International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 03 | March - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

IOT Based Perception Assistive Device for Visually Impaired Using AI

Mr.K.Parventhan[1], Dr.S.Ummamaheswari[2]

[1]Assistant Professor/ EEE Department/Mahendra Engineering College
[2]Professor/ EEE Department/Mahendra Engineering College

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Abstract -This document The goal of visual implants is to create artificial vision that can partially restore function. It can enhance the quality of life for visually challenged individuals by allowing them to experience light, even after years of darkness, by the use of 60 microelectrodes implanted in the retina. The artificial vision that is made possible by current visual system stimulators has very low resolution because of their small number of microelectrodes. Numerous researchers have sought to enhance artificial vision produced by low-resolution implants through the application of machine learning and image processing techniques. Because phosphine images have low resolution, users report unhappiness with the Retinal Prosthesis System. This underscores the important need for targeted research aimed at improving visual clarity and user pleasure in general. This study presents a novel system that uses voice-based help and real-time dynamic obstacle detection to improve the freedom and safety of blind people when navigating. The system creates a comprehensive and context-aware indoor environment by combining RFID-based pre-implemented tags with sophisticated indoor mapping and semantic mapping technologies.

This system's indoor map editor converts building structures into a digital format by parsing geometric information from architectural models. Semantic mapping uses this digital representation as its foundation and is enhanced with RFID-based tags that offer crucial contextual data such room names, exit points, and landmarks. By guaranteeing that the visually impaired user has access to pertinent spatial data, this semantic mapping improves interior navigation and orientation for the visually impaired user. The system's capacity to detect dynamic obstacles in real-time is one of its primary features. The system continuously scans the environment to identify moving items or obstacles in the user's path using a combination of sensors, cameras, and machine learning algorithms. The technology ensures the user's safety during navigation by detecting objects and instantly adjusting the intended navigation path to avoid collisions. The system incorporates voice-based help to offer simple and easy-to-use interface.

***Key Words*:** Visual Implants, Artificial Vision, RFID-Based Tags, Geometric Information, Voice-Based Assistance.

1.INTRODUCTION

The intricate, multifaceted process of seeing provides the feeling of sight. The act of seeing does not occur in the eyes. Instead, processing reflected light from the environment around us is the result of the brain, retinas, optic nerves, and eyes working together. Sustaining vision can have a significant impact on one's health and standard of living. Visual impairment, also referred to as low vision, is the loss of vision that cannot be treated with glasses, medication, or surgery. Daily activities like reading, shopping, identifying faces, and even crossing the street can be challenging for those who are vision impaired.

For those with vision or hearing impairments, the incorporation of artificial intelligence (AI) into assistive technologies has shown to be a game-changing way to improve accessibility and quality of life. An important development in assistive technology in this regard is the creation of an integrated AI-based smart gadget [1,2]. This gadget uses artificial intelligence (AI) algorithms to offer individualized support and assistance in a variety of daily activities, with the goal of addressing the particular obstacles experienced by visually and hearing challenged people. People who are visually or auditorily challenged frequently face challenges while interacting with others, navigating their surroundings, and getting information. In order to meet various needs, traditional assistive devices frequently need to be used in conjunction with one another and have limited performance.

Advanced AI algorithms for gesture recognition, speech recognition, picture identification, and natural language processing are all included in this AI-based smart assistive gadget [3]. Thanks to these artificial intelligence (AI) features, users can get help from the device in recognizing faces and objects, deciphering spoken language, turning text to speech, and comprehending gestures for engagement and communication. [4,5] In addition, the gadget makes use of sensory inputs from cameras, microphones, and other sensors to recognize the user's environment and offer *assistance and feedback in real time. For people with visual and/or hearing impairments, the gadget offers a smooth and intuitive user experience by utilizing a combination of audio, visual, and tactile feedback modalities.[6,7,8]*

Furthermore, the highly flexible and adaptive architecture of the integrated AI-based smart assistive device enables users to customize the device's functionality to suit their own needs and preferences.[8,9,10] Whether it's interacting with people, traveling new places, or getting digital information, the gadget offers tailored help and support to enable users in their everyday life[11,12].

The design, development, and deployment of an integrated artificial intelligence (AI) smart assistive device for people with visual and/or hearing impairments are presented in this study. We examine the AI algorithms, sensor technologies, and UI design concepts used in the apparatus and talk about how they might increase accessibility and boost the self-sufficiency and independence of people who are blind or deaf. Our goal is to build a more equal and inclusive society in which every person can fully engage in and contribute to their communities by integrating AI technologies into assistive devices.

2.INTERNET OF THINGS (IOT)

The way we connect with the world around us has been redefined by the Internet of Things (IoT), which has emerged as a new technology paradigm.

