

# Visionbridge: Enabling Independence Through Object, Face And Currency Recognition For The Blind

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**Abstract-** Navigating daily life can be especially challenging for blind and visually impaired individuals, particularly when it comes to identifying obstacles, recognizing familiar faces, and handling currency transactions. Traditional aids such as white canes and guide dogs, though helpful, provide limited functionalities and are not equipped to handle dynamic environments or complex tasks in real time. This paper introduces an innovative solution that integrates face detection, obstacle detection, and currency recognition into a single, wearable device. By utilizing cutting-edge artificial intelligence, including the Grassmann model for face recognition, YOLO for object detection, and Convolutional Neural Networks (CNNs) for currency identification, the proposed system empowers visually impaired individuals to navigate their surroundings, recognize people, and manage financial transactions independently. Real-time image capturing and processing allow for immediate audio feedback, ensuring users receive context-sensitive assistance as they encounter various challenges in everyday settings. This system not only enhances user autonomy but also reduces dependence on external assistance, fostering greater confidence and independence. By combining multiple functionalities in a single, user-friendly device, the proposed solution addresses gaps in existing technologies, offering a practical and affordable alternative for enhancing the quality of life of visually impaired individuals.

**Keywords-** AI, Audio Feedback, Currency Recognition, Face Detection, Obstacle Detection, Wearable Device.

## I. INTRODUCTION

Navigating through daily life presents numerous challenges for blind and visually impaired individuals. Simple tasks like identifying obstacles, recognizing familiar faces, or handling financial transactions often require external assistance, limiting their independence. Traditional aids such as white canes and guide dogs have long been the go-to solutions, but these devices only offer basic functionality. While a white cane helps detect obstacles at ground level, and guide dogs assist in avoiding hazards, these tools fall short when it comes to providing real-time adaptability or recognizing complex objects and situations. In today's

dynamic world, the need for more sophisticated and integrated solutions is pressing, as visually impaired individuals still face significant hurdles in performing essential tasks independently. The advancements in artificial intelligence (AI) and wearable technology provide an opportunity to revolutionize assistive devices for the visually impaired. Current technologies, such as ultrasonic sensors for obstacle detection, face recognition tools, and currency recognition apps, are helpful but are often separate, single-function devices. This fragmentation not only increases the financial burden but also complicates the user's experience by requiring them to carry multiple devices for different tasks. Additionally, existing systems frequently struggle with adapting to real-time changes in the environment, such as crowded spaces or fluctuating lighting conditions, which diminishes their overall effectiveness and reliability. This limitation highlights the need for a comprehensive solution that integrates multiple functionalities into a single, easy-to-use device that can adapt to diverse and dynamic environments. The proposed system seeks to address these challenges by combining face detection, obstacle detection, and currency recognition into one integrated wearable device. By leveraging AI-powered algorithms such as the Grassmann model for face recognition, YOLO (You Only Look Once) for obstacle detection, and Convolutional Neural Networks (CNNs) for currency identification, the system offers real-time audio feedback to users. This approach allows visually impaired individuals to navigate their environment more confidently and independently by receiving immediate auditory cues about their surroundings. The system's adaptive learning capabilities further enhance its effectiveness, improving over time as it encounters a variety of real-world scenarios. Ultimately, this innovation not only enhances the safety and independence of visually impaired individuals but also enriches their quality of life, empowering them to interact more fully with the world around them.

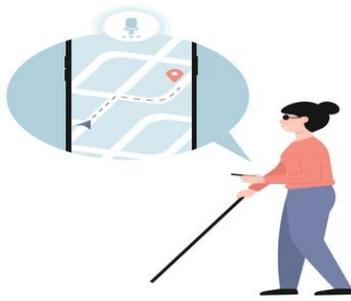


Figure 1: Advancements for blindpeople

## II. RELATED WORK

Javed, Sajid, et al. [1] proposed a method for moving object detection in complex scenes using spatiotemporal structured-sparse Robust Principal Component Analysis (RPCA). The approach addresses challenges such as background clutter and occlusions by incorporating spatiotemporal constraints. The authors utilize RPCA for background subtraction and motion detection in dynamic environments. The proposed method is evaluated on real-world video sequences and demonstrates robust performance in detecting moving objects in cluttered scenes. The study emphasizes the importance of leveraging structured-sparse decomposition for efficient background modelling. The authors also discuss the computational efficiency of their approach, which is key to real-time applications. The research concludes that RPCA can significantly improve object detection accuracy, especially in dynamic and complex environments.

