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⊕ www.ijirset.com ⊠ ijirset@gmail.com 🖄 +91-9940572462 🕓 +91 63819 07438



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Smart Blind Assist

Sushmitha S K, Tejas H C, Umashankar M, Yashwanth Raj B R, Divyashree H S

U.G. Student, Department of Electronics and Communication Engineering, P.E.S. College of Engineering, Mandya,

Karnataka, India

U.G. Student, Department of Electronics and Communication Engineering, P.E.S. College of Engineering, Mandya,

Karnataka, India

U.G. Student, Department of Electronics and Communication Engineering, P.E.S. College of Engineering, Mandya,

Karnataka, India

U.G. Student, Department of Electronics and Communication Engineering, P.E.S. College of Engineering, Mandya,

Karnataka, India

Assistant Professor, Department of Electronics and Communication Engineering, P.E.S. College of Engineering,

Mandya, Karnataka, India

ABSTRACT: The Blind Assist System is an intelligent wearable device designed to empower visually impaired individuals through real-time object detection, OCR-based text reading, obstacle avoidance, and emergency alerts. Built around a Raspberry Pi, the system employs a custom-trained CNN model (Convolutional Neural Network) for high-accuracy object recognition, detecting 91 classes from the COCO dataset and converting them into audio feedback via eSpeak. For text accessibility, Tesseract OCR extracts printed text from the Pi Camera feed and synthesizes speech. Distance measurement is achieved using an ultrasonic sensor, providing voice alerts for nearby obstacles. Additionally, a panic button triggers instant SMS alerts via a Telegram bot, ensuring emergency assistance

KEYWORDS: Assistive Technology, Visually Impaired Navigation ,Object Detection, OCR Text Recognition, Raspberry Pi, Emergency Alert System, Convolutional Neural Network (CNN), Ultrasonic Obstacle Detection.

I. INTRODUCTION

Navigating the world, presents unique challenges for visually impaired individuals, who often encounter difficulties such as identifying obstacles, understanding their surroundings, and traveling independently. While traditional mobility aids like white canes and guide dogs offer essential support, they come with significant limitations. White canes are primarily effective for detecting lowlying obstacles, while guide dogs require extensive training and may not always be available. However, the integration of artificial intelligence (AI) and machine learning (ML) technologies into mobility assistance is paving the way for more dynamic and interactive solutions.

This cutting-edge system transforms visual data into audio cues, allowing users to receive real-time information about their environment. Utilizing advanced AI and ML algorithms, the system processes camera input to identify obstacles, describe surroundings, and provide navigational guidance, thus enhancing the user's spatial awareness. In addition to navigation assistance, the system enhances personal safety through a built-in panic button. In an emergency situation, users can press the button to send their live location to authorities via a Telegram bot, ensuring that help can reach them quickly. This integration not only provides reassurance but also empowers visually impaired individuals to travel with greater independence and less anxiety.

Overall, the smart assist system represents a significant step forward in assistive technology, offering a comprehensive approach that combines navigation, safety, and enhanced interaction to significantly improve the quality of life for visually impaired individuals.

aquatic safety and environmental cleanliness by combining real-time hazard detection with autonomous waste collection in a single, integrated robotic platform.



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II. LITERATURE SURVEY

A real-time object detection system aids visually impaired individuals using YOLO, OpenCV, and audible feedback, as proposed by Najm et al. [1]. Observation: The use of the YOLO model for real-time object detection significantly enhances the mobility and safety of visually impaired individuals by providing immediate auditory feedback about their surroundings. The project assists the visually impaired by enabling text reading and object detection using Raspberry Pi, OCR, TensorFlow, Tesseract, and audio feedback for scalability, as proposed by Murali et al. [2].Observation: The project assists visually impaired people by reading text and detecting objects in images using OCR, TTS, and TensorFlow. It is scalable and adaptable to various situations, improving independence for visually impaired individuals. The research uses a ZED stereo camera and deep attention networks to assist blind individuals in navigating outdoor environments, achieving 81% accuracy on novel datasets by Yohannes et al. [3]. Observation: The project proposes a deep attention network to detect and recognize objects in outdoor environments using a ZED stereo camera. It aims to assist blind people by identifying objects like people, cars, stores, and traffic lights. To assists visually impaired individuals in grocery shopping using RFID, Raspberry Pi, audio feedback, obstacle detection, and automated billing for independence, as proposed by Gayathri et al. [4]. Observation: The project proposes a robot trolley equipped with a Raspberry Pi, RFID reader, headset, and motors to assist visually impaired individuals in grocery shopping. The trolley uses speech input to navigate, RFID tags to identify items, and audio output to provide information about items and prices. Obstacle detection ensures safe movement. This solution aims to enhance the independence and convenience of grocery shopping for visually impaired people. The wearable visual aid for visually impaired individuals uses Raspberry Pi, OpenCV, and speech commands for object and signboard identification, enhancing daily navigation, as proposed by Jain et al.[5]. Observation: The project proposes a wearable visual aid for visually impaired people using computer vision and speech commands. The system aims to identify objects and signboards, assisting users in managing daily activities and navigating their surroundings. Raspberry Pi and OpenCV are used for implementation. The low-cost wearable system for visually impaired individuals uses Raspberry Pi, TensorFlow, and ultrasonic sensors for obstacle detection and scene classification, enhancing daily routines, as proposed by Masud et al. [6]. Observation: The project proposes a wearable framework for visually impaired people using Raspberry Pi, a camera, ultrasonic sensor, and Arduino. It aims to as- sist users by detecting obstacles and classifying scenes using Viola Jones and TensorFlow Object Detection algorithms. The framework is designed to be affordable, convenient, and easy to wear

