



AI-Enhanced Smart Glasses for Real-Time Audio Navigation for the Visually Impaired

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ABSTRACT: Visual impairment often limits a person's ability to move independently and safely in unfamiliar environments. Conventional mobility aids mainly focus on basic obstacle sensing and do not provide intelligent awareness of people or surroundings. This proposed smart glasses system combines artificial intelligence and IoT-based sensing to assist visually impaired users through real-time person recognition, obstacle detection, and location-based voice notifications. A camera and ultrasonic sensing unit continuously monitor the environment, while the embedded controller processes the collected data. The system delivers audio guidance to improve navigation safety, user confidence, and independent mobility

KEYWORDS: Artificial intelligence, smart glasses, assistive technology, real-time navigation, audio guidance, computer vision, object detection, wearable devices, visually impaired assistance, human-machine interaction

I. INTRODUCTION

Assistive wearable technologies are becoming increasingly important in improving the quality of life for visually impaired individuals. Traditional white canes help users detect immediate obstacles but fail to provide contextual awareness such as person recognition or location guidance. Recent developments in AI-based computer vision and embedded electronics enable wearable devices to identify objects, faces, and environmental hazards in real time. By integrating these capabilities into smart glasses, users can receive continuous voice assistance that supports safer and more confident movement in both indoor and outdoor spaces.

II. OBJECTIVES

- To develop an intelligent wearable aid for visually impaired users.
- To identify familiar and unfamiliar individuals using camera-based AI recognition.
- To detect obstacles in real time for safer navigation.
- To provide location announcements and emergency guidance through voice alerts.
- To improve independent movement and environmental awareness.

III. LITERATURE REVIEW

Recent advancements in artificial intelligence, embedded systems, and IoT have significantly improved assistive technologies for visually impaired individuals. Several researchers have proposed smart wearable systems that combine obstacle detection, voice guidance, and computer vision to enhance independent mobility.

Inbamalar et al. (2025) presented a review on smart glasses with voice notification systems designed for blind and visually impaired users. Their study analyzed multiple vision-based assistive devices that use cameras and audio feedback to help users understand their surroundings. The review highlighted the importance of real-time environmental awareness, user safety, and intelligent voice alerts. However, the authors also noted limitations in accuracy, power consumption, and affordability. Mondal et al. (2025) developed a low-cost smart spectacle system focused on users in developing countries. Their work emphasized affordability by using cost-effective sensors and embedded platforms. The system mainly supported obstacle detection and voice guidance. Although it provided a practical low-budget solution, it lacked advanced features such as face recognition, adaptive AI processing, and smart location-based announcements.



Murugaiyan et al. (2025) proposed a hands-free smart glass system with real-time obstacle detection and traffic light recognition. Their system used computer vision and deep learning techniques to improve outdoor navigation safety. The study demonstrated strong performance in urban environments and helped users identify obstacles and traffic signals. However, wearable battery limitations and computational complexity remained major challenges. Hekal et al. (2024) introduced a deep learning-based smart glass system capable of object recognition and scene understanding. Their approach improved detection accuracy compared to conventional sensor-based systems and provided adaptive audio responses. The work proved that deep learning can significantly improve assistive wearables, though real-time deployment on lightweight hardware still requires optimization.

Poy et al. (2024) designed a standalone smart glass system that functions without depending on external mobile devices. Their system integrated basic vision sensing and voice output for navigation support. The portability and ease of use made it suitable for daily activities, but the lack of IoT connectivity and advanced environment intelligence limited its functionality. From the reviewed literature, it is evident that existing systems mainly focus on obstacle detection and simple voice guidance. Very few systems combine AI-based person recognition, obstacle detection, GPS location support, and emergency communication into a single wearable solution. This gap motivates the development of the proposed AI-enhanced smart glasses system, which aims to provide a more intelligent, safe, and user-friendly navigation experience.

IV. PROBLEM STATEMENT

Visually impaired individuals face significant challenges in recognizing nearby people, identifying obstacles, and understanding their surroundings during movement. Existing assistive devices mainly provide limited distance-based detection and lack intelligent decision-making. The absence of adaptive voice guidance reduces user confidence and safety. Therefore, there is a need for an AI-enabled wearable solution that provides real-time navigation support, person identification, and environment awareness.

V. EXISTING SYSTEM

The current assistive systems for visually impaired users mainly rely on traditional white canes, ultrasonic walking sticks, or basic sensor-based wearable devices. These systems provide only simple obstacle detection and warning alerts.

Most existing systems do not support:

- Face recognition
- Real-time person identification
- Smart location announcements
- IoT-based connectivity
- Adaptive voice navigation

As a result, the user receives limited information about their surroundings, reducing effectiveness in complex environments.

