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RASBERRY-PI VISION: INTELLIGENT ASSISTIVE DEVICE FOR BLIND PEOPLE

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ABSTRACT
Millions of blind people throughout the world require assistance on a regular basis. These visually challenged people struggle to travel independently outside of their houses. The Smart Blind Stick that we will build benefits the blind community by making it easier for them to move around independently. The stick contains ultrasonic sensors, a camera, and an earphone/speaker. This system uses a network of ultrasonic sensors to identify impediments up to 400cm in the users' direction, i.e. forward, left, and right. These ultrasonic sensors are connected to the Raspberry Pi for additional processing of data. The algorithm running on the Raspberry Pi estimates the distance to the obstacle and notifies the user via triggering a sound and showing the environment using the camera's acquired image. The camera is utilized for object recognition, & the images it captures are captioned and given to the user as audio. This audio will indicate what that picture is as well as what ought to be performed if it is a barrier, thereby serving to act as virtual eye to blind individuals.

Keywords—
Blind Cap, Image Processing, Object Detection, Raspberry Pi, Image Captioning, Recurrent Neural Network (RNN), Convolutional Neural Network (CNN), Camera etc.

I. Introduction
Blindness is a big problem that the world is now grappling with. According to an online poll, around 39 million individuals are blind, 940 million have some degree of visual loss, and 246 million have extremely impaired eyesight. Complete blindness is the most difficult of the conditions listed above to treat. It has unfathomable consequences for a person's life or mental health [1][2][3]. One of the most surprising statistics is that India now has the highest number of blind individuals; 15 million of the world's 39 million blind persons live in India [4]. India has one of the highest rates of eye donation, with 2.5 lakhs donated each year, yet only 70% of them are usable [5]. People with blindness suffer significant challenges, necessitating an immediate response to this rapidly rising problem. One of most sought-after solutions is the creation of a navigation system for those who are blind. Several technologies have been developed to help the blind navigate and identify obstacles. As technology advances, various varieties emerge. The most popular are Electronic Travel Aids (ETA), which are often equipped both navigation and obstacle recognition technologies. However, many of these gadgets have limited functionality and lack accuracy. To overcome some of the limitations with these currently available devices, a smart stick based on Raspberry Pi was proposed. The smart stick is equipped with a variety of sensors and electronics gadgets, allowing people who are blind to travel and carry out their daily activities more easily. Artificial intelligence and the web of things gathered a significant amount of data. It is feasible to make these people's lives more easier. Blind persons experience a variety of obstacles. Virtual impairment can make it harder for people to perform typical daily tasks. This project is intended to assist blind persons in navigating their surroundings through the use of their ears. This is

a visual project that consists of main components such as a camera and a Raspberry Pi installed together, as well as additional internet-working technologies that are interlinked. The project's input will be images/video, which will be taken and analyzed using a camera interfaced with a raspberry pi and artificial intelligence technologies. The object is identified, and information is supplied via audio and relayed to the blind person through speaker.

II. Problem Identification

Blindness poses significant challenges for individuals, affecting their daily lives and independence. According to global statistics, millions suffer from visual impairments, with India home to 15 million blind individuals. Despite large-scale eye donations, only 70% of donations are usable, leaving a vast population reliant on external support. Traditional aids like Electronic Travel Aids (ETAs) offer navigation and obstacle detection but often lack accuracy and functionality, limiting their effectiveness. Current solutions fail to fully empower blind individuals in navigating complex environments. With advancements in technology, especially Artificial Intelligence (AI) and the Internet of Things (IoT), there is an opportunity to develop smarter, more intuitive devices. The proposed solution involves creating a smart stick equipped with Raspberry Pi, sensors, and AI, designed to offer more reliable real-time assistance, enhancing obstacle detection and navigation through audio feedback. This aims to overcome limitations of existing aids and significantly improve the independence and quality of life for blind individuals.

III. Literature Review

Choudhary, P., & Gupta, A. (2017), This study introduces an assistive system designed for the visually impaired that utilizes sensors to detect obstacles and provide audio feedback. The system relies on a microcontroller to process real-time data from ultrasonic sensors. The paper emphasizes the limitations of traditional white canes and highlights the system’s capability in offering enhanced navigation support to users.

Saini, M., & Aggarwal, R. (2018), In this study, the authors propose a Raspberry Pi-based device integrated with ultrasonic and infrared sensors for obstacle detection. The system provides audio cues to the user, allowing them to navigate independently. The research also evaluates the system's effectiveness in terms of its affordability and reliability for real-world applications.

