

Real-Time Multimodal Assistive Technology for Navigation, Social Interaction, and Financial Management in Visually Impaired Individuals

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ABSTRACT: Navigating daily life is often very challenging for blind and visually impaired individuals. Simple tasks like avoiding obstacles, recognizing familiar faces, and handling money can become difficult, which can make them depend more on others and affect their confidence. To overcome these challenges, this project proposes an AI-based system that aims to improve independence and safety for visually impaired users. The system combines important features such as face detection, obstacle detection, and currency recognition into one compact solution. Overall, this system is designed to be affordable, efficient, and practical. It helps users become more independent, feel safer, and gain confidence in their daily lives. At the same time, it supports better social inclusion and opens the door for future advancements in assistive technology. This innovation can play an important role in making the world more accessible and improving the quality of life for visually impaired individuals.

I. INTROUCTION

Blindness and visual impairment make daily life difficult in many ways. Simple activities like walking safely, recognizing people, or handling money become challenging without vision. Because of this, visually impaired individuals often have to depend on others, which can reduce their confidence and limit their independence. Even though tools like white canes and guide dogs are useful, they only help to a certain extent. They mainly support movement but do not give detailed information about the surroundings. Nowadays, technologies like artificial intelligence and computer vision are developing very fast, creating new opportunities to build advanced assistive systems. These technologies can understand images, identify objects, and recognize patterns, which can be very helpful for visually impaired users. An AI-based system can combine features like obstacle detection, face recognition, and currency identification into one device.

OBJECTIVES OF THIS WORK INCLUDE:

The main aim of this work is to create a real-time assistive system that helps visually impaired people live more independently and safely. This system is designed to support easy movement by detecting obstacles and guiding users while they walk. It also helps in social situations by recognizing people around them and giving useful information. In addition, the system assists in handling money by identifying different currency notes correctly. By combining technologies like AI, cameras, and sensors, it provides quick feedback through voice or vibration. Overall, the goal is to make daily activities easier, improve confidence, and reduce dependence on others.

II. RELATED WORK**2.1: Automatic Object Detection Algorithm-Based Braille Image Generation System for The Recognition Of Real-Life Obstacles For Visually Impaired People**

Lee,Dayeon.,et.al.,[1] This study introduces a system that helps visu detecting obstacles and converting the information into braille images. It uses object detection to identify things like vehicles, poles, and people, and then provides the output in a form that can be read through touch. The system works in real time, giving immediate feedback to help users move safely.The main aim is to improve independence and reduce the need for traditional tools like white canes. Although there are some challenges like lighting issues and object blocking, the system shows good performance. Overall, it helps users navigate more confidently and supports better accessibility.

2.2: Smart Assistive System For Visually Impaired People Obstruction Avoidance Through Object Detection And Classification

Massud,Usman.,et.al.,[2] This study presents a system uses computer vision and machine learning to detect and classify different types of obstacles such as pedestrians, vehicles, and other objects. It provides voice alerts to inform the user about these obstacles, helping them avoid accidents while walking.The system works in real time and can handle different environments, even crowded or changing situations. It can also give information about the position and distance of objects, which makes navigation easier. The design focuses on accuracy and fast processing so that users get quick and reliable feedback.Overall, this system helps improve confidence and independence for visually impaired individuals.

2.3: A Wearable Assistive Device For Blind Pedestrians Using Real-Time Object Detection And Tactile Presentation

Shen,Junjie.,et.al.,[3] This paper team has developed a wearable assistive device to help visually impaired people navigate safely. The system detects obstacles like vehicles, objects, and uneven surfaces using object detection techniques. It then provides feedback through touch using a wearable interface, helping users understand the direction and distance of obstacles. The device works in real time, which allows users to react quickly and avoid collisions. It is designed to be comfortable and easy to use in daily life. Overall, this system improves safety, navigation speed, and independence.

2.4: Cnn-Based Object Recognition and Tracking System To Assist Visually Impaired People

Ashiq,Fahad.,et.al.,[4] This paper provides system based on CNN for object recognition and tracking. It can detect different types of objects such as pedestrians, vehicles, and other obstacles with high accuracy. The system also tracks moving objects and provides continuous updates through audio feedback. It works well in dynamic environments and helps users avoid accidents. The system is designed to be fast and efficient, making it suitable for real-time use. Overall, it improves mobility, confidence, and independence.

