ENVIRONMENT DETECTION FOR BLIND PERSON

Project Code

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Table of Contents

1. Abstract 3
2. Background and Justification 3
3. Project Methodology 3
4. Project Scope 4
5. High level Project Plan 5
6. References 5

1. Abstract

Visually impaired individuals face significant challenges in perceiving their surroundings, especially in outdoor environments where objects are constantly changing and moving. An object detection system can greatly assist visually impaired individuals in avoiding obstacles they encounter in their daily lives. The aim of this system is to provide a simple, user-friendly, portable, cost-effective, and efficient solution for visually impaired users.The objective of the proposed system is to detect objects in real time using a smartphone camera as the input device and to communicate the detected information to the user through audio feedback via headphones.This solution will enable visually impaired individuals to navigate safely and confidently in outdoor environments, thereby reducing accidents and promoting independence.

2. Background and Justification

According to the World Health Organization [1], around 2.2 billion people worldwide experience some level of vision impairment. This growing figure underscores the global need for assistive technologies that enhance safe and independent navigation. While traditional aids such as the white cane and guide dogs help detect nearby obstacles, they provide limited environmental awareness and cannot identify objects beyond close range [2].

To address these challenges, various Electronic Travel Aids (ETAs) such as SmartCane, UltraCane, and WeWALK have been developed, employing ultrasonic sensors to detect obstacles and provide vibration feedback [3][4]. Likewise, wearable devices like the Sunu Band and BuzzClip offer haptic feedback for nearby objects, while AI-powered visual aids such as OrCam MyEye and Envision Glasses use cameras and artificial intelligence to deliver real-time auditory descriptions of the surroundings [6]. These innovations have greatly improved the mobility and independence of visually impaired individuals.

Despite these advancements, existing solutions continue to face notable limitations. Ultrasonic and haptic devices often struggle to distinguish between different types of obstacles [5]. Meanwhile, AI-powered smart glasses and wearable systems, though effective, remain expensive, bulky, and inaccessible to many users [6]. Therefore, there is a critical need for a cost-effective, portable, and real-time solution that utilizes a smartphone camera to detect obstacles and provide immediate audio feedback—offering a more practical and affordable navigation aid for visually impaired individuals.

3. Project Methodology

Phase 1: Requirement Analysis & Planning

Identify user needs and define system requirements, including real-time object detection, audio feedback through Text-to-Speech (TTS), high accuracy, and low latency. Finalize the project scope, timeline, and plan for iterative development.

Phase 2: System Design

Design the system architecture and select technologies such as Android, TensorFlow Lite, and computer vision models. Develop an initial prototype with core modules — camera control, object detection, and audio output — and refine it through multiple iterations.

Phase 3: Testing & Improvement

Test each iteration to evaluate system performance, accuracy, and usability. Incorporate user feedback to improve system functionality, interface design, and reliability in subsequent versions.

Phase 4: Finalization & Deployment

Combine all refined components into the final version of the application. Package the software for deployment and prepare necessary documentation. Future iterations may include updates and performance enhancements.

4. Project Scope

Included:

- Real-time object detection using smartphone camera
- Image preprocessing (resizing, normalization, noise reduction)
- Audio feedback generation using offline Text-to-Speech (TTS)
- Direction identification (Left, Center, Right)
- Continuous real-time operation
- Simple and accessible mobile interface

Not Included:

- Distance estimation between user and objects
- Object size measurement
- Navigation or path planning features
- IoT or external hardware integration
- Facial recognition or text reading (OCR)

5. High Level Project Plan

- CP1

Phase	Activities	Duration
Phase 1: Project Proposal	Topic selection, background study, and proposal submission	4 weeks
Phase 2: SRS Development	Requirements gathering, use cases, and system design	4 weeks
Phase 3: Prototype Design	UI/UX mockups and architecture planning	4 weeks
Phase 4: Final Documentation	Prepare and submit final documentation	4 weeks

- CP2

Phase	Task Description	Duration
Phase 1: Development Setup	Environment setup and dataset preparation	3 weeks
Phase 2: Model Development	Train and fine-tune Term AI model	3 weeks
Phase 3: System Integration	Integrate camera, model, and TTS module	3 weeks
Phase 4: Testing & Optimization	System testing, bug fixing, performance tuning	3 weeks
Phase 5: Finalization & Presentation	Documentation, report, and final viva	5 weeks

6. References

[1] World Health Organization, "World report on Blindness and vision impairment," Aug. 10, 2023. Available: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

[2] “Guide Dogs vs. White Canes: The Comprehensive Comparison,” CloverNook, Sept. 18, 2020. Available: https://clovernook.org/2020/09/18/guide-dogs-vs-white-canes-the-comprehensive-comparison/

[3] A. Tesfaye, “Enhancing Mobility and Safety: A Smart Walking Cane for Visually Impaired Individuals with Ultrasonic Sensor, Infrared, and GSM Module,” Journal of Computational Science and Data Analytics, 2024. Available: https://journal.aastu.edu.et

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[5] “Hybrid Approach Using Ultrasonic and Vision-Based Detection for Obstacle Recognition,” International Journal of Engineering and Advanced Technology (IJEAT), vol. 8, no. 4, 2019. Available: https://www.ijeat.org

[6] “Efficacy and Patients’ Satisfaction with the ORCAM MyEye Device Among Visually Impaired People: A Multicenter Study,” *PubMed*, 2024 . Available: https://pubmed.ncbi.nlm.nih.gov/36645535/