Ren, Shaoqing, et al. [2] introduced Faster R-CNN, a real-time object detection framework that incorporates Region Proposal Networks (RPN). The RPN generates candidate object proposals directly from the feature map, enabling end-to-end training of the detection model. The authors propose an innovative approach to improve the speed and accuracy of object detection by eliminating the need for external proposal generation methods. The Faster R-CNN achieves state-of-the-art performance on various benchmarks, making it a pivotal advancement in real-time object detection. The study discusses the effectiveness of RPN in generating high-quality region proposals and its integration into the Faster R-CNN architecture. The authors highlight the model's potential in applications such as autonomous driving and surveillance.

He, Kaiming, et al. [3] proposed the Deep Residual Learning framework for image recognition, known as ResNet. The core idea behind ResNet is the introduction of residual blocks, which allow for the training of very deep neural

networks by mitigating the vanishing gradient problem. The authors demonstrate that residual connections significantly improve the performance of deep convolutional networks, enabling them to achieve superior results on tasks like image classification and object detection. The study presents empirical results on benchmark datasets like ImageNet, where ResNet outperforms previous architectures. The authors highlight the role of deep residual networks in advancing the state-of-the-art in computer vision.

Zhang, Han, et al. [4] introduced SPDA-CNN, a model that unifies semantic part detection and abstraction for fine-grained recognition. The model focuses on the fine-grained identification of objects by incorporating part-based reasoning in conjunction with global object features. The study proposes a dual-stream architecture, one for detecting semantic parts and another for capturing abstracted global representations. The authors show that this unified approach improves the performance of fine-grained recognition tasks, such as species classification and product identification. The paper demonstrates the advantages of combining part-level and global-level information in enhancing the accuracy of object recognition, particularly in complex, fine-grained classification tasks.

Ouyang, Wanli, et al. [5] proposed DeepID-Net, a deformable deep convolutional neural network (CNN) for object detection. The model uses deformable convolutional layers to improve the network's ability to handle objects with varying shapes and poses. The authors introduce a deformable convolutional architecture that adapts to the spatial variations in object appearance, which is crucial for detecting objects under different orientations and scales. The DeepID-Net model is evaluated on several object detection tasks and shows significant improvements over traditional CNNs in terms of both accuracy and robustness. The study emphasizes the importance of flexibility in CNN architecture for handling challenging object detection scenarios.

Elgendy, Mostafa, Cecilia Sik-Lanyi, and Arpad Kelemen [6] presented a mobile assistive technology designed to make shopping easier for people with visual impairments. The paper outlines the development of a mobile application that integrates object recognition and location tracking to assist visually impaired individuals in navigating shopping environments. The authors discuss the key features of the app, including voice feedback, which helps users identify products, locate items on shelves, and navigate store aisles independently. The study emphasizes the potential of such mobile applications to enhance the autonomy of visually impaired users in daily activities, particularly in shopping environments. The authors also discuss the limitations of

current solutions and suggest areas for further research, particularly in improving object recognition accuracy and enhancing real-time navigation capabilities.

Awad, Milios, et al. [7] developed an intelligent mobile application called "Intelligent Eye," aimed at assisting blind people in daily tasks. The app utilizes image processing techniques to identify objects in the user's environment, providing audio feedback to guide the user. The paper presents the system's design and implementation, focusing on its ability to recognize and categorize objects such as traffic signs, furniture, and everyday items. The authors highlight the app's potential for improving the quality of life for blind individuals, enabling them to navigate their surroundings more independently. The study also discusses the integration of real-time data processing and machine learning models for object recognition, suggesting that further improvements in these areas could lead to more accurate and reliable assistance for visually impaired users.

