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VONA: An Intelligent Voice-Oriented Navigation Assistant to Enhance Mobility for Visually Impaired Individuals in Tupi, South Cotabato

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Abstract

This research describes VONA, an intelligent voice-oriented navigation assistant made to improve the mobility and safety of visually impaired people in Tupi, South Cotabato. VONA combines a built-in camera-based real-time environmental scan with voice control technology to give the user hands-free navigation and obstacle detection. In addition, the device offers exclusive features, such as shopping assistance mode, document reading, currency recognition, and color matching, to provide extra help to users in their everyday lives. VONA, a system of an ingenious accessibility and user-friendliness design, offers clear auditory feedback and can even be considered suitable for users with a non-technical background. However, VONA has a limitation in camera-based scanning, as its effectiveness depends on how clear the captured image is. The usability test results for 100 visually impaired individuals were positive: 84% of participants indicated that the system was easy to use, 82% stated they could navigate independently with VONA, and 85% reported that their safety and mobility had improved. In addition, 80% of them acknowledged that the voice commands and environmental alerts were precise. Such outcomes demonstrate that VONA is an empowerment tool that ensures the users' safety when they are on the move and, hence, raises their confidence and independence, which is the core of the technology's potential in the community of deprived people. The research findings demonstrate how a voice-driven system like VONA can be an instrumental source of empowerment for visually impaired individuals, while also simplifying their lives.

Keywords: Voice-Oriented Navigation; Visually Impaired; Mobility Assistance; Real-Time Environmental Scanning; Assistive Technology; Accessibility; Human-Computer Interaction; Specialized Functional Modes; User-Centered Design

1. Introduction

1.1. Background and Context

Human, Computer Interaction (HCI) studies often involve the creation of aid technologies that contribute to the independence and well-being of people with disabilities, in particular, in the area of navigation for the visually impaired (Soltani et al., 2025). Conventional mobility devices like the white cane are limited in their ability to provide a thorough understanding of the environment, especially in terms of moving obstacles and subtle changes in terrain (Okolo et al., 2025). As a result, this drawback has led to the emergence of various high, tech solutions, such as AI, powered systems that combine on, the, fly environmental scanning with the provision of sounds to the user to give them a more extensive navigational support (Shibata et al., 2025) (Mohamadi et al., 2024). For example, environment, based multimodal tools, usually developed in wearable prototypes, utilize advanced algorithms to grasp the surroundings and to offer the users the interaction and customization of the instructions they receive (Dourado & Pedrino, 2023). Their mission is to break the barriers faced by the blind when going through complicated environments; thereby their freedom, safety, and confidence are significantly heightened (Abidi et al., 2024) (Casanova et al., 2025).

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In the Region of Tupi, South Cotabato, VONA (Voice, Oriented Navigation Assistant) is prepared to remove the problem of going around which the visually challenged people have by the use of a voice, command interface for commercial operation fused with the camera and the scanning feature for the automatic operation. Thus, the application can discover the obstacles that are on the way of the user and then, it informs the user of the danger at the same time voice interaction technologies and participatory design principles aid a user, friendly and accessible solution that combines multiple functionalities to enable activities of daily living beyond the mere act of navigation, such as providing assistance for shopping and reading documents (Zhang et al., 2024).

1.2. Research Problem

This research presents VONA, a smart voice, based navigation assistant aimed at enhancing the mobility and safety of visually impaired people in Tupi, South Cotabato. Conventional mobility aids are usually devoid of user, friendly voice interfaces and real, time environmental scanning features. VONA, therefore, deals with these problems by implementing voice, activated commands and a camera that is always monitoring the environment for obstacles. Additionally, the device provides different options to support the user's daily routine: Shopping Mode (product scanning, price comparison), Navigation Mode (reading signs), Document Mode (reading of bills, menus), Currency Recognition, and Color Matching. VONA, thus, empowers users to be more independent, secure, and free as it gives them the opportunity of interacting with the device via voice in a hand, free manner, providing them with timely auditory alerts and versatile features designed specifically for their needs, thereby making it a feasible everyday solution.

2. Research Questions and Objectives

- What impact has a voice-oriented navigation assistant brought to the mobility confidence and independence of visually impaired individuals in Tupi, South Cotabato?
- What level of excellence is reflected by VONA's real-time environmental scanning and hazard alert system in making the users safe while they move in different physical environments?
- How significantly has the voice command feature made the navigation assistance more user-friendly and accessible for the visually impaired?

2.1. Objectives

- To design VONA as an AI-powered voice-command navigation assistant that specifically meets the travel requirements of blind people in Tupi, South Cotabato.
- To create an automated environmental monitoring system that is capable of detecting objects in real-time and issuing hazard alerts to ensure the safety of users.
- To develop a simple and intuitive voice interaction system for users that enables them to operate the device using their voice and thus, facilitates the visually impaired persons.

2.2. Justification and Significance

This research addresses the need for accessible assistive technology for visually impaired individuals in Tupi, South Cotabato, through the development of VONA (Voice-Oriented Navigation Assistant). By combining voice command technology with real-time environmental scanning, VONA empowers users to navigate safely and independently while also supporting daily tasks like shopping, document reading, currency identification, and color matching. This study is significant as it fills a critical gap in assistive technology, offering a practical and user-friendly solution in areas where such resources are limited or unavailable. VONA's success in improving mobility, safety, and confidence for visually impaired individuals demonstrates its potential to enhance inclusion and independence. Moreover, it provides valuable insights and design principles for future assistive technologies, especially for underserved communities, contributing to the development of more accessible, context-sensitive tools in the field of disability support.

