IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

EYE MATE:A REAL-TIME VISUAL ASSISTANT

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Abstract: In a world where vision is a crucial sense for our survival, it is discouraging that millions of individuals struggle with visual impairments. These challenges significantly impact their ability to lead independent and safe lives, as they encounter obstacles in navigating their surroundings, accessing essential information, communicating effectively, and even obtaining dietary recommendations customised to their needs. However, the objective of the proposed work is nothing short of transformative. It seeks to bridge this gap by turning the visual world into an auditory world, offering a lifeline to those with visual impairments. Through an advanced application supporting image processing and machine learning technologies, this system provides real-time guidance using a camera, enabling users to identify objects, human faces, text and an emergency help command to seek assistance. But what truly sets this solution apart is its ability to provide food recommendations based on images captured, all conveyed through audio output. Also an assistive daily activity alarm system designed to empower visually impaired individuals by assisting them in managing their daily activities and schedules. Past efforts have struggled to accurately differentiate between objects, resulting in reduced precision and unacceptable performance. In contrast, this initiative is strongly dedicated to delivering not only exceptional accuracy and peak performance but also a overall, practical solution that empowers visually impaired individuals. It aspires to make the world a better place for them by addressing the adaptable, dietary and daily routine needs, ultimately enhancing their quality of life and encouraging to be independent.

IndexTerms **- Blind,Visually Impaired,Face Recognition,Object Detection,Audio.**

I. INTRODUCTION

Visual impairment is the main problem for people who have the loss of ability to see. Many individuals don't see the world as it appears because their vision is reduced. In an era where images have largely taken over for verbal cues for communication, navigation, and information access, visual problems that millions of people with visual impairments around the globe face continue to be worsen. This makes their independence, safety and ultimately, the quality of their lives deteriorate. While individuals take for granted tasks like navigating busy streets safely, reading printed materials or recognizing faces, these tasks remain overwhelmingly difficult for those who are losing sight. This might spark reliance on others for help resulting in a reduced level of independence; consequently, individuals may not participate in different life aspects, thus their quality of life could be decreased. The inadequacy of the resources of information in a human's power independently can also lead to obstacles, including education, employment and social inclusion.

To tackle these problems, the project seeks to utilize the latest innovations in image processing and machine learning to convert visual world into auditory domain that provides adequate accessibility to the visually impaired community. Using camera-based system in real time the users can perceive the sounds which identify the objects under observation, those who can recognize human faces, and the others that can transform printed text into the spoken words.

Even more, the system utilizes the cutting-edge approach that not only extends accessibility, but encourages more of a dependability and upper hand while moving on the physical terrain. As opposed to other approaches, this system has the ability to give diet advice that is personalized based on pictures of food scanned with the use of artificial intelligence, machine learning to adapt the diet recommendations toward the user. This will not only be symbolic but tools for providing selfsufficient health care and dieting for the blind. However, the system also helps in the current days interaction of both the environment with the creation of the daily alerting system of engagement which will be set to the users to help them prioritize and schedule themselves. This system not only teach us time management but also we come in a situation where the skill development of taking control of daily tasks such as meetings, personal matters and business affairs arise.

The end goal is to enable the visually impaired people in their day-to-day life via the means where we will apply establishing equality, trust and accessibility. Nevertheless, it underpins the idea that the tools of information and communication are the encouraging factors of self-empowerment of people with visual impairment issues. For this reason, this project builds the bridges that those impairments will prevent from crossing which will allow them to check and confirm resources sources information and thus lead the education, profession, and social live successfully.

We aim to utilize the technology to overcome the limitations and level the playing field. This goal is to build a society that cherishes various ways of life, which in return supports and inspires everyone no matter of their disabilities, to reach his or her potentials. Indeed, that plan becomes an important milestone in the direction to implement these dreams and the subsequent creation of such a world where everyone could be part of.

