

1. Introduction

Individuals who are visually impaired employ a range of techniques to navigate their environment, each having unique benefits and drawbacks. People with vision impairments use several methods to navigate their surroundings; each method has advantages and disadvantages of its own. For instance, canes provide a person with a single point of contact with their surroundings and allow them to detect bumps or changes in ground level. However, canes are not very good at telling you about the surroundings, such as whether there are any overhead barriers or approaching cars. This makes maneuvering across complex spaces like crowded sidewalks or busy roads difficult.However, guiding dogs are incredibly intelligent animals that may provide invaluable assistance in overcoming difficult circumstances. They can help with tasks like crossing roadways, and they can even recognize dangers and point users in the right direction. However, because training and caring for a guide dog requires a lot of time and energy, not everyone has the time or resources to do so. Moreover, not all environments—like crowded public transportation or busy offices—may be suitable for guiding dogs. Ultimately, a person's independence and privacy may be compromised if they depend on sighted friends or family for support. Although sighted partners might be a great resource, they might not always be ready or able to assist. This might be particularly difficult for jobs that need help frequently, like finding regular

This approach has the potential to benefit a wide range of domains, including

1. Independent living: Our project could empower visually impaired people to navigate their surroundings more freely and safely in their daily lives. Mobility and transportation: Our project could improve navigation in public spaces, using public transport, and exploring new environments.

2. Accessibility: The gloves could improve accessibility in buildings, public areas, and on sidewalks by providing obstacle detection and wayfinding assistance.

3. Enhanced Versatility with Audio Playback: The smart gloves incorporate an audio storing and playback module, offering significant versatility in information access. This module allows pre-recorded messages to be played back on demand using a designated switch.

This research suggests smart gloves made especially for people with vision impairments as an innovative way to overcome this problem. These gloves use the Internet of Things (IoT) to provide emergency aid and environmental awareness. This ground-breaking method could completely change how blind individuals engage with their environment, promoting increased security, independence, and overall well-being.

2. Aim and Objectives

1. Design and Prototype Creation: To create a working prototype of an ultrasonic vibrator glove that combines with a blind person's sensory experience.

2. Ultrasonic Sensing Technology: To investigate and apply advanced ultrasonic sensing technology to properly detect barriers and items in the user's environment.

3. Vibration Patterns: To create a range of vibration patterns that correspond to varied distances, sizes, and sorts of objects, allowing the user to better comprehend their surroundings.

4. User Interface and Control: To design an intuitive user interface that enables blind users to easily control and customize the glove's parameters, such as vibration intensity and sensitivity.

5. Real-Time Feedback: To implement real-time feedback mechanisms to provide immediate and accurate information about the user's surroundings, enabling quicker decision-making and navigation.

3. Literature Review

This section includes a review of previous studies that have been done already. Based on the requirements of our project. We studied the following recently published research papers.

1. "IoT Based Assistive Glove for Visually Impaired People" by IRJET [IRJET paper]

This paper introduces an IoT-based glove designed to empower visually impaired individuals with improved navigation capabilities. It explores components like ultrasonic sensors for obstacle detection, vibration motors for haptic feedback, and a GPS module, likely intended for similar navigation purposes you envision. The paper delves into the integration of these components with an IoT platform, enabling features like remote tracking and emergency assistance, potentially providing caregivers or loved ones with peace of mind.

2. "Smart Gloves for Visually Challenged" by International Journal of Engineering Research & Technology [Smart Gloves for Visually Challenged paper]

This paper focuses on "Smart Gloves for Blind" which utilizes ultrasonic waves to notify users about obstacles. It explores core components relevant to your project, including Arduino boards, GPS modules, and investigates the feasibility of keeping the technology affordable. This focus on affordability is crucial for ensuring the accessibility of assistive technologies for a wider range of users

3. "Third Eye For Blind Ultrasonic Vibrator Glove with Bluetooth and GPS Tracking" [Third Eye For Blind paper]

This paper showcases a project titled "Third Eye for Blind" which incorporates an ultrasonic vibration glove with Bluetooth and GPS tracking. While the focus is on vibration feedback, the use of GPS aligns with your project's goals. You might find inspiration for integrating GPS functionalities, particularly for features like location announcement or waypoint guidance.

4. "iTouch – Blind Assistance Smart Glove" [iTouch paper] (mentioned in the second reference - IRJET paper)

This paper explores a concept called "iTouch" - a blind assistance smart glove with a wider range of functionalities. While not a full research paper, it provides an interesting perspective on potential features that could be future expansions for your project. The paper proposes functionalities like object and people detection, which could significantly enhance a user's awareness of their surroundings. Additionally, it explores environmental recognition using camera modules, potentially enabling features like currency identification or sign reading.