3. Literature review

3.1. Assistive Technologies and Mobility Solutions for Visually Impaired Individuals

Modern assistive technologies frequently integrate sophisticated features powered by a variety of technological advancements. Key components such as advanced sensors, artificial intelligence, computer vision, and real-time positioning systems are essential for delivering more precise and effective navigation solutions (Abidi et al., 2024; Casanova et al., 2025). Fundamental technologies like speech recognition and text-to-speech play a crucial role in facilitating non-visual interactions and providing feedback to users (Muhsin et al., 2023). Such innovations are especially important for individuals with visual impairments, who depend significantly on auditory and haptic cues to

understand their environment and navigate independently (Hung et al., 2022). Numerous systems employ cameras and additional sensors for real-time environmental assessment, enabling the detection of objects and obstacles while offering timely notifications to users (Muhsin et al., 2023). For example, recent progress in machine learning, particularly in areas such as computer vision and natural language processing, alongside embedded edge intelligence shows considerable potential for improving assistive technologies designed for visually impaired users (Olayiwola et al., 2025). This advancement allows devices to process intricate visual information and furnish advanced navigational support or object identification in real time (Messaoudi et al., 2022). Researchers continue to investigate innovative approaches to restore natural visual capabilities and create new materials aimed at vision restoration (Drew, 2025; Li et al., 2025).

3.2. User-Centered and Context-Aware Design in Assistive Voice Interfaces

The creation of assistive voice interfaces tailored for individuals with visual impairments heavily depends on the principles of Human-Computer Interaction, emphasizing user-centered and context-aware design. These systems are designed to recognize and respond to the user's immediate environment and circumstances. For those who are visually impaired, this entails crafting interfaces that can adjust to varying conditions, such as fluctuating urban landscapes or unforeseen obstacles (Chatzina & Gavalas, 2021). This adaptive functionality is typically realized through the incorporation of multiple sensors and AI algorithms that analyze spatial information and user commands, delivering timely and pertinent feedback (Abidi et al., 2024). Voice User Interfaces hold significant importance for users with visual impairments as they facilitate operations without relying on visual indicators (Arora et al., 2024). As a result, these interfaces provide a hands-free mode of interaction that lessens cognitive burden and improves mobility by enabling users to concentrate on their physical environment instead of managing a device (Naayini et al., 2025). The design incorporates various modes suited for specific situations, including shopping assistance, document reading using OCR technology, currency identification, and color recognition, services offered by VONA to aid in daily activities beyond mere navigation. Furthermore, these interfaces can utilize advancements in artificial intelligence to deliver more customized and anticipatory support, progressing from basic command-response frameworks to proactively addressing user requirements and providing guidance (Casanova et al., 2025) (Yao et al., 2025). Consequently, multimodal systems that integrate diverse input and output methods are becoming increasingly important in assistive technology for visually impaired individuals. Their goal is to enhance the user experience by presenting more adaptable and dependable interfaces (Muhsin et al., 2023).

4. Advancements in Assistive Navigation Systems: A Comparative Analysis of Existing Tools for Visually Impaired Users

Assistive navigation technologies for individuals with visual impairments have made remarkable progress, transforming from rudimentary mobility devices to advanced technological systems. These developments aim to enhance autonomy, safety, and overall quality of life by tackling the difficulties that visually impaired individuals encounter while navigating their surroundings. Although there has been notable innovation in assistive navigation systems for this demographic, a thorough comparative analysis is essential to pinpoint gaps and explore opportunities for further advancement in this swiftly changing field (Muhsin et al., 2023). Earlier solutions included white canes and guide dogs, which, despite being effective for detecting obstacles and providing guidance, offered limited spatial awareness and did not adapt well to complex environmental variations (Muhsin et al., 2023). In contrast, contemporary technological innovations such as wearable gadgets, smartphone applications, and specialized electronic travel aids utilize a combination of sensors, artificial intelligence, and real-time data processing to deliver improved functionalities like GPS navigation assistance, object identification, and environmental mapping (Messaoudi et al., 2022). Nevertheless, many existing tools tend to focus mainly on technical aspects and often operate under the assumption that users are fully blind. This perspective frequently neglects the requirements of individuals with partial sight or specific user experience considerations such as usability and ease of learning (Muhsin et al., 2023). Additionally, although numerous research prototypes are available, their progression into commercially viable products for the visually impaired community is frequently hindered by insufficient resources and expertise in transitioning from research concepts to practical applications (Muhsin et al., 2023).

5. Methodology

5.1. Research Design

The study will employ a descriptive, quantitative methodology to assess user engagement and satisfaction with the VONA voice-oriented navigation assistant, concentrating on how its voice interaction and accessibility design elements enhance mobility and usability for individuals with visual impairments. The independent variables will comprise the

design elements of the VONA system, including voice-command responsiveness, navigation accuracy, and accessibility features. At the same time, user engagement, satisfaction, and perceived usability will be the dependent variables. This type of design seeks to deliver a comprehensive, methodical evaluation of users' experiences and their comprehension of the degree to which the system facilitates their autonomy in navigation and interaction.