II. BACKGROUND

In a world where sight is fundamental to survival, the challenges faced by millions with visual impairments are profound, affecting every aspect of their lives. Navigating surroundings, accessing information, and even obtaining personalized dietary recommendations become haunting tasks. However, apart from these difficulties, a ray of hope emerges through a revolutionary proposal aiming to transform the lives of the visually impaired. This groundbreaking initiative seeks to bridge the gap between the visual and auditory worlds, offering a lifeline to those in need. By utilizing the power of advanced image processing and machine learning technologies, this innovative system turns visual inputs into auditory cues, providing real-time guidance through a camera interface. Users can identify objects, recognize human faces, and even access text, all through audio output. But what truly distinguishes this solution is its unique ability to offer food recommendations based on captured images, catering to the individual dietary needs of each user. Furthermore, an assistive daily activity alarm system is integrated, empowering visually impaired individuals to manage their schedules with ease. Unlike previous endeavors surrounded by inaccuracies, this initiative is committed to in delivering exceptional accuracy and performance, ensuring a practical and reliable solution for the visually impaired community. Ultimately, the goal is not merely to address immediate needs but to enhance overall quality of life, fostering independence and empowerment. By catering to adaptable, dietary, and daily routine requirements, this initiative strives to create a world where visually impaired individuals can thrive, embracing a newfound sense of autonomy and dignity.

III. PROBLEM STATEMENT

This is a world where vision problems affect many people, and it is disheartening to see them struggle with everyday tasks. Simple things like getting around, reading signs, or knowing what is on their plate become real challenges. Previous attempts to help them haven't been very successful. New idea is on the horizon, aiming to change the game for those with visual impairments. This innovative solution wants to turn what we see into something we can hear. Imagine using special technology, like smart computers and cameras, to help people "see" with their ears. It's like having a personal guide that describes the world around them. But it doesn't stop there. This technology can even give personalized advice about what food to eat, making mealtime less daunting. And to help with daily routines, there's an alarm system that assists with tasks like remembering appointments or taking medication. This idea isn't just about making life a bit easier for people who can't see well; it is about giving them the tools to feel more independent and included in the world around them.

IV. LITERATURE SURVEY

A literature review establishes familiarity with and understanding of current research in a certain topic that includes information like characteristics, problem and solution.

A. Reading Aid and Translator with Raspberry Pi for Blind People

Across the world, many people live with visual impairments. According to the World Health Organization, nearly 1.3 billion people suffer from vision difficulty, and around 36 million people experience complete blindness. Reading can be a difficult task for those with visual impairments, especially when done independently. This system proposes a device to assist visually impaired individuals in reading independently. The hardware includes a camera connected to a Raspberry Pi, utilizing Optical Character Recognition (OCR) to convert captured text into audio speech. The Text-to-Speech (TTS) conversion unit on the Raspberry Pi enables reading in both English and local languages, like Telugu. Optical Character Recognition (OCR) technology offers a solution for visually impaired people. This can convert text from documents or images into a digital format and that can be heard via audio output in the chosen language. This technology benefits not only the visually impaired people but also anyone who find difficulty to read documents in English or other languages. The Raspberry Pi 3B+ executes the program, capturing images of documents for OCR processing, and delivering voice-based output through connected earphones. This device not only aids the visually impaired but also benefits those struggling to read English text documents. The Raspberry Pi 3B+ serves as the central component, ensuring program execution and providing a user-friendly solution for text-to-speech conversion.

- **Implementation**

  The image is uploaded as input to the Raspberry Pi and this image can be seen in a laptop by connecting the Laptop to the Raspberry Pi. Power supply to the Raspberry Pi can be given by using a power bank or by connecting it to a laptop When the image is uploaded . Python language can be used for the implementation of program and necessary libraries are installed in the Raspberry Pi. For producing the output, the image should be preprocessed. The Optical Character Recognition used here extracts the text out from the input image and these extracted text will be modified to be read by the machine. After the conversion of the text and after the recognition of words are completed, the identified text is given as audio output from the Raspberry Pi by using the Text-toSpeech converter. Handwritten texts can also be identified in this system. If the user needs to convert the text into their regional language such as Telugu, the system will provide the converted text from English to Telugu. This could help many people who suffer difficulty in reading English and they can make use of this technique for reading various kinds of English articles.