III. METHODOLOGY

The system design of the Smart Blind Assist System is designed to aid visually impaired individuals by providing obstacle detection and audio feedback. A Raspberry Pi 4 Model B acts as the central controller, running the software and managing all components. The Ultrasonic Sensor continuously measures the distance to nearby obstacles, alerting the user to potential hazards. The Raspberry Pi Camera captures images or video, which can be processed for object recognition or streamed to a remote caregiver. A switch is used to start or stop the system manually for user convenience. The audio output is delivered through earphones which provide spoken alerts or navigation instructions. A Power Bank supplies portable power for field use, ensuring the system remains operational for hours. The MicroSD card stores the operating system, application software, and any recorded data or logs.

The Block Diagram of the proposed system, it represents the hardware architecture of a Smart Blind Assist System using a Raspberry Pi as the central processing unit. All input and output devices are interfaced with the Raspberry Pi to perform various assistive functions. The system is designed to collect data, process it, and provide meaningful audio or digital feedback to the user or a remote recipient. On the input side, a camera is connected to the Raspberry Pi, which is used for capturing images or video for object detection or text reading. A switch is used to control the system manually, allowing the user to turn the device on or off or trigger specific modes. An SD card is connected to the Raspberry Pi to store the operating system, code, and any collected data, while a power supply (such as a power bank) provides the necessary energy for the system to operate. On the output side, earphones are connected to deliver audio feedback, such as obstacle alerts, recognized objects, or text readouts, enabling real-time guidance for the visually impaired user. Additionally, a Telegram Bot is integrated to communicate important alerts or data (like emergency notifications or camera captures) to a remote caregiver or family member through the Telegram app. This setup ensures both local assistance via audio and remote monitoring or support via messaging



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Fig. 1 Block diagram of system design approach.

IV. EXPERIMENTAL RESULTS

The Smart Blind Assist system was successfully tested in real-world indoor and outdoor settings. The object detection module accurately identified common obstacles like people and furniture, while unsinging ultrasonic sensor reliably detected nearby hazards. The OCR feature, using Tesseract, performed well with printed text but struggled with cursive handwriting. Audio feedback through earphones provided clear and timely guidance, and emergency alerts were successfully sent via the Telegram Bot, confirming effective communication features. The compact, portable design powered by a power bank allowed for several hours of continuous use. Users found the system helpful and easy to operate in daily environments. However, improvements are needed for low-light camera performance and OCR accuracy with complex or handwritten scripts. Overall, the prototype proved to be a cost-effective, user-friendly assistive device with strong potential for supporting the visually impaired in everyday navigation.



Fig. 2 (a) Smart Blind Assist. (b) Emergency Alert.



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V. CONCLUSION

The Blind Assist System presented in this project demonstrates a cost-effective, multi-functional solution to enhance independence and safety for visually impaired individuals. By integrating real-time object detection (using a custom CNN model), OCR-based text reading, ultrasonic obstacle avoidance, and emergency SMS alerts, the system addresses critical challenges faced in daily navigation and accessibility. Leveraging Raspberry Pi's edge-computing capabilities, the device processes data locally, ensuring low latency and offline functionality—unlike many smartphone-dependent alternatives. The hardware design prioritizes portability and affordability, while the software stack (OpenCV, Tesseract OCR, eSpeak, and Telegram Bot) ensures scalability and ease of use.

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