A SURVEY ON INTELLIGENT AIDING SYSTEM FOR VISUALLY CHALLENGED PEOPLE: A MULTI-SENSOR APPROACH

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Abstract*— This research survey introduces an innovative Smart Blind Device (SBD) designed to enhance the independence and safety of visually impaired individuals by leveraging a combination of advanced sensors and communication technologies. The SBD integrates key components such as Arduino, Ultrasonic Sensor, Wet Sensor, Accelerometer Sensor for Fall Detection, Emergency Switch, Nodemcu for Message Intimation, Bluetooth for Voice Intimation Output, Laptop Camera for Object Recognition, Image to Speech, Gesture to Speech, Speech to Text, and Color Recognition. The Ultrasonic Sensor detects obstacles, while the Accelerometer Sensor specializes in fall detection, triggering immediate alerts in case of a potential fall. The Wet Sensor enhances safety by identifying wet surfaces and cautioning the user to avoid slippery areas. In emergency situations, the user can activate the Emergency Switch, initiating message intimation through Nodemcu to pre-defined contacts. The Bluetooth module facilitates voice-based communication, allowing users to receive audible information. The Laptop Camera employs advanced object recognition, color recognition, and image-to-speech technologies, enabling the device to describe visual surroundings to the user. To further enhance user interaction, the SBD incorporates Gesture to Speech technology, enabling users to communicate with the device through predefined gestures. Additionally, the Speech to Text functionality allows spoken words to be converted into text, facilitating two-way communication. This multi-sensor approach aims to create a comprehensive, user-friendly device that empowers visually impaired individuals by providing real-time information, enhancing safety, and fostering effective communication.

Keywords*— Smart Blind Device, Ultrasonic sensor, Accelerometer Sensor, Wet sensor, Object recognition, text to speech, image to speech, Bluetooth module, Emergency Switch.

I. INTRODUCTION

In response to the unique challenges faced by the visually impaired community in navigating and interacting with their surroundings, this research introduces the Smart Blind Device (SBD). The SBD is designed as a comprehensive assistive system, integrating cutting-edge components such as Arduino, Ultrasonic Sensor, Wet Sensor, Accelerometer Sensor for Fall Detection, Emergency Switch, Nodemcu for Message Intimation, Bluetooth for Voice Intimation Output, Laptop Camera for Object Recognition, Image to Speech, Gesture to Speech, Speech to Text, and Color Recognition.

The primary objective of the Smart Blind Device is to enhance the independence and safety of visually impaired individuals. By combining multiple sensors, the device aims to offer a holistic solution addressing various daily challenges. The Ultrasonic Sensor detects obstacles in the user's path, providing greater awareness for navigation. The Accelerometer Sensor ensures fall detection, triggering immediate alerts for prompt assistance. The inclusion of a Wet Sensor alerts the user to wet surfaces, reducing the risk of slips and falls.

In emergency scenarios, the Emergency Switch enables quick communication of distress signals through Nodemcu, informing predefined contacts about the user's situation and location. Communication is a key aspect, and Bluetooth technology facilitates voice-based interaction. The Voice Intimation Output provides audible information, aiding in navigation. The SBD's functionality extends beyond safety features, with the Laptop Camera enabling object and color recognition. The Image to Speech technology converts visual information into spoken words for a more immersive experience. Gesture to Speech technology allows users to interact through predefined gestures, and converting spoken words into text, Speech to Text provides a written representation of verbal communication for seamless two-way communication. The integration of these technologies aims to provide real-time environmental information and enhance the overall experience of visually impaired individuals.

II.LITERATURE SURVEY

Numerous strategies are employed to facilitate navigation of visually challenged individuals, incorporating Electronic Orientation Aids (EOAs), Place Locator Devices (PLDs), and Electronic Travel Aids (ETAs) [9]–[11]. The recommended technology offers not just guidance even it monitors the health of visually challenged persons. A clever ETA is proposed, utilizing an ultrasonic sensor capable of detecting obstacle echo sound waves within the close approximation of 5 to 35 cm. This approach effectively identifies obstacles at ground and waist levels up to a maximum of 4 m using ultrasonic sensors.

Another approach in the study focuses on non-interfering wearable devices [12], which use three-dimensional and semantic data to present scenes in ahead of the user, transmitting information through text-to-speech or providing feedback. A tiny and lightweight transmission system, presented in [13], assists the blind in interpreting signs by utilizing wireless transmission across the Communication using frequencies within the visible light range. The communication between a sign and a wearable smart glass mimics the working of light transmission mechanisms. In an alternative system [14], the Internet of Things plays a crucial role, heavily relying on analytics and data science. The gathered data is analyzed and utilized to identify hindrances, ultimately improving basic navigation by providing haptic feedback [15]. This diverse set of approaches aims to strengthen the navigation experience for individuals with visual impairments, combining advanced technologies for effective and comprehensive assistance.

III.PROPOSED SYSTEM

The aim of this paper is to aid people in need to "see" their surroundings by designing an Intelligent aiding system for visually challenged people with a multi-sensor approach. This system involves integrating various sensors and technologies to provide comprehensive assistance. Enhancements could be made to elevate the device's mobility compared to the current design, reducing the time needed for setup. The utilization of IoT not only makes the equipment more portable but also offers visually impaired individuals the opportunity to move independently without assistance.