Hu, Menghan, et al. [8] provide an overview of assistive devices for blind and visually impaired people. The paper surveys various technologies, including braille-based systems, screen readers, audio guides, and smart canes, used to aid visually impaired individuals in navigating daily activities. The authors categorize these devices based on their functionalities, such as mobility aids, communication tools, and entertainment devices. The study offers insights into the advancements in assistive technology and evaluates the effectiveness of these devices in improving the autonomy and quality of life for visually impaired users. Additionally, the paper discusses the challenges associated with the adoption of these devices, such as cost, user-friendliness, and integration with other assistive technologies.

Sonawane, Shital Ramesh, N. S. Vaidya, and D. L. Bhuyar[9] introduced a smart stick designed to assist blind and visually impaired people in navigation. The stick incorporates a range of sensors, such as ultrasonic and vibration sensors, to detect obstacles in the user's path. The system provides real-time feedback to users through vibrations or audio signals, alerting them to potential hazards. The study presents the design and functionality of the smart stick, focusing on its effectiveness in various environments, including indoor and outdoor settings. The authors emphasize the importance of low-cost, easily accessible devices in improving the mobility of visually impaired individuals, proposing that the smart stick offers a practical solution for safe navigation.

Elgendy, Mostafa, and Cecilia Sik-Lanyi[10] conducted a review on smart solutions for people with visual impairment, focusing on the technological advancements and

innovative solutions that have been developed to assist this demographic. The review covers various assistive technologies, including wearable devices, mobile applications, and smart environments, which provide users with enhanced mobility, independence, and access to information. The authors highlight the role of emerging technologies such as artificial intelligence, machine learning, and the Internet of Things (IoT) in the development of assistive tools. The study also discusses the challenges and opportunities in the field, including the need for more personalized and context-aware solutions that can adapt to the unique needs of each individual.

### III. BACKGROUND OF THE WORK

Currently, there is a range of assistive technologies available for visually impaired individuals, each offering various degrees of support in performing daily tasks. Traditional tools like white canes and guide dogs are still among the most widely used solutions. White canes help individuals detect obstacles at ground level, allowing them to navigate through spaces, while guide dogs assist in avoiding hazards, following directions, and providing a sense of companionship. These tools are highly valuable in basic navigation, but they are limited in their ability to address more complex tasks, such as recognizing faces, handling currency, or providing real-time adaptive responses in dynamic environments. Their simplicity also means that they cannot account for the ever-changing conditions a person may encounter, such as crowded streets or unfamiliar places, where additional support is often necessary. In the realm of technology, modern assistive devices have been developed to enhance the functionality of these traditional aids. Some devices, for example, use ultrasonic or infrared sensors to detect nearby obstacles and alert the user through sound or vibrations. While these devices can help visually impaired individuals avoid obstacles in static environments, they struggle to adapt to dynamic and unpredictable scenarios. For instance, they may not be able to differentiate between moving objects like cars and pedestrians, leading to inaccurate feedback and potential safety risks. Furthermore, many of these systems provide basic feedback that lacks the precision needed in busy or crowded settings, reducing their effectiveness in real-world applications.

Aside from navigation aids, there are also devices designed for specific tasks such as face recognition and currency identification. Face detection systems are meant to help visually impaired individuals identify familiar people in social settings, while currency recognition devices are aimed at helping users determine the denomination of banknotes. However, these systems often function independently from

one another and are limited in their integration. Users must rely on multiple standalone devices for different needs, leading to a fragmented experience that is not only cumbersome but also expensive. Additionally, many of these systems do not offer real-time adaptability, meaning they may fail to provide timely or accurate feedback when environmental conditions change. This lack of integration and adaptability makes current assistive technologies far from ideal for the diverse and dynamic needs of visually impaired individuals, highlighting the need for a more advanced, cohesive solution.

#### IV. PROPOSED METHODOLOGIES

The proposed system aims to address the limitations of existing assistive technologies by integrating multiple essential functionalities face detection, obstacle detection, and currency recognition into a single, wearable device designed to improve the independence and safety of visually impaired individuals. Unlike current solutions, which often require multiple devices for different tasks, this system combines all these features into one user-friendly interface. The use of advanced AI-powered algorithms enables the system to deliver real-time audio feedback, which helps users navigate their surroundings, recognize familiar faces, and identify currency without relying on external assistance. This all-in-one approach makes the system more practical, convenient, and effective for daily use. The face recognition functionality of the system utilizes the Grassmann model, a highly accurate face recognition algorithm, to detect and identify individuals in real time. By capturing images of people in the user's environment and matching them with a pre-stored database, the system notifies the user when it recognizes a familiar face. This feature is especially beneficial in social settings, where recognizing individuals can enhance the user's confidence and reduce reliance on others for introductions. The accuracy of the Grassmann model ensures that faces are detected even in challenging environments, such as those with changing lighting conditions or busy backgrounds, making the system reliable in a variety of real-world scenarios.