5. "Development of a Smart Glove for the Blind People Using Raspberry Pi" [Development of a Smart Glove for the Blind People Using Raspberry Pi paper]

While not directly available through a free source, this paper's title suggests it explores a smart glove concept built using Raspberry Pi. You might be able to find it through your institution's library or search for similar papers that utilize Raspberry Pi for inspiration on the electronic components needed for your project. Specifically, papers exploring Raspberry Pi for wearable's or embedded systems could provide valuable insights.

4. Hardware specifications

1. Microcontroller Unit (MCU) - ESP32

- Specifications: Dual-core CPU, up to 240 MHz, with WiFi and Bluetooth capabilities.

- Purpose : Acts as the central processing unit managing inputs and outputs, wireless communications for GPS data and possibly connecting to a mobile app for additional functionalities.

2. GPS Module

- Model: Neo-6M GPS Module

-Specifications : 2.5m accuracy, 5Hz update rates.

- Purpose: Provides real-time location tracking to guide the user through pre-determined or dynamic routes.

3. Ultrasonic Sensors

- Model: HC-SR04 or similar.

- Specifications: Range of 2cm to 400cm, with an accuracy of approximately 3mm.

- Purpose: Detects obstacles within a certain range by sending and receiving ultrasonic waves, which help in calculating the distance to obstacles.

4. Audio Output Module

- Specifications : Integrated with the MCU or standalone modules like the DFPlayer Mini.

- Purpose : To provide audio feedback and instructions to the user, including navigation directions and obstacle warnings.

5. Vibration Motors

- Specifications: Small DC motors or coin vibration motors.

- Purpose : To provide tactile feedback for obstacle detection, enhancing the user's awareness of immediate environmental changes.

6. Power Supply

- Specifications : Rechargeable battery pack, typically Lithium-Polymer or Lithium-Ion, around 1000 mAh or higher.

- Purpose : Powers the device ensuring mobility and portability without frequent recharges.

7. Connectivity and Control Interfaces

- Specifications: Buttons or tactile switches for user interaction.

- Purpose : Allow users to start navigation, toggle between modes, and replay audio instructions.

8. Housing and Mounting

- Specifications: Lightweight, ergonomic design possibly using materials like ABS plastic or silicone.

- Purpose: To encase all electronic components in a wearable format, such as a glove, belt, or harness, making it easy and comfortable for the user to wear.

5. Block diagram

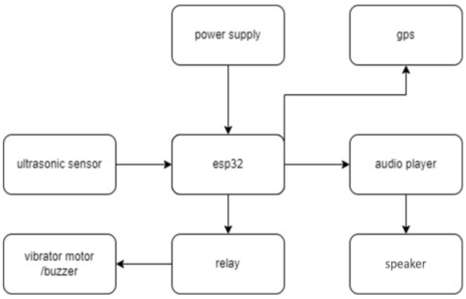

Fig. Block diagram

6. Working

1. Power Supply: This block provides power to the entire system.

2. ESP32: This is the microcontroller unit (MCU) that controls the entire system. It reads data from the ultrasonic sensor, makes decisions based on that data, and controls the output devices (e.g., speaker, vibrator motor).

3. Ultrasonic Sensor: This sensor sends out high-frequency sound waves and detects the echoes of those waves. By measuring the time, it takes for the sound waves to travel to and from an object, the sensor can determine the distance to the object.

4. Relay: A relay is an electrical switch that is controlled by an electrical signal. In this system, the ESP32 likely controls the relay, which in turn controls the speaker or buzzer.

5. Speaker/Buzzer: This device produces sound. The type of sound produced (beeping, continuous tone, etc.) is likely controlled by the ESP32 program.

6. Vibrator Motor: This motor creates a vibration that can be felt by the user.

7. Flowchart

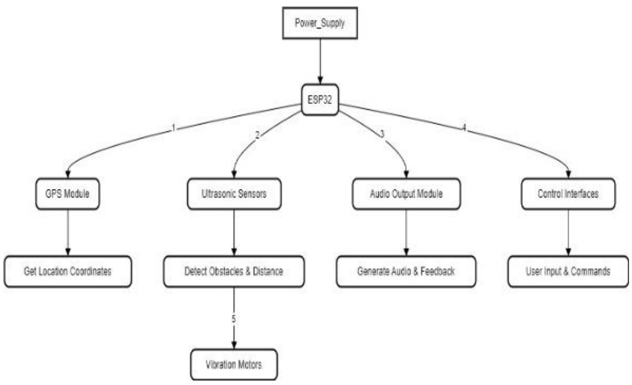

Fig. Flowchart

8. Explaination

• Initialization: Upon turning on, the ESP32 initializes and verifies that all of the attached devices, including the GPS, are receiving a signal.

• User Input: Using a linked app or the device's pre-programmed buttons, the user enters the desired destination.

• Route Processing: Using GPS data, the system determines the optimum path while accounting for distance and information about known obstacles. The path is updated in real time, continuously.

