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Drishti: A Smart Wearable Design for Obstacle Detection and Navigation Aid for Visually Impaired Individuals

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***Abstract*—Visually impaired individuals face daily challenges in independent mobility and safe navigation. This paper presents Drishti, a conceptual design of a smart wearable assistive device aimed at detecting obstacles and guiding users in real time. The system proposes the use of an ESP32-S3 Sense board integrated with ultrasonic sensors, Bluetooth communication, and a mobile application for enhanced navigation and emergency support. Key features include real-time obstacle detection, audio feedback, SOS alerts, and location sharing with family members. This paper focuses on the system design, component selection, and expected implementation methodology. The device is currently under prototype development and is intended to provide an affordable and effective solution for visually impaired users in both indoor and outdoor environments.**

***Keywords*—Smart wearable; obstacle detection; visually impaired; ESP32-S3; Bluetooth; navigation aid**

I. INTRODUCTION

According to the World Health Organization (WHO), approximately 253 million people worldwide live with some form of visual impairment. Traditional aids such as white canes or guide dogs offer partial support, but do not always ensure safety or confidence in complex or unfamiliar environments. This paper introduces Drishti, a proposed design of a smart wearable device that aims to bridge this gap using embedded technology. Drishti is intended to support visually impaired individuals with real-time obstacle detection, Bluetooth-based connectivity, and navigation support through an integrated BLE beacons mobile app. The system uses the ESP32-S3 Sense board, ultrasonic sensors, and audio feedback modules to enhance user awareness of their surroundings. The paper outlines the design, architecture, and intended outcomes of this wearable solution.

II. LITERATURE REVIEW

In recent years, many technological methods have been proposed to solve the problems of visually impaired individuals

1. Arduino Based Obstacle Detection:

Early Assistive devices used ultrasonic sensors like HC SR04 with Auruino boards to detect obstacles and provide assistance through buzzers or vibration [1]. This were low cost and simple but lacked portability, bluethooth and smart features.

2. Raspberry Pi and Vision Based System
   Some projects used Raspberry Pi with cameras and deep learning models for obstacle detection and path guidance [2]. These system were more intelligent but also often bulky, expensive and not practically wearable
3. GPS and GSM based Navigation aids: several researchers proposed GPS- enabled devices with GSM for location tracking and emergency messaging [3]. However, these are less reliable indoors and depend heavily on mobile networks
4. Bluetooth and Beacon based Indoor Navigation: Bluethooth based indoor system used BLE beacons or path guidance and tracking [4] . These required fixed infrastructure and calibration, making them harder to deploy for everyday use
5. Gap In Existing Solution:
   Most current solutions either lack real time wireless communication and are not optimized or wearable comfort and ease of use. Drishti addresses this by using the ESP32-S3 sense board , which is compact, Bluethooth – enabled, and supports integration with a mobile app or navigation, SOS alerts, and live location sharing.

III. METHODOLOGY

The proposed system, Drishti, is designed as a smart wearable device to aid visually impaired individuals with real-time obstacle detection and navigation. The system architecture consists of the ESP32-S3 Sense board integrated with ultrasonic sensors, a passive buzzer, and Bluetooth communication for interfacing with a mobile application.

The core components include:

(a) Ultrasonic Sensors: Positioned on the wearable to detect obstacles within a predefined range using the time-of-flight principle.

(b) ESP32-S3 Sense Board: Functions as the central processing unit to gather sensor data, process it, and trigger appropriate responses.

(c) Audio Feedback: A passive buzzer or speaker provides alert signals to the user when an obstacle is detected.

(d) Mobile Application: Developed using Flutter or Android Studio, this app provides voice navigation, Bluetooth connectivity to the device, and live location sharing.

(e) Power Supply: A rechargeable 3.7V Li-Po battery powers the entire circuit, ensuring portability and continuous use.

The software is programmed using the Arduino IDE, with modules for Bluetooth communication, obstacle detection logic, and data transmission to the mobile device. Future enhancements will include AI-based image processing for object recognition and improved user customization through the app interface.

