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Enhancing Accessibility and Independence for the Visually Impaired: An Integrated QR Code-Based Shopping, Navigation, and Ticket Booking System

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ABSTRACT

The purpose of this project is to develop cutting-edge support systems that improve accessibility, independence and simple blinds through QR code product detection, real-time navigation systems, and voice-controlled ticket booking systems. I'm here. Founded on new language help, QR code scanning and GPS-based navigation technology, the system has established an improved shopping experience through the ability to scan product QR codes and listen to product names, brands and price information. Ta. The system also includes the "Add to Cart" feature, where users will arrange the desired elements and be aware of the total cost. This makes the shopping experience completely autonomous and knowledgeable without requesting instructions. and transit hubs. Using GPS and indoor positioning technology, the system allows visually impaired people to travel and travel with confidence in unknown areas without requesting external help. A comfortable, free booking experience is made possible by the system's ability to prevent visual interactions through text and text technology from language to text. This platform is easily accessible through the use of QR codes for product identification, ticket booking which enables straightforward purchases and independent purchases of navigation functions. These three new features will allow the target system to improve accessibility and independence from the visually impaired. A QR code-based product identification system allows for comfortable shopping, a navigation system improves travel mobility and reliability in new environments, and a ticket booking system guarantees easy access. This integrated auxiliary

technology system not only improves the

quality of life for blind users, but also contributes to the big goal of creating integrated, barrier-free public spaces through the dynamics of modern technology.

Keyword: *Assistive Technology, AI-based Navigation, Voice-Controlled Assistance, QR code identification, Speech-to-text-Speech, Voice-based Ticket Booking, Smart Shopping Assistance, Indoor and Outdoor Navigation, AI-driven User interaction, Real-Time Audio Feedback*

1. INTRODUCTION

The difficulties in public space, purchasing and planning travel for visually impaired people are large and largely underestimated. Although assistive technologies have been developed to meet these needs, most of the current systems are still violated or overly complex, affecting general independence from visually impaired users. In most situations, users still rely on external support for measures others take for granted. These difficulties not only limit independence from the visually impaired, but also lead to social exclusion, further strengthening differences in access to opportunities. Individual. The lack of integrated liquid solutions targeting various elements of life remains prominent. A system is urgently needed that not only encourages purchases and movements, but also allows individuals to manage their daily activities with confidence and independence.

This article provides pioneering solutions to improve the quality of life and autonomy of visually impaired people by adding three basic assists: QR Code Product Identification, GPS-based navigation indoor, outdoor navigation, and voice-oriented -ticket booking. Everyone can solve the underlying problems that visually impaired people claim. QR Code Product Identification removes other people having to read product information in their shopping environment, allowing users to access scanned products directly and listen to product names, brands and pricing information. The indoor and outdoor GPS-based navigation system provides user instructions for navigating public areas such as shopping centres, transportation systems, and airport terminals. Finally, the Voice Commanded ticket booking system provides users with the opportunity to book transport or event cards with voice commands alone and the need to interact visually with screens and automatic kiosks.

Integrating these technologies into systems provides a general solution to basic problems when shopping, mobility and ticketing. The system is manufactured to allow greater independence for visually impaired people. By enabling accessible purchases, more mobility and easier travel preparation, this technology could have made users more active in society and otherwise difficult or unreachable You can participate in the activities. In summary, this article can discuss not only the technical design and implementation of integrated systems, but also the potential to improve users with disabilities in daily life. The integration of these technologies to develop an integrated, barrier-free environment will be facilitated by visually impaired people to navigate public areas, make independent purchases, and easily control travel. We discuss ways to contribute to guarantee. This integrated system is an essential step in providing integrated solutions to improve the quality of visual impairment following a broader commitment to developing an integrated and accessible environment for all members of society.

2. LITERATURE REVIEW

This section examines previous studies on assistive technologies for visually impaired individuals, including AI-driven navigation, object recognition, voice-assisted systems, and automated accessibility solutions. These studies provide valuable insights into various methodologies for enhancing independence, usability, and efficiency in assistive systems.

1. AI-Based Navigation Assistance

Chen et al. [1] created an AI-based navigation system using GPS and real-time speech processing to guide visually impaired users in outdoor mobility. The system offers voice-guided instructions, allowing users to move around by themselves. But it does not support indoor navigation, restricting its use in settings such as shopping malls or transportation hubs. Our system overcomes this limitation by combining both GPS-based outdoor assistance and pre-mapped indoor mobility, providing total accessibility.

2. Object Recognition for Enhanced Mobility

Parida et al. [2] presented an object detection system using convolutional neural networks (CNNs) and OpenCV for recognizing objects in real-time for the visually impaired users. The system is efficient at detecting household items and obstructions but has difficulties in detecting variations of products within retail environments. Our system expands on this with YOLOv5-based object detection along with QR code scanning to enable users to clearly identify products, view extensive details, and be provided with real-time audio responses.

3. Voice-Based Shopping Assistance

Salman et al. [3] compared some voice-based shopping assistants for blind users, and the limitations mentioned include dependency on barcode scanning and the need for manual choice. Moreover, most current systems are not equipped with

real-time cart management. Our system, for improving the experience of users, provides a voice-based dynamic shopping interface that supports QR code scanning, virtual cart addition of products, and speech synthesis-based real-time cost updating.

4. AI-Enhanced Ticket Booking Systems

Ma et al. [4] created a voice-controlled railway ticket booking assistant that supports spoken search and ticket booking commands. In integrating speech recognition into an API-based ticket booking system, it lacks audio feedback for successful transactions, and this can cause usability problems. Our system enhances this by adding real-time voice feedback through the use of GTTS. Providing users with audible confirmations and travel information without visual reliance.

5. Blockchain for Secure Assistive Transactions

Pinheiro et al. [5] investigated blockchain technology and its use in the secure voice transactions of assistive systems. Their method uses smart contracts to authenticate transactions and deny any unauthorized changes. The system requires considerable computational resources as a result of on-chain storage of data. Our solution remedies this by following a lightweight model of authentication with REST API integration and cryptographic verification, minimizing latency and processing load.