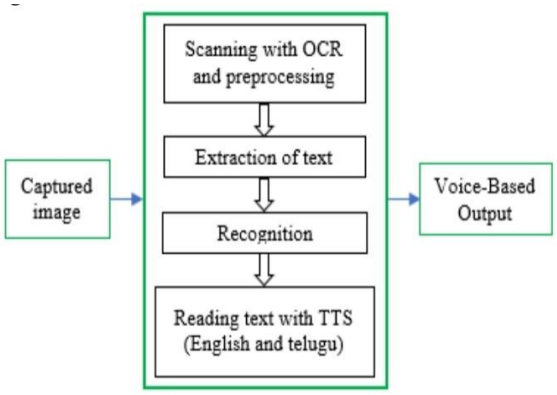

Fig. 1. flowchart of the reading aid

- **Hardware and software**

Fig. 2. Raspberry pi 3B+

In the hardware part, we have a Raspberry Pi 3B+ which has 40 general purpose input and output pins, a power supply port, a HDMI port and 2 USB ports. SD card is used which is having 1GB of memory. This memory can be used to store the necessary programs for the execution on the Pi board. Raspberry Pi is Quad-core, The CPU is of 64 bit and 1.2 GHz Broadcom BCM2837. Among the 40 general input output pins, 4 of them are power pins in which 2 of them are 5 volt pins and these pins are directly connected to power input of the Raspberry Pi and the other two are of 3.3 volt pins.

Fig. 3. camera

Zebronics camera is used for taking pictures of the article/paper. After the shot is taken, the text which is present in the image is converted. Headphones/Earphones can be used for hearing the voice output provided from the Raspberry Pi. Earphones are connected to the audio port/socket which is present on the raspberry Pi board. For the implementation of code for the execution of program of the conversion of text from the images into audio output, python language is used. Tesseract is a platform and is an open source for the Optical Character Recognition (OCR).The OCR converts the text form a document or image into a readable text for the system. After the text is converted into a readable format for the system, the TTS(Text-to-Speech)library is used. TTS can be used for read the text aloud which has already been extracted from the image

- **Interface**

The hardware part consists of a wooden plank and a wooden stand. The wooden stand is used to mount the camera at the top of the wooden stand as shown in Fig.4. Camera position is fixed. Raspberry Pi is placed on the wooden plank and the wooden stand is placed on the wooden plank. Two pushbuttons in which one is used to capture the image and next one is used for reading out the text that is shown at the desktop screen. Software used here are python,OCR, and TTS is installed on the SD card of the Raspberry Pi. Power is supplied to the Raspberry Pi through Power bank. RAspberry Pi can be connected to the laptop/system for the execution of program. For analysing the image captured, Open CV is used. Open Cv can be used for improving the snapped image.

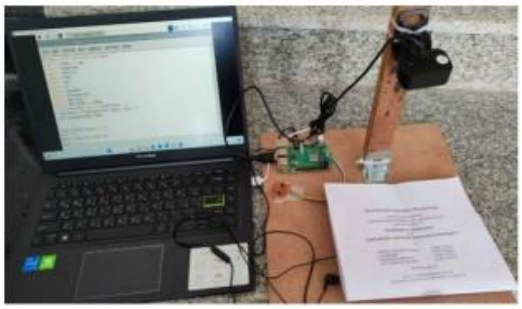

Fig. 4. Hardware Implementation

B. Object Detection and Video Analyser for the Visually Impaired

This research introduces a novel pattern designed to assist visually impaired individuals, aiming to tackle the challenges faced by over 285 million people worldwide. The model is centered around real-time object recognition using a modified version of YOLO V5, encoder-decoder sequences for generating video descriptions, and features for estimating distances. It incorporates LSTM and VGG16 to alert users about nearby objects, providing audio descriptions of input videos or photos for a comprehensive solution tailored to the needs of the visually impaired community.

The combination of object recognition, video description generation, and distance estimation in the proposed model holds significant potential to enhance the daily lives of visually impaired individuals. Leveraging video/image processing techniques, LSTM, and VGG16 for visual analysis, along with methodologies like triangular similarity and frozen graphs, the model achieves precise distance measurements and identifies objects in the user's immediate path, thereby improving safety. The utilization of datasets such as COCO and Flickr-30k further enhances the model's effectiveness. The COCO dataset improves accessibility for visually impaired individuals by focusing on object detection in images, while the Flickr30k dataset is instrumental in natural language understanding and image description generation, particularly for creating sentences or captions to describe images.

