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Smart Neckband for Visually Impaired People

Najiya Mansuri[1], Sakshee Nonare[2], Triveni Pandhare[3], Poonam Jibhakate[4], Saurabh Malewar[5]

[1,2,3,4,5]Students, Department of Computer Science and Engineering, Priyadarshini College of Engineering, Nagpur

Abstract

The advancement of assistive technology has significantly improved the mobility and independence of visually impaired individuals. Smart wearables, particularly smart neckbands, have emerged as an effective aid for navigation and obstacle detection. This paper presents a literature survey on smart neckbands for blind individuals, focusing on the integration of ultrasonic sensors, GSM800, GPS, Nano board, microcontroller, lithium-ion battery, gyroscope, and buzzer. These components work together to provide real-time obstacle detection, location tracking, and emergency alerts. The study reviews various research contributions in the field and highlights the effectiveness of different sensor-based navigation systems. The survey aims to provide insights into existing technologies and suggest areas for future improvements in assistive wearables.

Keywords: Smart Neckband, Visually Impaired, Ultrasonic Sensor, GSM800, GPS, Microcontroller, Lithium-ion Batteries, Gyroscope, Buzzers.

1. Introduction

Blind individuals face significant challenges in navigating unfamiliar environments. Traditional mobility aids like white canes provide limited assistance in detecting obstacles, especially those at head level. With advancements in IoT and embedded systems, wearable smart devices have emerged as a solution to enhance the mobility of visually impaired individuals. A smart neckband equipped with sensors and communication modules can provide real-time feedback, guiding the user safely,it is a compact, wearable device designed to assist visually impaired users through real-time obstacle detection, navigation support, and voice-based interaction.

This paper reviews previous research on smart wearables and navigation aids for the visually impaired. It discusses various implementations of ultrasonic-based obstacle detection, GPS tracking, and alert systems integrated into smart wearables.

2. Literature Review

Several research studies have explored the integration of IoT and embedded systems in assistive devices for the visually impaired.

3. Ultrasonic Sensor-Based Navigation Systems

Several studies have demonstrated the use of ultrasonic sensors for detecting obstacles in the environment. According to [1], ultrasonic sensors provide effective short-range obstacle detection and are widely used in smart canes and wearables. Another study by [2] proposed a wearable navigation system using ultrasonic sensors and vibratory feedback to guide users.

GPS and GSM-Based Location Tracking

Location tracking is essential for enhancing the safety of blind individuals. In [3], a GPS-GSM-based system was proposed to track users in real-time and send their location to caregivers. GSM800 modules allow emergency communication, as highlighted in [4], where an alert message was sent to predefined contacts upon detecting an emergency situation.

Microcontroller-Based Smart Wearables

Embedded controllers like Arduino Nano and microcontrollers have been widely used in wearable assistive devices. Research by [5] suggested that using an Arduino-based microcontroller reduces power consumption and enhances system performance.

Gyroscope for Motion Detection

Studies such as [6] investigated the role of gyroscopes in detecting the orientation of visually impaired individuals, improving balance, and enhancing navigation accuracy. A gyroscope-based fall detection system was introduced in [7], which helps in alerting emergency responders in case of sudden falls.

Buzzer and Audio Alerts for Feedback

Research in [8] demonstrated the use of audio feedback via buzzers to provide real-time alerts to blind individuals. Vibratory and audio-based feedback were found to be more intuitive compared to other forms of notifications

Sensor Technologies in Wearable Devices

Smart assistive devices incorporate various sensors for effective navigation:

Ultrasonic sensors: Commonly used for detecting obstacles at different distances (Singh & Sharma, 2020).

Infrared sensors: Aid in nighttime navigation by detecting heat signatures.

4. Future Directions

To further improve smart neckbands for the visually impaired, future research and development could focus on:

Enhanced Sensory Feedback: Integrating advanced haptic feedback mechanisms and auditory cues to provide more intuitive and comprehensive environmental information.

Artificial Intelligence Integration: Employing machine learning algorithms to predict user intent and adapt assistance based on contextual understanding.

Miniaturization and Ergonomics: Developing more compact and comfortable designs to ensure ease of use and user acceptance.

Energy Efficiency: Improving power management to extend battery life and reduce the frequency of recharging.

User-Centric Design: Involving visually impaired individuals in the design process to ensure the devices meet their needs and preferences.

5. Discussion

The reviewed literature highlights the effectiveness of sensor-based wearables in assisting visually impaired individuals. Ultrasonic sensors provide obstacle detection, while GPS and GSM enable real-time tracking. The integration of gyroscopes further enhances stability and motion detection. Despite these advancements, challenges such as battery efficiency and user comfort remain key areas for future research. Smart neckbands provide a hands-free assistive solution compared to traditional white canes and guide dogs. They improve safety, mobility, and independence for visually impaired individuals.

6. Research Gap

The Despite technological advancements, several challenges need to be addressed:
Real-time Object Detection – Enhancing the speed and accuracy of AI-based vision models.

Energy Efficiency – Developing low-power solutions to extend battery life.

Environmental Adaptability – Ensuring the device functions effectively in different lighting and weather conditions.

User Comfort and Acceptance – Designing lightweight and ergonomic devices that are easy to wear for long durations.

Affordability and Accessibility – Making the technology cost-effective for widespread adoption.

7. Future Scope

Integration with IoT – Connecting the neckband with smart city infrastructure for enhanced navigation support.

5G and Edge Computing – Reducing latency in real-time data processing.

Improved AI Models – Enhancing deep learning algorithms for better obstacle recognition and decision-making.

Multi-Modal Feedback Systems – Combining audio, haptic, and visual cues for a more intuitive user experience.

8. Conclusion

Smart neckbands for blind people have the potential to significantly improve navigation and safety. The integration of ultrasonic sensors, GPS, GSM, and gyroscope technology provides an effective assistive solution. Future developments should focus on enhancing battery life, improving accuracy, and incorporating AI-based navigation assistance. Smart neckbands offer a promising solution for visually impaired individuals, providing real-time navigation assistance and obstacle detection. While current technologies show significant progress, further research is needed to enhance accuracy, power efficiency, and user adaptability. The development of cost-effective smart neckbands can revolutionize assistive technology, improving the quality of life for visually impaired individuals.

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