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Smart Assistive System for Visually Impaired Person

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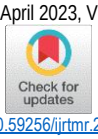

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Abstract: Visually impaired individuals face significant challenges in their day-to-day lives due to limited or no vision. These challenges include difficulties in performing everyday tasks such as reading, writing, cooking and navigating new places. As a result, visually impaired individuals may feel isolated and it leads to limited opportunities for learning and work. In this project, the main objective is to address the obstacles of visually impaired people and assure the happy and independent living. The proposed system is a personal assistant device designed to aid visually impaired individuals. It is a wearable device that comes equipped with a camera. The camera captures images and then converts them into audio feedback. This helps visually impaired people to get a better understanding of their surroundings. Additionally, the device includes a voice assistant that interacts with user using voice commands. By using this device, visually impaired individuals can navigate their environment with more independence, confidence and ultimately enhancing their quality of life.

Key Word: Artificial Intelligence, Assistive Device, Raspberry Pi, Object Recognition, Face Recognition, Text Recognition, OCR, YOLO, Voice Assistance.

1. Introduction

Blind individuals are those who have lost their sight or have limited vision that interferes with their day-to-day activities. Blindness can result from a variety of causes including injury, hereditary eye diseases, age-related macular degeneration and other medical conditions. Blindness is a physical condition that presents unique challenges for individuals who experience it. However, with the right resources and support blind individuals can overcome these challenges and lead fulfilling lives. The blind individuals often face significant challenges due to their visual impairment. These challenges can include difficulties in navigation, limited access to information and educational resources. Blindness is often seen as a disadvantages or a limitation which can lead to misconceptions and discrimination. This can further exacerbate the challenges they already face and can lead to decreased self-esteem and a reduced quality of life. Past few years have seen wide scale applications of artificial intelligence ranging from national defense, scientific research, automated vehicles to space exploration. Taking advantage of the monumental advances in artificial intelligence and helping blind people is our main goal.

2. Problem Identification

Blind individuals face numerous challenges in their environment due to their lack of vision. These challenges can include Navigation, Accessibility, Information and education, social isolation and discrimination.

Objective

The main objective of the project for helping the blind people based on Artificial Intelligence. The objectives are described as follows:

- To design and build a working prototype of a system that will help visually impaired person to sense the obstacle in front of them by sending audio form to the user.
- To guide the visually impaired by detecting objects or person and portray the information to them in the form of speech.
- To store unknown person details by using camera and microphone in real time.
- To recognize the text in the frame and read the information to the user.

- To replay the user command for making the system interactively.

3. Proposed System

The proposed system consists of multiple components such as Raspberry Pi 4 B model development Board, Pi Camera Module with infrared light, USB Microphone and Earphone. The each component aimed at addressing different areas of concern for the visually impaired. One of the primary components of the system is a wearable device that will be equipped with camera. This camera will capture images and the system utilizes image processing techniques to detect object or person. The system provides the user with auditory feedback to avoid obstacles and safely navigate the environment. It also stores the unknown person details in real time if the user wants to store that person's details. This device also includes voice assistance that allows visually impaired individuals to interact with system. The system will improve their day-to-day tasks and also manageable. The general block of the proposed system is depicted in Figure 3.1.

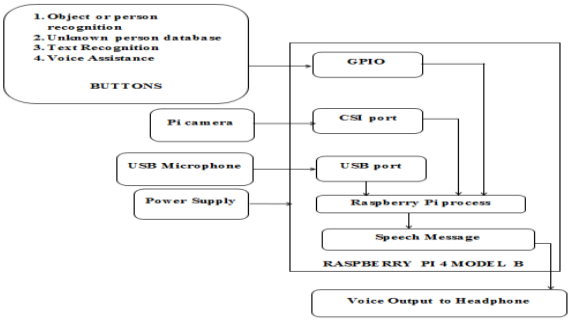

Figure 3.1 General Block Diagram

Additionally, the proposed system includes a feature for accessing educational resources like reading books, newspaper and other resources that will help the visually impaired with their education and personal development. Overall, this system for visually impaired people will improve their quality of life. It provides more accessibility, independence, and access to information and technology.