In terms of object recognition, the model transitions from YOLO V3 to YOLO V5 for improved performance and accuracy, utilizing OCR to assist visually impaired individuals. The inclusion of CNN for feature extraction, consisting of layers such as YOLO, PANet, and CSP Darknet, ensures precise object detection results, including class, score, position, and size. For distance estimation, the range assessor package employs Python TensorFlow for spacing calculation and distance determination, leveraging the "triangular similarity" assumption and computer vision libraries for live footage processing. Live input from an Android smartphone's webcam is captured, frames are extracted through OpenCV, and VGG-16 is used to extract features from images, facilitating accurate distance calculations and audio caption generation.

Overall, this model represents a significant advancement in assisting visually impaired individuals, offering a holistic approach to object recognition, video description, and distance estimation, ultimately enhancing accessibility and independence in daily life.

C. A Real-time Object Detection Method for Visually Impaired using Machine Learning

Vision serves as a vital human sense, enabling individuals to perceive and interact with their surroundings. However, more than 200 million people worldwide contend with visual impairments, which impose limitations on their daily activities. This study addresses the crucial need for individuals who are blind to comprehend their environment by introducing a tool that utilizes advanced object detection algorithms, specifically YOLO V3 and R-CNN, to provide real-time object recognition and audio guidance. YOLO V3, a convolutional neural network, demonstrates superior effectiveness and accuracy in object detection, assisting blind individuals in navigating various scenarios safely and promoting independence, while R-CNN further enhances accuracy.

The proposed Android app aims to serve as a practical and cost-effective object detection tool for visually impaired individuals, enhancing their independence and accessibility. By integrating YOLO V3 and R-CNN, two state-of-the-art object detection techniques, the app offers real-time identification of objects with high accuracy. Leveraging convolutional neural networks (CNNs) for feature extraction through layerwise convolution operations, the app ensures efficiency and accuracy surpassing that of other object detection algorithms. The fusion of YOLO V3 and R-CNN represents a significant advancement in assistive technology, empowering visually impaired individuals to navigate their surroundings with increased independence and confidence. The seamless integration of these algorithms facilitates rapid object detection with YOLO V3 while refining accuracy with R-CNN, enhancing system precision.

The real-time nature of the system provides immediate feedback to users, enabling informed decisions and confident navigation. Continuously capturing and processing new images, the system delivers a continuous stream of object descriptions, locations, and interaction guidance, empowering visually impaired individuals to interact with their environment autonomously.

- **The system's operation involves several key steps:**

Image capture using an input device like a camera, feature extraction using YOLO V3, enhanced object identification with R-CNN, audio output through an audio recorder, and result delivery via a smartphone. Evaluation of the system's object detection accuracy using the VOC 2012 real-time test dataset and diverse datasets including wildlife animals, household objects, food items,

electronic devices, and clothing items yielded an impressive accuracy rate of 96.48%. These results affirm the system's effectiveness in recognizing a wide range of environmental items.

V. PROPOSED SYSTEMS

The proposed system utilizes real-time image processing and machine learning to execute a range of critical functions. Initially, it employs the YOLO algorithm to swiftly and accurately identify objects in images. This capability is pivotal across various applications, including enhancing security measures, tracking objects, and proficiently managing inventory.Additionally, the system integrates facial recognition capabilities through the Dlib library. This functionality enables the system to discern individuals based on their unique facial features, thus contributing to access control in restricted areas or safeguarding valuable resources.

Another essential feature of the system lies in its ability to extract text from images utilizing Tesseract OCR (Optical Character Recognition) technology. This facilitates the conversion of text within images into audible speech through the Text-to-Speech (TTS) library, significantly enhancing accessibility for individuals who encounter difficulties with reading. Furthermore, the system utilizes a Convolutional Neural Network (CNN) to recommend food items based on image analysis. By inspecting images, particularly those depicting food items, the system can propose recipes tailored to user's preferences and dietary needs, thereby aiding in meal planning and offering personalized culinary suggestions. Moreover, the system empowers users to create and manage to-do lists, with reminders delivered through voice commands. This functionality enhances user organization and productivity by ensuring that crucial tasks are recalled and completed without delay. An emergency help command is also introduced inorder to seek help from the caretakers in dangerous situations.