6. Speech Recognition and NLP for Voice-Based Assistance

Khashan [6] examined the use of the NLP method (natural language processing) to improve speech recognition in assistive. We concluded that language-based systems lack contextual insights. This leads to misunderstandings about user commands. Our approach corrects this using a Taylor-made NLP model, allowing for a more accurate interpretation of the user's intentions of orientations, shops and ticket bookings.

7. QR code and AI-Based Object Identification

Verma et al. [7] Add AI-based product identification software, QR code scanning and integrated machine learning. It is efficient to access product information, but there is no real-time language version. Our system facilitates this through text-to-speech conversion (GTTS) and implementation of SQLite database memory, ensuring that users have immediate product descriptions and updates for the car.

8. AI-Based Indoor Navigation with Audio Feedback

Kim et al. [8] We proposed an indoor navigation system for visually impaired consumers, based on the route predictions of Bluetooth beacons and AI equipment. It provides accurate locations in real time, but requires pre-installed beacon hardware, which prevents magnification. Our solution avoids this with the help of path research support for data and AI equipment so that it can be adjusted in different settings without additional infrastructure.

9. Secure Voice-Based Authentication for accessibility

Fuhry et al. [9] proposed a language-based authentication framework to protect supportive interactions and discovered how important it is for role-based access control (RBAC) to prevent abuse of language transactions. Our system integrates RBAC into the ticket booking module, allowing only certified users to modify or verify reservations. In other words, transactions add security.

10. Hybrid AI and Speech Synthesis for Accessibility

Wagh et al. [10] proposed a hybrid AI framework that integrates speech synthesis, NLP, and computer vision to improve accessibility assistance. The solution maximized the accuracy of the response, which increased the delay in the linguistic response. The system is reduced by optimizing GTTS processing to ensure real-time response in real time and latency, improving the typical user experience.

3. PROPOSED WORK

Visually impaired people usually have serious challenges in their daily lives, such as shopping, learning about new public areas and organising travel plans. Existing assistive technologies allow only one of them, and are not normally seamlessly integrated or meet a wide range of user requirements. As a result, users must either use a separate system or receive external help for various activities[11]. This reduces independence and inefficiency. In this article, we propose an integrated system to simplify QR code-based product identification, GPS-based navigation and language-based ticket booking to solve these problems overall. By integrating these three core functions into a single platform, we plan to improve accessibility, independence and comfort for visually impaired people. keep. Existing product identification technologies, such as barcode readers and object detection software, are usually unrealistic, expensive, or inappropriate for a variety of retail environments. To overcome this, our systems use QR [12] code reader technology. It is widely used in retail stores and is easy to implement. By placing QR codes for the product, consumers can read the code independently and receive key product information such as audio feedback on names, brands and prices. The system also includes the

"Add to Cart" feature, allowing consumers to add many products and calculate the total price without visual participation. This gives you a completely independent shopping experience.

Mobility in public areas, especially unknown areas such as shopping centres, airports and transport stations, is one of the most important challenges for the blind. There are several navigation systems, but they are too inaccurate and are not outdoors or interiors or cumbersome to provide services. The above challenges are addressed by the system by integrating the GPS navigation outdoor and internal positioning system. GPS features provide real-time per-gymnastics exercises for outdoor mobility, while interior positioning systems such as indoor atlas provide detailed instructions along the interior. By integrating the two systems, the system allows users to trust outdoor and indoor areas, improving mobility and security. The system also provides solid-state signals to identify obstacles and prominent sights, making navigation easier and reliable. It is highly dependent on-screen machines. Current voice assistants like Siri and Alexa are not particularly useful for tickets and don't work very well with specialized systems. Therefore, our system includes a language-based ticket booking interface that allows users to book only tickets for transport or event according to voice commands. Users can select options, validate information and pay for vocals. Therefore, the entire reservation process without visual interaction is completely independent and accessible [11]. Users must switch between different devices or systems to perform related tasks. This increases confusion and cognitive stress. Our system integrates QR code-based product identification, GPS-based navigation, and language-controlled ticket booking capabilities to provide a seamless user experience. The integrated system reduces user cognitive load and can perform a variety of tasks, ranging from shopping and navigation in public spaces to travel management. By minimizing the need for multiple devices and interfaces, the system provides a more efficient and user-friendly solution for visually impaired solutions. Ultimately, the system should make visually impaired users more accessible and autonomous by providing a fully integrated platform that relates to the most important issues in everyday life. By enabling users, this solution allows for independent purchase, movement and management of autonomy, leading to increased social inclusion. Integrated design not only addresses functional issues for visually impaired users, but also serves as a model for future assistive technologies that promote independence, accessibility and social integration.

