RV College of Engineering

Experiential Learning Report

Project-Based Learning

2024-25

Smart glasses for Visually Impaired

Student(s)

USN	Name
RVCE24BCI101	Arya Wadhwa
RVCE24BCI	Bahuleya Mahesh
RVCE24BME013	Devansh Mathur
RVCE24BBT012	Shivani Srinivasan

Mentor

Name, Designation & Department
Ashwin Thammaiah, Assistant Professor , Civil Department

1. Executive Summary

This project aims to develop smart glasses tailored for visually impaired individuals, providing features such as object detection, navigation assistance, and voice guidance. By leveraging advanced technology and user-centered design, these glasses seek to enhance independence and quality of life. The project includes thorough research, prototyping, and collaboration with experts to create a cost-effective and impactful solution.

2. Introduction

- **Background:** Over 285 million people worldwide live with visual impairments, often facing challenges in mobility and daily activities. Existing assistive technologies lack precision, have limited functionality, and are often expensive.
- **Rationale:** There is a critical need for an affordable, versatile device to assist visually impaired individuals.
- **Objectives:**
    - Develop smart glasses with enhanced accuracy and object detection range.
    - Create a user-friendly navigation system with real-time feedback.
    - Integrate advanced yet cost-effective technology.

3. Project Description

- **3.1 Problem Statement**

Visually impaired individuals face difficulties in recognizing objects, navigating unfamiliar environments, and avoiding obstacles. Current solutions are either expensive or insufficiently effective.

- **3.2 Project Scope**

The project focuses on designing and developing a functional prototype of smart glasses with object detection, obstacle avoidance, and voice feedback systems. It excludes the development of medical-grade visual aids or full-scale commercial distribution.

- **3.3 Features and Functionalities**
    - Object detection with real-time audio feedback.
    - Navigation assistance using GPS and proximity sensors.
    - Obstacle avoidance with haptic alerts.
    - Compact, lightweight design for everyday use.

4. Methodology

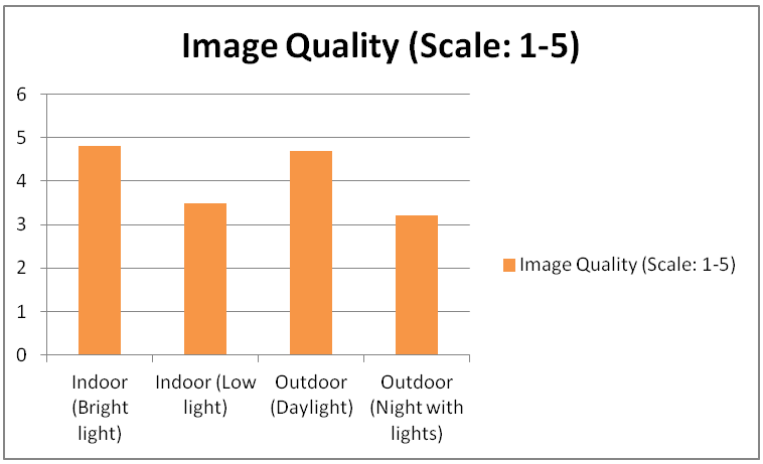
- **4.1 Research and Development**

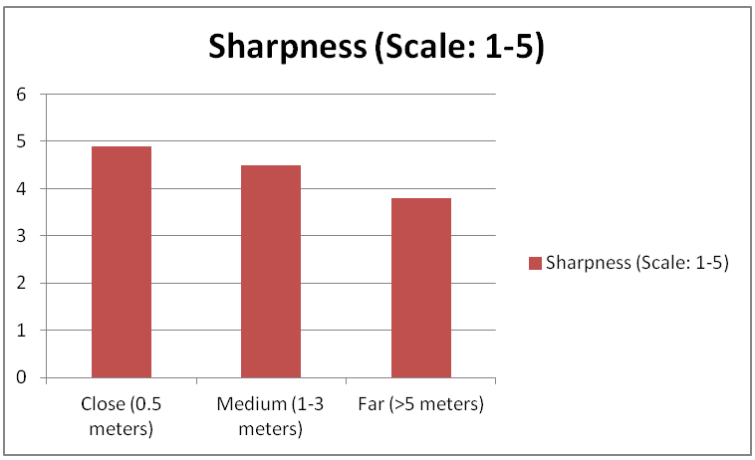
Conducted surveys and interviews with visually impaired individuals to understand their needs. Reviewed existing assistive technologies to identify gaps.