4. Proposed Methodology

The proposed methodology involves four types of tasks performed in this system. For the first three tasks, the camera will take pictures within its range. The fourth task involves using a microphone to listen to the user's voice. Each of these four tasks will be explained in more detail as follows,

Object or Person Recognition

Object or Person recognition refers to the ability to identify and classify objects or individuals within a given image or video. This process involves analyzing features such as shape, color, texture, and size to determine what is the object or person. The Figure 4.1 is shows the flow chart of object or person recognition.

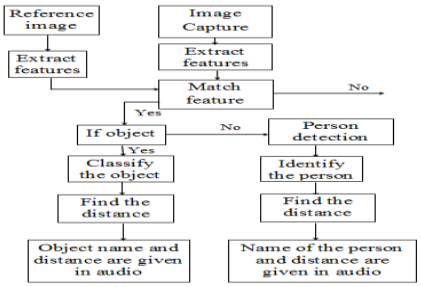

Figure 4.1 Flow chart of Object or Person Recognition

From the above flow chart the system first captures real-time frames in front of the user. Then the system will read the input image and get its width and height to an adequate level. YOLO Object detection algorithm is applied to this altered frame. YOLO (You Only Look Once) is a real-time object recognition algorithm that uses a convolutional neural network to detect objects in an image. The algorithm divides the input image into a grid of cells. Each cell is responsible for detecting objects within its boundaries. YOLO uses anchor boxes which are predefined bounding boxes of different sizes and shapes. The convolutional neural network extracts features from the image and predictions are made for each cell based on these features and the anchor boxes. If the extracted feature image matches with the reference image the system classifies the object. The final output of YOLO is a list of bounding boxes and their associated class probabilities.

If the extracted feature image is the person then the system switches its focus to detecting and identifying the person within the frame. The first step in the process is to detect and extract the face from an input video. This is done by applying face detection algorithm. The face detection algorithms Haar cascades based models used in this project. Once the face is detected then it needs to be aligned so that the facial features such as eyes, nose, and mouth are in the correct

position. This is typically achieved using techniques such as affine transformation. The next step is to extract the relevant features from the aligned face. This can be done using Convolutional Neural Networks (CNNs). Once the features are extracted then they are compared with the features of previously enrolled faces in the system. This comparison can be done using techniques such as Euclidean distance. Finally, the system makes a decision based on the similarity score. If the similarity score is above a certain threshold then the face is recognized and the person's identity is their name. If the similarity score is below the threshold then the face is unknown and the person's identity is "unknown person".

Our system aims to produce an audio output for the visually impaired. The Detected object or person labels are converted into speech using the pyttsx3 library.

Text Recognition

Text recognition is the process of converting printed text into digital text. The process involves several stages including image acquisition, image pre-processing to enhance image quality, segmentation to separate individual characters, feature extraction to identify characteristics of each character, and classification to recognize the characters and convert them into digital text. The flow chart of the Text Recognition process is shown in Figure 4.3.

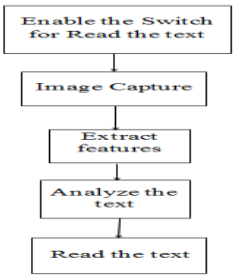

Figure 4.3 Flow chart of Text Recognition

The user first enables the corresponding switch for text recognition. The image can be captured from a Pi camera. Once the image is acquired, it needs to be preprocessed to enhance the quality of the image and remove any noise or artifacts that may hinder recognition. In order to recognize individual characters the text image needs to be segmented into separate characters. Once the characters are segmented then the features of individual characters such as stroke width, shape and texture are extracted. This is done using OCR. The recognized characters are compared to a pre-defined dictionary to identify the text. Finally, the pyttsx3 library proceeds to read the analyzed text aloud to the user.

Unknown Person Database

Storing the details of an unknown person involves recording and storing information about a person whose identity is not yet known. The workflow of the unknown person database process is shown in Figure 4.2.

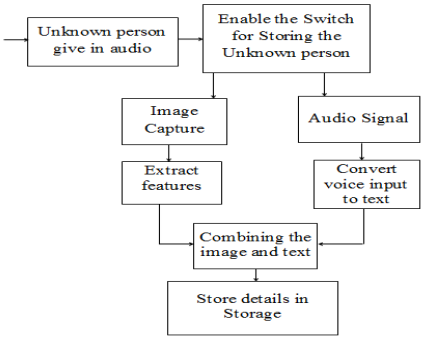

Figure 4.2 Flow chart of storing unknown person details

The extracted feature image does not match with any of the stored reference images of the person. Then the system will relay a voice output starting "unknown person". Subsequently, the user has the option to enable a switch that initiates the process of storing the details of the unknown person.