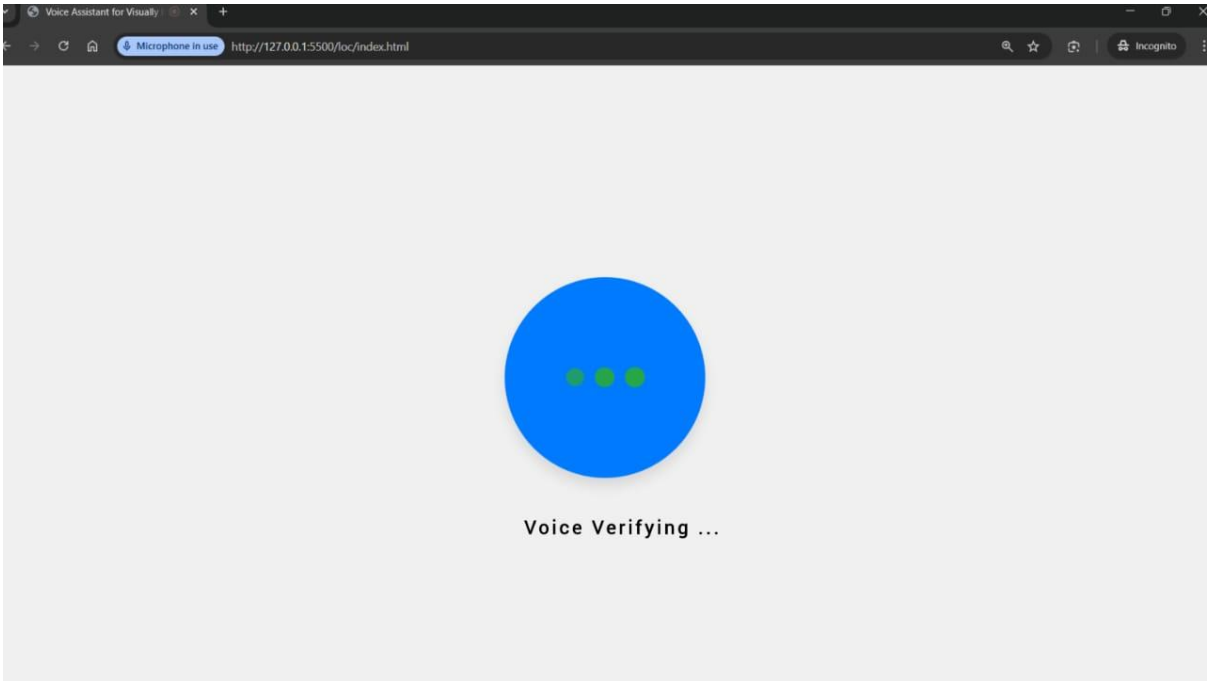

Figure 1. Landing page for verifying user's voice

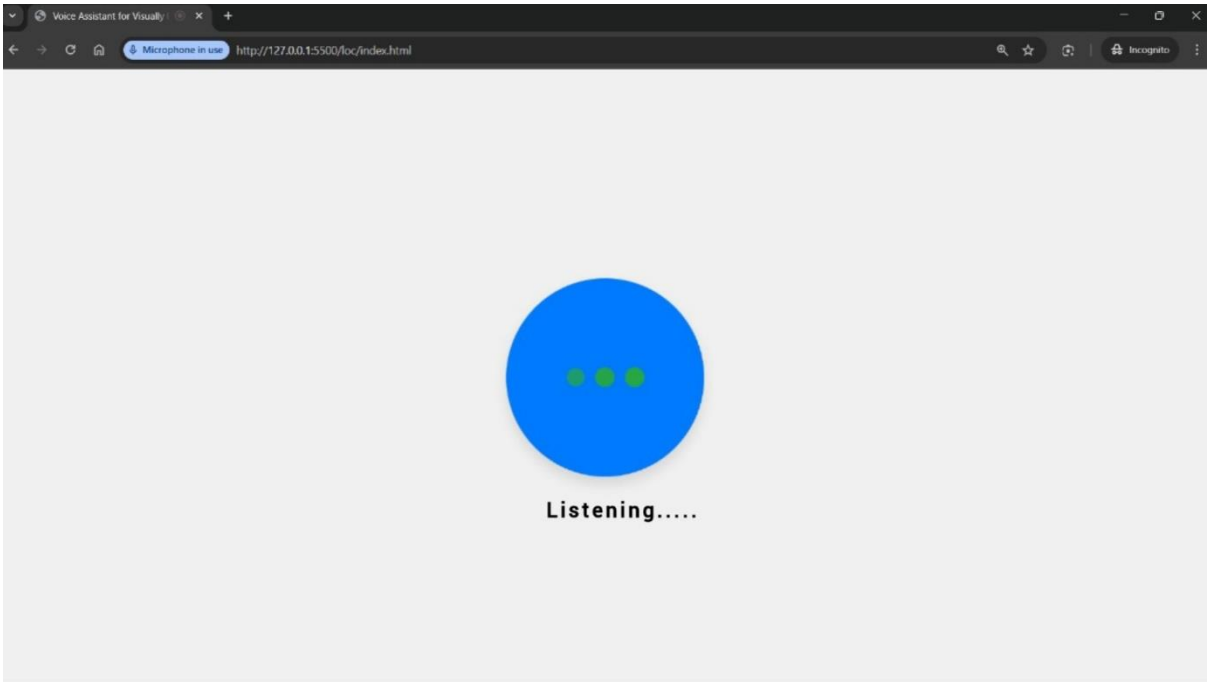

Figure 2. Landing page when voice assistant starts listening to the user

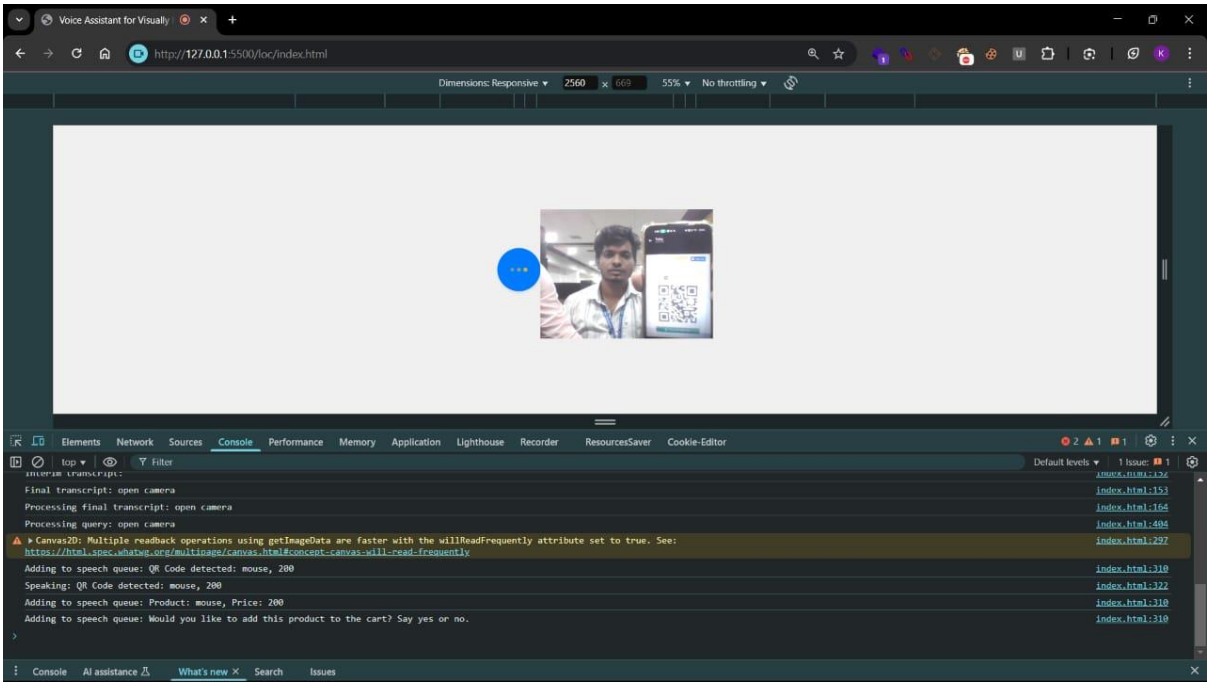

Figure 3. System response after receiving open camera command from user

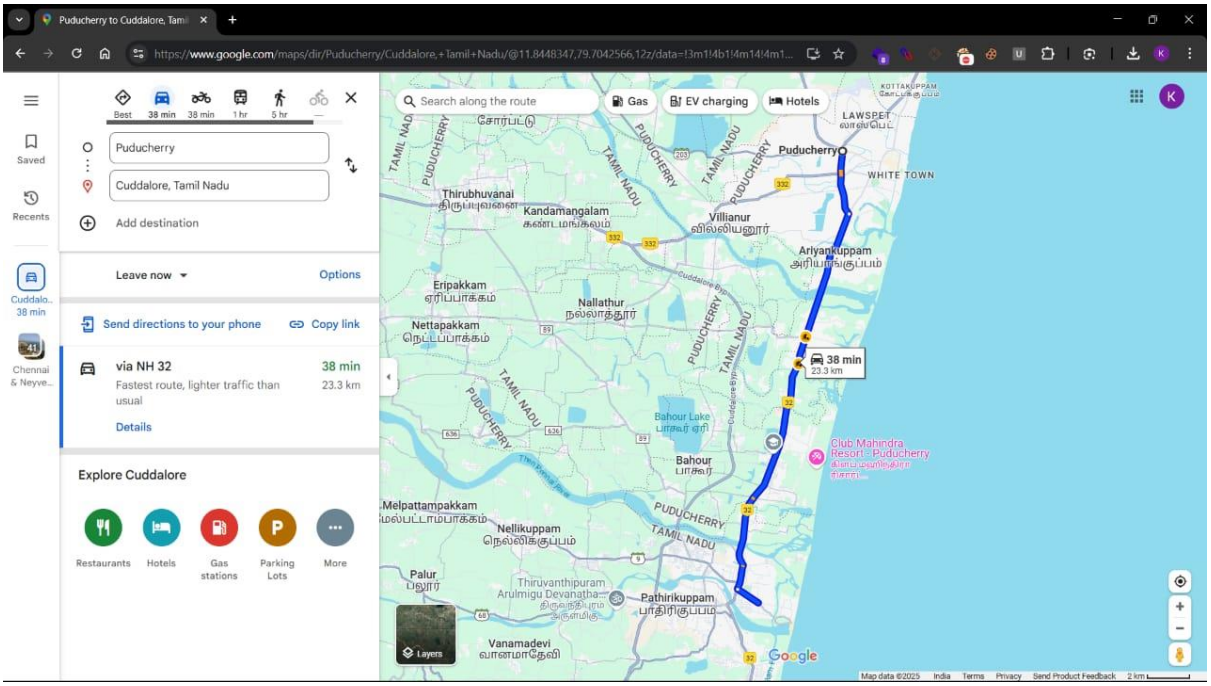

Figure 4. System response when user request for navigation guidelines

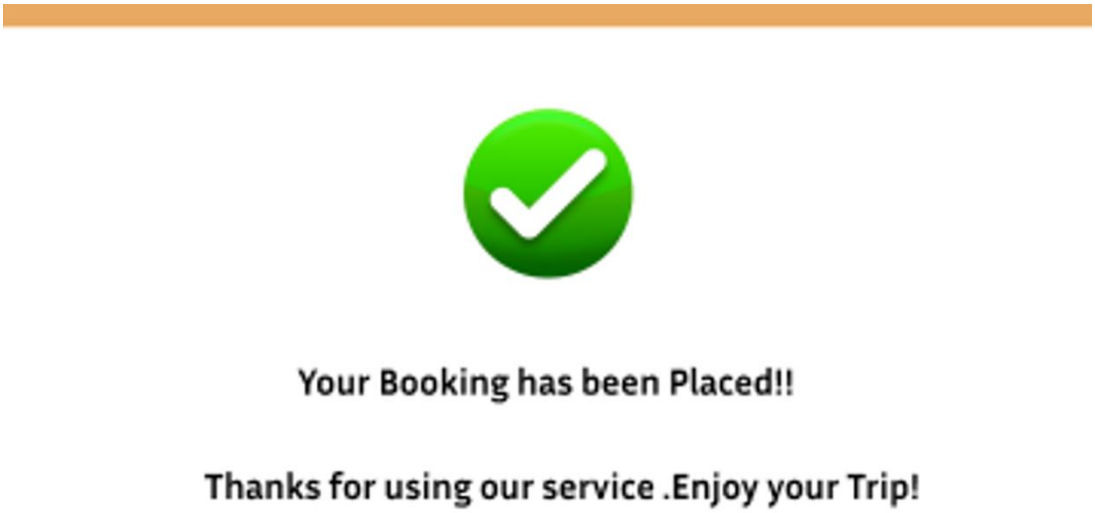

Figure 5. System response after booking the ticket with audio feedback

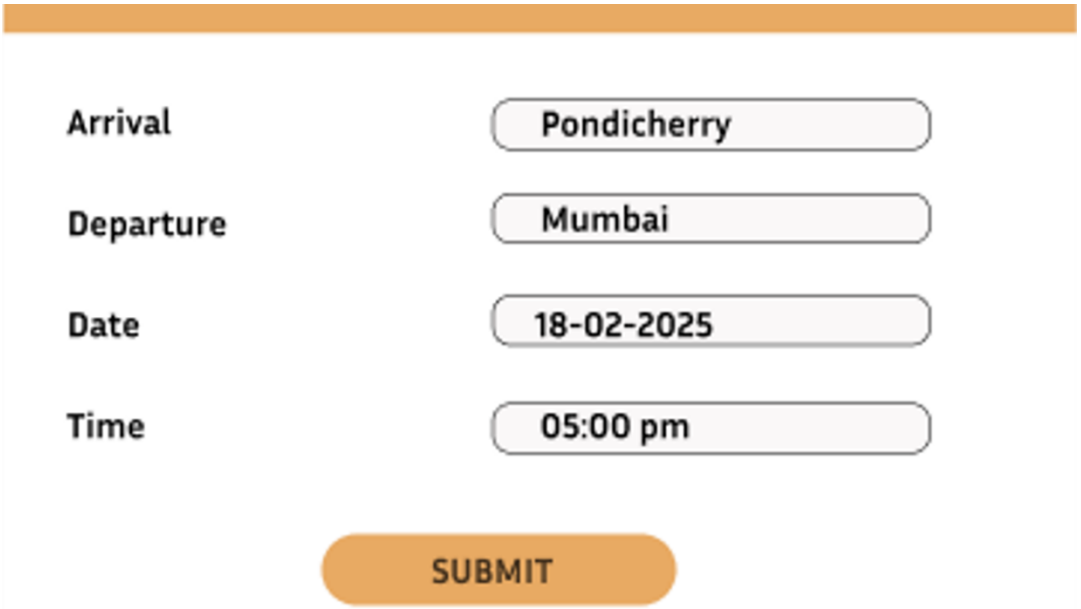

Figure 6. System collects ticket booking information through audio

4. SYSTEM OVERVIEW

The proposed system aims to overcome the difficulties of visually impaired people with daily activities such as shopping, navigation and travel booking. It combines three key elements: product identification using QR codes, GPS-based navigation, and product identification using language manipulation to provide a one-stop solution that improves accessibility, autonomy and comfort. The system architecture is based on a cloud-based backend for user management and interaction processing using a user interface on mobile or portable devices. The device is equipped with sensors such as cameras and GPS modules, allowing users to communicate with the system in certain situations through voice input, audio feedback, and other haptic feedback. QR code-based product identification system is a crown jewel of purchasing features, where users scan QR codes