- **4.2 Design and Implementation**
    - Hardware: Includes microcontrollers, and lightweight frames.
    - Software: Developed algorithms for object detection and pathfinding.

- **4.3 Testing and Validation**

Testing is planned with a sample group of visually impaired users. Key metrics include image clarity and image recognition.





5. Resources and Materials

- **Components:**
    - **Raspberry Pi Microprocessor**: Serves as the core processing unit for running AI models.
    - **Raspberry Pi Camera**: Captures real-time images for object detection and processing.

    - **Lithium-ion Battery and battery controller**: Powers the device, enabling portability and prolonged use.
    - 3D-printed frames for prototypes.
- **Software Tools:**
    - Python for programming.
    - OpenCV for image processing.
    - ROS (Robot Operating System) for navigation.

6. Project Timeline

Phase 1 Evaluation (26th October 2024)

- Presentation, feedback, and roadmap creation.

Research & Market Analysis (November 2024)

- Analyzed market demand, user preferences, and assistive tech trends.

Component Sourcing & Assembly (November 2024)

- Sourced components, finalized budget, and initiated assembly.

Programming & Prototyping (December 2024)

- Initial sensor testing, software integration, and voice command trials.

3D Printing & Iteration (December 2024)

- Refined CAD designs, 3D printed prototypes, and tested for fit and function.

User Feedback & Funding Exploration (December 2024)

- Conducted surveys, explored funding options, and discussed next steps.

System Integration & Testing (January 2025)

- Integrated hardware/software, conducted testing, and refined algorithms.

Review & Documentation (11th January 2025)

- Consolidated test results and prepared for the next phase.

7. Budget and Financial Plan

Component	Quantity	Estimated Cost (₹)
ESP32-CAM	1	₹600 - ₹800
Ultrasonic Sensors (HC-SR04)	2	₹200 - ₹300
Mini Speaker or Buzzer	1	₹100
Vibration Motors (Coin Motors)	2	₹100 - ₹200
Battery (18650)	1	₹300 - ₹500
Battery Charger Module (TP4056)	1	₹50 - ₹100
Miscellaneous Components (Wires, etc.)	-	₹100
Software Tools	-	Free

Total Estimated Cost: ₹1,450 - ₹2,100

---

8. Challenges and Risks

- **Challenges:**
    - Ensuring real-time processing with limited hardware.
    - Designing for diverse user needs and preferences.
- **Risks:**
    - Potential hardware malfunctions.
    - User adoption hurdles due to unfamiliarity with technology.
- **Mitigation Strategies:**
    - Extensive testing and user training.
    - Modular design for easy troubleshooting.

---

9. Conclusion and Future Directions

This project demonstrates the potential of smart glasses to transform the lives of visually impaired individuals. Future efforts will focus on refining the prototype, exploring partnerships with assistive technology organizations, and preparing for commercial production.

---

10. References

"Assistive Technologies for People with Visual Impairments: Smart Glasses and Beyond"

Parmar, V., Reddy, D. C., & Kumar, S. (2020). Assistive smart glasses: Improving mobility for the visually impaired. International Journal of Engineering Research and Technology (IJERT), 9(7), 1134-1139.

"Echolocation Glasses: Enabling the Visually Impaired to Sense Their Environment" Chang, K.-W., Zeng, Y., & Lin, T.-K. (2024). Echolocation glasses: Enabling the visually impaired to sense their environment. ICAEEE

“Assistive Object Recognition System for Visually Impaired”

Zhang, L., Liu, Q., & Wang, Y. (2020). Assistive Object Recognition System for Visually Impaired. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 28(3), 756-765.

"Assistive Technologies for People with Visual Impairments: Smart Glasses and Beyond"

Pham, H.-H., Takahashi, H., & Yamamoto, T. (2021). Assistive technologies for people with visual impairments: Smart glasses and beyond. Sensors, 21(10), 1-23. https://doi.org/10.3390/s21103538