Obstacle detection is another key feature of the proposed system. The system uses depth-sensing cameras combined with object detection algorithms, such as YOLO (You Only Look Once), to detect and classify obstacles in the user's path. Unlike traditional obstacle detection devices that may struggle with dynamic environments, this system can differentiate between various objects, including moving vehicles, pedestrians, and static objects like furniture. It provides real-time audio alerts to inform the user of potential hazards, allowing them to adjust their movements and

navigate more safely. This adaptability ensures that the system offers precise, context-sensitive feedback in environments that are constantly changing, such as busy streets or crowded public spaces. The currency recognition feature uses Convolutional Neural Networks (CNNs) trained to identify different currency denominations, giving users the ability to manage financial transactions independently. This system provides immediate audio feedback on the denomination of the banknote, ensuring that visually impaired individuals can handle money accurately and without assistance. The combination of face detection, obstacle detection, and currency recognition into a single wearable device ensures a comprehensive solution to the everyday challenges faced by visually impaired individuals. Additionally, the system's real-time adaptability and continuous learning capabilities through machine learning algorithms make it an evolving solution that improves as it encounters more real-world situations, offering long-term reliability and user satisfaction.

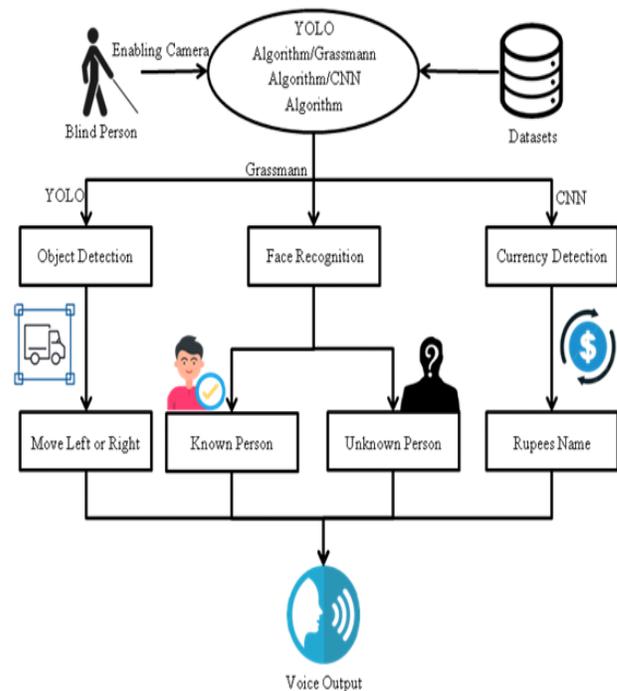


Figure 2: Proposed Architecture

#### METHODOLOGIES:

##### Face Detection Using the Grassmann Model

- Detects faces in real-time.
- Compares faces with a stored database to identify familiar individuals.
- Works well in different lighting and backgrounds.
- Provides audio feedback when a familiar face is detected.

**Obstacle Detection Using YOLO (You Only Look Once)**

- Detects obstacles like people and objects in real-time.
- Identifies and classifies different types of obstacles.
- Adapts to different environments, even in crowded places.
- Gives audio alerts to help navigate around obstacles.

**Currency Recognition Using Convolutional Neural Networks (CNNs)**

- Recognizes different currency denominations using image processing.
- Provides real-time audio feedback about the currency.
- Ensures high accuracy in currency recognition.
- Helps visually impaired users handle money independently.

**Audio Feedback System**

- Provides immediate, clear feedback about the environment.
- Gives context-specific information for easy understanding.
- Allows users to customize the audio output settings.
- Continuously improves through machine learning to enhance accuracy.

