SmartVision: Augmented Reality Glasses for Assisting the Visually Impaired in Real-Time Navigation and Object Detection

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ABSTRACT

This paper introduces "SmartVision," a wearable augmented reality (AR) system designed to assist visually impaired individuals in daily navigation and object recognition. The device uses a combination of real-time image processing, voice feedback, and environmental sensing to offer audio-based guidance. The system integrates AR smart glasses with an onboard camera and AI engine that can detect obstacles, recognize faces, read signboards, and provide turn-by-turn navigation indoors and outdoors. The key innovation lies in the simplicity of the user interface and its ability to function hands-free, making it a practical assistive device. With rapid advancements in edge computing and wearable technology, SmartVision aims to bring digital sight and spatial awareness to those with limited or no vision. Real-world testing demonstrates that the system can significantly enhance independence, safety, and confidence. The project was designed with affordability and accessibility in mind, using low-cost AR hardware and open-source tools to ensure widespread adoption. This paper discusses the design, architecture, components, and implementation of SmartVision, including the results of a pilot study conducted with visually impaired participants. The feedback and performance metrics collected indicate a high level of usability, satisfaction, and accuracy in object detection and path guidance. The study concludes that SmartVision could serve as a revolutionary aid in assistive technology, bridging the gap between disability and independence.

Keyword: Augmented Reality, Assistive Technology, Object Detection, Visually Impaired Navigation

1. INTRODUCTION

SmartVision is built to solve one of the major issues faced by visually impaired individuals: independent navigation. This system incorporates augmented reality with assistive technology to offer live feedback and enhance the real-world experience through audio instructions. As per Kong, the density of obstacles in urban environments increases navigation difficulty [3]. It is reported that smart assistance improves mobility confidence [2].

1.1 Challenges in Assistive Navigation

Blind and visually impaired individuals encounter dynamic and static obstacles in real-world navigation. Conventional aids like white canes provide only partial assistance. SmartVision addresses these limitations by integrating AI-based detection with AR feedback, allowing users to receive voice-based alerts in real-time.

1.2 Augmented Reality in Accessibility

AR technology has immense potential in accessibility tools. SmartVision employs lightweight AR glasses with embedded cameras and microphones. It enhances environmental understanding by translating visual inputs into speech, thus aiding in safe movement through complex surroundings.

2. SYSTEM DESIGN AND IMPLEMENTATION

SmartVision is composed of four major components: AR Glasses, Object Detection AI, Voice Output Interface, and Navigation Assistant. This section details each component and how they integrate to create a seamless user experience.

Chart -1: System Architecture

The system consists of sensors feeding real-time data to a mini processor that interprets it and sends commands to the speaker module for user guidance.

Fig -1: Hardware Setup

The figure shows the AR glasses connected to a Raspberry Pi Zero with camera module and Bluetooth speaker integrated into the frame.

2.1 Voice Feedback and Alerts

SmartVision provides timely voice alerts such as ‘Obstacle Ahead’, ‘Turn Left’, and ‘Person Recognized’. This is achieved using a pretrained YOLO model and Google Text-to-Speech engine.

2.2 Navigation in Urban Environments

The system uses GPS and Google Maps API to deliver turn-by-turn navigation. In indoor scenarios, SmartVision relies on Bluetooth beacons.

3. TESTING AND RESULTS

Tests were conducted with a group of 10 visually impaired participants. Each was tasked to navigate through a controlled indoor and outdoor setting. Metrics such as obstacle detection rate and average completion time were measured.

Chart -2: User Testing Performance

3.1 Feedback and Evaluation

Most participants reported improved confidence and mobility. Users were especially satisfied with the voice feedback accuracy and detection reliability.

Fig -2: User Navigation Path

The image demonstrates a side-by-side path of a blindfolded subject with and without SmartVision assistance.

4. CONCLUSIONS

SmartVision demonstrates a highly effective use of augmented reality in assistive technology. The seamless integration of object detection and navigation tools helps visually impaired individuals navigate safely. This system proves to be affordable, accessible, and impactful.

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6. REFERENCES

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