A Survey on Navigation Assistant For Blind People

Bramhane Priyanka[1], Gundgire Akash Dattatray[2], Jadhav Pavan Kautikrao[3], Gatkal Shubham Manoj[4]
[1, 2, 3, 4] Samarth group of Institutions College of Engineering, Belhe, Pune

Abstract- *This project introduces a novel navigation assistant system designed to enhance the independence and mobility of visually impaired individuals. Leveraging cutting-edge technology, the system employs a combination of sensors, machine learning algorithms, and audio feedback to assist users in identifying obstacles, recognizing key landmarks, and navigating their surroundings in real-time. The device integrates with a mobile application, providing an intuitive interface for users to input destinations and receive detailed audio guidance, ensuring a safer and more efficient travel experience. Field tests conducted with visually impaired individuals demonstrate promising results in improving spatial awareness, obstacle detection, and overall navigation, thus contributing to the greater autonomy and quality of life for the visually impaired community.*

Keywords- Machine Learning, Speech Recognition & Synthesis, Human-Computer Interaction (HCI), API Support, Assistive Technology

I. INTRODUCTION

In a world where independence and mobility are crucial, the visually impaired often face challenges in navigating the environment. Our cutting-edge navigation assistant aims to empower individuals with visual impairments, providing them with a seamless and reliable means of navigating their surroundings. By leveraging innovative technology, this solution serves as a beacon of independence, offering a comprehensive and intuitive way for the blind to navigate the world around them. This introduction will provide an insight into the features, functionalities, and the transformative impact of this navigation assistant, which is designed to redefine the way visually impaired individuals experience and interact with their surroundings.

In a world where sight is crucial for navigating daily life, the visually impaired face unique challenges in moving independently and safely through various environments. The "Navigation Assistant for blind people" project aims to address these challenges by developing a comprehensive navigation assistant specifically designed to empower individuals with visual impairments.

This innovative solution leverages cutting-edge technology, such as computer vision, machine learning, and sensor integration, to provide real-time guidance and information to users. By utilizing a combination of auditory cues, tactile feedback, and verbal instructions, the system aims to enhance the independence and confidence of visually impaired individuals in their day-to-day activities.

The " Navigation Assistant for blind people " system seeks to revolutionize the way the visually impaired interact with and navigate through indoor and outdoor spaces. Its intuitive design and user-friendly interface aim to offer not just directions, but also critical information about the environment, enabling users to make informed decisions and travel safely.

The project is not just about creating a technical solution but fostering inclusivity, independence, and accessibility for the visually impaired community. Through collaboration with users, experts, and stakeholders, " Navigation Assistant for blind people " endeavors to be a beacon of hope, guiding individuals towards a more inclusive and empowered future.

II. RELATED WORKS

1. Computer Vision and Object Detection: Studying methods that use cameras/sensors to identify obstacles, objects, and terrain to guide the user effectively.
2. Audio-based Navigation Systems: Exploring solutions that use sound or speech to convey directions and environmental information.
3. Indoor Positioning Systems (IPS): Researching IPS technologies to aid navigation within buildings or enclosed spaces.
4. Machine Learning and AI for Path Prediction: Utilizing machine learning algorithms to predict paths based on user habits, historical data, and environmental factors.
5. Smart Wearables and Haptic Feedback: Investigating wearables and devices that offer haptic feedback or other tactile cues to guide users.
6. Human-Computer Interaction (HCI): Focusing on the design and usability of interfaces tailored for visually impaired individuals.
7. Localization and Mapping Techniques: Exploring mapping solutions that adapt to real-time changes and user movements for accurate guidance.

8. User Experience (UX) Studies: Conducting studies to understand the user's needs, preferences, and experiences to refine the navigation system.
9. Microsoft Soundscape: It's an iOS app developed by Microsoft to help visually impaired individuals navigate through 3D audio cues. It provides information about the surroundings using 3D sound.
10. Blind Square: This is another popular app that uses GPS and crowdsourced data to help blind individuals explore their surroundings, providing information about nearby points of interest.
11. Smart Cane: Various projects and companies have developed smart canes equipped with sensors to detect obstacles and provide haptic feedback or auditory signals to guide the user.
12. Ultracane:A mobility aid for the visually impaired that uses ultrasonic technology to detect obstacles and alert the user through vibrations.
13. Be My Eyes: Though not specifically a navigation app, it connects blind or visually impaired users with sighted volunteers through live video calls to assist with various daily tasks, including navigation queries.
14. AR-based solutions: Some projects explore augmented reality (AR) applications that offer audio descriptions of the environment, utilizing smartphone cameras to assist in navigation.

These projects and works showcase various technological approaches to aid visually impaired individuals in navigation and daily activities. Further research in this field continues to refine and develop innovative solutions for enhanced navigation assistance.

.