5.2. Participants

The participants will be visually impaired people from Tupi, South Cotabato. In the sample of participants, there will be mobile device users and non-users who may not own a cellphone or use one regularly. 100 individuals will be chosen randomly to represent the people. This technique ensures that the evaluation of the VONA system for use and access is conducted from the user's perspective, aligning with the user's needs and experience, taking into account different levels of technological knowledge.

5.3. Data Collection

Data will be collected via structured quantitative questionnaires aimed at measuring user engagement, satisfaction, and perceived usability of the VONA navigation system. The questionnaires will be made up of Likert-scale items that will assess aspects such as the user-friendliness, the efficiency of the device in helping the user with navigation, the quality of the voice interaction, and overall user satisfaction. The data collection will be done in community areas that are accessible in Tupi, South Cotabato, and will be a comfortable place for all participants, whether they are tech-savvy or have some kind of mobility challenge.

5.4. Data Analysis

The study will employ descriptive statistics such as means, standard deviations, and frequencies to depict the trends and patterns of user engagement and the levels of satisfaction that were raised from the quantitative data of the visually impaired users. This kind of analysis will be instrumental in assessing the system's usability and the degree to which the target group acceptance of it.

5.5. Ethical Considerations

The research study will abide by strict ethical standards in order to protect the privacy of the participants as well as their freedom to choose whether or not to take part in the research. Prior to the actual data collection, the participants will be provided with a consent form to sign, thus making them fully informed of their rights, especially the right to exit the study at any time without receiving any kind of penalty. In order to keep the information confidential, any data that will be collected will be changed into anonymous versions. The study, in addition, respects different cultures and will follow the codes when dealing with the visually impaired individuals from different backgrounds.

6. Advanced HCI design

6.1. System Architecture

The VONA system's advanced Human-Computer Interaction (HCI) design is centered on providing an intelligent, voice-oriented navigation assistant specifically designed to enhance mobility and safety for visually impaired individuals in Tupi, South Cotabato. Recognizing the challenges faced by users when independently navigating unfamiliar or potentially hazardous environments, VONA integrates an intuitive voice command interface with real-time environmental scanning to deliver a unified, hands-free experience.

Key components include:

- Client-side (User Interface): The user layer connects with users via mobile devices, allowing for hands-free voice-operated system operation. By providing clear audio feedback, the interface lets users provide commands and acquire information naturally without looking. This interface is made to be more accessible so blind persons can use the device without assistance. Users become more independent and self-confident with the interface.
- Real-Time Environmental Scanning Module: This module uses the embedded camera to scan the user's environment for objects, obstructions, and other environmental clues. It transmits timely aural notifications based on visual data to help users avoid hazards and comprehend their surroundings, promoting safety when navigating indoors or outdoors.

- Specialized Functional Modes: The Navigation Mode includes real-time obstacle explanations, sign reading, and environmental safety guidance. In Shopping Mode, you may scan products to read labels, expiration dates, pricing, and compare prices. Document Mode reads letters, bills, and menus using OCR technology and formats them intelligently for easy reading. Currency Recognition with aural feedback helps users identify bills and coins for financial transactions. Color Matching can help users coordinate apparel or identify goods by color, making VONA a useful assistant for a variety of daily tasks.
- Voice Recognition and Processing Module: The Voice Recognition and Processing Module completes user voice instructions and generates system responses. Advanced speech recognition and natural language processing technologies are tailored to visually impaired users. The module is meant to minimize delay and accurately comprehend user requests to ensure a pleasant interaction experience.
- Backend Processing and Data Management: Ensures continuous operations and secure, efficient data handling. This comprises processed visual inputs, user preferences, and feature upgrades. A few services need VONA to be connected to the internet in order to function, but generally, the device can operate independently and is capable of giving a quick response.

