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ECHO GUIDANCE: VOICE ACTIVATED APPLICATION FOR BLIND WITH SMART ASSITIVE STICK USING MACHINE LEARNING

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ABSTRACT

Navigating the world without sight presents profound challenges for millions of visually impaired individuals. Echo Guidance includes a pioneering application, addresses these obstacles by facilitating independence and mobility through voice-driven interaction and an IoT smart assistive device for obstacle detection by utilizing Ultrasonic, GPS and GSM modules powered by Arduino. This study explores the design and evaluation of Echo Guidance, highlighting its utilization of advanced algorithms like RGB888 conversion, matrix transformation, and Optical Character Recognition (OCR) for real-time object recognition. The application boasts a voice-centric interface tailored to the needs of the visually impaired, seamlessly integrating day-to-day functionalities such as weather forecasting, reminders, and a calculator accessible through voice commands. Central to Echo Guidance is its innovative object detection and recognition approach, employing the MobileNetObjDetector class powered by TensorFlow Lite for swift and accurate object detection. The OverlayView class visually represents detected objects, enhancing spatial awareness. Additionally, the integration of IoT devices, such as the smart stick with ultrasonic sensors for obstacle detection and head-level obstacle detection, coupled with SOS functionality in case of any emergency using GPS and GSM modules, further enhances Echo Guidance's capabilities. This research underscores Echo Guidance's transformative potential in improving the quality of life for visually impaired individuals, representing a significant advancement in assistive technology. Prioritizing accessibility and user experience, this paper empowers individuals worldwide with newfound independence and confidence in navigating their surroundings.

I.INTRODUCTION

In contemporary society, individuals with visual impairments confront formidable challenges in navigating their environments independently.

Traditional assistive technologies [1], predominantly reliant on visual feedback, often prove inadequate in addressing the multifaceted needs of this population. Echo Guidance emerges as a transformative solution, seeking to redefine the landscape of navigation assistance for the visually impaired through a novel voice-driven interface. This research paper focuses on investigating the efficacy of Echo Guidance in facilitating navigation for individuals with visual impairments, with meticulous attention to its integration with Internet of Things (IoT) technology, utilization of

machine learning (ML) algorithms for enhanced object recognition, incorporation of Optical Character Recognition (OCR), and integration of an SOS functionality. Echo Guidance represents a paradigm shift in navigation aids by offering a purely voice-driven interaction paradigm, alleviating the reliance on visual cues. Central to its functionality is the seamless integration with an IoT device [2], notably a blind stick fortified with ultrasonic sensors. These sensors, strategically positioned to cover all directional angles, facilitate real-time detection of obstacles in the user's immediate vicinity. Additionally, an ultrasonic sensor integrated into the cap provides supplementary coverage for head-level obstacles [3]. The sensory data captured by the IoT device is processed in real-time using Arduino technology, enabling prompt and accurate audio feedback to the user concerning their surroundings. Furthermore, Echo Guidance harnesses ML algorithms, particularly the MobileNet architecture, to augment object recognition capabilities. The application leverages TensorFlow Lite, a lightweight variant of the TensorFlow framework [4] optimized for mobile and embedded devices, to execute the trained ML model efficiently. Through techniques such as RGB888 conversion and matrix transformation, visual data captured by the device's camera is transmuted into auditory cues [5], empowering users to perceive and navigate around detected objects in real-time. This fusion of ML and IoT technologies underscores the multifaceted approach employed by this paper to address the complex challenges of navigation for individuals with visual impairments. In addition to its core functionalities, Echo Guidance incorporates OCR capabilities [6], further enriching its utility for users with visual impairments. Through OCR, textual information present in the user's environment is captured and converted into auditory feedback, facilitating greater access to printed materials and signage. Moreover, the integration of an SOS functionality enhances the safety and security of users in emergency situations. A dedicated SOS button on the IoT device triggers the transmission of distress signals via SMS, leveraging GSM modules, to predefined contacts, thus ensuring timely assistance when needed most. In summary, this research paper aims to comprehensively evaluate the effectiveness of Echo Guidance in addressing the navigation needs of individuals with visual impairments. By examining its integration with IoT technology, utilization of ML algorithms, this study seeks to underscore the transformative potential of Echo Guidance in enhancing the independence, safety, and overall quality of life for individuals with visual impairments.