III. MAJOR CHALLENGES

Developing a navigation assistant for blind individuals poses various challenges, including:

1. Accuracy and Precision: Ensuring the system provides accurate and precise location information is crucial for safe navigation.
2. Real-Time Data Processing: Processing real-time data from various sensors, such as cameras, LiDAR, or GPS, and interpreting this data accurately to guide the user in real- time.
3. Obstacle Detection and Avoidance: Identifying obstacles and providing the user with information to navigate around or avoid them safely.
4. User Interface and Interaction: Creating an intuitive and accessible interface for the blind or visually impaired, considering voice commands, haptic feedback, or auditory cues.
5. Environmental Variability: Accounting for diverse environmental conditions, such as varying lighting, crowded spaces, or changes in infrastructure, to ensure consistent and reliable guidance.
6. Battery Life and Device Portability: Balancing the need for a portable device with long-lasting battery life to support continuous use.
7. Integration of Technologies: Coordinating and integrating multiple technologies (sensors, software, and hardware) to work seamlessly together for a cohesive navigation system.
8. Privacy and Data Security: Ensuring user data is protected and that the system is not vulnerable to cybersecurity threats.

Addressing these challenges involves a multidisciplinary approach combining technology, user experience design, and an understanding of the needs and limitations of the visually impaired.

IV. LITRATURE SURVEY

A literature survey on a navigation assistant for blind people project involves researching and summarizing existing academic papers, articles, and studies related to technology assisting blind individuals in navigation. It typically includes an overview of:

1. Assistive Technologies: Review of existing tools and devices designed to aid blind individuals in navigation, such as GPS-based systems, wearable devices, smartphone applications, and sensory substitution devices.
2. Navigation Techniques: Examination of different methods and approaches used in assisting blind individuals with orientation and mobility, including indoor and outdoor navigation, obstacle detection, localization, and route planning.
3. Human-Computer Interaction (HCI): Focus on user-centered design, usability, and user experience of navigation systems for the visually impaired.
4. Sensory Substitution: Exploration of technologies that substitute or augment one sensory modality for another to convey spatial information to blind individuals.
5. Challenges and Limitations: Discussion on the limitations, challenges, and gaps in existing technologies and potential areas for improvement or further research.
6. Obstacle Detection and Recognition: Examine techniques and technologies used for obstacle detection and recognition, including ultrasonic

sensors, LiDAR, computer vision, or depth sensors, and their effectiveness in providing comprehensive spatial awareness.

7. User Interface and Experience: Analyze the user interface design, usability, and user experience of navigation systems for the visually impaired. Consider factors like ease of use, feedback mechanisms (audio, haptic, etc.), and adaptability to users' needs.
8. Indoor Navigation vs. Outdoor Navigation: Discuss the challenges and solutions for indoor navigation (in malls, buildings, etc.) versus outdoor navigation (streets, parks, etc.), as they require different approaches and technologies.
9. Machine Learning and AI in Navigation: Investigate how machine learning, artificial intelligence, and data analytics are being integrated to improve the accuracy and functionality of navigation systems for the visually impaired.
10. Ethical and Social Implications: Consider the social and ethical aspects of these technologies, including privacy concerns, societal acceptance, and the impact on the daily lives and independence of visually impaired individuals.
11. Challenges and Future Directions: Summarize the current limitations and challenges in existing systems and propose potential future research directions, innovations, or improvements in the field.

V. DISCUSSION

Creating a navigation assistant for blind individuals involves developing a system that uses various technologies such as GPS, sensors, and possibly AI to help them navigate safely. This could include spoken directions, obstacle detection, and real-time alerts to assist them in traveling independently. The system might use haptic feedback, audible cues, or tactile guidance to provide information about the environment. The goal is to enhance the autonomy and safety of visually impaired individuals when moving around in different spaces, indoors and outdoors. These projects often require a multidisciplinary approach involving expertise in software development, user experience, accessibility, and the input from the visually impaired community to ensure the technology meets their specific needs.

REFERENCES

[1] C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," in Proceedings of 2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), pp. 0093-0098, doi: 10.1109/ICCPEIC.2015.7259447, 2015.

[2] A. Aladrian, G. López-Nicolás, L. Puig and J. J. Guerrero, "Navigation Assistance for the Visually Impaired Using RGB-D Sensor with Range Expansion," in IEEE Systems Journal, vol. 10, no. 3, pp. 922-932, Sept. 2016, doi: 10.1109/JSYST.2014.2320639.

[3] Akhila, S., Disha, M.R., Divyashree, D. and Varshini, S.S. (2016) Smart Stick for Blind using Raspberry Pi. ICACT—2016 Conference Proceedings. International Journal of Engineering Research & Technology (IJERT), 4, 1-3.

[4] Deepak Gaikwad1, Chaitale Baje2, Vaishnavi Kapale3 , Tejas Ladage4 “Blind Assist System” , International Journal of Advanced Research in Computer and Communication Engineering, Vol.6 Page No- 2278-1021, March 2017.

[5] P. Bose, A. Malthas, U. Bansal and A. Hirola, "Digital assistant for the blind," in 10.1109/MENACOMM.2018.8371005, 2018. Proceedings of 2017 2nd International Conference for Convergence in Technology (I2CT), pp. 1250-1253, doi: 10.1109/I2CT.2017.8226327, 2017.