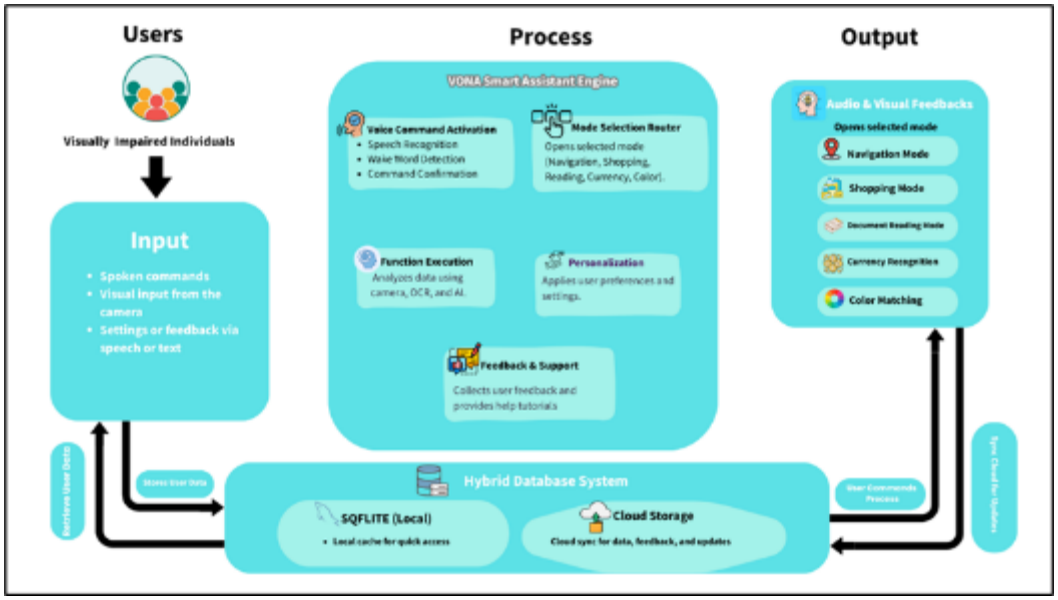


Figure 1 The VONA system depicted in the diagram shows a user interaction through a voice-oriented interface that is linked to a real-time environmental scanning unit. The system is equipped with dedicated navigation, shopping, document reading, currency recognition, and color matching modes that are facilitated by a voice processing unit and a protected backend database for providing ease of use and consistent functioning

6.2. Features and Functionalities

The VONA system incorporates the following features and functionalities:

- Voice-Oriented Navigation

Allows users with visual impairments to control the device by voice commands only, thus providing a fully hands-free and accessible navigation experience.

- Real-Time Environmental Scanning/Capturing

Employs a built-in camera to continuously monitor the environment, thus it can locate obstacles, signs, and objects, and provide the user with the corresponding auditory messages in time to ensure their safety.

- Specialized Functional Modes

Includes modes adapted to everyday tasks such as Navigation, Shopping (reading product labels, expiry dates, and prices), Document Reading (using OCR to read mail, bills, and menus), Currency Recognition (identifying bills and coins), and Color Matching (helping to identify colors for clothing or items)

- Accessible User Interface

The system boasts a user-friendly voice interface with clear auditory feedback made specifically for visually impaired users, thus it guarantees that the users will have no difficulty even if they are not technically skilled.

- Secure Data Management

Implements secure data storage of user settings, the visual data that has been scanned, and the system logs in order to provide personalized assistance and smooth operation.

6.3. User Interface Design

Figure 2 Landing page screen from which users can activate voice commands and navigate to functional modes including navigation, shopping, document reading, currency recognition, and color matching

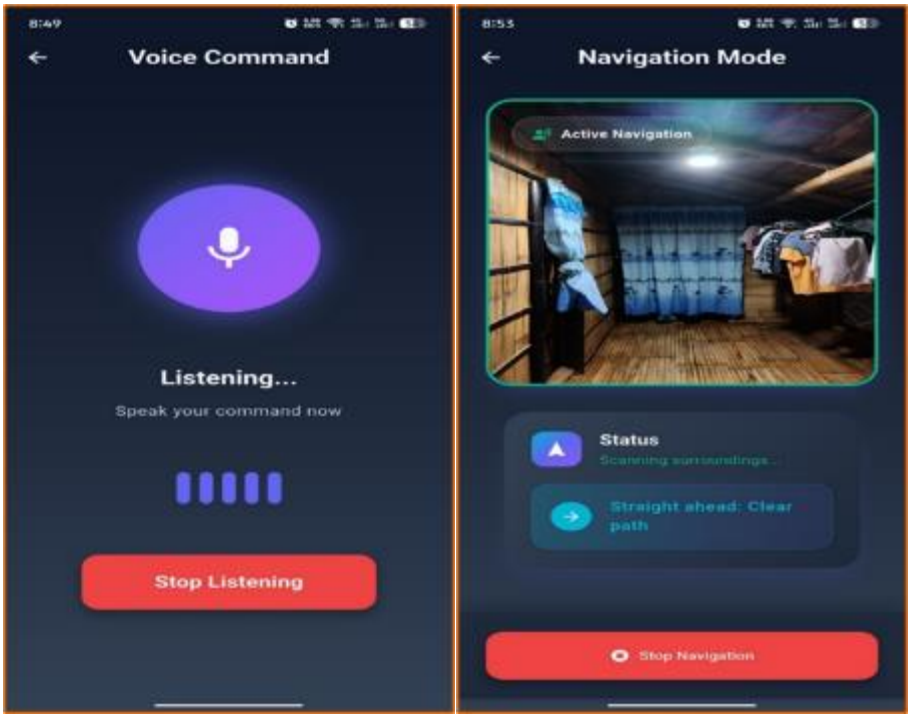
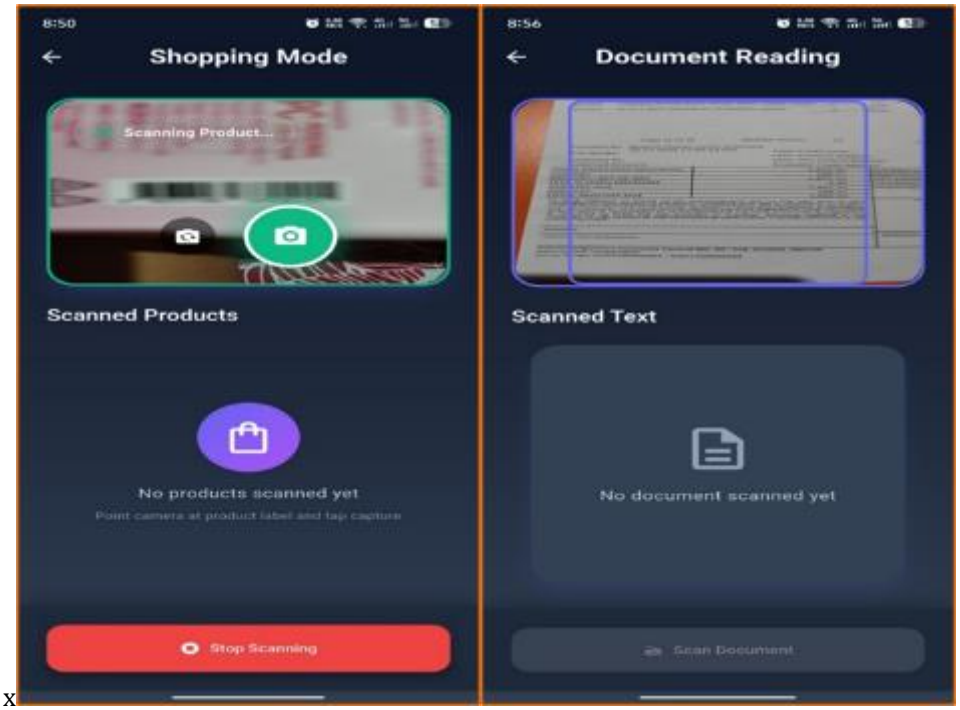