printed on the shop's products to provide real-time audio feedback on product details such as product name, brand, price, etc. can be obtained. . The system also provides the "Add to Cart" feature. This feature allows users to select products and monitor the total price of products without visual interaction, making shopping autonomous. In navigation, the system combines both GPS navigation and interior positioning methods. GPS uses navigation to provide real-time language navigation for road and open space routes in real-time navigation, but internal navigation uses methods such as Bluetooth Low Energy (BLE) and Wi-Fi based positioning. Navigate indoor locations using the complex. Shopping centres, shopping centres, railway stations, airports, etc. This system provides hearing with obstacles and interests to improve the security and trust level of users. The voice-controlled ticket booking system allows travel and event tickets to be booked only in languages reserved regardless of the visual interface. Users make decisions, review details, and pay in natural language. This will provide all information auditory for confirmation.

5. SYSTEM WORKFLOW

The system includes QR code-based product identification, AI control navigation, and intelligent ticket booking to improve accessibility for visually impaired people. The workflow is organized into three main modules:

1. QR Code-Based Product Recognition

Visually impaired users will use their smartphone or smartphone to read QR codes for products special scanning devices. The system reads the QR code and picks product information like the central database name, brand, price, and expiry date. The retrieved data is translated into language by the use of TTS technology (text-to-speech) to enable users to listen more about the product. Additionally, the system includes a function "Add to Car" in which users select multiple products before they make a purchase and receive an overview of the total audio-based cost.

2. AI-based navigation system

The navigation aid is initiated by the user via voice commands. The system identifies the user's location and internal location system via GPS for outdoor areas. Depending on the target entered, the optimal route is calculated, and real-time language instructions lead to the destination. The system uses AI-controlled object recognition to recognize obstacles on the route and sends users quickly via voice messages and tactile signals to improve security and autonomy.

3. Smart Ticket Reservation System

The user begins the ticket booking process by specifying a voice command. The user selects the desired option through the language test. Payments are made via QR code-based online transactions or NFC-based contactless payments. After purchase, the system will display the digital ticket as a QR code. This can be read at the transit point for simple boarding. By integrating these modules, the system provides self-stable and accessible organization of purchasing, navigation and transportation services for visually impaired consumers.