Fig:1 Internet of Things

The Internet of Things (IoT) is fundamentally an interconnected network of systems, sensors, and gadgets that allow them to easily share, collect, and transfer data. Beyond just being convenient, this connectivity has impacted many aspects of our life, from smart homes and healthcare to industries and cities, ushering in a new era of efficiency and connectivity. A number of household functions are synchronized by Internet of Things (IoT) devices, such as smart appliances that can be managed remotely and thermostats that adapt in response to weather forecasts. The Internet of Things' incorporation into homes not only increases convenience but also encourages cost and energy savings, radically changing how we view and use our living areas.

3. DEEP LEARNING

Artificial intelligence (AI)'s subset of deep learning has become a potent paradigm for handling challenging issues in a variety of fields, including computer vision, natural language processing, healthcare, and autonomous systems. The structure and operation of the human brain, particularly the interconnected network of neurons that support learning and decision-making, are the fundamental sources of inspiration for deep learning. Deep learning algorithms, on the other hand, employ deep neural networks to build hierarchical representations of data straight from raw input, in contrast to typical machine learning methods that rely on manually designed features and explicit programming.

Neural networks, which are computational models made of linked layers of artificial neurons, or units, are the basic building blocks of deep learning. Every neuron takes in input signals, applies a nonlinear activation function to process them, and then sends the resultant signals to layers above. Through a technique known as backpropagation, the network learns the weights—connections between neurons—from data. It then modifies its parameters to minimize the difference between predicted and actual outputs. Deep neural networks are able to learn ever-more-abstract and complicated representations of input by stacking layers upon layers of neurons. This allows the networks to identify complex patterns and relationships that could be challenging to identify using traditional methods.

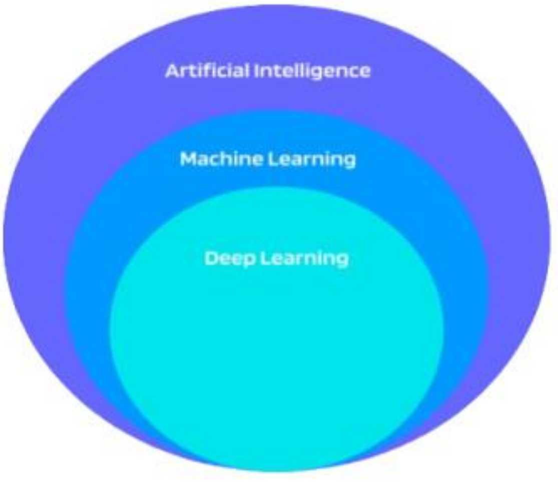

Fig:2 Deep Learning

Deep learning's capacity to automatically identify and extract hierarchical features from unprocessed data without the need for human feature engineering is one of its main advantages. By learning hierarchical representations at several levels of abstraction, this end-to-end learning technique enables deep neural networks to handle high-dimensional and unstructured data, including text, audio, and images, with effectiveness. Deep convolutional neural networks (CNNs), for instance, are able to learn hierarchical feature maps for computer vision applications, which enable them to recognize visual patterns ranging from basic edges and textures to intricate object shapes and contexts.

4 .LITERATURE REVIEW

R. KanesarajRamasamy,etalThe depth and usefulness of current assistive technology for visually impaired people (VIPs), such guide dogs and white canes, are restricted. Furthermore, mobility and real-time distance estimation are two areas where current electronic devices frequently fall short. This study fills these gaps by presenting a novel wearable that combines a pretrained convolutional neural network, a camera module, and a Raspberry Pi into a pair of smart glasses. These glasses are made to recognize things and gauge how far away they are from the wearer while giving immediate haptic or audio input. The development process was intense and included the integration of camera and sensor technology into a lightweight, user-friendly frame as well as the application of machine learning techniques for object detection. Quantitative measurements were used to thoroughly assess the system's performance, demonstrating its accuracy, speed, and usefulness. In summary, this research represents a substantial advancement in wearable assistive technologies, providing VIPs with improved spatial awareness, autonomy, and quality of life.

Hafeez Ali A.; Sanjeev U. Rao,et al,, Tasks involving scene recognition are likely to present challenges for Blind and Visually Impaired People (BVIP). Systems created for and with the BVIP community have benefited greatly from research and evaluation conducted in part because of wearable technology. In order to help BVIP with scene recognition tasks, this study provides a Google Glass-based system that serves as a visual assistant. The image of the surroundings is taken with the camera built into the smart glasses, and it is then examined using Microsoft's Custom Vision Application Programming Interface (Vision API) from Azure Cognitive Services. When the BVIP user wears Google Glass, the voice output from the Vision API is transformed. In order to enhance the performance of the scene description task in Indian situations, a dataset including five thousand additional annotated photographs is generated. Using this dataset, the Vision API is evaluated and trained, resulting in an IoU> 0.5 and an increase in mean Average Precision (mAP) from 63% to 84%. The suggested application's total reaction time was found to be less than one second, allowing for the real-time delivery of accurate data. With the assistance of the BVIP instructors and students at the "Roman & Catherine Lobo School for the Visually Impaired" in Mangalore, Karnataka, India, a Likert scale analysis was carried out.

