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IoT-Based Navigation Assistance for Visually Impaired People

Shruti Hosamani[1], Prof. Deepak Sharma[2]

[1,2]Department of Electronics and Communication, KLS Vishwanathrao Deshpande Institute of Technology, Haliyal, Karnataka, India

ABSTRACT
People view sight as the most significant sense. Thanks to advanced engineering, blind people can communicate with their surroundings more easily. Information is shared quickly and widely, affecting people everywhere and greatly impacting human life. This increases opportunities for comfort and entertainment while reducing hardship and suffering in many areas. Since blind people are a part of our society, technology must have a big influence on their life to enable them to do things that were previously unattainable. The IoT-based navigation aid system presented in this study is intended to improve the freedom of people with visual impairments. The system uses a GPS for real-time location tracking, sensors for obstacle detection, an accelerometer for monitoring user movement and orientation, and an ESP8266 microcontroller for data processing and connectivity. By integrating these components, the device provides audio navigation instructions and immediate alerts through a speaker and buzzer. This ensures that users can navigate unfamiliar environments safely and effectively, receiving real-time feedback and guidance. The system aims to be a cost-effective, reliable, and user-friendly solution for visually impaired individuals, significantly improving their daily navigation experiences.

Keywords: Visually impaired, Obstacle detection, Real-time tracking, Audio guidance

I. INTRODUCTION

For blind persons, unaided navigation is extremely difficult. They required suggestion from others and conventional aids like canes or assistance dogs.These methods are effective up to some extent, they come with limitations, such as limited reach and dependence on another person or animal. The development of modern technology offers an opportunity to enhance mobility and independence for visually impaired people, providing a new level of autonomy and safety.

This paper introduces an IoT-based navigation assistance system designed specifically for visually impaired individuals.

The system integrates several key components: a GPS module for real-time location tracking, sensors to detect obstacles, an accelerometer to monitor user movement and orientation, and an ESP8266 microcontroller for data processing and connectivity. These components work together to provide a solution that offers both directional guidance and immediate obstacle alerts. Ultrasonic sensors strategically placed to detect obstacles in the user's path, sending alerts through a buzzer to prevent collisions. The accelerometer monitors the user's movements, ensuring that the system can adapt to different walking speeds and detect falls. The ESP8266 microcontroller serves as the central hub, providing data from all sensors and coordinating the system's responses.

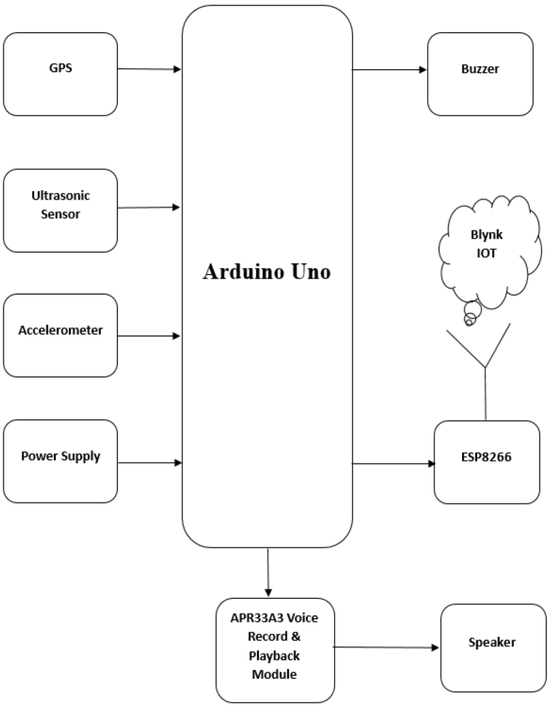
II. LITRATURE SURVEY:

1. This paper presents a low-cost navigation assistance system for sightless individuals using IoT technology. The system incorporates various sensors such as ultrasonic, IR, gyroscopic, and accelerometer, along with a microcontroller (ESP32), battery, and vibration motor to provide real-time obstacle detection and navigation support. [1].
2. The authors propose a smart assistance system that uses IoT to help blind people navigate safely. The system includes sensors for obstacle detection, a buzzer for audio alerts, and web-based servers for emergency assistance. [2].
3. This study focuses on using SMART technology to provide optical detection and navigation support for eyeless individuals. The combination of modern technologies aims to improve the mobility and safety for blind users in both inside and outside environments [3].
4. This paper discusses an indoor navigation system for eyeless individuals using IoT and Bluetooth Low Energy (BLE) technology. The use of BLE enables the identification of smart devices and provides detailed navigation support, enhancing the user's ability to move independently indoors [4].
5. This paper presents a prototype of an assistive shoe designed for visually impaired individuals. The shoe is equipped with ultrasonic sensors and an Arduino UNO board to detect obstacles and provide real-time alerts. [5].
6. The authors propose a smart navigation system using an ESP32 microcontroller, radar sensor, ultrasonic sensor, and GPS. The system detects obstacles and converts the information into audio signals for the user. It also includes Bluetooth for audio navigation, making it a comprehensive and user-friendly solution for vision-less individuals to navigate safely [6].
7. This paper introduces a smart stick that uses IoT and image sensing technologies to assist blind individuals. The device combines cameras and artificial intelligence algorithms to detect obstacles and provide auditory and tactile feedback. [7].
8. In this study, the authors present a smart cane that uses sensors to detect object and provide haptic feedback to the user. The system demonstrates the potential of assistive technology in improving mobility for vision-less individuals by alerting them to obstacles in real-time. [8].
9. Reinhardt's research focuses on a wearable system that user ultrasonic sensors to detect object and provide feedback through vibration motors. The study highlights the effectiveness of wearable devices in enhancing spatial awareness for visually impaired users. Nevertheless, the absence of GPS integration limits the system's capability to provide comprehensive navigation assistance [9].
10. This paper explores the use of haptic feedback for navigation assistance. The system employs an array of sensors to detect obstacles and conveys information through haptic signals. While effective in simple navigation tasks, the study recognizes the need for multimodal feedback, including audio, to handle more complex environments and provide detailed guidance [10].

III. METHODOLOGY

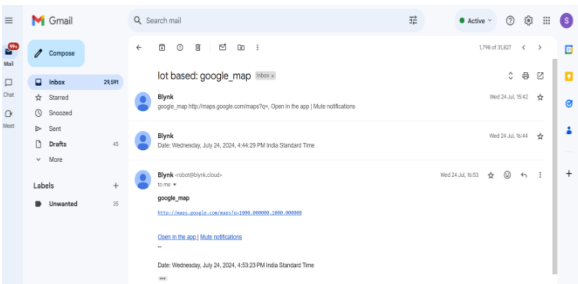
To provide thorough, real-time assistance and object detection, the suggested IoT-based navigation support system for visual impairments is made to incorporate several sensors and components. The primary components include a GPS module for real-time location tracking, sensors for obstacle detection, an accelerometer for movement monitoring, an ESP8266 microcontroller for data processing and connectivity, a speaker for delivering audio instructions, and a buzzer for immediate alerts.

This system relies heavily on the GPS module to provide real-time location data. It continuously update the user's coordinates, which are sent to the ESP8266 microcontroller for processing. This enables the system to guide the user through unfamiliar environments with precise navigation instructions. Obstacles in the consumer's path are found using ultrasonic sensors. These sensors send out ultrasonic waves and time to takes for them to be reflected by objects. The system can determine the distance and proximity of barriers by utilizing this reflection time to calculate the calculation. The ESP8266 microcontroller receives data from the ultrasound sensors, processes it, and outputs the necessary alarms.

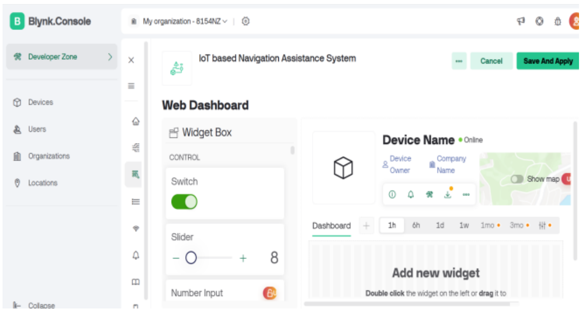


System Block Diagram

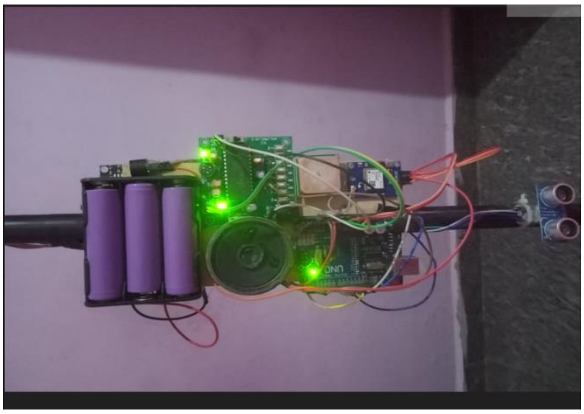
IV. OUTCOME



Proposed system



Blynk Console



Blind Stick

CONCLUSION:

The development of IoT-based technologies in navigation assistance systems for blind individuals represents a significant advancement in enhancing their mobility and independence. This study presented a comprehensive solution combining GPS for real-time location tracking, ultrasonic sensors for obstacles detection, accelerometers for monitoring movement, and an ESP8266 microcontroller for data processing and connectivity. The project capable to provide real-time audio feedback and alerts notice that person can stable to navigate both indoor and outdoor environments with increased confidence and safety. By leveraging affordable and readily available components, this solution addresses the critical need for accessible assistive technology, as well as integrating additional sensors for enhanced environmental perception.

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