Patel, H., & Shah, M. (2019), they discuss a novel AI- powered navigation aid designed to enhance obstacle detection accuracy for the visually impaired. The device uses a combination of cameras and AI algorithms to identify objects and provide real-time audio feedback. This study highlights the improvement of AI-based systems over traditional ETAs, especially in detecting dynamic obstacles.

Kumar, R., & Singh, P. (2020), This paper introduces an IoT-enabled smart stick, using Raspberry Pi to process data from multiple sensors. The device sends data to a smartphone application and provides auditory signals to the user. The system's real-time obstacle detection and remote monitoring feature make it a versatile tool for the visually impaired.

Rai, A., & Verma, S. (2021), they explore AI-based object detection and its integration with Raspberry Pi for visually impaired individuals. Their proposed system uses a camera and image recognition algorithms to assist users in identifying obstacles, providing voice-guided navigation. The paper discusses the system’s potential in improving mobility and independence for blind users.

Verma, A., & Sharma, K. (2017), This paper presents a low-cost system based on Raspberry Pi for assisting blind individuals in navigation. The system uses ultrasonic sensors to detect obstacles and employs a text-to-speech module to provide audio feedback to the user. The authors focus on real-time navigation, highlighting the system’s affordability and efficiency in obstacle avoidance.

Bhatia, S., & Rao, P. (2018), This study proposes a smart cane with embedded ultrasonic sensors connected to an Arduino microcontroller for detecting obstacles. The system alerts users via vibration or sound signals when an obstacle is detected. The authors emphasize the ease of use and portability of the smart cane, making it a suitable alternative for traditional white canes.

Das, S., & Mukherjee, P. (2019), Das and Mukherjee propose an artificial vision system based on machine learning, using image recognition and object detection algorithms. The system captures images using a camera module interfaced with a Raspberry Pi and processes the data to provide verbal feedback to the user. The study demonstrates the use of AI for assisting visually impaired individuals with more dynamic environments.

Prasad, R., & Kumar, S. (2020), This research introduces a wearable device for blind people, equipped with sensors for detecting obstacles and environmental conditions. The system uses Raspberry Pi and IoT technology to communicate with a smartphone app, providing real-time feedback through vibration and audio cues. The authors stress the significance of mobility and independence that the device offers.

Singh, A., & Patel, M. (2021), This paper explores the use of deep learning for object recognition in a vision-based navigation system for visually impaired users. The authors implemented a Raspberry Pi-based system that uses a convolutional neural network (CNN) for detecting objects in the environment and providing real-time audio feedback. The study highlights the superior accuracy and adaptability of deep learning algorithms compared to traditional obstacle detection methods.

Kumar, P., & Reddy, V. (2019), This research focuses on developing a smart vision system using IoT and AI technologies. The system captures real-time video data through a camera module, processes it using Raspberry Pi, and provides auditory feedback via a speaker. The authors emphasize the system's ability to detect multiple objects and dynamically assist the visually impaired in navigating complex environments.

Nayak, S., & Gupta, T. (2020), they developed a smart glass equipped with ultrasonic sensors and a camera, connected to Raspberry Pi for real-time image processing and obstacle detection. The system provides verbal instructions to the user through an audio output, allowing visually impaired individuals to detect obstacles and receive navigation guidance. The study highlights its portability and usability in outdoor environments.

Sharma, D., & Mehta, A. (2018), This paper introduces a computer vision-based object detection system using Raspberry Pi. The system uses image processing techniques to identify objects in the environment and relays the information to the user through a text-to-speech engine. The authors discuss the system's high accuracy and potential to improve the autonomy of visually impaired people.

Raj, M., & Rani, P. (2021), This research presents a wearable device that uses ultrasonic sensors and a microcontroller to detect nearby obstacles and alert users via haptic feedback. The authors highlight the system's cost- effectiveness and user-friendly design, which enhances the mobility of visually impaired individuals by providing real- time guidance in indoor and outdoor settings.

Saxena, R., & Singh, A. (2022), This study explores the application of deep learning algorithms combined with IoT technology in developing a visual aid system. The system uses Raspberry Pi for object recognition, employing neural networks to provide detailed auditory descriptions of the surroundings. The research showcases the efficiency of AI in accurately detecting and classifying objects, offering a more intelligent and adaptive assistive technology for the blind.

