EMBEDDED SMART SHOES

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Introduction:

Navigating the world with impaired vision presents a multifaceted challenge that extends beyond the physical act of movement. For individuals with visual impairments, each step represents a complex negotiation of space, obstacles, and potential hazards, requiring not only physical dexterity but also acute spatial awareness and decision-making skills. While traditional mobility aids like canes and guide dogs have long served as indispensable tools, their efficacy in providing real-time feedback about the surrounding environment remains limited. This shortfall underscores the critical need for innovative solutions capable of augmenting the sensory landscape of visually impaired individuals, empowering them to traverse the world with confidence and independence. The primary objective of this project is to design, develop, and evaluate smart shoes tailored specifically to the needs of visually impaired individuals. Key objectives include integrating state-of-the-art sensor technology, microcontrollers, and haptic feedback mechanisms to provide real-time navigation assistance, enhancing user experience and usability through iterative design and testing processes, evaluating the efficacy and impact of smart shoes in real-world settings, with a focus on safety, autonomy, and quality of life, and facilitating seamless integration with existing assistive technologies and infrastructures to maximise accessibility and inclusivity. By addressing these objectives, the project aims to empower visually impaired individuals to navigate their environments with confidence, independence, and dignity, ultimately fostering greater social inclusion and participation.

Objectives:

1. Develop an Integrated System: Design and develop a comprehensive system that integrates sensor technology, microcontrollers, and haptic feedback mechanisms into a wearable form factor, capable of providing real-time navigation assistance to visually impaired individuals.
2. Sensor Integration: Incorporate a diverse array of sensor technologies, including ultrasonic sensors, infrared sensors, and depth cameras, to enable accurate detection and spatial mapping of obstacles, hazards, and environmental features in the user's surroundings.
3. Microcontroller Implementation: Utilise Arduino Uno microcontrollers as central processing units to collect, process, and interpret sensor data in real-time, employing sophisticated algorithms and software to facilitate intelligent decision-making and adaptive response mechanisms.
4. Haptic Feedback Mechanisms: Integrate haptic feedback mechanisms, such as vibrating motors and tactile actuators, to convey spatial information and navigation cues to the user through subtle vibrations or tactile cues in response to detected obstacles or changes in terrain.
5. Usability Testing and Iterative Design: Conduct usability testing with visually impaired individuals to evaluate the effectiveness, usability, and user experience of the smart shoes in real-world scenarios, iteratively refining the design based on feedback and user insights.

Methodology:

Left Shoe

Fig.1 : Block Diagram Of Left Shoe

The ultrasonic sensor mounted on the servo motor is initially aligned to 0^0 to provide the left view to the ultrasonic sensor. Then the servo motor is rotated by the steps of 10^0 to cover the field at the ground level i.e from 0^0 to 180^0, so the setup of the ultrasonic sensor with servo motor will give the ground level obstacle detection. If the obstacle is detected on the left side (0^0 to 90^0), the vibration motor is turned on for 1 second. If the obstacle is detected on the right side (90^0 to 180^0) the vibration motor is turned on for 2 seconds. The piezoelectric materials are used to generate the electrical energy from the pressure applied while walking. The bridge circuit is used to increase the efficiency of the generated energy. This generated energy is stored in the battery and is used to power the other electronic components that are present on the shoe.

Right Shoe

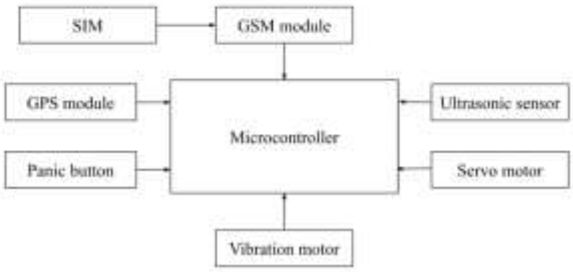

Fig.2: Block Diagram Of Right Shoe

The ultrasonic sensor which is a type of proximity sensor and servo motor alignment is a bit different on this shoe in order to give the view in terms of elevation. The initial position is defined to ground level with the elevation of 0^0. The elevation is raised with the rotation of blades of the servo motor in steps of 5^0. And height is calculated, If the calculated height is below 6 feet and above 3 feet, then the alert signal for 1 second is given. If it is in range of 0 to 3 feet, a signal of 2 seconds is given with the help of a DC vibration motor. In case of any emergency the panic button is pressed, and at that instance the location coordinates are loaded to the microcontroller. The alert message with the location coordinates is sent to the specified caretaker. The piezoelectric materials along with the bridge circuit is used to generate the energy while the user is walking. To power the microcontroller board the batteries are incorporated.

Conclusion:

Our project aims in developing the Embedded Smart Shoe for the Blind community which include improved safety, increased independence, enhanced navigation capabilities, user-friendly interface, customization options, durability, and seamless integration with existing assistive technologies. These outcomes collectively contribute to enhancing the mobility and quality of life of individuals with visual impairments

In conclusion, the Embedded Smart Shoe for the Blind community represents not only a technological achievement but also a testament to the transformative power of innovation in improving the lives of individuals with visual impairments. As we embrace the possibilities offered by assistive technology, as we move closer to realising a future where disability is not a barrier to participation and inclusion.

Parameters	Accuracy
Distance	0 - 2 cm
Height	5 -10 cm
Angle	5^0
Location	15 - 20 m
Time taken for message delivery	4 -5 seconds
Battery backup	1 - 1.5 hours
Obstacle dimensions	5 * 5 cm

Scope for future work:

This project can be further extended by incorporating a wider range of sensors, including infrared cameras, depth sensors, and environmental sensors, to provide more comprehensive spatial awareness for users.

AR technology could be integrated into smart shoes to overlay digital information onto the user's surroundings, enhancing navigation cues and providing contextual information about nearby objects, landmarks, and points of interest.Future smart shoes could offer personalised user profiles and customizable preferences, allowing users to tailor navigation cues, feedback mechanisms, and interface settings to their individual needs and preferences.

Overall, the future of Embedded Smart Shoes seems promising, with numerous possibilities for enhancing health, safety, convenience, and personalization in various aspects of daily life.