Overall, the proposed system offers a total solution includes object detection, facial recognition, text extraction, food recommendation, and task management functionalities. By integrating these features, the system provide users with a seamless and efficient experience while addressing their different needs.

1) Object Detection using YOLO Algorithm:

The system utilizes the YOLO algorithm, known for its efficiency and speed, to detect objects in real-time. The mobile device's camera captures images of the indoor environment, which are then processed by the YOLO algorithm. This algorithm is trained to recognize various indoor objects and can detect multiple objects simultaneously.

As the user moves through the indoor space, the YOLO algorithm analyzes the live camera feed, dividing the images into a grid and predicting bounding boxes and class probabilities for each grid cell. This allows the algorithm to identify and classify objects in real-time. The detected objects are translated into actionable information for the user. This information can be conveyed through audio feedback using Text-to-Speech (TTS) technology, where the system verbally announces the identified objects.

2) Face Recognition with Dlib Library:

The proposed system integrates Dlib's facial recognition capabilities to identify familiar individuals. When a person recognized by the system comes into view, the process begins with image capture using the device's camera. Dlib then detects facial landmarks, such as the eyes, nose, and mouth, generating a unique facial feature vector.

This vector, representing the familiar person's facial attributes, is securely stored in the system's memory or database for future comparisons. When face recognition is triggered, a new image of the person's face is captured and analyzed. Dlib once again detects facial landmarks in the new image, creating a new facial feature vector. The system compares this new vector with the stored feature vectors using mathematical analysis or machine learning techniques. If a match is found within an acceptable threshold, the system authenticates the familiar person.

Upon authentication, the system provides audio output via the application, announcing the person's name and their relation to the blind user. This functionality enhances user experience by providing real-time recognition and identification of familiar individuals, facilitating smoother interactions and social connections.

3) Food Recipe Recommendation Using CNN:

The system facilitates food recipe recommendations for visually impaired individuals, leveraging a mobile camera application for image processing. It accepts realtime images of various food items, captured through a camera.

At the core of the system lies a Convolutional Neural Network (CNN) trained on a diverse dataset of food images. This enables the CNN to recognize patterns and features associated with different ingredients and dishes. Upon receiving input images, the CNN performs object detection to identify and localize food items, drawing bounding boxes around each recognized item for further analysis. Subsequently, recognized food items are categorized into specific ingredients, leveraging the CNN's ability to associate visual patterns with different types of food.

The system is integrated with a comprehensive database of recipes, annotated with ingredient lists and detailed preparation instructions. It matches the recognized ingredients against the ingredients listed in the recipe database to identify recipes that can be created using the detected food items. Based on the matched ingredients and considering user preferences, dietary restrictions, and personalized criteria, the system recommends relevant recipes to the blind as audio output.

4) Tesseract OCR for Text Extraction:

The integration of Tesseract OCR (Optical Character Recognition) and Text-to-Speech (TTS) technology improves accessibility for visually impaired individuals in navigating digital content. This collaborative system not only extracts text from images but also converts it into audible speech, making information more accessible and facilitating document reading.

Initially, the system captures images containing textual content, which can originate from various sources such as printed materials or documents. Tesseract OCR plays a crucial role in carefully analyzing these images, recognizing individual characters and assembling them into words and sentences.

Once the text is recognized, it is extracted from the images, transforming visual information into machinereadable textual data. Subsequently, the extracted text undergoes preprocessing to ensure accurate pronunciation and natural-sounding speech. A TTS engine, whether it's a software-based solution or a cloud-based service, is then employed to convert the processed text into audible speech. This integration allows visually impaired individuals to listen to the content instead of relying on visual reading, enhancing their accessibility to digital information.

5) Daily routine alarms:

The system helps users create and manage daily alarms easily. Users can use voice commands to add tasks, set due dates, and specify priorities. It uses Natural Language Processing (NLP) to understand spoken commands, like task names and due dates. This helps keep track of tasks accurately.