The camera is used to capture an image of the unknown person and the microphone is utilized to recognize the user's voice then it converts into text format. These two information are combined and stored as part of the details for the unknown person.

Voice Assistance

Voice assistance refers to technology that allows users to interact with the device using their voice. It uses speech recognition algorithms to transcribe user speech into text. Then it processed using natural language processing (NLP) techniques to understand the user's intent and respond appropriately. The workflow of the Voice Recognition process is shown in Figure 4.4.

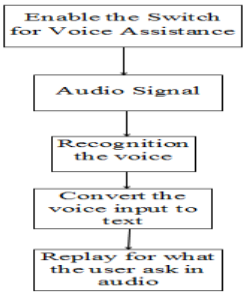

Figure 4.4 Flow chart of Voice Assistance

The user first enables the corresponding switch for Voice Assistance. The system utilizes a microphone to listen for the user's voice. Advanced speech recognition algorithms are then employed to convert the user's speech into text format. Finally, the system responds to the user's inquiry through headphones. It provides a clear and concise answer to the user's request.

5. Result and Discussion

In the developed system is to be easier for the visually impaired people which utilize the artificial intelligence technique. The general idea in our project is using the camera to recognize objects, faces and text. The process involves analyzing the features for to determine the object or person and also database containing the facial images with name. The captured image that describes the original image be highlighting the characteristics of the face by use radius and neighboring. Form the image the histograms are extracted. Each histogram created from the training dataset to represent each image. Try this step for new image to compare the histogram for the new image and training dataset. A picture of that person and compares the image with dataset to know the name of the person, then the blind people gets the result by a voice. In addition, the system can recognize things like cars, bikes and animals. This system can also read the text in the book or newspaper. We also added the voice assistance, that used by the blind people when they want to interact with the system. In our upcoming discussion, we will delve into the outcomes of individual tasks.

Object or Person Recognition

The results of Object or Person Recognition have two tasks. One is Object Recognition and another one is Person Recognition which is explained in below:

Objects Recognition - The result of object recognition is identifying and labeling objects in an image or video. Figure 6.1 is represents the results of object recognition are typically presented as a list of labels corresponding to the objects detected in the image or video.

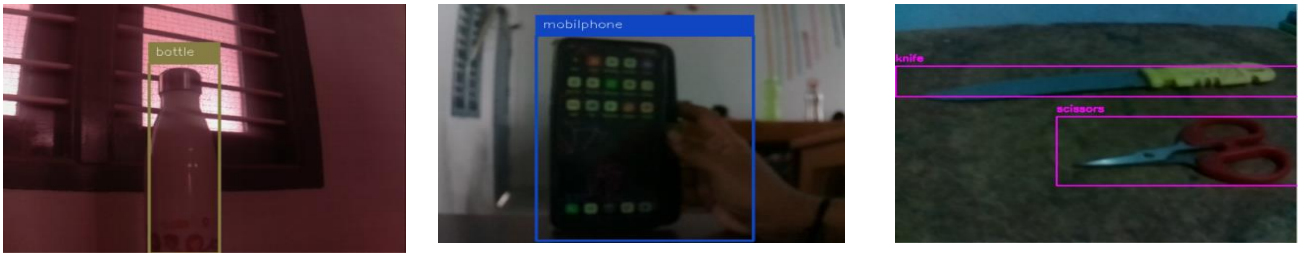

Figure 6.1 Results of Object Recognition

These labels may include the names of common objects such as "Backpack", "car", or "dog" as well as more specific labels for less common objects or specific parts of objects. The accuracy of object recognition results depends on the quality of the input image or video, the complexity of the objects being detected, and the performance of the object recognition algorithms such as YOLO and Open CV being used.

Person Recognition - Person recognition is the task of identifying and verifying the identity of an individual based on their facial features. Figure 6.2 represents the results of face recognition are typically presented as a match score or confidence level indicating the likelihood that the input face matches a known face in a database.

Figure 6.2 Results of Person Recognition

The match score is often accompanied by the name or identifier of the person who is believed to be the best match. The accuracy of face recognition results depends on factors such as the quality of the input image or video, the variability of the facial features being detected, and the performance of the face recognition library being used.