These papers collectively address the progression from traditional aids to more advanced systems leveraging Raspberry Pi, AI, and IoT for real-time assistance, helping enhance the quality of life for the visually impaired. Each system addresses different aspects of mobility and interaction, providing a comprehensive understanding of the ongoing efforts to improve the quality of life for blind individuals. The innovative approaches being employed to develop visual assistance systems for the blind, with a focus on cost-effectiveness, portability, and real-time obstacle detection using advanced technologies like AI, IoT, and deep learning. These studies underline the growing reliance on technology to significantly improve the autonomy and quality of life for individuals with visual impairments.

IV. Proposed System

The DC supply provide pure 12 V DC voltage to the raspberry pi. Ultra sonic sensor transfer sound

waves and analyze. the echo which is received from the sensor. The sensor measure the time interval between transmitted and received echoes so that the distance to the target is known. Camera capture images and videos transfer from raspberry pi then raspberry pi matches image and video with stored videos and images. Sound gives audio message or vibration on fist.

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- video with stored videos and images. Sound gives audio message or vibration on fist.

The system solves the problem of object identification for a blind person. object detection algorithm can identify the category of object and object name also. accuracy of object detection is a minor issue faced in this methodology and can be overcome with the training of models with different data sets. The problem of interaction with system for a blind person is solved with the help of voice kit. the user simply gives voice commands to search the required object and can be navigated to the object with the use of voice kit and vibration on the fist. The efficiency of voice kit depends on pronunciation of words as well as API used for voice kit.

The main advantage of the system is that it helps the blind people in both indoor and outdoor, care-free navigation. The devices placed in the stick makes it comfortable and easy to handle. The smart stick helps in detecting obstacles placed at a distance in front of the user. The system is suitable for both indoor and outdoor environment. The information regarding obstacles is given through voice alerts, eliminates the difficulty of understanding vibration patterns which was used in earlier systems. The system is a moderate budget mobile navigational aid for the visually impaired.

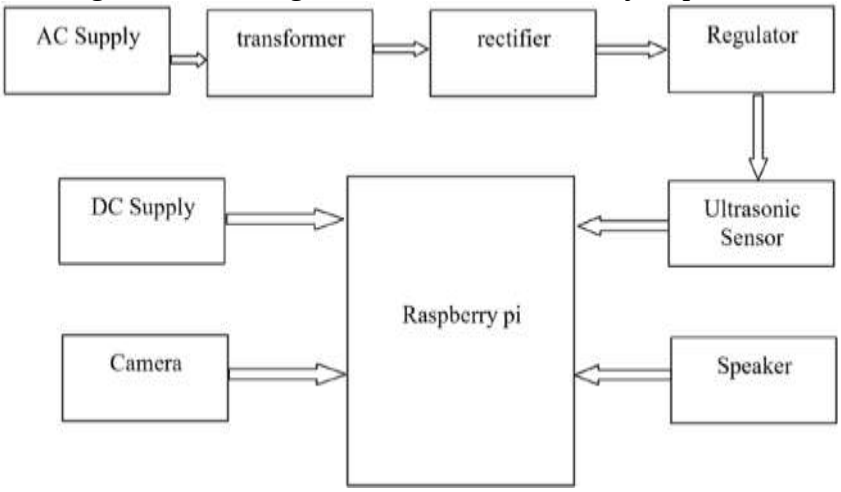

Fig. 1. Block Diagram of system

V. Flow Diagram

A. Image Capture and Match Object

Videos and images are captured using the pi-camera. Images and videos is already captured on the raspberry pi and then a message are transfer to the speaker and vibrator when the image and video match the captured ones.

B. Detect Object

The target distance is calculated using an ultrasonic distance sensor and the output form the sensor is provided to the signal conditioning section and then is processed using an arduino microcontroller. The result from the microcontroller is fed to the LCD display.

C. LCD Display and Audio Output

If an object is matched, the raspberry pi sends the message “Object are present” or “Object are not

present" to the LCD display. An ultrasonic sensor transmits sound waves and analyze the echo received from the sensor. If the object is present in front, you should move from the left side or move from the right side.