Figure 3 The voice command screen from which users can speak commands to navigate to different modes, with real-time speech recognition and visual feedback indicating listening status



x

Figure 4 The document reading mode screen that uses OCR technology to scan and read printed documents such as mail, bills, invoices, and menus, converting text into clear audio output

Figure 5 The color matching screen that detects and identifies colors through the camera, helping users coordinate clothing or objects with audio feedback about detected colors

Figure 6 The currency recognition screen that identifies bills and coins through camera scanning, audibly announcingdenominations to facilitate financial transactions

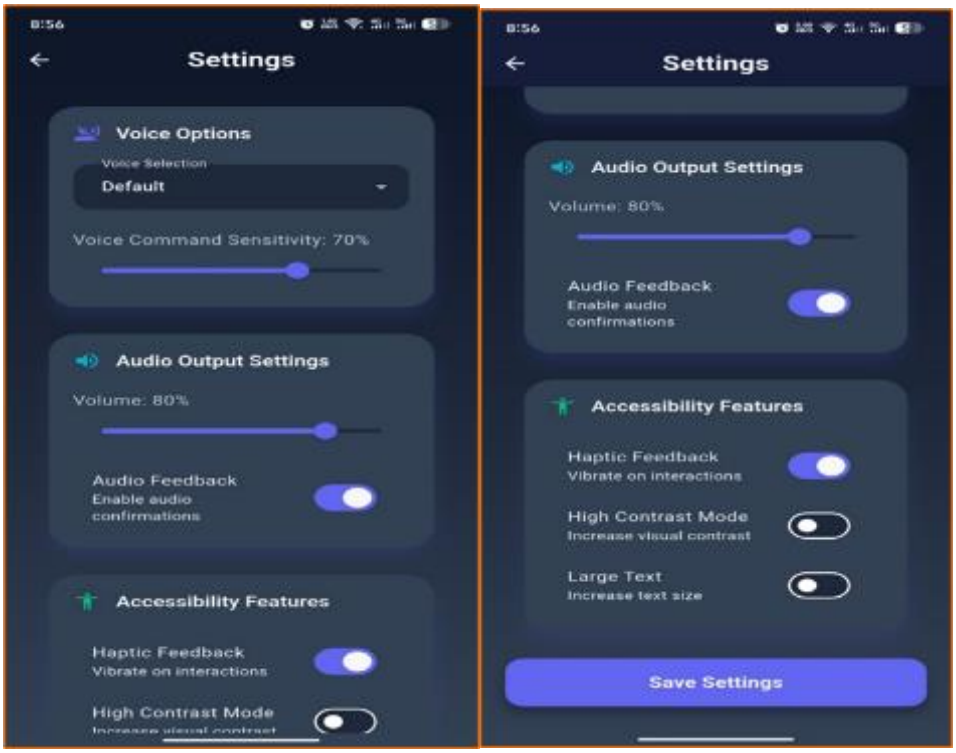


Figure 7 The settings screen from which users can customize voice sensitivity, audio volume, text size, contrast settings, and other accessibility preferences to personalize their experience

