EC463 Senior Design Project Proposal: Smart Assistive System for the Visually Impaired

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Introduction

In an effort to enhance the independence and quality of life for visually impaired individuals, our team proposes the development of an innovative smart assistive system. This system comprises two key components: a smart glove and a smart cap. By combining cutting-edge technologies such as infrared sensing, haptic feedback, computer vision, and artificial intelligence, our project aims to provide a comprehensive solution for spatial awareness and environmental interaction.

Project Overview

The smart assistive system consists of two main components:

- Smart glove equipped with infrared sensors for proximity detection
- Smart cap featuring an integrated camera for real-time environmental scanning

Smart Glove Details

The smart glove will be designed to augment the user's sense of touch and spatial awareness. The smart glove will ideally replace conventional white canes as a hands-free alternative.

Key features include:

- Infrared Sensors: Strategically placed sensors will detect features of the ground.
- Haptic Feedback: Vibration motors embedded in the fingertips and palm will convey proximity information through varying intensities and patterns.
- Microcontroller: A low-power, compact microcontroller will process sensor data and control haptic outputs.
- Ergonomic Design: The glove will be crafted from breathable, flexible materials to ensure comfort during extended use.

Smart Cap Details

The smart cap will serve as the system's "eyes," providing crucial visual information to the user.

Key features include:

- High-Resolution Camera: A wide-angle camera capable of capturing the user's field of view in various lighting conditions.
- Embedded Computer: A powerful, energy-efficient single-board computer (e.g., Raspberry Pi) for real-time image processing and AI inference.
- Computer Vision Algorithms: Custom-trained models for detecting and classifying objects and reading text.
- Audio Feedback: Speakers integrated into the cap's structure for discreet audio cues without obstructing environmental sounds.

- Gesture Detection: Allows users to fine tune the behavior of the smart assistive system for different situations (environment navigation, reading text, etc).

Technical Challenges and Solutions

- Power Management: Optimizing battery life through efficient coding and low-power components.
- Real-time Processing: Utilizing edge computing techniques to minimize latency in object detection and feedback.
- Accuracy in Varied Environments: Developing robust algorithms that perform well in diverse lighting and weather conditions.
- User Interface: Creating an intuitive, non-visual interface for system control and customization.

Societal Impact

This smart assistive system has the potential to significantly improve the lives of visually impaired individuals by:

- Enhancing independence in daily activities through an innovative hands-free alternative
- Improving safety in navigation and obstacle avoidance
- Increasing access to written information in the environment

Final Deliverables

- Functional Prototype: One system of a smart glove and a smart cap
- Software Package: Embedded software for the glove and cap's microcontroller
- Technical Documentation: Detailed system architecture and component specifications
- Project Report: Comprehensive documentation of the design process
- Presentation Materials: Project demonstration video
- Future Development Roadmap: Suggestions for further enhancements and features

Conclusion

The Smart Assistive System for the visually impaired represents a significant step forward in assistive technology. By combining advanced sensing technologies with intuitive feedback mechanisms, this project aims to create a practical, user-friendly solution that can make a real difference in the lives of visually impaired individuals. Our team is committed to delivering a high-quality prototype that demonstrates the potential of this innovative approach to assistive technology.