Vision Document

1. Executive Summary

Project Overview:
This project focuses on developing a sophisticated assistive system designed to aid visually impaired individuals in supermarkets. Using computer vision models like YOLOv8 and YOLOv9, the system detects grocery items and provides real-time audio feedback to help users identify and select products. This system addresses key challenges that visually impaired shoppers face, such as difficulty in recognizing items, reading labels, or navigating aisles independently.

Goals:

- Enhance independence for visually impaired individuals in grocery shopping.
- Provide accurate and real-time grocery item detection and feedback.
- Create a user-friendly, cost-effective, and scalable solution that can be integrated into smartphones or wearable devices.

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2. Problem Statement

Current Challenges for Visually Impaired Shoppers:

- **Product Identification:** Visually impaired individuals often struggle to identify products on shelves due to the inability to read labels or distinguish between similar items.
- **Navigation:** Navigating supermarket aisles without assistance can be overwhelming, especially in large or unfamiliar stores.
- **Independence:** A lack of suitable assistive technology leads to over-reliance on others for grocery shopping.

This project seeks to resolve these challenges by employing AI-driven object detection techniques to empower visually impaired users with real-time product recognition and navigation aids.

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3. Project Scope

Inclusions:

- Development of a grocery detection system using pre-trained object detection models (YOLOv8 and YOLOv9).
- Integration of an intuitive audio interface that provides real-time feedback.
- Compatibility with smartphone and wearable devices for portability and ease of use.

Exclusions:

- This system will not focus on general indoor navigation for non-grocery environments.
- Advanced item scanning (e.g., price detection or full shopping cart management) will not be included in the initial prototype.

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4. Key Stakeholders

- **Visually Impaired Users:** The primary beneficiaries of the system, enhancing their shopping independence.

- **Supermarkets:** Retailers who can integrate this technology to make their stores more accessible.
- **Caregivers and Family Members:** Secondary stakeholders who benefit indirectly by assisting visually impaired users.
- **Assistive Technology Providers:** Potential partners for distributing or expanding the technology.

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5. System Overview

Core Features:

1. **Product Detection:**
    - Utilizes computer vision models (YOLOv8 and YOLOv9) for real-time product detection.
2. **Audio Feedback System:**
    - Converts product recognition results into real-time, understandable audio cues.
3. **Mobile Compatibility:**
    - The system will work on smartphones and wearables for portable use during grocery shopping.
4. **Voice Interface:**
    - Users can interact with the system through voice commands, offering ease of use.

Technology Stack:

- **YOLOv8/YOLOv9:** Pre-trained models for object detection.
- **Mobile Development:** Android/iOS platforms for app development.
- **Text-to-Speech Engines:** For real-time audio feedback.
- **Python/C++:** Programming languages for AI model integration and system development.

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6. Assumptions & Constraints

Assumptions:

- Users will primarily use smartphones or wearable devices in supermarkets.
- The system will function in real-world environments, handling common shopping challenges like lighting variations, cluttered shelves, and similar-looking products.

Constraints:

- **Hardware Limitations:** Devices must handle computationally intensive tasks, such as object detection, in real-time without significant battery drain.
- **Real-Time Accuracy:** The system needs to provide near-instant feedback with high accuracy to be effective.

- **Environmental Factors:** Lighting and item placement in supermarkets may affect object detection performance.

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7. Requirements

7.1 Functional Requirements

1. **Grocery Item Detection:**
    - The system should accurately detect and classify grocery items on shelves using YOLOv8 and YOLOv9 models.
2. **Real-Time Audio Feedback:**
    - Convert detected items into audible descriptions (e.g., product name and category).
3. **Voice Commands:**
    - Allow users to interact with the system through voice commands, such as “What is this item?” or “Scan this aisle.”
4. **Offline Mode:**
    - Ensure basic functionality works without an internet connection, utilizing locally stored data and pre-trained models.
5. **Emergency Assistance:**
    - Include an SOS function that can alert a caregiver or store assistant if a user requires help.

7.2 Non-Functional Requirements

1. **Performance:**
    - The system should provide feedback within 1-2 seconds of detecting an item to ensure smooth user experience.
2. **Scalability:**
    - The system should be scalable to detect a wide variety of grocery items in different stores.
3. **Security:**
    - Ensure that user data, such as location tracking or voice commands, are securely processed and stored, following data protection regulations.

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9. Development Milestones

1. **Research & Planning (Weeks 1-4):**
    - Research user needs and gather data on existing assistive technologies for shopping.
2. **Prototype Development (Weeks 5-10):**
    - Implement basic grocery item detection using YOLOv8 and YOLOv9.
3. **Testing & Iteration (Weeks 11-14):**
    - Conduct user testing and optimize the system based on feedback.
4. **Final Development & Launch (Weeks 15-20):**
    - Finalize product and prepare for deployment.

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10. Future Scope

1. **Indoor Navigation:**
    - Add navigation features to help users find specific aisles or sections within a supermarket.
2. **Wearable Integration:**
    - Explore the possibility of integrating the system with smart glasses or other wearable technologies for a hands-free experience.
3. **Personalization:**
    - Implement learning algorithms to recognize users' preferred products and brands, offering customized assistance.
4. **Global Rollout:**
    - Localize the system for different countries, supporting multiple languages and adapting to different store layouts.

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11. Appendix

- **Glossary:**
    - **YOLO:** “You Only Look Once” – A family of real-time object detection algorithms.
    - **TTS:** Text-to-Speech – The process of converting text data into audible speech.