VI. PROPOSED SYSTEM

The proposed system consists of smart glasses integrated with a camera, ultrasonic sensor, microcontroller, GPS/GSM support, and audio output unit. The camera captures live visual data to recognize faces and classify individuals as known or unknown. The ultrasonic sensor detects nearby obstacles and calculates the distance in real time. The microcontroller processes the sensor information and triggers voice alerts through a buzzer or speaker. GPS and GSM modules can additionally provide emergency location support. This intelligent integration ensures safe and user-friendly navigation for visually impaired people.

VII. BLOCK DIAGRAM

Input Section

- Camera Module
- Ultrasonic Sensor
- Emergency Key
- GPS Module



Processing Section

- Arduino Nano / NodeMCU
- AI-based Person Recognition
- Obstacle Detection Algorithm

Output Section

- LCD Display
- Buzzer / Voice Alert
- GSM Alert Message
- Location Announcement

VIII. HARDWARE COMPONENTS

1) Arduino Nano

Chosen for its compact size, easy programming, and reliable sensor interfacing capability.

2) Ultrasonic Sensor

Used for real-time obstacle detection through distance measurement.

3) LCD Display

Provides visual debugging and system status information.

4) Buzzer

Acts as the audio alert system for obstacle and warning notifications.

5) GPS Module

Used for live location tracking during emergencies.

6) GSM Module

Supports SMS/call-based emergency alerts and caregiver communication.

7) Emergency Key

Allows manual activation of emergency location or safety mode

IX. SOFTWARE REQUIREMENTS

- Arduino IDE – for embedded C programming and code uploading
- Proteus 8.13 – for circuit simulation and testing
- AI Model Support Tools – for face and obstacle recognition logic implementation

X. CONCLUSION

The AI-enhanced smart glasses system provides an effective assistive solution for visually impaired individuals. By combining obstacle detection, person recognition, GPS navigation, and voice alerts, the system improves safety, mobility, and independence. This project demonstrates how biomedical engineering, AI, and IoT can be integrated to create impactful healthcare assistive devices. Future improvements may include cloud connectivity, advanced deep learning models, and lighter wearable designs.

REFERENCES

1. Inbamalar, T. Merlin, et al., A Review on Smart Glass with Voice Notification for Blind and Visually Impaired, IEEE, 2025.
2. Mondal, Shuvra, et al., Low-Cost Smart Spectacles to Assist Blind Individuals in Developing Countries, IEEE, 2025.
3. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
4. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2



5. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
6. S.Tamilselvi, R.Prakash, C.Nagarajan, "Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
7. S.Tamilselvi, R.Prakash, C.Nagarajan, " Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epr.2025.112428
8. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
9. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31, April-June.2013, DOI: 10.2478/aei-2013-0025.
10. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, Frontiers of Electrical and Electronic Engineering, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
11. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
12. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
13. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: <https://doi.org/10.1590/1517-7076-RMAT-2024-0721>
14. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
15. .Murugaiyan, Bharanitharan, et al., Hands-Free Smart Glass for the Visually Impaired with Real-Time Obstacle Detection, IEEE, 2025.
16. .Hekal, Asmaa A., et al., Utilizing Deep Learning in Smart Glass System to Assist the Blind and Visually Impaired, 2024.
17. .Poy, Yi-Ler, et al., Standalone Smart Glass System for the Blind and Visually Impaired, IEEE, 2024. **Kiran, A., Rubini, P., & Kumar, S. S. (2025).** Comprehensive review of privacy, utility and fairness offered by synthetic data. *IEEE Access*.
18. **Gopinathan, V. R. (2024).** Real-Time Financial Risk Intelligence Using Secure-by-Design AI in SAP-Enabled Cloud Digital Banking. *International Journal of Computer Technology and Electronics Communication*, 7(6), 9837-9845.
19. **Udayakumar, R., Elankavi, R., Vimal, R., & Sugumar, R. (2023).** Improved Particle Swarm Optimization with Deep Learning-Based Municipal Solid Waste Management in Smart Cities. *Environmental & Social Management Journal*, 17(4).
20. **Anand, L. (2023).** An Intelligent AI and ML-Driven Cloud Security Framework for Financial Workflows and Wastewater Analytics. *International Journal of Humanities and Information Technology*, 5(02), 87-94.
21. **Soundappan, S. J. (2020).** Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. *International Journal of Advanced Research in Computer Science & Technology*, 3(1), 2248-2253.
22. **Rajasekar, M. (2024).** Real-Time Predictive DevOps Intelligence for Risk-Aware Digital Business Processes in Cloud and SAP Ecosystems. *International Journal of Advanced Research in Computer Science & Technology*, 7(4), 10713-10718.
23. **Poornima, G., & Anand, L. (2024, May).** Novel AI Multimodal Approach for Combating Against Pulmonary Carcinoma. In **2024 5th International Conference for Emerging Technology (INCET)** (pp. 1-6). IEEE.
24. **Prabha, P. S., & Rengarajan, A. (2025).** Adaptive Cloud Resource Allocation Using Attention-Driven Deep Reinforcement Learning. *Engineering, Technology & Applied Science Research*, 15(6), 29334-29340.
25. **Jagadeesh, S., & Sugumar, R. (2017).** A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.