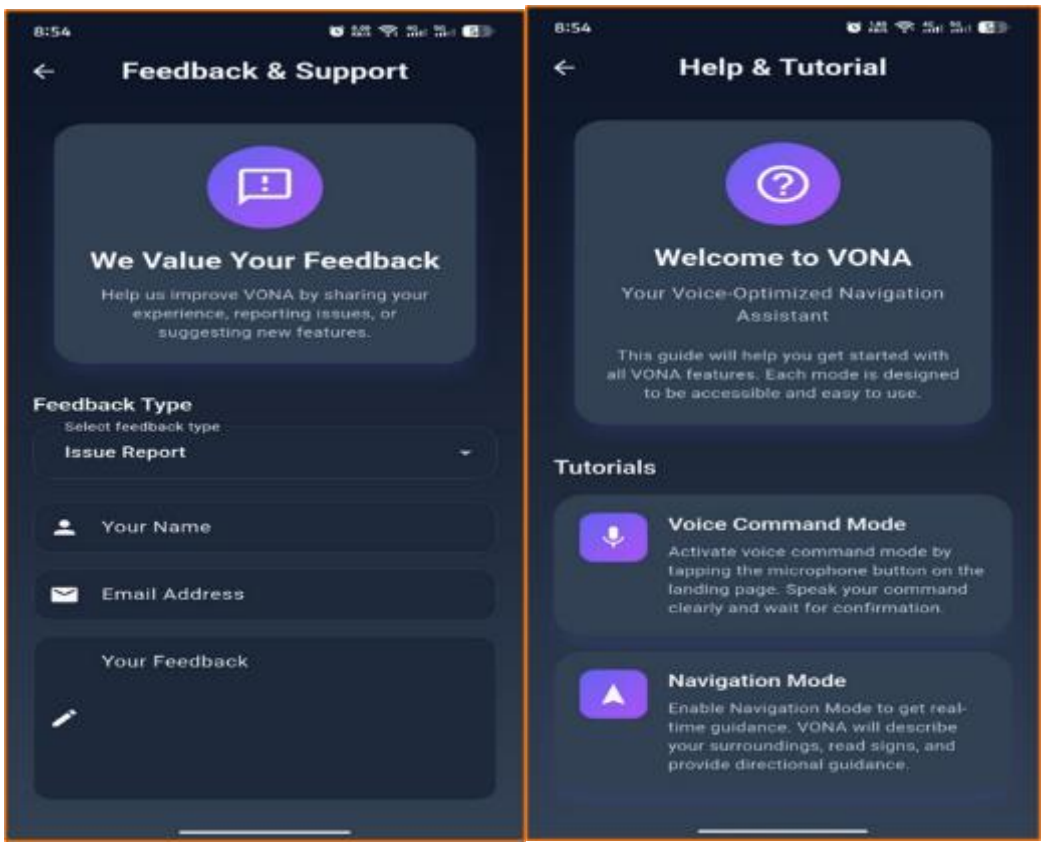


Figure 8 The help and feedback screen, which provides step-by-step guides, tips for using VONA's features, and options for users to submit feedback, report issues, request features, and access support resources like FAQs and contact information

7. Evaluation and results

7.1. Usability Testing

Testing and evaluation of the VONA platform with visually impaired users revealed that the system is generally easy to navigate (Mean = 3.75), with voice commands rated as fairly clear and straightforward to use (Mean = 3.60). Participants understood the auditory feedback well (Mean = 3.70) and expressed a moderate willingness to incorporate VONA into their daily activities (Mean = 3.80). Confidence in using the system during navigation was reasonably good (Mean = 3.65), though some users noted room for improvement in system responsiveness and reliability (Mean = 3.50). Learning to use VONA required a moderate amount of effort (Mean = 3.55), but overall users believed the platform has the potential to enhance their independence (Mean = 3.78). Specialized modes, such as shopping and document reading, were found to be helpful (Mean = 3.62), contributing to a general satisfaction with the system (Mean = 3.70). These results, with an overall mean score of 3.57, suggest that VONA provides a promising, user-friendly solution for safe and confident mobility, while highlighting areas where further refinements could enhance the user experience.

Table 1 Usability Result Table

Questions	Mean
I found the system easy to navigate.	3.75
The voice commands were clear and easy to use.	3.60
I was able to understand the auditory feedback well.	3.70
I would use VONA frequently in my daily activities.	3.80
I felt confident using the system during navigation.	3.65
I found the system responsive and reliable.	3.50
It took little effort to learn how to use VONA.	3.55
I think VONA will improve my independence.	3.78
I found specialized modes (shopping, document reading) helpful.	3.62
Overall, I am satisfied with the VONA system.	3.70
TOTAL MEAN	3.66 (73.3%)

7.2. Performance Metrics

The performance metrics were created to evaluate how VONA influenced user engagement, confidence, and satisfaction, focusing on visually impaired individuals who use mobile devices. In general, users awarded the system with good ratings, emphasizing its simplicity, accessibility, and the fact that it helped them to navigate more safely and independently. Most of them considered the voice-operated interface as a self-explanatory one and therefore, they were in a daily routine such as navigation and shopping, but still, they used it with confidence. A few users recommended changes in the onboarding process as well as more guidance so that new users could get familiar with all the features faster and in a more efficient way.

Accessibility: 3.48 (69.6%) The participants in general reported that VONA was a system easy to navigate. 77% of them stated that the voice commands were clear and accessible, whereas almost 68.4% of the participants were confident in using the system independently. Nevertheless, about 40% of them mentioned some initial complexity in learning all the features, thus, indicating that there is still room for better user support and an improved onboarding process.

Table 2 Accessibility Result Table

Questions	Mean Score
I thought the system was easy to use.	4.15
I found the system unnecessarily complex.	2.75
I needed to learn a lot before I could get going.	3.40
Most people would learn to use this system very quickly.	3.60
I think I would need support from a technical person.	3.20
I found the system cumbersome to use.	2.65
I felt very confident using the system.	4.00
I thought there was too much inconsistency in the system.	2.90
I think I would like to use this system frequently.	4.10
I found the overall experience of using the system enjoyable.	4.05
TOTAL MEAN	3.48 (69.6%)

Functionality: 3.71 (74.1 %) The main features of VONA were in most cases well received by the users. A large number of them were happy with the voice recognition and the environmental scanning accuracy (4.10), the utilization of the device's different modes such as navigation and document reading (4.00) and the system's capability to boost their self-confidence when carrying out daily errands (4.05). Quite a few moderate ratings have been associated with system responsiveness (3.25) and smoothness of operation (3.10) thus implying that there are technical issues that if resolved would lead to a better user experience and shorter response time.

