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Smart Voice Assistance for Visually Impaired Using IOT and Deep Learning

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Abstract: *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 provide ability to 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.[6] 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.*

Keywords: visually impaired people

I. INTRODUCTION

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 provide ability to 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.[6] 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.

1:The proposed system captures real-time images, then images are pre-processed, their background and foreground are separated and then the Deep Neural Network module with a pre-trained coco 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 objectname is stated as voice output with the help of text-to-speech conversion.

2: The system will also be able to recognize text in books and using text detection extract the information in a book and convert it into audio format using audio synthesis

3: The system has in built sonar sensor which will be able to measure the distance of obstacle and play it through earphones in centimeters.

4: The system has emergency button; on pressing button it sends emergency sos message to caretakers.

1.1 Problem Statement

Conventional blind sticks are useless when it comes to situation like crossing traffic lights as sticks cant detect weather cars or other moving vehicle. And also using stick the obstacle can only be detected after contact of stick with object And blind stick cannot differentiate between different kind of obstacle.Blind sticks are incapable of identifying any objects or obstacle distance greater than 2 meters. For example If a blind person walks in a room he cannot find where the water bottle is or a switch board is with the blind stick.

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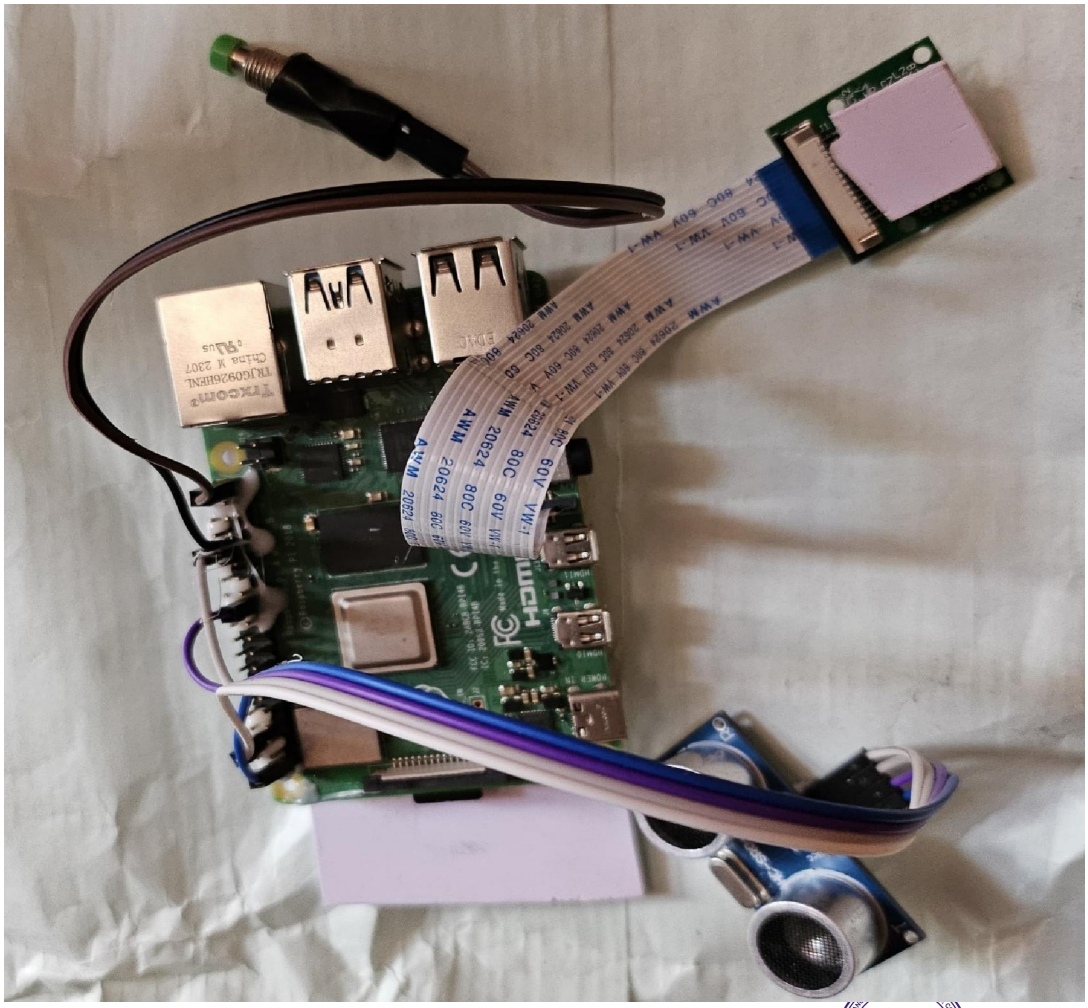
Our proposed system focuses on
1: identification of object
2: measurement of distance
3: text recognition
4: emergency alert ,feature to overcome existing system drawback.