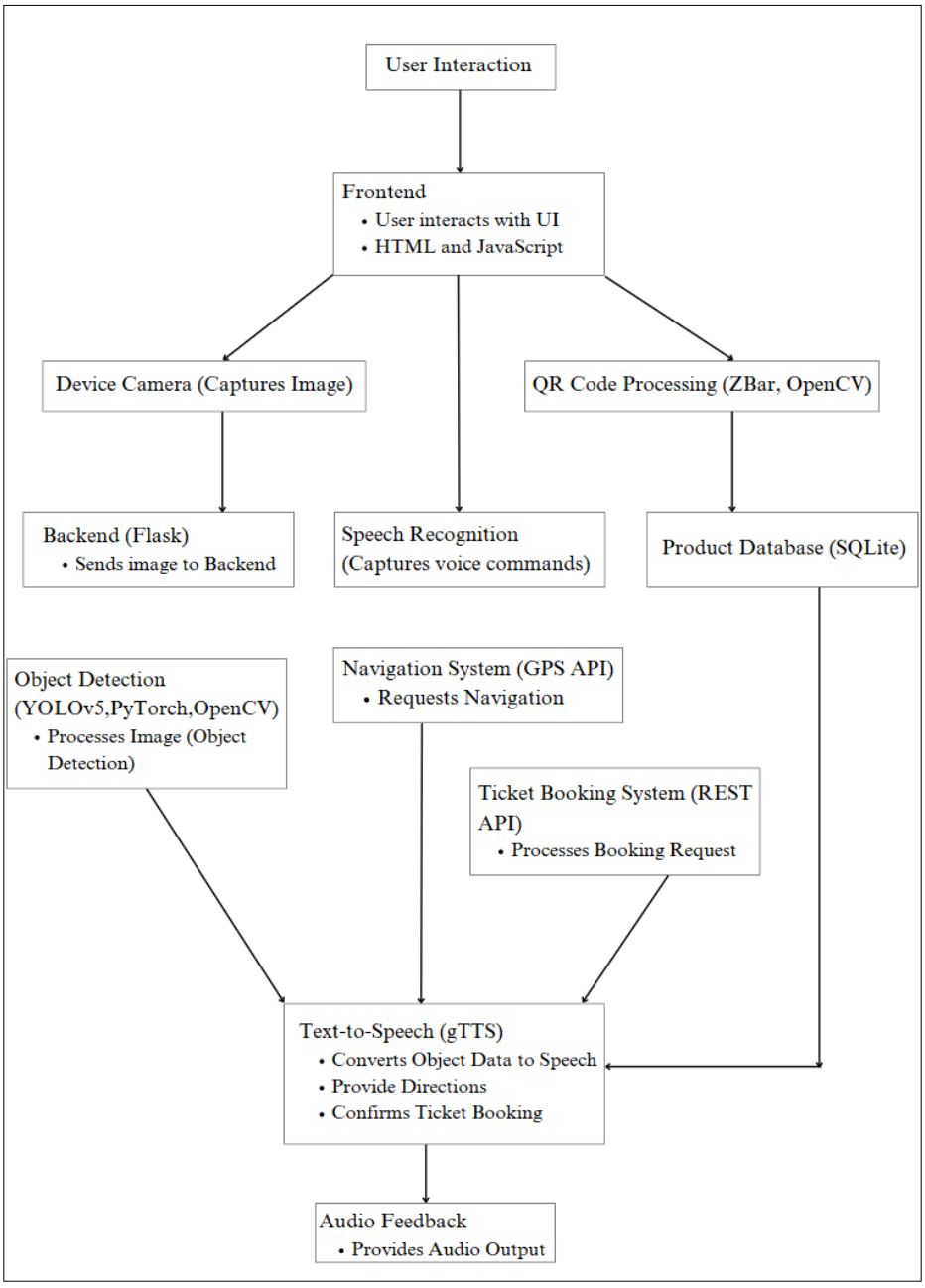

Figure 7. Workflow diagram ensures AI-driven accessibility, enabling navigation, product recognition, and voice-based ticket booking.

6. SYSTEM ARCHITECTURE

The proposed assistive system is a fully AI-driven software solution designed for visually impaired users, built using Flask as the backend. The architecture consists of

1) Frontend (HTML and JavaScript) providing an intuitive, voice-interactive interface.
2) Speech Recognition and AI processing (Speech recognition, YOLOv5, OpenCV) enabling real-time voice commands, object detection, and QR code scanning.
3) Database (SQLite) storing navigation data, product details, and booking history for quick retrieval.

4) API integrations (GPS API, REST API) handling navigation assistance and ticket booking seamlessly.
5) Text-to-Speech (gTTS) delivering real-time audio feedback, ensuring a hands-free, independent experience.