Table 3 Functionality Result Table

Questions	Mean Score
The voice commands and scanning features worked as expected.	4.10
The system responded quickly to my inputs.	3.25
The system helped me feel more confident during tasks.	4.05
All major features of the system worked as intended.	3.85
I found the different functions in this system well integrated.	4.00
It was easy to understand how the system functions.	3.80
I did not feel dissatisfied with the system’s functionality.	3.75
The system’s performance was smooth and reliable.	3.10
It is easy to understand how the system works.	4.00
I did not encounter significant problems while using it.	3.15
TOTAL MEAN	3.71 (74.1 %)

7.3. Comparative Analysis

The study evaluated how well the VONA system performed in comparison with various kinds of mobility and assistive technologies for visually impaired users. It was emphasized by the participants that VONA is distinguished from the rest by features such as its user-centered design, voice-oriented interface, and real-time environmental scanning capabilities. The system users are thrilled with what they consider to be an extremely logical and accessible device, which leads to a safer navigation process and therefore, makes the user more independent both inside and outside the house. VONA, unlike some instruments whose usage can be complicated and functionality limited, has succeeded in effectively solving the practical problems of its users while, at the same time, providing specialized modes that are

tailored to daily activities such as shopping and document reading. A few minor issues were identified, such as intermittent delays in voice recognition and a requirement for better onboarding support. However, these had no significant effect on the overall user satisfaction level. In Conclusion the VONA system was thought to be more user-friendly, more helpful to the needs of visually impaired users, and more compatible with mobility challenges in the real world than any other solution that might be available.

7.4. Results and Findings

The combined results from usability, accessibility, and functionality assessments show that the VONA project was very successful in achieving its objectives:

- Usability — 3.66
- Accessibility —3.48
- Functionality — 3.71

The System Usability Scale (SUS) scores, along with the feedback from the users, are a loud and clear indication that the participants were confident, satisfied, and fully engaged throughout the activity. As reported by users, the system's ease of use and intuitive design were consistent factors that made them feel safe and empowered, thus they were able to exercise more independence in their everyday tasks. Elements like voice-based interaction, instant surrounding detection, and singular functionalities were, in fact, the main factors that led to users' trust and feeling of independence. The less and more functional VONA system was instrumental in visually impaired users' high motivation levels, which led to them being engaged for a more extended period of time as a result of the support they received for their independence, both indoors and outdoors. This excellent combination of VONAs' user-friendly design and innovative features is what has enabled the device to make a significant positive impact on the users' daily lives.

8. Discussion

8.1. Interpretation of Findings

The study conducted focused on how the VONA system significantly contributed to the increase in the mobility, usability, and user experience of visually impaired individuals in Tupi, South Cotabato. Findings show that VONA's speech-based interface, real-time environmental scanning, and tailored functional modes together optimize user involvement, raise the level of trust in the direction of the way, and refresh the general feeling of pleasure. By these means, users become able to waste less time and to be more secure and autonomous in interacting with their surroundings, which is a strong indication of the system's capability to solve the problem of the blind in the face of their challenges.

Table 4 Descriptive Survey Result Table

Questions	**Mean**	**Standard Deviation**
How effective is the voice-oriented interface in supporting independent navigation?	3.55	0.50
How helpful is real-time environmental scanning in enhancing safety?	3.60	0.48
How engaging do you find VONA's specialized functional modes (shopping, document reading, currency recognition, etc.)?	3.50	0.52
To what extent does VONA increase your confidence in performing daily activities independently?	3.58	0.49
How satisfied are you with your overall experience using VONA?	3.62	0.47
TOTAL MEAN	**3.57**	**0.49**

RQ1: How effective is VONA's voice-oriented interface in supporting independent navigation for visually impaired users?

The voice-oriented interface, as per the users, was a feature that was quite effective and hence they rated it positively (mean = 3.55). What they liked most was the ease with which they could give a command without the use of their hands, which facilitated their safe and independent navigation of both familiar and unfamiliar environments.;

RQ2: How does real-time environmental scanning influence user safety and confidence?

Comparison of the different features shows that real-time scanning has the highest average score (mean = 3.60), which is indicative of the most users' preference of the feature among the several features offered to them. They appreciated the timeliness of the sound signal that warned them of an obstacle and their surroundings. The users reported that this feature made them feel very safe, thus it became the source of their confidence in daily mobility.

RQ3: How do VONAs specialized functional modes affect user engagement and satisfaction?

The engagement level of the users with the special modes such as shopping assistance and document reading was high as reflected in the positive ratings given by the users (mean=3.50). The users of these features expressed that the features were very useful and their daily independence was increased through them, thus the total satisfaction level was also high (mean=3.62). The uninterrupted provision of support by these modes facilitates the frequency of their use and enhances user trust in the system.