26. Varma, K. K., & Anand, L. (2025, March). Deep Learning Driven Proactive Auto Scaler for High-Quality Cloud Services. In *International Conference on Computing and Communication Systems for Industrial Applications* (pp. 329-338). Singapore: Springer Nature Singapore.
27. Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS*, 19(11), 3841-3855.
28. Poornima, G., & Anand, L. (2025). Medical image fusion model using CT and MRI images based on dual scale weighted fusion based residual attention network with encoder-decoder architecture. *Biomedical Signal Processing and Control*, 108, 107932.
29. Archana, R., & Anand, L. (2025). Residual u-net with Self-Attention based deep convolutional adaptive capsule network for liver cancer segmentation and classification. *Biomedical Signal Processing and Control*, 105, 107665.
30. Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII Transactions on Internet and Information Systems*, 19(11), 3841-3855.
31. Rengarajan, A. (2025). Cloud-Based AI-Driven Threat Detection Framework for Smart Grid Cybersecurity. *International Journal of Future Innovative Science and Technology*, 8(6), 16065.
32. Murugeswari, B., Sudharson, K., Panimalar, S. P., Shanmugapriya, M., & Abinaya, M. (2020). SAFE– Secure Authentication in Federated Environment using CEG Key code.
33. Raj A. A., & Sugumar, R. (2023). Early Detection of COVID-19 with Impact on Cardiovascular Complications using CNN Utilising Pre-Processed Chest X-Ray Images. *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC), IEEE*.
34. Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.
35. Selvi, G. V., Anbarasan, A. B., Murthy, B. A., & Prabavathy, S. (2023). An Application Oriented Integrated Unequal Clustering Algorithm for Wireless Sensor Network. In *Underwater Vehicle Control and Communication Systems Based on Machine Learning Techniques* (pp. 140-154). CRC Press.
36. Sruthi, R. S., Ananya, S., & Murugeswari, B. (2010). Web Based Virtual Control System Laboratory and On-Line Temperature Control of Electrophoresis Equipment using LabVIEW. *International Journal of Computer Applications*, 975, 8887.
37. Vimal Raja, G. (2021). Mining Customer Sentiments from Financial Feedback and Reviews using Data Mining Algorithms. *International Journal of Innovative Research in Computer and Communication Engineering*, 9(12), 14705-14710.
38. MATHEW, A. R. (2025). Neurosecurity and Brain-Computer Interfaces.
39. Soundappan, S. J. (2024). AI-Driven Customer Intelligence in Enterprise Lakehouse Systems Sentiment Mining Governance-Aware Analytics and Real-Time Data Synchronization. *International Journal of Advanced Engineering Science and Information Technology (IJAESIT)*, 7(5), 14905.
40. Mathew, A. (2025). Human–AI Collaboration in Security Operations: Measuring Alert Trust, Automation Bias, and Analyst Upskilling in AI-Augmented SOC Environments. *International Journal of Computer Technology and Electronics Communication*, 8(5), 11375-11380.
41. Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. *International Journal of Research Publications in Engineering, Technology and Management (IRPETM)*, 5(4), 7106-7110.
42. Poornima, G., & Anand, L. (2024, April). Effective Machine Learning Methods for the Detection of Pulmonary Carcinoma. In *2024 Ninth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)* (pp. 1-7). IEEE.
43. Garg, V. K., Soundappan, S. J., & Kaur, E. M. (2020). Enhancement in intrusion detection system for WLAN using genetic algorithms. *South Asian Research Journal of Engineering and Technology*, 2(6), 62–64.
44. Rengarajan, A., Jayakumar, C., & Sugumar, R. (2012). Optimization Of Recent Attacks Using Internet Protocol. *National Journal of System and Information Technology*, 5(1), 8.
45. Mathew, A. (2024). AI TRiSM: Trust, Risk, and Security Management in Cybersecurity. *Cybersecurity*, 4(3), 84-90.
46. Mathew, A. (2025). Deep seek vs. ChatGPT: A deep dive into AI Language mastery. *Int J Multidisciplinary Res*, 7(1), 1-5.