All tasks are stored in a central database, sorted by due dates and priorities. This makes it easy to find and manage tasks efficiently. The system schedules reminders based on task timing and user preferences. Reminders are delivered as audible speech through Textto-Speech (TTS) technology.

Users get reminders through voice commands from a voice assistant or built-in interface. They include details about the task and due date, keeping users updated on their daily tasks.

VI. ARCHITECTURE DIAGRAM

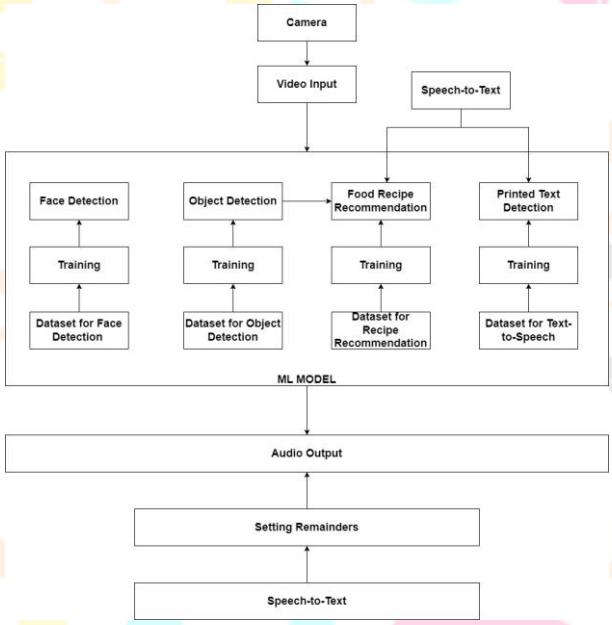

Fig. 5. Architecture Diagram

A system architecture is the conceptual model that defines the structure, behavior of a system.An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.A system architecture can consist of system components and the sub-systems developed, that will work together to implement the overall system.

The architectural diagram is like a map showing how different parts of the software system work together. It includes things like Audio/Video Input, ML Model, Speech-to-Text, and Audio Output, which help the system process audio and video data smoothly.There are special models for Face Detection and Object Detection, trained on specific datasets, so the system can accurately identify faces and objects accurately. Different datasets help refine the system's abilities, like recognizing faces, detecting objects, suggesting recipes, and converting text to speech. The system also uses Speech-to-Text for recipe suggestions and provides audio reminders for visually impaired users.Overall, the diagram shows how everything fits together to make the system work well, from processing audio and video in real-time to helping users with different tasks.

VII. SYSTEM IMPLEMENTATION

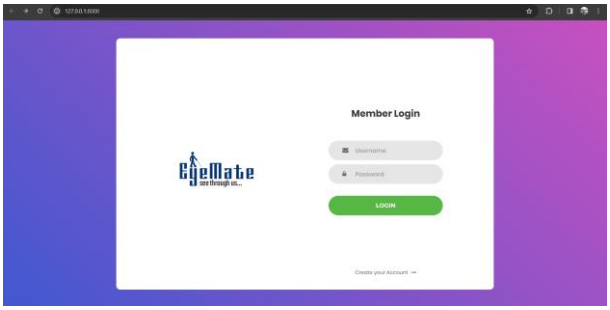

Fig. 6. Login Page

This is the login page for admin and caretaker. Both admin and caretaker can access their respective home pages by entering their corresponding username and password.
When a user enters their username and password and clicks the login button, the system authenticates the user and grants access to system. Or else the user access is denied.

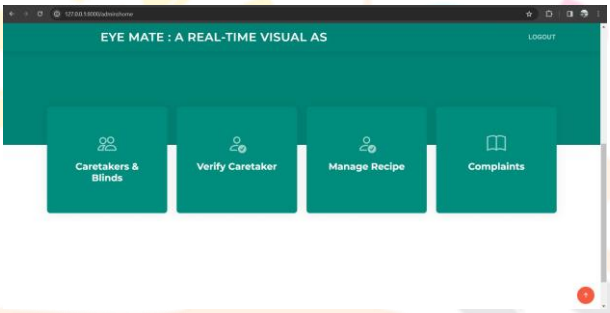

Fig. 7. Admin Home

Fig. 7 is the home page for admin. Various functions/tabs are included in the admin home page which includes Caretakers and Blinds, Verify Caretaker, Manage Recipe and Complaints.