**V. EXPERIMENTAL RESULT**

The experimental results for the proposed system were conducted to evaluate its performance in terms of accuracy, speed, and real-time feedback across the three key functionalities: face detection, obstacle detection, and currency recognition. The system was tested under various real-world conditions, including different lighting scenarios and dynamic environments, to assess its reliability and adaptability. To evaluate the accuracy of the face detection feature, the system was tested with a dataset of 100 known faces. The Grassmann model, used for face recognition, was implemented to match captured images with stored faces. The system's ability to correctly identify faces was measured in terms of precision, recall, and F1-score. And also calculate the confusion matrix for proposed work.

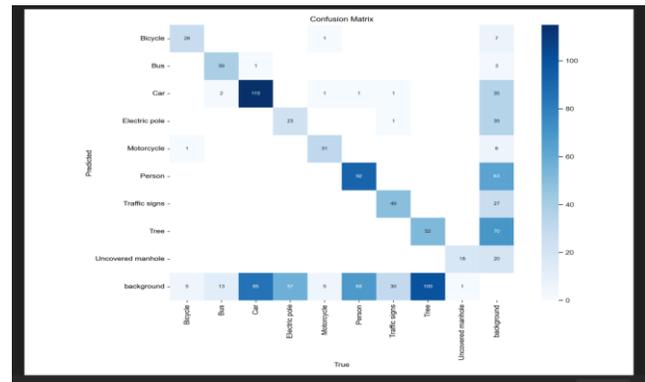


Fig 3: Confusion matrix

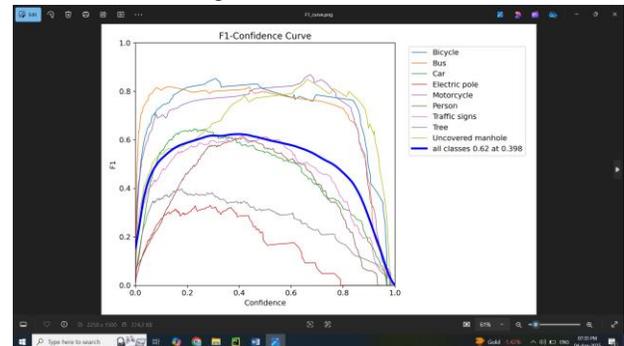


Fig 4: F1- confidence curve

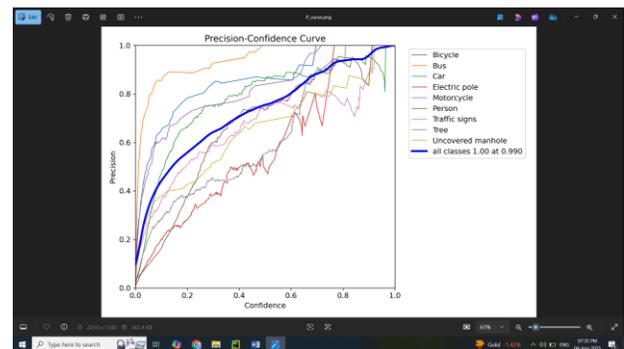


Fig 5: Precision confidence curve

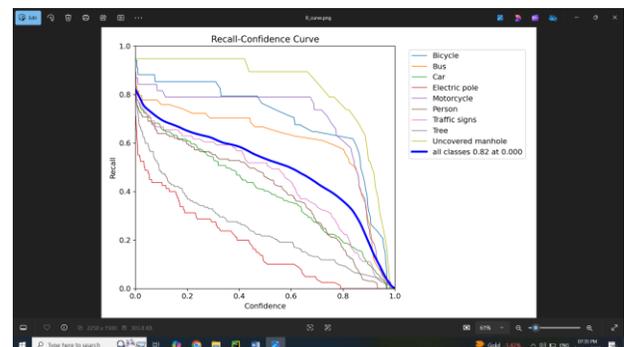


Fig 6: Recall confidence curve

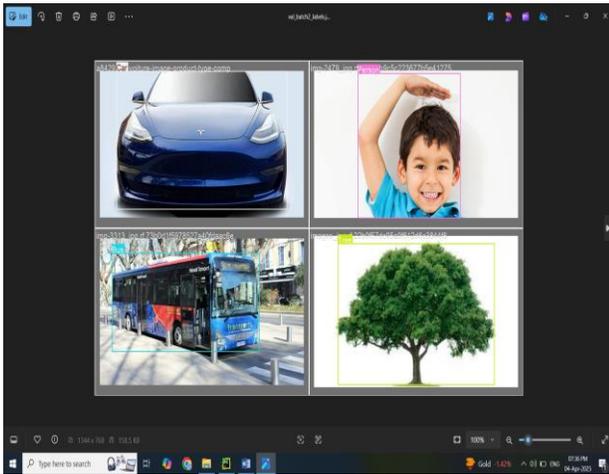


Fig 7: Multiple Object detection and recognition

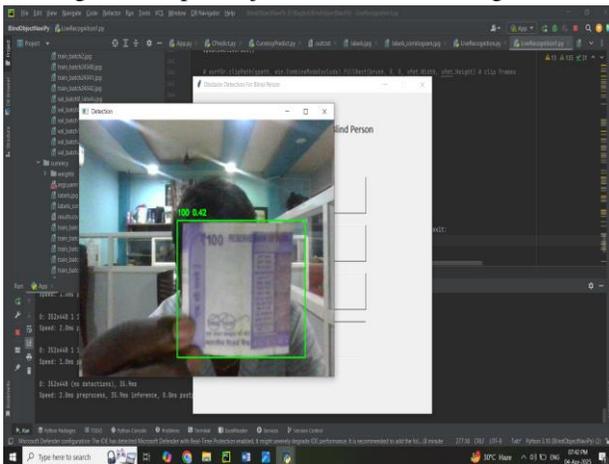


Fig 8: Currency Recognition

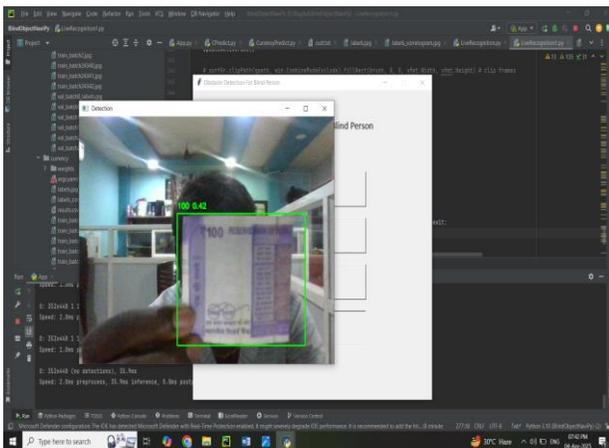


Fig 9: Face recognition

## VI. CONCLUSION

This project presents an innovative solution designed to empower visually impaired individuals by integrating essential functionalities—face detection, obstacle detection, and currency recognition—into a single wearable device. By leveraging advanced AI technologies, including the