Md. ZahidulHasan,et al,,People without vision suffer more than those with other forms of disability, and visual impairment is a global issue. People who are blind constantly require a partner when moving about, and in an emergency, they might be alone. There are always issues when he is by himself on the street, trying to find the person nearest to him, and dodging obstructions. For years, researchers have used sensor-based distance measurement devices to deal with visually impaired persons. This research presents a novel way to calculating distance and suggests a Computer Vision based system to navigate visually impaired people using Artificial Intelligence. Through the use of a camera mounted inside a sunglass, the system will record images in real time. A trained YOLO V3 model will then process the video frames. Following processing, the application will recognize seven more items in addition to the 80 pre-trained objects—a person, a car, a bicycle, and broken roads—and generate a navigation command to be heard over headphones. The main achievements of this paper are summarized in a comparison assessment with other comparable works. A number of validation and testing processes were used to get the best possible performance and precise distance measurement.The results, which were confirmed using mathematical computations and the required measuring equipment, show that the suggested system works better than the state-of-the-art in terms of object detection, distance measurement, computing costs calculation, and accessibility for the visually handicapped. This system has a big impact on the growth of a smart city as well as on disabled people because Industry 4.0 demands smart automation.

V.P.Gowtham Raj; E.EsakkiVigneswaran,et al,The results demonstrate that the suggested system outperforms the state-of-the-art in terms of object detection, distance measurement, computing costs calculation, and accessibility for the visually impaired. These findings were verified through mathematical computations and the necessary measuring equipment. Due to Industry 4.0's requirement for intelligent automation, this system has a significant impact on both the development of smart cities and the lives of disabled people. With the aid of this gadget, the virtual smart glass, they may walk independently and get assistance when needed. These glasses aid in orienting oneself in the surrounding environment, and the device is mounted on the glass frame. The microcontroller receives object detection technology as input to determine whether an obstacle is in its path. The gadget will notify the user via audio if there is an obstruction.

Ira Flores,et al,The World Health Organization estimates that 1.3 billion people worldwide suffer from some form of near- or far-sightedness. Individuals who are visually impaired face several challenges in their daily lives since sophisticated assistive technology often falls short of consumer expectations regarding both cost and help level. Building a sophisticated electronic assistive gadget designed for people with visual impairments is the main objective of this paper. The glasses and the smart cane are the two devices used in this investigation. Text identification and recognition—a function of image processing—is handled by the glasses. In addition, the VL53L0X and Ultrasonic combination sensors on the smart cane are in charge of obstacle detection. According to this study, smart glasses and canes work as intended to warn users of potential hazards, facilitate navigation, and interpret text that has been caught by the camera. The accuracy of the smart cane in detecting obstacles is 100%, whilst the smart glasses have an overall accuracy of 98.13% for text in documents and 91.33% for text in natural scenes.

5. PROBLEM STATEMENT

Blind individuals face significant challenges in navigating and orienting themselves in both indoor and outdoor environments. The absence of vision restricts their ability to perceive obstacles, landmarks, and spatial cues, making independent mobility a daunting task. Existing assistive technologies, such as white canes and guide dogs, offer limited support and often fall short in providing comprehensive assistance. Additionally, current indoor navigation systems lack the sophistication required to guide blind individuals effectively through complex indoor spaces, such as malls, airports, and public buildings. The lack of real-time obstacle detection and contextual information exacerbates the difficulties faced by blind people, leading to safety concerns and reduced independence. Therefore, there is a critical need for innovative solutions that address these challenges by leveraging advancements in technology, such as sensors, machine learning algorithms, and voice-based interfaces, to develop robust and user-friendly navigation systems tailored to the unique needs of the blind population. These systems should prioritize real-time obstacle detection, provide accurate spatial information, and offer intuitive interaction mechanisms to enhance the safety, confidence, and independence of blind individuals in navigating their surroundings.

6.PROPOSED SOLUTION

The proposed solution combines cutting-edge technology with user-friendly design to completely transform the navigation experience for blind and visually impaired people. In order to offer a safer, more autonomous, and effective navigation experience, our all-encompassing mobile solution focuses on real-time dynamic obstacle detection, thorough indoor mapping, voice-based assistance, and object and water detection capabilities.