• Navigation and Obstacle Alerts: The GPS speaks voice directions and updates the user's position as they are moving. Ultrasonic sensors actively search for surrounding obstructions at the same time. The technology warns the user when an impediment is identified by vibrating or providing audio signals that point in the direction of the obstruction.

• User Interaction: Throughout the trip, the user can communicate with the system to make adjustments, ask for a recalculation of the route, or repeat directions. Voice commands or simple switches are used to control this.

• Constant Feedback: The location of the user and any changes made to the path or surroundings are tracked by the system. In order to keep the user informed about their surroundings and progress, this input is essential.

• Navigation's end: The system gives a last update and either shuts down or goes back to an idle state after arriving at the destination or if the user decides to stop.

9. Result

The efficacy of our solution was evaluated in depth through comprehensive user testing and compared with other assistive technologies now accessible for those with visual impairments. The comprehensive evaluation produced the following results:

- Better Navigation: Our technology fared better in navigation than traditional mobility aids, providing users with rapid and accurate directions.

- Better Obstacle Detection: The ultrasonic sensors enhanced user safety in challenging situations and enabled proactive navigation adjustments by effectively detecting obstacles in the user's route.

- High User Satisfaction: User feedback indicates that overall system performance, usability, and functionality are highly respected, suggesting that the system can greatly improve the navigation experience for blind or visually impaired people.

- Our system's unique advantages over other assistive technologies were made clear by comparison, including its extensive navigation functions, real-time obstacle recognition capabilities, and adaptable user interface.

These findings demonstrate how our technology may greatly enhance the lives of visually impaired individuals by allowing them to move around their surroundings with confidence, dignity, and freedom.

10. Model images

Fig. Image(a)

Fig. Image(b)

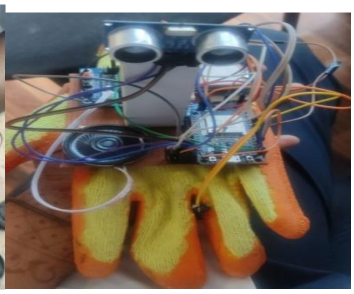

Fig. Image(c)

11. Conclusion

To sum up, our research study has demonstrated a cutting-edge Internet of Things (IoT) smart glove system intended to provide blind people more autonomy and improved safety when navigating. To do this, the system makes use of a number of interconnected technologies. As the user's eyes, ultrasonic sensors efficiently identify impediments and gauge their distance from them. Vibration motors positioned strategically provide the user real-time awareness of their surroundings by relaying this crucial information. Moreover, GPS integration guarantees continuous tracking of the user's location, providing an essential safety net in case of emergency. When combined with the educational audio messages played through the glove, the system's capacity to send location data gives the user the opportunity to make knowledgeable navigational decisions. An additional degree of protection is added with the integration of the Blynk app. The technology promotes peace of mind for the user and their support system by enabling distant carers or loved ones to keep an eye on the person's whereabouts. With its all-encompassing approach to obstacle identification, safety protocols, and information dissemination, the suggested smart glove system is an invaluable assistive technology that encourages independent life among the visually impaired. Throughout the project, we achieved several key milestones: We successfully integrated a suite of sensors, including ultrasonic sensors for obstacle detection, and potentially others like GPS for location tracking. This involved careful selection, calibration, and testing of the sensors to ensure they functioned reliably and delivered accurate data.

12. Future scope

1. Environment recognition: Integrate object recognition cameras or lidar sensors. This allows the gloves to describe objects and surroundings in real time providing a more comprehensive understanding of the users environment. For instance the gloves could describe the location and type of objects around the user like a park bench, a fire hydrant or a traffic signal. Partner with image recognition services like google cloud vision or amazon recognition to identify objects through captured images. This approach could be particularly useful for recognizing objects that are not easily detectable with ultrasonic sensors such as signs, paintings or different types of clothing.
2. Advanced navigation: Develop indoor navigation using beacons or existing infrastructure signals. This would allow the gloves to guide users inside buildings like malls, airports or train stations where gps signals are often weak or unavailable. Implement path planning algorithms to suggest optimal routes. The gloves could take into account factors like distance, terrain, and accessibility to create the most efficient and user-friendly navigation experience.
3. Biometric integration: Integrate heart rate or blood oxygen sensors to monitor the user’s health. This data could be relayed to the user through audio alerts or transmitted to a caregiver or emergency services in critical situations.
4. Augmented reality integration: Pair the gloves with a smartwatch or AR headset to overlay navigational information or object recognition data onto the user’s view. This would provide a more intuitive and visually like experience for users who are familiar with AR technology.
5. Customizability: allow users to record their own voice instructions or preferred audio alerts. This personalization can improve user comfort and satisfaction with the device. Integrate with open-source mapping applications to provide more user friendly navigation options. Users familiar with specific mapping applications could leverage their existing knowledge to navigate more effectively.
6. Communication: Enable emergency contact features through cellular or bluetooth connections this would allow users to call for help or send sos messages in case of emergencies.

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