2.5: Assistive System For The Blind With Voice Output Based On Optical Character Recognition

Dhinakaran,D.,et.al.,[5] This paper provides an assistive system that uses Optical Character Recognition (OCR) to read printed text and convert it into speech. The system captures images of text using a camera and processes them to identify words and sentences. It then provides voice output so that users can understand the content easily. It works in real time and can handle different types of documents. This system helps visually impaired people read independently and improves their access to information.

2.6: Assist: Evaluating The Usability And Performance Of An Indoor Navigation Assistant For Blind And Visually Impaired People

Nair,Vishnu.,et.al.,[6] This paper introduced an indoor navigation system designed for visually impaired users. The system uses sensors and mapping techniques to guide users inside buildings like offices and malls. It provides step-by-step instructions through audio feedback and alerts users about obstacles or turns. The system adapts to changes in the environment and ensures safe navigation. It is designed to be simple and user-friendly. Overall, it helps users move independently and confidently indoors.

2.7: Teleguidance-Based Remote Navigation Assistance for Visually Impaired and Blind People—Usability and User Experience

Chaudary,Bahar.,et.al[7] This paper proposes a teleguidance system where a remote person helps visually impaired users through live video and audio communication. The user shares their surroundings through a camera, and the remote guide gives instructions in real time. This system is useful in complex or unfamiliar environments where automated systems may not be enough. It improves safety, navigation speed, and confidence. The system combines human support with technology to provide better assistance.

2.8 : A Smartphone-Based Mobility Assistant Using Depth Imaging For Visually Impaired And Blind

See,Aaron.,et.al[8] This research paper developed a smartphone-based assistive system that uses depth imaging to detect obstacles. It uses the phone's camera and sensors to understand the distance and position of objects. The system provides audio feedback to guide the user safely. It works in real time and is easy to carry since it uses a smartphone. This makes it affordable and practical for everyday use. Overall, it improves safe navigation and reduces dependency on others.

2.9 : Opportunities For Human-Ai Collaboration In Remote Sighted Assistance

Lee,Sooyeon.,et.al[9] This paper introduces how human support and AI can be combined in assistive systems. AI helps by detecting obstacles and giving basic information, while a human guide provides detailed instructions. This combination improves accuracy and reduces errors. It also increases user trust and confidence. The study shows that working together, AI and humans can provide better assistance than using only one method.

2.10 : Tools And Technologies For Blind And Visually Impaired Navigation Support: A Review

Kuriakose,Bineeth.,et.al[10] This paper has reviewed different technologies used for assisting visually impaired people. They discussed traditional tools like white canes and guide dogs, as well as modern AI-based systems. The study highlights the advantages and limitations of each method. It also shows that combining different technologies, such as audio and touch feedback, can improve user experience. Overall, the review provides useful ideas for developing better assistive systems in the future.

III. EXITING SYSTEM

Blind and visually impaired people still face many difficulties in their daily lives, such as recognizing people, avoiding obstacles, and handling money. Most of the assistive systems available today are limited because they focus on only one function, like detecting objects or identifying currency. Traditional tools like white canes and guide dogs help with basic movement, but they do not give detailed information about the surroundings. For example, they cannot detect moving objects, recognize faces, or tell the difference between people, which are important for safe and independent living. Because of this, visually impaired individuals often have to depend on others, which affects their confidence and independence.

At the same time, many modern mobile apps and digital tools also have problems. Most of them need an internet connection to work, so they are not useful in places without network access. They may also give inaccurate results, work slowly, or fail in crowded or changing environments. Another issue is that these tools do not combine all features in one system. Users often need to use different apps or devices for tasks like obstacle detection, face recognition, and currency identification, making the process complicated and time-consuming. In addition, advanced assistive technologies are often expensive, which makes them difficult for many people to afford.

3.1.1 DISADVANTAGES :

- Existing tools are not integrated, so users need multiple devices.
- Most systems do not work well in changing environments.
- Object and face detection accuracy is low.
- Slow processing causes delays in feedback.
- Users still depend on others for daily tasks.

IV. PROPOSED SYSTEM

The proposed system is an advanced AI-based assistive solution developed to improve the independence, safety, and confidence of visually impaired individuals. Unlike traditional methods, this system combines important features such as obstacle detection, face recognition, and currency identification into a single compact and easy-to-use device. The system uses the YOLO algorithm to detect obstacles and guide the user safely, the Grassmann algorithm to recognize familiar people, and a CNN model to identify different currency notes. Based on the processed information, the system provides clear voice instructions to help the user understand their environment, interact with others, and manage daily tasks without depending on others. All these functions work together at the same time, giving quick and accurate feedback through an audio output system, making the device highly useful in real-life situations.