Real-Time Dynamic Obstacle Detection

This system's real-time dynamic obstacle detection function is its core component. The system, which is outfitted with sensors or cameras, keeps an eye on its surroundings in order to detect any moving or immovable obstructions. These sensors gather information about the items around the user and provide it to the navigation stick's processor. By analyzing this data and making real-time adjustments to the user's path to prevent collisions, the system improves navigation safety through the application of sophisticated machine learning algorithms.

Indoor Mapping and Semantic Understanding

To have created an indoor map editor that can parse geometric data from architectural models to enable indoor navigation. This editor creates a semantic map that is enhanced by pre-implemented RFID tags that are positioned thoughtfully throughout the indoor space. By giving the user access to contextual information like room names, exit points, and landmarks, these tags help them better comprehend and navigate their surroundings.

Voice-Based Assistance

In order to improve accessibility and user interaction, our system incorporates a voice-based interface. Simple voice commands allow the user to interact with the system and receive feedback and instructions in audible form. The user experience is improved overall by this hands-free interface's ability to facilitate smooth communication between the user and the system and lessen cognitive strain.

Object and Water Detection

Our system has advanced object and water detecting capabilities in addition to obstacle identification. The device can detect possible hazards like water bodies, steps, or other impediments in real-time by using specialized algorithms. The user can safely and freely move around these threats after the system warns them upon identification.

User-Friendly Design and Portability

The system is lightweight, portable, and user-friendly since we recognize how important comfort and convenience are to users. The navigation stick features a tactile feedback mechanism to help the user navigate, as well as ergonomic controls that are sized to fit comfortably in the user's hand. The system also has a long-lasting battery life that allows for prolonged operation, guaranteeing dependability and consistency in helping the user.

Integration and Connectivity

The suggested system can be seamlessly integrated and connected because it is made to work with a wide range of platforms and devices. Whether integrating with other assistive technology or connecting to a smartphone for extra functionality, our system is flexible and adaptable enough to fulfill the many demands of people who are blind or visually impaired.

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Proposed Block Diagram

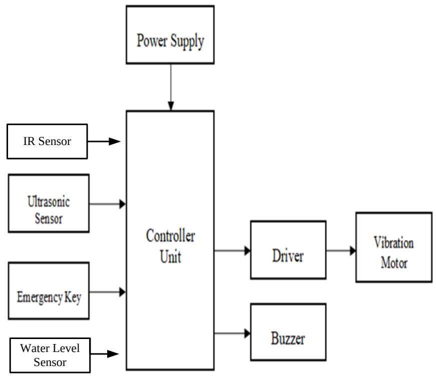
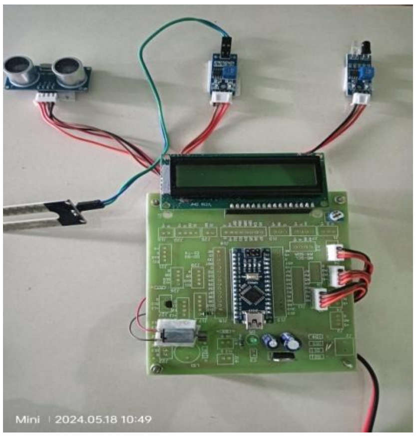


Fig:3 Block Diagram

7 .Hardware

Hardware output Image



8 RESULT

The result of the project has demonstrated significant advancements in the navigation experience for blind and visually impaired individuals. By integrating real-time dynamic obstacle detection, users are now able to navigate their environments with greater safety and confidence, avoiding hazards that might otherwise pose a risk. The comprehensive indoor mapping feature allows users to easily find their way through complex indoor spaces, such as shopping malls or office buildings, enhancing their autonomy and reducing dependence on others for guidance. Voice-based assistance provides intuitive and accessible interaction with the system, ensuring that users can easily receive navigational instructions and updates without needing to rely on visual cues.

Moreover, the inclusion of object and water detection capabilities further elevates the system's effectiveness by addressing common challenges faced by blind and visually impaired individuals. The technology can identify and alert users to objects in their path and detect water hazards, preventing accidents and enhancing overall safety. The user-friendly design ensures that these advanced features are accessible and easy to use, making the technology a practical tool for everyday navigation. As a result, the project has successfully created a more inclusive and empowering solution that significantly improves the quality of life for its users.

9. CONCLUSION & FUTURE SCOPE

This project involves significant advancements in artificial vision technology aimed at enhancing the quality of life for visually impaired individuals. By leveraging machine learning, image processing, and innovative mapping techniques, this project seeks to address the limitations of current low-resolution visual implants. Future developments could include increasing the number of microelectrodes to improve visual clarity, refining real-time dynamic obstacle detection to enhance safety, and expanding the use of semantic mapping and RFID-based tags to provide more comprehensive and contextually relevant indoor navigation. As these technologies evolve, the potential for creating a more immersive and functional artificial vision experience grows, ultimately aiming to restore greater levels of independence and satisfaction for users.

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