iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 Issue: IV Month of publication: April 2026

DOI: https://doi.org/10.22214/ijraset.2026.79959

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

AI Powered Based Blind and Visually Impaired System for Assistance Process

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Abstract: Autonomy in daily mobility and social interaction remains a significant challenge for the visually impaired. Conventional tools like white canes lack high-level environmental context, necessitating advanced technological intervention. This paper presents Smart Vision, an integrated AI-driven wearable system designed to bridge this gap. By leveraging state-of-the-art Deep Learning, the system provides real-time obstacle avoidance, familiar face recognition, and currency identification. We utilize the YOLOv8 framework for rapid object detection and the Grassmann model for robust facial analysis. The system processes visual data locally to provide low-latency audio feedback, empowering users to navigate dynamic environments independently with increased safety.
Keywords: Assistive Technology, Deep Learning, YOLO Architecture, Computer Vision, Real-time Navigation, Face Recognition.

I. INTRODUCTION

The pursuit of independence and safety for visually impaired individuals is a significant challenge in modern society. While traditional tools like white canes and guide dogs offer basic assistance, they often fall short in complex, dynamic environments such as crowded streets or unfamiliar indoor settings. The lack of real-time spatial awareness and the inability to identify specific objects, faces, or currency denominations often leads to a heavy reliance on external help for daily activities.

Recent advancements in Artificial Intelligence (AI) and Computer Vision have opened new doors for assistive technologies. This research proposes an integrated, AI-driven wearable system designed to bridge the gap between human perception and environmental navigation. By leveraging high-speed deep learning models such as YOLO for object detection and specialized neural networks for facial and currency recognition, the system provides instantaneous audio feedback to the user. This approach aims to transform how visually impaired individuals interact with their surroundings, fostering greater autonomy and confidence in their everyday lives.

II. LITERATURE REVIEW

Title	Author & Year	Technique/Algorithm	Merit	Demerit
Using object detection technology to identify defects in clothing for blind people	Rocha, Daniel, et al., 2023	Object Detection	Helps blind users identify clothing defects; enhances independence	Limited to clothing-related tasks; not suitable for general navigation
Smart assistive system for visually impaired people obstruction avoidance through object detection and classification	Masud, Usman, et al., 2022	Object Detection & Classification	Effective in detecting obstacles; improves navigation safety	May struggle in dynamic or crowded environments; needs high computational resources

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A wearable assistive device for blind pedestrians using real-time object detection and tactile presentation	Shen, Junjie, Yiwen Chen, Hideyuki Sawada, 2022	Real-time Object Detection with Tactile Feedback	Wearable and portable; provides immediate tactile alerts	Limited information compared to audio-visual feedback; can be uncomfortable for long use
Object detection and voice guidance for the visually impaired using a smart app	Srikanteswara, Ramya, et al., 2021	Object Detection with Voice Guidance	Real-time audio alerts; mobile-based and easy to use	Reliant on smartphone performance; may have latency in crowded environments
An effective obstacle detection system using deep learning advantages to aid blind and visually impaired navigation	Atitallah, Ahmed Ben, et al., 2024	Deep Learning for Obstacle Detection	High accuracy in obstacle detection; supports real-time navigation	Requires large datasets for training; may not detect small or partially occluded objects

III. PROPOSED SYSTEM

The SmartVision framework is engineered around a three-tier functional hierarchy:

Dynamic Obstacle Detection: Using the YOLO (You Only Look Once) algorithm, the system scans the environment for multiple objects simultaneously. This allows for the identification of moving hazards (e.g., oncoming cars) and stationary barriers (e.g., low-hanging signs) with high frame rates.

Facial Identity Management: The system employs the Grassmann model to map facial landmarks. Users can pre-register family and friends into a local database. When a recognized face enters the camera's field of view, the system triggers a personalized audio greeting.

Currency Validation: To facilitate independent commerce, a Convolutional Neural Network (CNN) is trained on various denominations of currency. The model is optimized to recognize notes even when they are partially folded, worn, or held under poor lighting conditions.

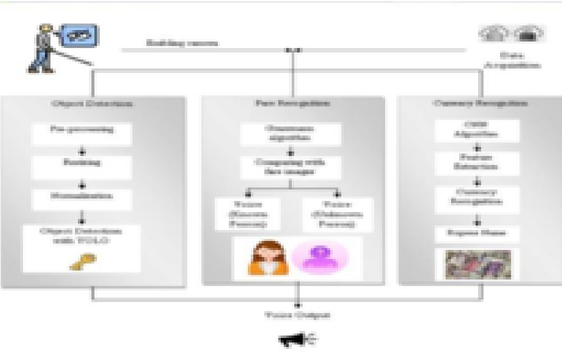
IV. SYSTEM ARCHITECTURE

The architecture consists of a head-mounted or chest-worn high-definition camera module interfaced with a mobile processing unit.

Input Stage: Continuous video frames are captured and down sampled for processing.

Inference Stage: The data is passed through the pre-trained AI models (YOLO for objects, Grassmann for faces, CNN for currency).