II.EXISTING SYSTEM

Previous research has extensively explored the fusion of object recognition algorithms with voice assistance systems to provide navigation aid for visually impaired individuals. Notably, studies by Lilhare et al., [7] limitations in recognizing a diverse range of objects, risks of technological obsolescence, and complexities in feature extraction have been noted, posing significant hurdles in achieving real-time performance and versatility in assistive technologies. Despite the advancements like a voice-based access system for visually impaired people [8] where users can open camera with voice command and camera will detect live objects and give result in the

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form of voice, reliance on traditional camera-based approaches may limit adaptability and realtime performance. Moreover, voice-only output may lack detailed information and potentially hindering user comprehension as well as interaction. Furthermore, IoTbased navigation devices, as investigated by Apu et al., [9] have gained attention for their potential to enhance navigation assistance for the visually impaired. These devices integrate sensors and connectivity modules to detect obstacles and provide real-time feedback. However, concerns regarding reliance on technology, effectiveness in complex environments, and maintenance issues have been raised, necessitating further optimization and development in IoTbased solutions**.**

III.PROPOSED SYSTEM

The architecture of the Echo Guidance system comprises a mobile app [19]tailored for visually impaired users, seamlessly integrated with an IoT Smart Stick. The mobile app incorporates modules for OCR, object detection, utility features, location services, and user interaction, providing comprehensive navigation assistance and accessibility features. Through OCR integration, printed text is converted to speech, enhancing accessibility. Object detection algorithms and machine learning enable real-time detection of obstacles, while utility features like weather forecasting and a calculator further enrich the user experience. Integration with the IoT Smart Stick, equipped with Arduino microcontrollers, ultrasonic sensors, GPS, and GSM modules, enhances navigation with obstacle detection, precise geolocation, and emergency communication capabilities. Together, this architecture empowers visually impaired individuals to navigate with confidence, promoting independence and inclusivity in everyday life.

IV.LITERATURE SURVEY

A. K. P. C. S. B. a. R. G. K. Patil, "Guidance System for Visually Impaired People," in 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), Coimbatore, India, 2021.

The issue of visual impairment or blindness is faced worldwide. According to statistics of the World Health Organization (WHO), globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion are blind. In terms of regional differences, the prevalence of vision impairment in low- and middle-income regions is four times higher than in high-income regions. Blind people generally have to rely on white canes, guide dogs, screen-reading software, magnifiers, and glasses to assist them for mobility, however to help the blind people the visual world has to be transformed into the audio world with the potential to inform them about objects, direction information using lidar as well as their spatial locations with GPS. Therefore, we propose to aid the visually impaired by introducing a system that is most feasible, compact, and cost effective. So, we implied a system that makes use of Raspberry Pi in which you only look once (YOLO v3) machine learning algorithm trained on the coco database is applied. “ONLY BECAUSE ONE LACKS THE USE OF THEIR EYES DOES NOT MEAN THAT ONE LACKS VISION.” Eyesight is one of the essential human senses, and it plays a significant role in human perception about the surrounding environment. For visually impaired people to be able to provide,

experience their vision, imagination mobility is necessary. The International Classification of Diseases 11 (2018) classifies vision impairment into two groups, distance and near presenting vision impairment. Globally, the leading causes of vision impairment are uncorrected refractive errors, cataract, age-related macular degeneration, glaucoma, diabetic retinopathy, corneal opacity, trachoma, and eye injuries. It limits visually impaired ability to navigate, perform everyday tasks, and affect their quality of life and ability to interact with the surrounding world upon unaided. With the advancement in technologies, diverse solutions have been introduced such, as the Eye- ring project, the text recognition system, the hand gesture, and face recognition system, etc. However, these solutions have disadvantages such as heavyweight, expensive, less robustness, low acceptance, etc. Hence, advanced techniques must evolve to help them. So, we propose a system built on the breakthrough of image processing and machine learning. The proposed system captures real-time images, then images are pre-processed, their background and foreground are separated and then the DNN module with a pre-trained YOLO model is applied resulting in feature extraction. The extracted features are matched with known object features to identify the objects. Once the object is successfully recognized, the object name is stated as voice output with the help of text-to-speech conversion The key contributions of the paper include: ● Robust and efficient object detection and recognition for visually impaired people to independently access familiar and unfamiliar environments and avoid dangers. ● Offline text-to-speech conversion and speech output. People who are visually impaired face two major obstacles to leading fully independent lives: the ability to consume mass media and the ability to safely navigate unfamiliar environments. Electronic reading materials and various other text to speech technologies have significantly improved the ability of visually impaired people to consume the majority of mass media. Engineers, however, have largely failed to develop user-friendly and effective technologies for assisting in navigation. The team sought to develop a LIDAR-based navigation system with auditory feedback that would allow the blind to navigate in unfamiliar environments and perform basic obstacle avoidance. The system need be cost-effective compared to that of a guide dog and practically effective compared to that of a cane or previously developed technological solutions. GPS system provides the information regarding to his current location. The system has one more advanced feature integrated to help the blind find their stick if they forget where they kept it.