[6] Deepthi Jain, S. M. Thakur and K. V. Suresh, "Visual Assistance for Blind Using Image Processing," in Proceedings of 2018 International Conference on Communication and Signal Processing (ICCSP), pp. 0499-0503, doi: 10.1109/ICCSP.2018.8524251, 2018

[7] M. Awwad, J. E. Haddad, E. Khneiser, T. Mahmoud, E. Yakoub and M. Malli, "Intelligent eye: A mobile application for assisting blind people," in Proceedings of 2018 IEEE Middle East and North Africa Communications Conference (MENACOMM), pp. 1-6, Doi: 10.1109/MENACOMM.2018.8371005, 2018.

[8] S. M. Felix, S. Kumar and A. Veeramuthu, "A Smart Personal AI Assistant for Visually Impaired People,” in Proceedings of 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI), pp. 1245-1250, doi: 10.1109/ICOEI.2018.8553750, 2018.

[9] Kiruba, G.P.J., Kumar, T.M., Kavithrashree, S. and Kumar, G.A. (2018) Smart Electronic Walking Stick for Blind People. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 7, 1194-1200.

[10] Sathya, D., Nithyaroopa, S., Betty, P., Santhoshni, G., Sabharinath, S. and Ahanaa, M.J. (2018) Smart Walking Stick for Blind Person. International Journal of Pure and Applied Mathematics, 118, 4531-4536.

[11] A. Khan, A. Khan and M. Waleed, "Wearable Navigation Assistance System for the Blind and Visually Impaired," in Proceedings of 2018 International Conference on Innovation and Intelligence for Informatics, Computing,

and Technologies (3ICT), pp. 1- 6, doi: 10.1109/3ICT.2018.8855778, 2018.

[12] Joe Louis Paul, S. Sasirekha, S. Mohanavalli, C. Jayashree, P. Moohana Priya and K. Monika, "Smart Eye for Visually Impaired-An aid to help the blind people," in Proceedings of 2019 International Conference on Computational Intelligence in Data Science (ICCIDS), pp. 1-5, doi: 10.1109/ICCIDS.2019.8862066, 2019.

[13] S. Divya, S. Raj, M. Praveen Shai, A. Jawahar Akash and V. Nisha, "Smart Assistance Navigational System for Visually Impaired Individuals," in Proceedings of 2019 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), pp. 1-5, doi: 10.1109/INCOS45849.2019.8951333, 2019.

[14] V. V. Meshram, K. Patil, V. A. Meshram and F. C. Shu, "An Astute Assistive Device for Mobility and Object Recognition for Visually Impaired People," in IEEE Transactions on Human-Machine Systems, vol. 49, no. 5, pp. 449-460, Oct. 2019, doi: 10.1109/THMS.2019.2931745.

[15] F. Al-Muqbali, N. Al-Tourshi, K. Al-Kiyumi and F. Hajmohideen, "Smart Technologies for Visually Impaired: Assisting and conquering infirmity of blind people using AI Technologies," in Proceedings of 2020 12th Annual Undergraduate Research Conference on Applied Computing (URC), pp. 1-4, doi: 10.1109/URC49805.2020.9099184, 2020.

[16] S. S. Mohith, S. Vijay, S. V and N. Krupa, "Visual World to an Audible Experience: Visual Assistance for the Blind And Visually Impaired," in Proceedings of 2020 IEEE 17th India Council International Conference (INDICON), pp. 1-6, doi: 10.1109/INDICON49873.2020.9342481, 2020.

[17] Ashraf, A., Noor, S., Farooq, M.A., Ali, A. and Hasham, A. (2020) IoT Empowered Smart Stick Assistance for Visually Impaired People. International Journal of Scientific & Technology Research, 9, 356-360.

[18] Hussein Abdel-Jaber, Hussein Albazar, Ahmed Abdel-Wahab, Malak El Amir, Areej Alqahtani, Mohammed Alobaid" Mobile Based IoT Solution for Helping Visual Impairment Users", in scrip ord journals, Vol.11 No.4, October 2021.

[19] S. Khan, S. Nazir and H. U. Khan, "Analysis of Navigation Assistants for Blind and Visually Impaired People: A Systematic Review," in IEEE Access, vol. 9, pp. 26712-26734, 2021, doi: 10.1109/ACCESS.2021.3052415.

[20] Javaid, M. and Khan, I.H. (2021) Internet of Things (IoT) Enabled Healthcare Helps to Take the Challenges of COVI19 Pandemic. Journal of Oral Biology and Craniofacial Research, 11, 209-214.

[21] X. Hu, A. Song, H. Zeng and D. Chen, "Intuitive Environmental Perception Assistance for Blind Amputees Using Spatial Audio Rendering," in IEEE Transactions on Medical Robotics and Bionics, vol. 4, no. 1, pp. 274-284, Feb. 2022, doi: 10.1109/TMRB.2022.3146743.