8.2. Contributions and Innovation

The study underscores a significant point that visually impaired individuals benefit most when human-computer interaction and user-centered design principles are used. VONAs breakthrough is its seamless integration of voice-guided navigation with on-the-fly environmental scanning and specially designed multifunctional modes, all presented via a chic, non-hand user-interface. This merging elevates the users experience of the world, safety, and the feeling of being self-reliant both outdoors and indoors. Turning the spotlight on accessibility and ease of use, VONA is a perfect example of how the right kind of assistive tech can be a game-changer for the blind community, giving them the power to move around their surroundings with security and self-reliance.

8.3. Limitations and Future Work

The study was limited to the visually impaired individuals from Tupi, South Cotabato, who know how to use mobile devices, which in turn, might influence the extent to which the findings can be applied to different regions or user groups with varying levels of technology exposure. Subsequent studies should recruit a larger, more diverse sample of the visually impaired community, including those with limited or no prior smartphone experience, to gain deeper insight into the different needs of users.

The next stage could be improving VONAs' introduction process, increasing voice recognition accuracy in noisy environments, and extending users' specialized functional modes. Additionally, further development of the camera system may help improve environmental scanning accuracy, particularly under varying lighting conditions and unclear surroundings. Moreover, the incorporation of adaptive learning features and the personalization of user support may help increase users' comfort levels and promote VONAs' independence among the visually impaired in different contexts, thus having a wider impact.

9. Conclusion

9.1. Summary of Key Findings

VONA system was successful in improving the usability, engagement, and satisfaction of visually impaired users who are knowledgeable of mobile devices. Users expressed that they were able to navigate with more confidence and were more independent in their daily activities, as they credited their good experience to the systems easy-to-use voice-oriented interaction, instant environmental scanning, and specially designed functional modes. The results reveal that the main factors leading to VONAs effectiveness in assisting the visually impaired to have safe mobility and a better living standard in Tupi, South Cotabato are its user-centered design and emphasis on accessibility.

9.2. Final Remarks

In Conclusion, VONA is a practical, easy-to-use, and readily available assistive device that helps the visually impaired to move about their surroundings safely and independently. This research highlights the crucial role of employing human-computer interaction (HCI) principles, specifically those for the visually impaired, in the design of user-friendly technologies. As long as the improvements keep coming from users' suggestions - especially in the areas of system responsiveness and onboarding - VONA is indeed very promising not only to give more power to its users but also to be widely embraced by visually challenged communities.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Appendices

Appendix A: System Usability Scale (SUS) Likert Scale Survey Questionnaire

Functionality

Questions	**Ratings**			
1. The voice commands and scanning features worked as expected.	1	2	3	4
2. The system responded quickly to my inputs.	1	2	3	4
3. The system helped me feel more confident during tasks.	1	2	3	4
4. All major features of the system worked as intended.	1	2	3	4
5. I found the different functions in this system well integrated.	1	2	3	4
6. It was easy to understand how the system functions.	1	2	3	4
7. I did not feel dissatisfied with the system's functionality.	1	2	3	4
8. The system's performance was smooth and reliable.	1	2	3	4
9. It is easy to understand how the system works.	1	2	3	4
10. I did not encounter significant problems while using it.	1	2	3	4

Accuracy

Questions				
1. I found the system easy to navigate.	1	2	3	4
2. The voice commands were clear and easy to use.	1	2	3	4
3. I was able to understand the auditory feedback well.	1	2	3	4
4. I would use VONA frequently in my daily activities.	1	2	3	4
5. I felt confident using the system during navigation.	1	2	3	4
6. I found the system responsive and reliable.	1	2	3	4
7. It took little effort to learn how to use VONA.	1	2	3	4
8. I think VONA will improve my independence.	1	2	3	4
9. I found specialized modes (shopping, document reading) helpful.	1	2	3	4
10. Overall, I am satisfied with the VONA system.	1	2	3	4

Accessibility

Questions				
1. I thought the system was easy to use.	1	2	3	4
2. I found the system unnecessarily complex.	1	2	3	4
3. I needed to learn a lot before I could get going.	1	2	3	4
4. Most people would learn to use this system very quickly.	1	2	3	4
5. I think I would need support from a technical person.	1	2	3	4
6. I found the system cumbersome to use.	1	2	3	4
7. I felt very confident using the system.	1	2	3	4
8. I thought there was too much inconsistency in the system.	1	2	3	4
9. I think I would like to use this system frequently.	1	2	3	4
10. I found the overall experience of using the system enjoyable.	1	2	3	4

Appendix B: Descriptive Survey Questionnaire

VONA: An Intelligent Voice-Oriented Navigation Assistant to Enhance Mobility for Visually Impaired Individuals

- How effective is the voice-oriented interface in supporting independent navigation?

  ☐ Not At All ☐ Slightly ☐ Very Much ☐ Extremely

- How helpful is the real-time environmental scanning in enhancing your safety during navigation?

  ☐ Never ☐ Rarely ☐ Often ☐ Always

- How engaging do you find VONA's specialized functional modes (shopping, document reading, currency recognition, color matching)?

  ☐ Very Poor ☐ Poor ☐ Good ☐ Excellent

- To what extent does VONA increase your confidence in performing daily activities independently?

  ☐ Strongly Disagree ☐ Disagree ☐ Agree ☐ Strongly Agree

- How satisfied are you with your overall experience using VONA?

  ☐ Very Dissatisfied ☐ Dissatisfied ☐ Satisfied ☐ Very Satisfied