1.2 Solution

Our solution to the problem is to create a device which can recognize obstacles using camera and voice alert.The system uses small compact arm computer raspberry pi,and the system is battery powered.The design of module is small and compact also easy to carry.

This system will continuously record video of the surrounding and will convert it into frames. After analyzing these frames the system will alert the person about some obstacle or the surrounding. The main advantages are the portable, affordable and accessible system using image processing technologies is able to help visually impaired people. By using text recognition algorithm we will be able to identify text and play audio in ear phone. By using ultrasonic sensor we will be able to measure distance between obstacle and person. Also by pressing emergency button we will be able to alert the care takers through SMS.This system will help the visually impaired people to navigate their way through any obstacle and will give them a sense of visualization of world around them.SOS button is used to send emergency SMS using telegram.



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II. SPECIFIC REQUIREMENTS

2.1 Functional Requirements

1. Real-Time Image Capture: The system should capture real-time images using a small camera.
2. Image Pre-processing: Images should be pre-processed to enhance quality and separate background from foreground.
3. Object Recognition: Utilize a Deep Neural Network (DNN) module with a pre-trained COCO model to recognize objects in the images.
4. Text Recognition: Implement text recognition using the Tesseract algorithm to recognize and convert text from images into audio format.
5. Distance Measurement: Integrate an ultrasonic sensor to measure the distance of obstacles and convert it into audio format for the user.
6. Emergency Alert: Include an emergency button that, when pressed, sends an SOS message to caretakers via SMS or messaging platform like Telegram.

2.2 Non-Functional Requirements

1. Accuracy: The system should accurately recognize objects and text, as well as measure distances with high precision.
2. Reliability: Ensure the system operates reliably under various lighting conditions and environments.
3. Portability: Design the system to be small, compact, and battery-powered for easy carrying by visually impaired individuals.
4. Usability: The user interface should be intuitive and accessible for visually impaired users, with clear voice outputs and tactile buttons.
5. Affordability: The system should be cost-effective and accessible to visually impaired individuals regardless of their economic status.
6. Security: Implement security measures to protect user data and ensure the integrity of emergency alerts.
7. Scalability: Design the system to be scalable, allowing for future updates and enhancements to functionality.