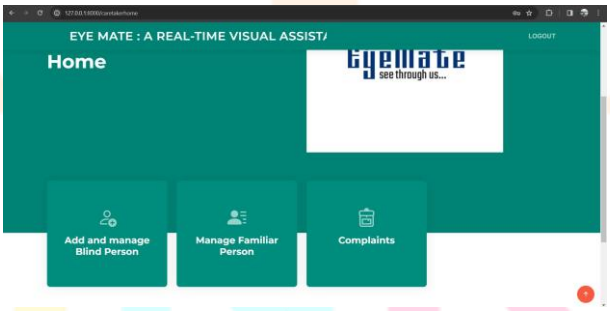

Fig. 8. Caretaker Home

Fig. 8 is the home page for caretaker. Various functions/tabs are included in the caretaker home page,which includes Add and Manage blind person, Manage familiar person and Complaints. Blind can be tracked by the track function from the

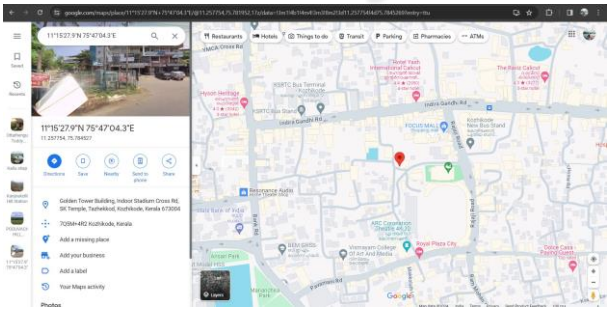

Fig. 9. Track Blind

caretaker page (Fig. 9) The current location of the blind is displayed on the screen to ensure the safety of blind in dangerous situations.
A help command is given in which when command is provided, a video call along with an emergency message is sent to the corresponding caretaker.

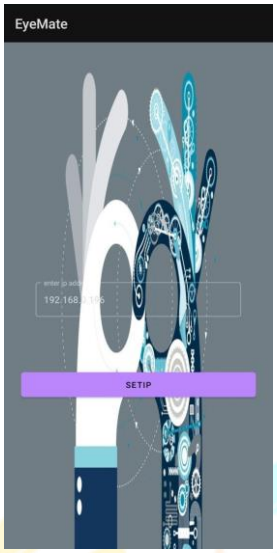

Fig. 10. Eye Mate App

Fig. 10 is the front page for the Eyemate app. Blind can enter into the application with the help of caretaker. Object detection,familiar person recognition, food recipe recommendation and daily routine alarms are performed in this application.

VIII. RESULT ANALYSIS

The system works well for visually impaired peoples. It uses YOLO to find objects quickly and accurately, helping them know what's around them. Dlib recognizes faces accurately, making it easier for them to interact with others. Tesseract OCR turns text from images into speech, so they can listen to it instead of reading. The food recipe recommendation system suggests recipes based on what it sees, helping them plan meals better.
Overall, the system helps visually impaired people in different ways. It's reliable and practical, making their lives easier. In the future, we'll make it even better to keep helping them live independently and happily.

IX. CONCLUSION

This is a world where people with visual impairments face daily challenges, the proposed system offers a ray of hope. It aims to turn these obstacles into opportunities by using advanced technologies like image processing and machine learning. The goal is to bridge the gap between what they can see and what they can hear, providing crucial assistance as they navigate their environment and access important information.

With a mobile app offering real-time guidance, users can easily recognize objects, faces, and text. They can also get personalized food recommendations tailored to their dietary needs. Additionally, the system includes a daily activity alarm feature, empowering users to manage their schedules independently and improving their overall quality of life. At the heart of the system are sophisticated algorithms and libraries that serve specific functions. For example, the YOLO algorithm detects objects, Dlib handles facial recognition, and Tesseract OCR extracts text. By seamlessly integrating these technologies, the system not only makes things more accessible but also ensures accuracy and reliability. Overall, this innovative solution aims to create a more inclusive world for people with visual impairments. It addresses their various needs with precision and practicality, using technology to promote independence and empower them to live fulfilling lives.

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