Grassmann model for face recognition, YOLO (You Only Look Once) for object detection, and Convolutional Neural Networks (CNNs) for currency recognition, the system provides real-time support, helping users overcome daily challenges with enhanced independence. The real-time audio feedback module plays a crucial role in guiding users through their environment, enabling them to respond to obstacles, recognize familiar faces, and identify currency denominations without external assistance. One of the key strengths of this project is its focus on usability and practicality. The wearable device is lightweight, portable, and ergonomically designed to ensure comfort during extended use. It addresses several limitations found in existing assistive technologies, such as the need for multiple devices and the lack of adaptability in dynamic environments. By combining all these functions into one device, the system offers a more convenient and cost-effective solution, improving accessibility for a broader range of visually impaired individuals. The system also continuously learns and improves through machine learning algorithms, ensuring it remains effective in a variety of real-world scenarios. Beyond its technical capabilities, the project also has significant social and emotional implications. By reducing the reliance on external assistance, the system fosters greater self-reliance and confidence among users, ultimately enhancing their quality of life. The ability to navigate their surroundings, recognize faces, and handle currency independently promotes a sense of autonomy, allowing visually impaired individuals to engage more fully in social, professional, and personal activities. While the current implementation meets its primary objectives, the project also lays the groundwork for future improvements and expansions, offering exciting possibilities for further development in the field of assistive technology.

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