Text Recognition

The results of text recognition are typically presented as a plain text output that represents the recognized text. The accuracy of text recognition results depends on several factors, such as the quality of the input image, the font and style of the text, and the performance of the OCR algorithm being used. The text recognition results shows in Figure 6.4.

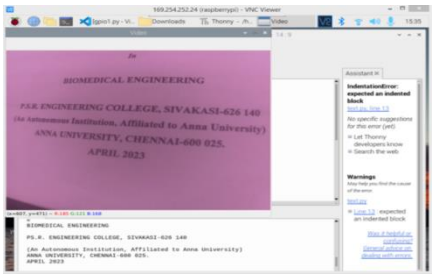

Figure 6.4 Results of Text Recognition

Unknown Person Database

The results of face recognition are typically presented as a match score or confidence level indicating the likelihood that the input face matches a known face in a database. The match score is less than a threshold level it indicate the unknown person. The visually impaired people want to store the person details in real time they first enable the switch for unknown person database. The result of storing unknown person details is shown in Figure 6.3.

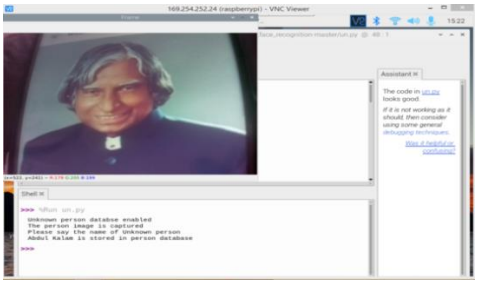

Figure 6.4 Results of Unknown person database

The system first captures image of the unknown person. A microphone is capture audio information of the unknown person name. This audio information can be processed using speech recognition algorithms to extract useful information. This information is stored in a database along with the image and name of the person.

Voice Assistance

The results of a voice assistance system are shown in Figure 6.5 which is typically presented as spoken responses to the user's queries or commands.

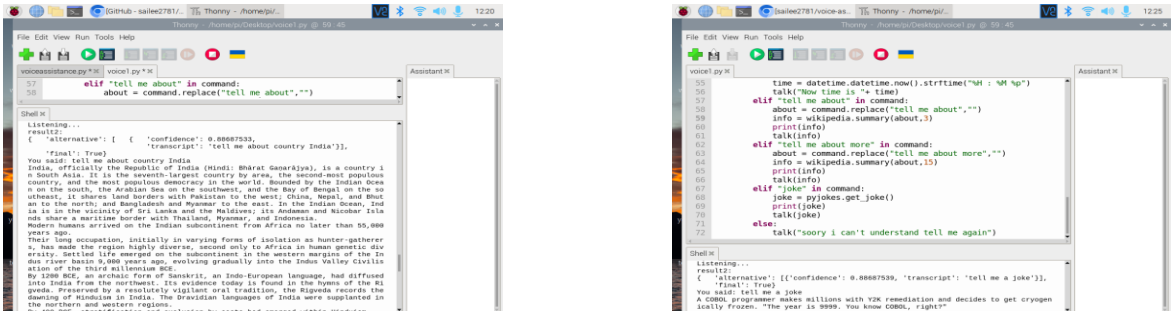

Figure 6.5 Results of Voice Assistance

These responses may include information such as the weather, news updates, directions, or recommendations for nearby restaurants. The accuracy of voice assistance results depends on the performance of the speech recognition algorithm being used, as well as the quality of the input audio and the user's speaking style and language proficiency.

6. Conclusion

This system helps people who are visually impaired to get a better understanding of the surroundings. It told to the user what is present in front of them. Hence it helping them to avoid obstacles and giving them the ability to like “see”

what's around them. This device makes the world a better living environment for people who are visually impaired or have a tough time seeing. From the results seen above it is clear that the user can greatly benefit in terms of knowing what is around them. There are wide varieties of objects that the device can detect. Hence it can be used for everyday activities to enhance their experience and create a better place for them. The main specification of this device contains face detection. If there are any familiar faces, they can be recognized. If the faces are unknown, it stores the person details.

Also the text conversions would help the users read books or posters and signs to enhance their understanding even more. The voice assistance would help the users interact with the system and they not feel alone.

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