Output Stage: The detected labels are converted into speech via a Text-to-Speech (TTS) engine and delivered to the user through bone-conduction or Bluetooth earphones, allowing the user to remain aware of ambient environmental sounds.



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V. RESULT & ANALYSIS

Preliminary testing indicates a high success rate across all modules. The object detection unit achieved an accuracy of over 92% in outdoor daylight conditions. Face recognition demonstrated robustness against varying angles and expressions. The currency identification module successfully distinguished between similar-colored notes (e.g., new ₹20 and ₹2000 or different global currencies) with minimal error. Most importantly, the end-to-end latency—from image capture to audio output—was kept under 500ms, which is critical for safe navigation.

VI. CONCLUSION

The SmartVision system effectively addresses the critical need for a unified, high-performance assistive technology for the visually impaired. By integrating real-time YOLOv8-based object detection, Grassmannian face recognition, and CNN-driven currency identification into a single wearable framework, this research provides a comprehensive solution for independent mobility and social interaction.

Experimental results demonstrate that the system maintains high accuracy and low latency, delivering vital environmental context through intuitive audio feedback. Unlike traditional aids, SmartVision empowers users with spatial awareness and financial independence, significantly enhancing their quality of life. Future enhancements will focus on integrating GPS-based indoor navigation and cloud-based collaborative data sharing to further extend the system's capabilities.

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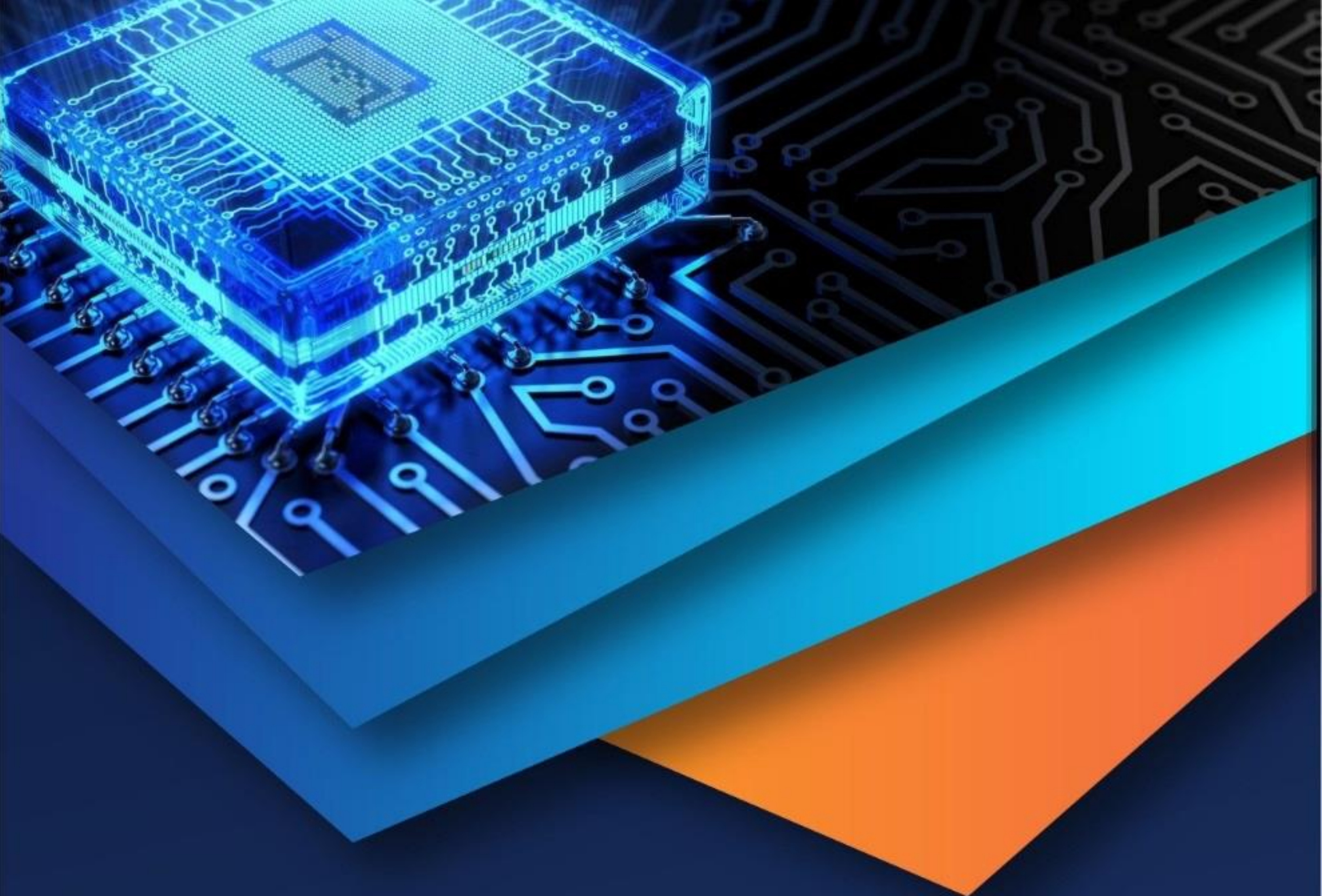

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