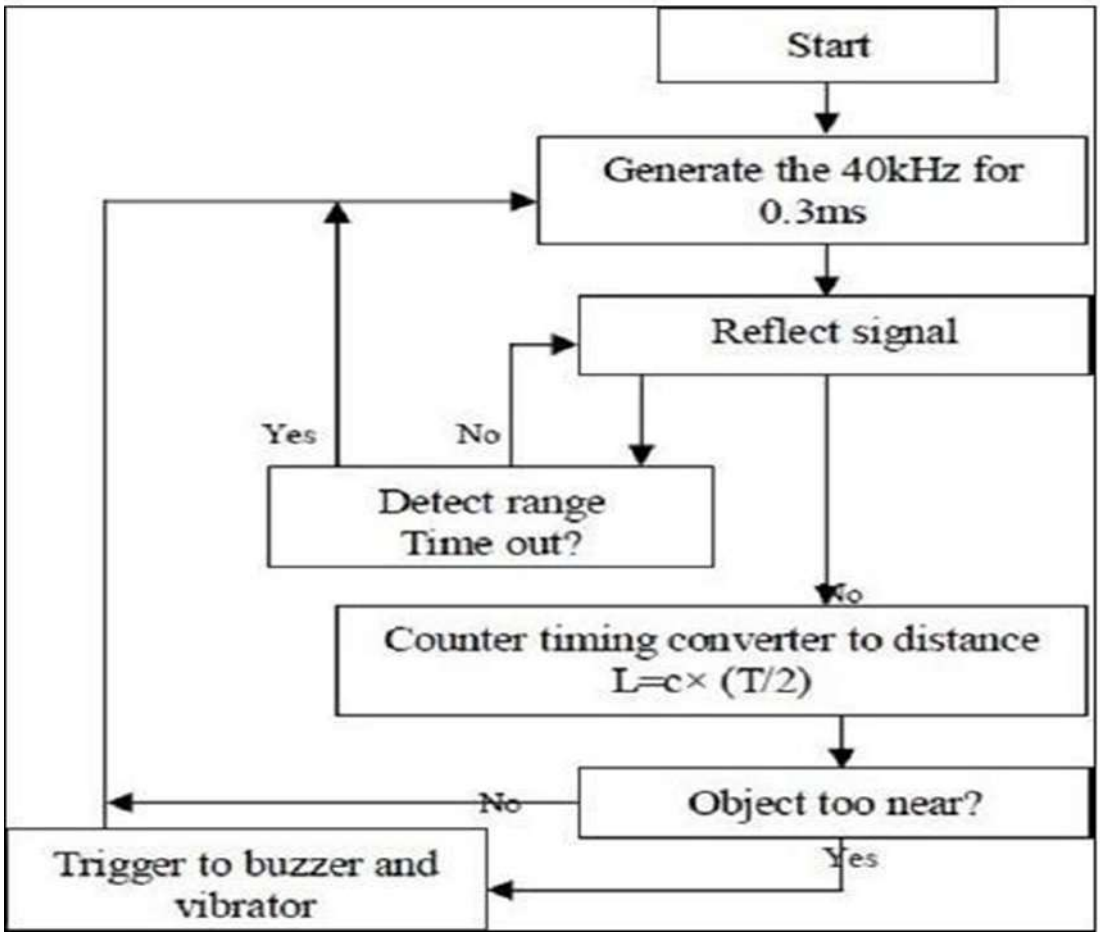

Fig. 2. Flow Diagram of system

VI. Advantages

1) The any obstacles can detect with the help of ultrasonic sensor.
2) Simple to use.
3) Project can support blind people in any situation.
4) There will be fewer accidents with blind peoples.
5) It can many features like detection of light intensity, tracking the location of the lost stick.
6) It functionality addresses the identification of object and signboards.

VII. Application

1. This system used for blind people
2. The proposed system aims to create a wearable visual aid for visually impaired people.
3. It can be used by blind people as well as visual impaired people.
4. It can be helpful for blind people to reach their destination.
5. Help to blind people to walk easily.
6. Help blind people to avoid obstacle.

VIII. Conclusion

This paper presents a novel technique for assisting visually impaired people. The proposed system has as simple architecture and make user friendly Making the subject independent blind people home. The

system also aims at helping the blind people to navigate in detecting obstacles , locate
, read signboards and texts. The system is made user friendly by accepting speech as the input to access his basic necessitate.

The reviewed literature highlights the advancements in assistive technologies for visually impaired individuals, focusing on the integration of sensors, AI, and IoT to improve navigation and obstacle detection. Various systems have been developed using Raspberry Pi, ultrasonic sensors, and AI-powered object recognition algorithms. These solutions provide real-time audio feedback, significantly enhancing the autonomy and mobility of blind individuals. However, challenges remain in terms of system accuracy, cost-effectiveness, and adaptability to dynamic environments. Overall, the studies emphasize the potential of smart assistive devices to improve the quality of life for visually impaired users, with further advancements in AI and IoT expected.

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