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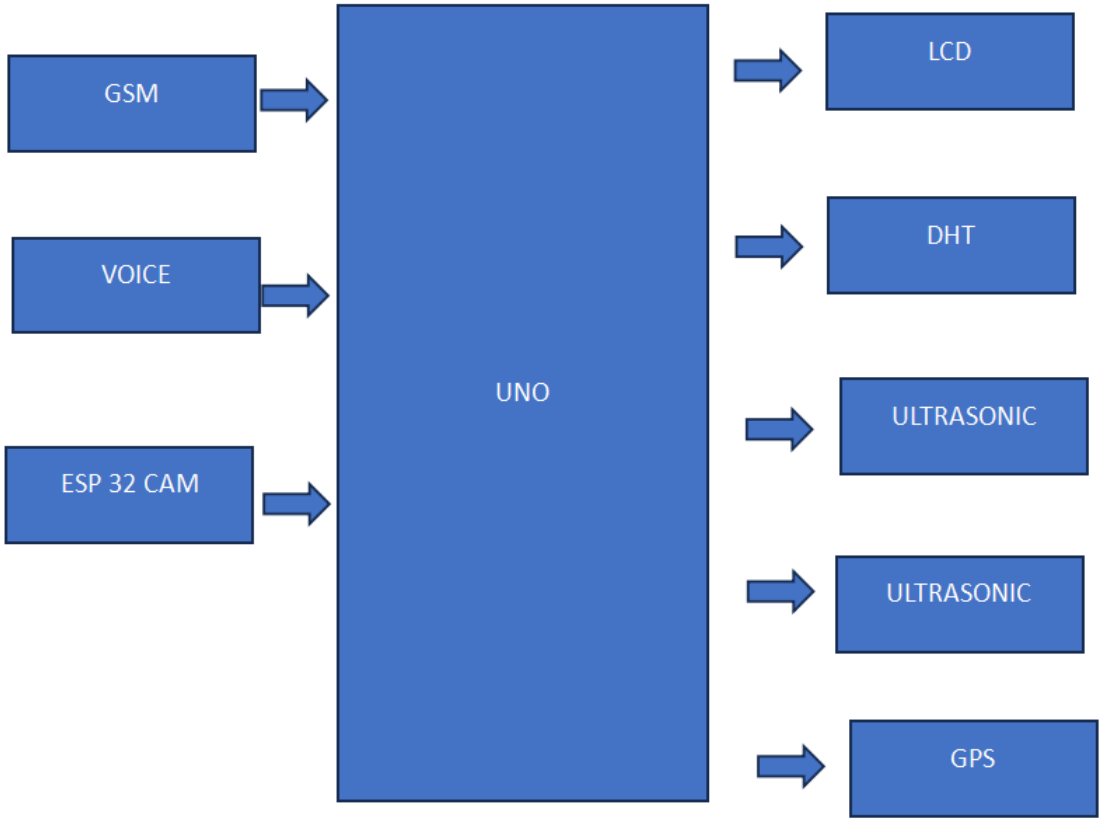
Block diagram



V.CONCLUSION

In conclusion, the findings of this paper shed light on the transformative potential of Echo Guidance in redefining navigation assistance for individuals with visual impairments. Through a comprehensive investigation and meticulous evaluation, the study has revealed the diverse capabilities of Echo Guidance. The integration of Echo Guidance with an IoT device, equipped with ultrasonic sensors, GPS, and GSM modules, represents a significant leap forward in navigation aid technology. The real-time feedback provided by the IoT component enhances spatial awareness and safety, enabling users to navigate independently in various environments. Furthermore, the incorporation of ML algorithms, particularly those based on the MobileNet architecture, empowers Echo Guidance to deliver precise object recognition capabilities. By translating visual data into intuitive auditory cues, users can navigate with confidence, surmounting obstacles with ease. Additionally, the integration of OCR capabilities promotes greater accessibility for users with visual impairments. The inclusion of an SOS functionality adds an extra layer of security, ensuring swift assistance during emergencies. In essence, Echo Guidance represents a paradigm shift in assistive technology, embodying a holistic approach to addressing the diverse needs of individuals with visual impairments. By emphasizing user-centric design principles and rigorous evaluation, Echo Guidance is poised to empower users to navigate their environments with newfound independence and safety.

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