III. SYSTEM ARCHITECTURE

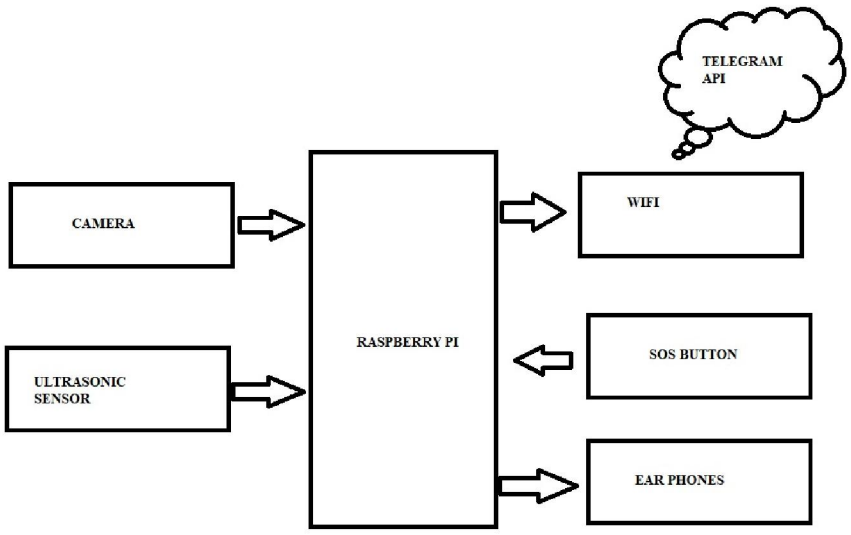

Fig no: 3.1

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IV. DATA FLOW DIAGRAM

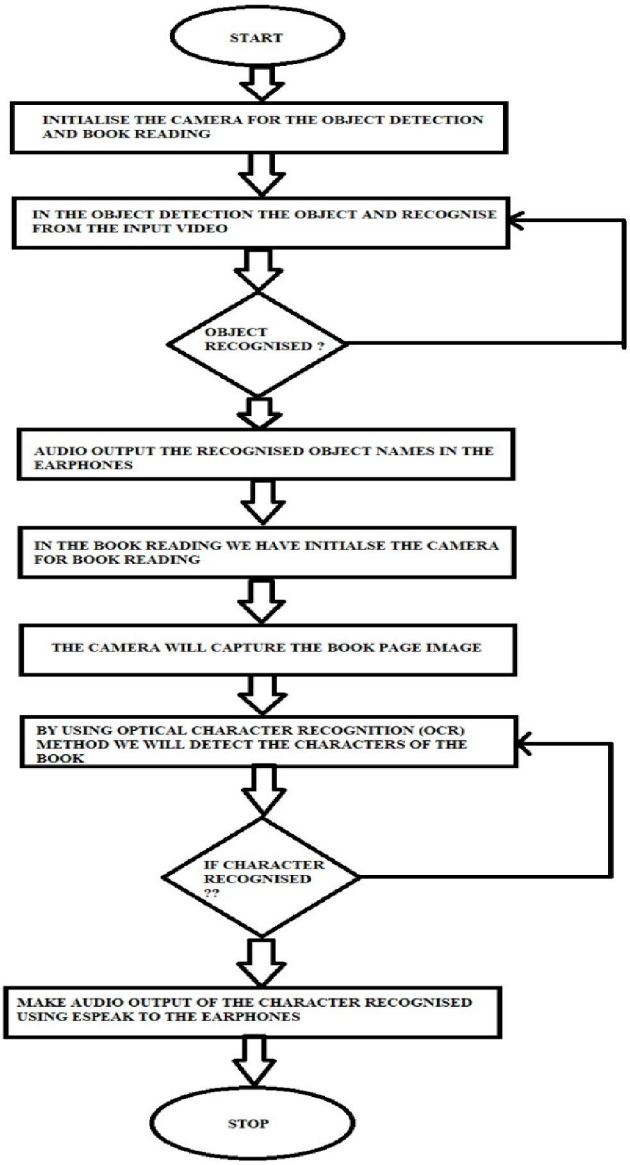

Fig no: 4.1

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V. OBJECT-ORIENTED ANALYSIS AND MODELLING(OOAM)