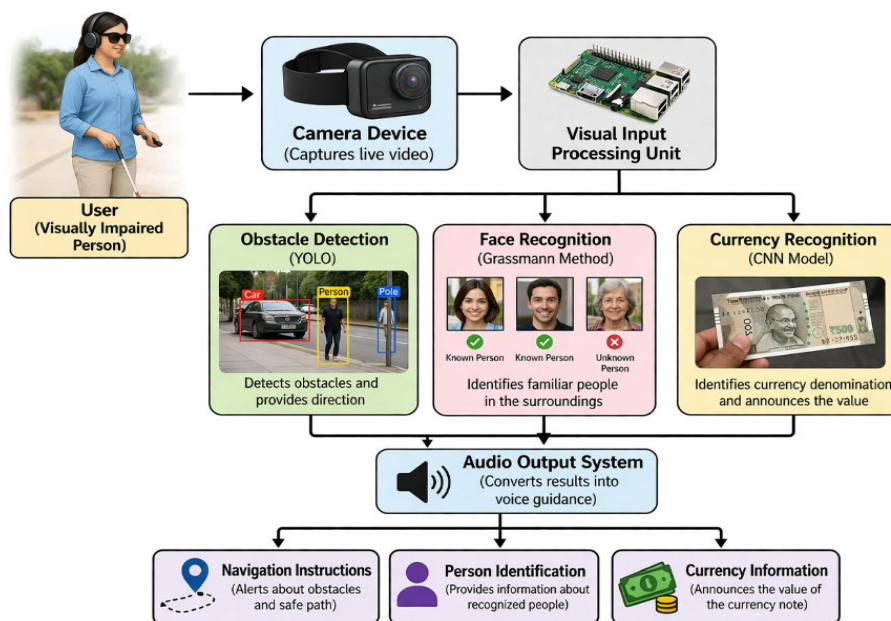
4.1.1 ADVANTAGES :

- Gives real-time audio guidance.
- Combines multiple features in one device.
- Provides better accuracy and faster performance.
- Improves independence of users.
- Affordable and easy to use.

V. SYSTEM ARCHITECTURE

The system architecture of the proposed AI-based assistive device is designed as a combination of both hardware and software components that work together to provide real-time support for visually impaired individuals. The system starts with a camera that continuously captures images of the surroundings. These images are then sent to a processing unit, such as a microcontroller or an embedded system, where different intelligent algorithms are applied. The system uses the YOLO algorithm to detect obstacles, the Grassmann algorithm to recognize familiar faces, and a CNN model to identify different currency notes. After processing, the information is converted into audio signals through a voice output module, so the user can understand the surroundings easily. Additional components like the power supply, memory, and communication interfaces help the system function smoothly and make it easy to carry and use.

VI. BLOCK DIAGRAM



VII. CONCLUSION

The AI-based assistive system for visually impaired people is a useful and innovative solution that improves accessibility. It uses technologies like object detection, face recognition, and currency identification to help users understand their surroundings. This system provides real-time support, allowing users to walk safely, recognize people, and handle money without depending on others. Unlike traditional tools such as white canes or guide dogs, this system is more advanced and can handle multiple tasks at the same time. The audio feedback feature makes it easy to use by converting visual information into sound, helping users make decisions confidently.

This project shows how artificial intelligence can be used to make life easier and more independent for visually impaired individuals. It also promotes inclusion and equal opportunities. The system is affordable, easy to expand, and can be improved in the future by adding features like GPS navigation or better learning methods. Overall, it is a strong step toward developing smarter and more helpful assistive technologies.

VIII. FUTURE WORK

The system is designed in a flexible way, so it can be improved in the future. Features like GPS can be added to help with outdoor navigation, and cloud technology can improve accuracy over time. This project creates a strong base for developing better assistive technologies. In the future, the system will become smarter and easier to use with advanced AI. It will understand surroundings better and allow natural voice interaction. Navigation will improve with the help of smart city systems and IoT, providing guidance both indoors and outdoors.

Wearable devices like smart glasses and AI earbuds will become lighter, more comfortable, and suitable for daily use. The system will also improve social interaction by recognizing emotions and gestures, helping users communicate confidently. Security features for money-related tasks will become stronger with voice authentication and fraud detection. The system may also work without the internet using edge computing, making it faster and reliable in all areas. It will support multiple languages and adjust according to user needs. Future systems may also include health monitoring and emergency support for better safety. Overall, these improvements will make the system more useful, affordable, and helpful in increasing independence and quality of life for visually impaired people.

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