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IV. SYSTEM ARCHITECTURE

The hardware setup of Drishti includes the following parts:

• ESP32-S3 Sense Board – a microcontroller equipped with a built-in camera, Wi-Fi, and Bluetooth capabilities
• HC-SR04 Ultrasonic Sensor – used to measure distances
• Passive Buzzer – for giving sound alerts
• 3.
7V Li-Po Battery – to power the device when it is on the go
• Bluetooth Module (built-in) – for linking with the mobile application

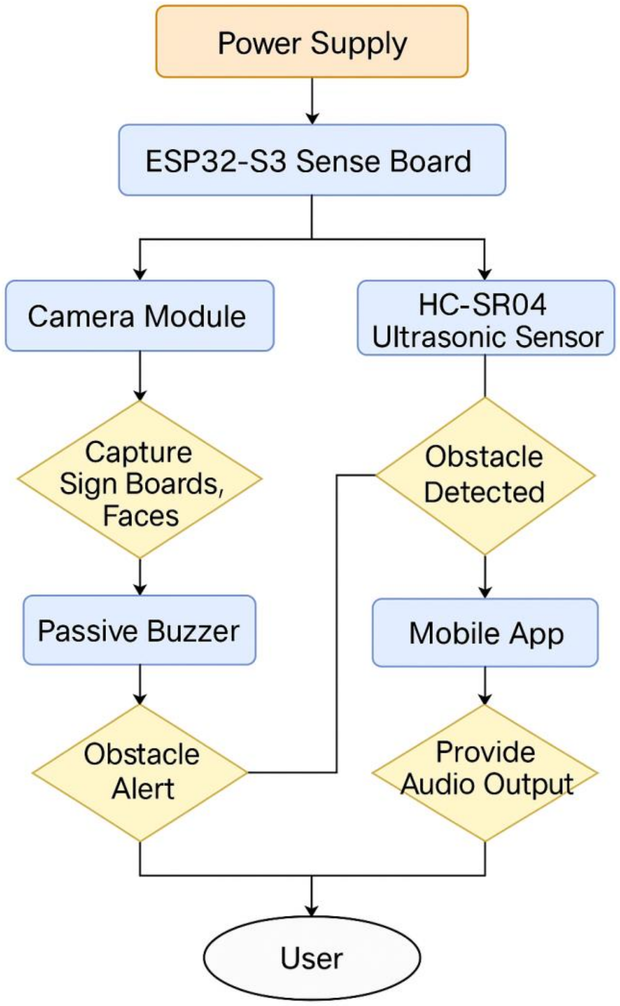
System Workflow:
1.Power Supply
The ESP32-S3 Sense board is supplied with power from a rechargeable 3.
7V Li-Po battery, which starts up the device.

2.System Initialization
Once the device is powered on, the microcontroller runs its embedded software.
The camera module starts taking pictures of nearby signs and faces, which helps in understanding the surroundings in real time and supports future use with AI-based recognition systems.

3.Obstacle Detection
At the same time, the HC-SR04 ultrasonic sensor starts scanning the area.
If it detects an object within a certain range, the passive buzzer gives a sound alert to warn the user.

4.Mobile App Integration
The connected Android mobile app is built using MIT App Inventor.
It uses text-to-speech technology to speak out information about the surroundings and any objects detected. When the user is wearing Bluetooth earbuds, they can hear these alerts clearly and privately.

5.Emergency Support and Live Tracking
The app also allows sending live location data and alerts to pre-set family members or caregivers, helping to ensure the user's safety and enabling constant monitoring.



V. EXPECTED RESULTS

The expected outcomes from the Drishti system include:

- Accurate detection of nearby obstacles (0.2m to 3m range)
- Real-time audio feedback with negligible delay
- Seamless Bluetooth pairing with Android device
- Live location sharing and SOS alert capability
- Battery life of approximately 6–8 hours on a single charge

The prototype is expected to be lightweight, wearable, and operable via a simple mobile interface, making it highly practical for daily use by the visually impaired

VI. CONCLUSION

This paper presented Drishti, a conceptual smart wearable solution designed to improve navigation and safety for visually impaired individuals. It combines obstacle detection, real-time audio feedback, and mobile-based navigation support using ESP32-S3 and ultrasonic sensors. With a focus on portability, ease of use, and low cost, Drishti addresses the limitations of earlier assistive devices and provides a

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promising solution that can be further enhanced with AI-based vision and edge computing.

Future work includes the physical development and testing of the prototype, refining app features, and conducting real-world trials to improve usability and reliability.

REFERENCES

[1] Kumar, R. et al. "Ultrasonic Sensor Based Blind Stick," IJERA, vol. 4, 2014.
[2] Roy, A. et al. "A Computer Vision-Based Navigation System for Visually Impaired," IEEE Access, 2019.
[3] Sharma, D. et al. "Smart Blind Stick: A Step Towards Betterment of Visually Impaired," IRJET, vol. 6, 2019.
[4] Singh, M. et al. "Bluetooth Based Indoor Navigation System," IJRASET, vol. 7, 2020.