5.1 Use Case Diagram

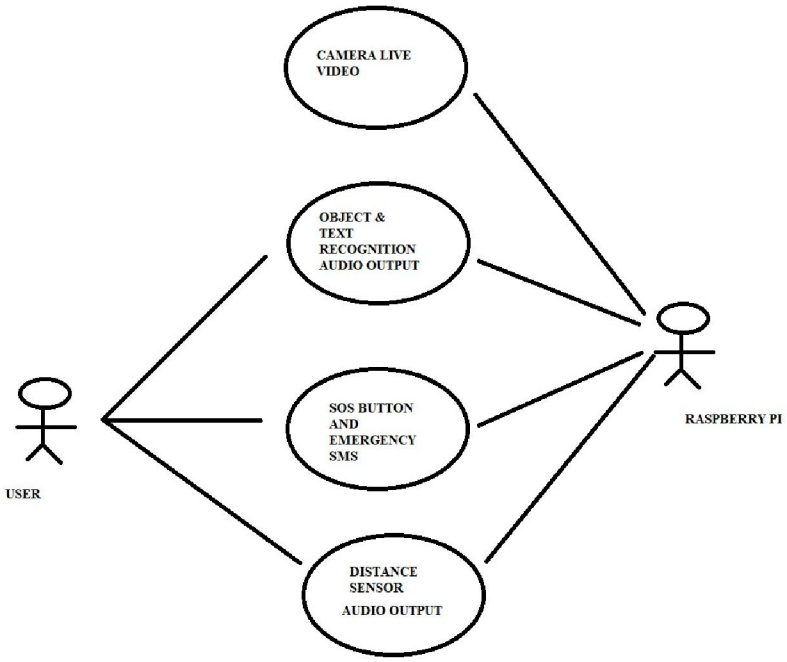

Fig no: 5.1

5.2 System Sequence Diagram

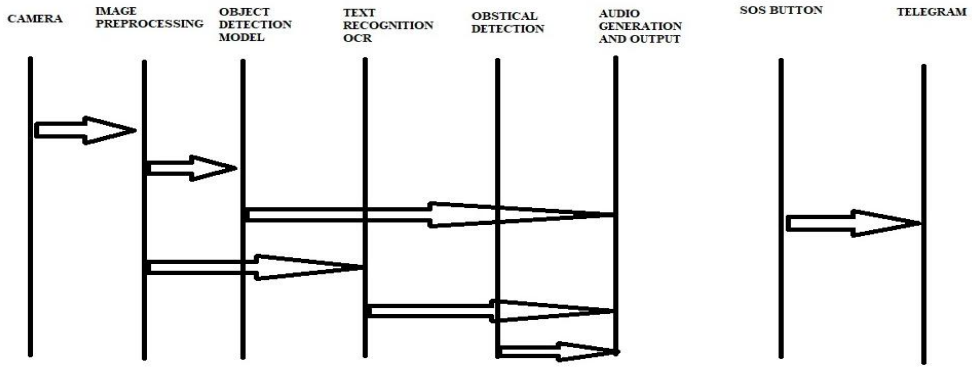

Fig no: 5.2

VI. CONCLUSION

In conclusion, the proposed system offers a comprehensive and innovative solution to address the challenges faced by visually impaired individuals in navigating their surroundings. By leveraging cutting-edge technologies such as image processing, machine learning, and sensor integration, the system provides real-time assistance in object recognition, text extraction, distance measurement, and emergency alerting. Its portability, affordability, and user-friendly interface make it accessible to a wide range of users, enhancing their independence, safety, and overall quality of life. With a commitment to reliability, accuracy, and scalability, the system holds promise for improving the everyday experiences of visually impaired individuals and promoting greater inclusivity in society. Through continued refinement and

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collaboration, assistive technologies like this can play a crucial role in creating a more accessible and equitable world for all individuals, regardless of their abilities.

VII. DEFINITIONS, ACRONYMS, ABBREVATIONS

Definitions:

1. *Real-Time Image Capture*: The process of continuously capturing and processing images as they occur.
2. *Image Pre-processing*: The technique of enhancing data images prior to computational processing.
3. *Tesseract Algorithm*: An optical character recognition engine for various operating systems. It is free software, released under the Apache License.
4. *Ultrasonic Sensor*: A device that measures distance by using ultrasonic waves. It operates by sending out a sound wave at a frequency above the range of human hearing and measuring how long it takes for the echo of the sound to return.
5. *SOS Message*: An international code signal of extreme distress, used especially by ships at sea.
6. *SMS*: Short Message Service, a text messaging service component of most telephone, internet, and mobile device systems.
7. *Raspberry Pi*: A series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries.
8. *Telegram*: A cloud-based instant messaging app where users can send messages and exchange photos, videos, stickers, audio, and files of any type.

Acronyms and Abbreviations:

1. *AI*: Artificial Intelligence
2. *API*: Application Programming Interface
3. *GPU*: Graphics Processing Unit
4. *CPU*: Central Processing Unit
5. *IoT*: Internet of Things
6. *ML*: Machine Learning
7. *DL*: Deep Learning
8. *ANN*: Artificial Neural Network
9. *CNN*: Convolutional Neural Network
10. *RNN*: Recurrent Neural Network
11. *LSTM*: Long Short-Term Memory
12. *NLP*: Natural Language Processing
13. *RGB*: Red Green Blue (color model)
14. *FPS*: Frames Per Second

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