The presented system encompasses object spotting and identification through a camera, obstacle avoidance using ultrasonic sensors, and an audio feedback system (text to speech, speech recognition). Additionally, it includes emergency assistance features such as fall detection and contacting emergency services. This Intelligent Assistive System can offer comprehensive support to visually challenged individuals, improving their mobility, safety, and overall independence.

The device's applications extend beyond individual use, extending to implementation in old age homes where elderly individuals face challenges in their daily activities due to decreased vision. Regular updates and improvements based on user feedback are deemed essential for the ongoing effectiveness of the process.

IV.METHODOLOGY

The first study proposes an intelligent aiding system for optically challenged individuals using a union of a camera and ultrasonic sensors. The system captures images, detects obstacles, and provides feedback through a buzzer, advising the visually challenged to turn left or right for a clearer pathway. The ultrasonic sensors gauges obstacle distance and communicates the details to the optically challenged individuals. The program employs an Arduino, servomotor, and a buck-boost voltage regulator for technical precision. In contrast, the second study focuses on a comprehensive sensor-based system with Arduino as the central controller. It integrates various sensors, including ultrasonic sensors, wet sensor, and accelerometer sensor, for obstacle detection, wet condition alerts, and fall detection. The system also incorporates communication modules such as NodeMCU for Wi-Fi alerts, Bluetooth for voice messages, and OpenCV for object recognition. Furthermore, it introduces advanced features like gesture recognition, speech-to-text, and color identification. While the first study emphasizes spotting barriers for navigation, the second study The execution is done using YOLO algorithm in this system. It offers a broader range of functionalities, including fall detection, emergency alerts, and advanced object recognition.

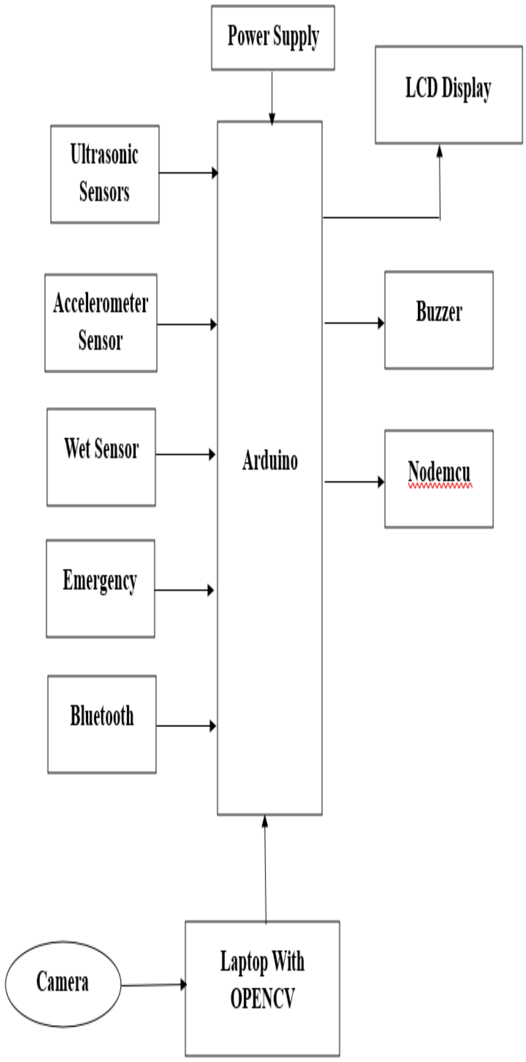

FIGURE 1 Proposed block diagram of intelligent aiding system for visually challenged

V.CONCLUSION

In conclusion, developing a Smart Blind device integrating Arduino, various sensors, communication modules, and advanced recognition technologies represents a huge step towards enhancing the independence and safety of visually impaired individuals. The integration of Ultrasonic Sensor, Wet Sensor, Accelerometer Sensor, Emergency Switch, NodeMCU, Bluetooth, Laptop Camera, Image-to-Speech, Gesture-to-Speech, Speech-to-Text, and Color Recognition creates a multifaceted system designed to address different aspects of the user's environment and communication needs. The Ultrasonic Sensor provides real- time obstacle detection, allowing the user to navigate their surroundings with increased awareness and safety. The Wet Sensor adds a weather-sensing dimension, enabling the device to warn the user about wet conditions. The Accelerometer Sensor contributes fall detection capabilities, ensuring timely assistance in emergency situations. The Emergency Switch act as a quick-response mechanism, empowering the user to signal for help when needed. NodeMCU facilitates instant message intimation to caregivers or contacts, enhancing the communication feature of the device. The incorporation of Bluetooth technology enables voice intimation output, allowing the device to communicate important information and instructions to guide visually impaired via Bluetooth-enabled earpiece or speaker.

The utilization of Laptop Camera, associated with foremost algorithms, introduces object recognition capabilities, enriching the user's understanding of their surroundings. The Image-to-Speech functionality converts recognized objects into spoken words, providing an auditory description of the environment. Gesture-to-Speech further expands the interaction possibilities by allowing users to convey commands or preferences through recognized gestures. Speech-to-Text converts spoken words into text, enhancing the device's ability to better understand user input. The inclusion of Color Recognition enhances the device's perceptual abilities, providing additional context and Details pertaining to the surroundings.

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