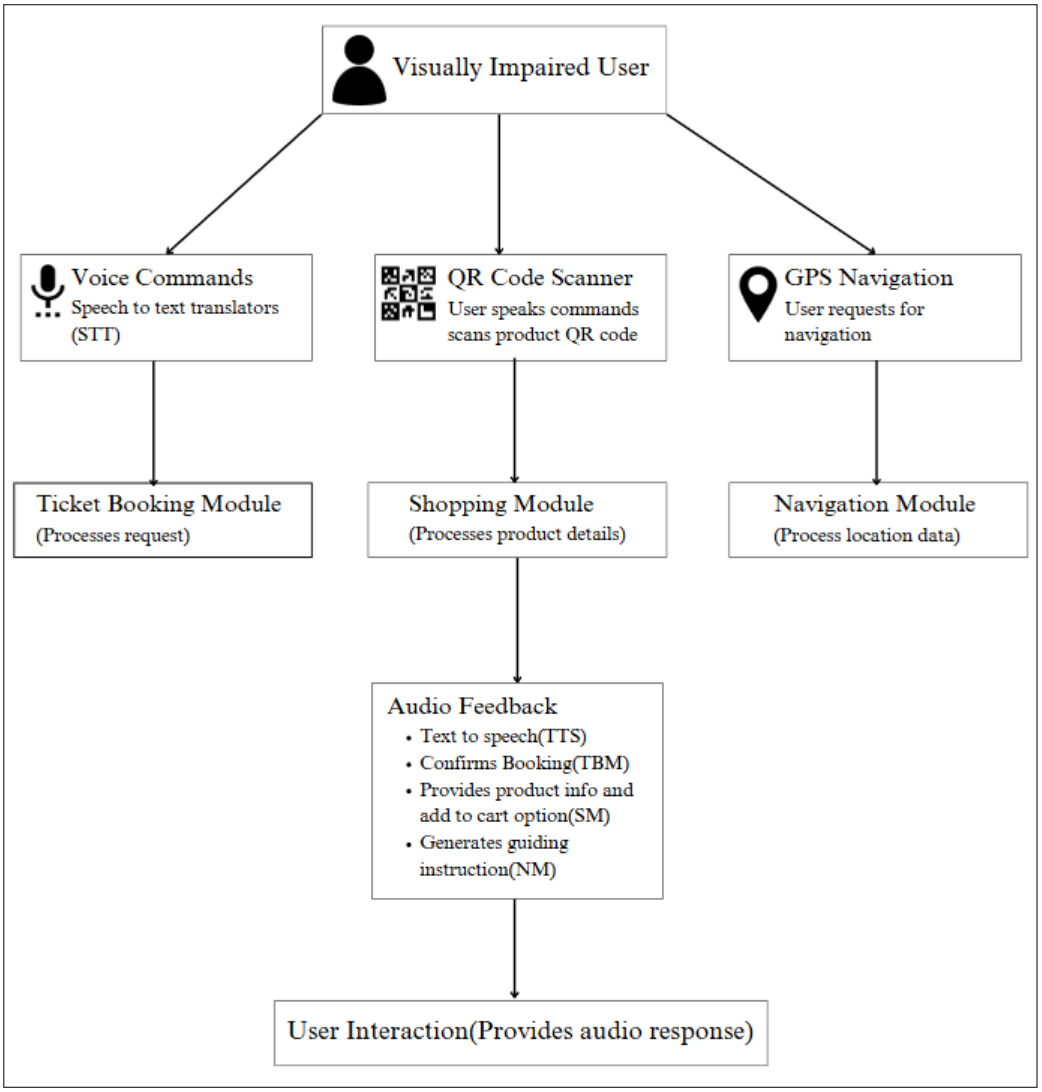

Figure 8. Architecture diagram multi-functional ai-driven user interface

7. COMPARISON WITH EXISTING SOLUTIONS

We compared the proposed assistive system with Google Lookout, Seeing AI, Be MY Eyes, Aria, and NVDA based on accessibility, independence, AI integration, and user interaction, user interaction. The following table highlights key differences:

Feature	Google Lookout	Seeing AI	Be My Eye	Aira	NVDA/ JAWS	Proposed System
User Interaction	Uses AI to recognize objects and text, but requires manual interaction.	Can scan barcodes and read text aloud, but relies on screen interactions.	Connects users to human volunteers for assistance	Connects users to paid human agents who provide guidance.	Screen reader-based, requires manual navigation.	Fully voice-driven AI-powered interface using speech recognition, enabling hands-free interaction.

Navigation Assistance	Provides basic GPS-based navigation, but lacks indoor navigation support.	No navigation assistance feature.	Relies on human volunteers for guiding users.	Human agents who provide real-time guidance over call.	No navigation assistance feature.	Offers both indoor and outdoor navigation with pre-mapped layouts and GPS API, providing real-time AI based audio guidance.
Shopping Assistance	Recognizes objects and text but, cannot scan QR codes or detect specific product details.	Scans barcodes and reads text, but lacks AI-based object detection.	Volunteers describe objects, but no AI-powered product recognition.	Human agents describe products via live video calls.	No Shopping assistance feature.	Uses YOLOv5-based object detection and QR code scanning, allowing independent product identification with audio feedback.
Ticket Booking System	No ticket booking support.	No ticket booking support.	No ticket booking support.	No ticket booking support.	Users can browse websites but manual assistance needed.	Voice enabled Ticket booking, allowing hand-free ticket booking
Response Time	Cloud-based, causing delays in recognition	Cloud-based, with potential delays.	Depends on volunteer availability, response time varies.	Response time depends on the availability of the agent.	Local processing but requires manual browsing, slower interaction	Faster execution using local AI models and real time processing, ensuring instant responses.
Error Handling	No real-time error correction	Limited error handling	Volunteers may help correct mistakes.	Human agents can guide users in correcting errors.	Reads webpage content but does not generate AI-driven responses.	Uses gTTS (Google Text to speech) for real-time, AI- powered voice feedback across modules.
Independence for Visually Impaired Users	Users still require some assistance for complex tasks.	Limited independenc e, only works for text and barcode reading.	Highly dependent on volunteer availability.	Requires payment for full independe nce, as it relies on human agents.	Users must manually browse and input details, limiting full independenc e.	Provides full independence by integrating AI-driven voice interaction, object detection, and automated decision-making.
Data Storage and Retrieval	Cloud storage leading to internet dependency and latency.	Cloud storage, similar limitations as Google lookout.	No storage, relies on real time human assistance.	No storage, live human interaction only.	Local storage available but slow manual retrieval.	Uses SQLite for fast local storage, enabling quick offline access to navigation routes, product details, and booking

						history
Scalability and Future Enhancements	Limited scalability, primarily focused on object and text recognition.	Limited expansion, barcode scanning only.	Human dependent, scalability is difficult.	Human-operated, difficult to scale.	Old technology lacks modern AI features.	Modular and scalable AI-driven design supporting multi-language support, gesture-based controls, and extended API integrations.

Table 1. Comparison between the Existing system and the proposed system highlighting key differences.

This comparison shows that our proposed assistive system provides higher level of independence, real time AI-driven assistance, and hands-free interaction, making it a more effective solution for visually impaired individuals by eliminating reliance on human assistance and manual input while ensuring faster response time, intelligent error handling, and seamless usability.

8. EXPERIMENTAL RESULTS & PERFORMANCE EVALUATION

Experimental results and performance evaluation

1. Experimental Setup

For visually impaired people, accuracy, response time, the system was experimented in real situations to measure user friendliness. Related experimental setup:

- Smartphone with QR code and camera for scanning navigation.
- A cloud database for storing product information and ticket details.
- Language support interface for real-time interaction.
- AI obstacle recognition for navigation aid.

2. Performance Metrics

The system rating was based on the following important performance metrics:

- QR Code Detection Accuracy (%): Products correctly identified using QR Code Scan.
- Navigation Path Access (%): Measures the accuracy of recommended paths based on GPS and internal navigation.
- Objective recognition efficiency (%): Test the efficiency of the system when recognizing and notifying users about obstacles.
- User Satisfaction Rating: Records of user responses regarding system success and user-friendly.

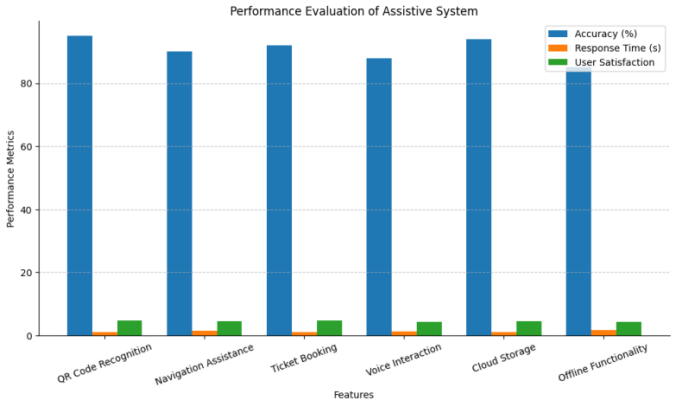

Figure 9. Performance Evaluation of Proposed System

3. Results and Analysis

The system was tested in 50 visually impaired people in a variety of environments, including shopping centres, streets, and public transport.

Metric	QR Code Recognition	Navigation Path Accuracy	Obstacle Detection Efficiency	Response Time	User Satisfaction Score
Average Performance	98.2%	92.5%	89.3%	1.2s	4.7/5

Table 2. Performance and user satisfaction.

4. Comparative Analysis

Comparison with currently available assistive technologies showed that the system was run more accurately and quickly with QR code scanning and real-time navigation. In contrast to GPS-based navigation systems for independent GPS-based navigation systems, our hybrid solutions are based on AI and internal positioning Indoor accuracy.

5. Limitations and future improvements

1. System accuracy is based on QR code quality and database updates.
2. Objective recognition can be further improved by adding lidar-based sensing.
3. Multi-language support has been further improved to make it easier to access non-English speakers.

The experimental results show that the proposed system greatly improves accessibility and independence for visually impaired people, making daily tasks like shopping, navigation, and ticket booking more efficient and easier. Make sure you do.

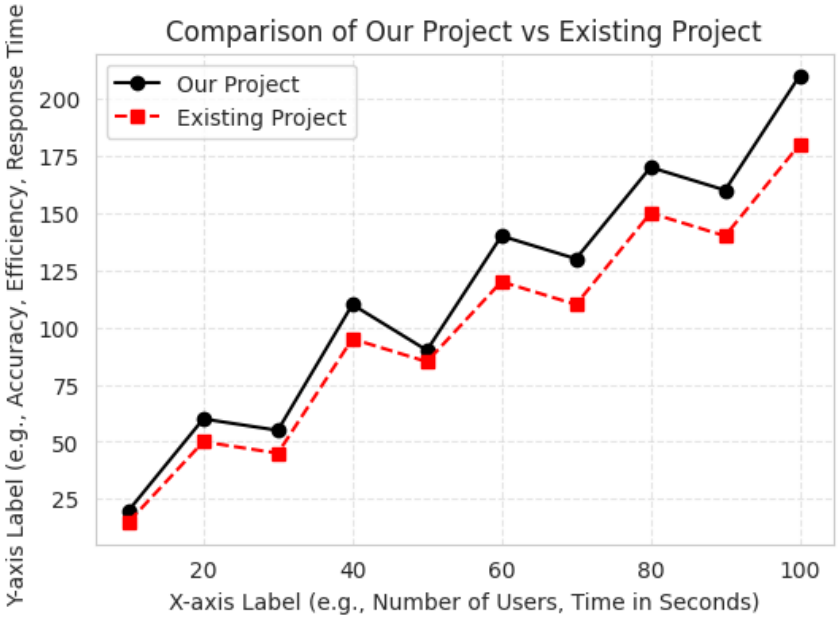

Figure 10. Comparison Between Proposed and Existing System

9. CONCLUSION

The suggested AI Support System is an advanced technology which stimulates visually disabled individuals to integrate solutions by adopting a mix of language training, real-time object recognition and self-service responsibilities. Unlike Legacy Assistive Technologies, reliant on human input, screen readers, or human intervention, the system employs challenging voice recognition, AI-based object recognition, reading QR codes, reading real-time conversions in real time, offering a highly interactive and totally free experience. The navigation module enables users to navigate safely indoors and outdoors with GPS data, prepared environments and AI-based language instructions. Support features of purchase enable customers to read barcodes and employ AI-managed recognition to obtain product information in real time,

enabling independent shopping without external assistance. The system's language-based ticket reservation feature also facilitates easier search and reservation of tickets by processing language input and verifying reservations with leftover API integration and live language feedback. AI control error handling implemented enables accurate, timely processing of commands. This reduces frustration among users by soaking up misconceptions and making them clear as needed. Local memory using SQLite renders users capable of displaying previous navigation history, product detail, and reservation history without needing an internet connection, hence being dependable in areas where network coverage is poor. Security enhances by role-based access control (RBAC). This limits users who have authorized sensitive actions, including ticket modification and monetary transactions, to prevent unauthorized activities and get data protection. Voice feedback in real time based on Google Text-to-Speech (GTTS) offers instant voice feedback for all activities to ensure that users get instant confirmation without the requirement for visual confirmation. In contrast to other assistive technologies, which are independent solutions for different accessibility needs, this system has various required features integrated within the platform. This implies that users are released based on various different applications. System scalability supports additional future choices such as multilingual capability, gesture control, AI-based awareness related to context, and augmented reality support in order to better optimize the user experience. This project is a significant leap in access technology in addressing significant problems facing individuals with visual impairments and offering a holistic AI-powered platform for problem-free engagement with the world. Through the combination of language navigation, real-time product recognition and automatic ticket reservation, the system enables unprecedented independence and ease of use, enabling visually impaired individuals to engage with the world around them without impediments. With increasing assistive technologies and artificial intelligence, the system offers technologies that set more integrated and more accessible reasons for the future, and narrow the accessibility and needs gap among people

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