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SMART ASSISTIVE SYSTEM FOR VISUALLY IMPAIRED PEOPLE USING DIGITAL IMAGE PROCESSING

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Abstract: Every person in our earth is mainly depending on five sense in that vision is very important one. As per WHO records there are many people are facing with visual impairing or completely blind. Hence the fulfillment of the tasks of daily life will be extremely difficult for them. This can create difficulties that can only be dealt with temporarily subdued by some assisting personal, and there are cases where certain situations can be fatal not only for the individual but also for everyone around them. They are facing so many challenges to complete the day to day activities or tasks. The main agenda of this proposed system is to make every visually impaired person life is simple and Easier. The proposed system consists of Raspberry Pi, camera and speaker. The main features of the proposed system are it will detect and identify the faces and objects it will give the voice commands to the blind person using viola jones, Tensorflow object detection algorithm

***Index Terms* – Raspberry pi-4, Camera, Speaker, Viola jones, Tensor flow API.**

I. INTRODUCTION

The life of every human being depends on the five basic senses, of which sight is probably the most important. Visual impairment is the limited ability to see something at a level that the eye cannot see even with ordinary means such as contact lenses or glasses. Visually impaired people do not have this sense of sight. Therefore, it becomes extremely difficult for them to carry out activities of daily living. This can create difficulties that can only be temporarily overcome by some helpers, and there are instances where certain situations can be life-threatening, not only for the individual but for everyone around them. Along with innovations in science, many studies have been proposed that define the design of devices for the blind. These gadgets were simple and durable, but they were flawed in terms of usability and accuracy

Individuals who are completely blind or have disabled vision as a rule have a troublesome time navigating outside the spaces that they're usual to. They had to depend on the external support system which can maintained by humans, guided dogs, or special electronic gadgets. Another major problem they had to face is identifying a person in a variety of social interactions

The intelligent blind assistance system using digital image processing is a project that aims to enable visually impaired people to live a better and more independent life by developing a system for recognizing the surroundings. This system uses digital image processing techniques to capture images and process them in real time, providing the user with accurate and up-to-date information. The project aims to help visually impaired people move around and carry out daily activities without depending on others. The system is able to recognize objects, text and even people, allowing the user to move around easily and safely. The system has also been designed to be user-friendly, making it easy to use and navigate for people with visual impairments
.

This system uses digital image processing techniques to capture images and process them in real time with the camera Viola-Jones and LBPH algorithms The Viola-Jones algorithm is used for face detection and the LBPH algorithm is used for face Identification.Identify the Face ID and give a voice command to a blind person through a speaker. Likewise, it recognizes objects and identifies the object name using the Tensor Flow Object Discovery API. gives the blind person a voice command over the loudspeaker.

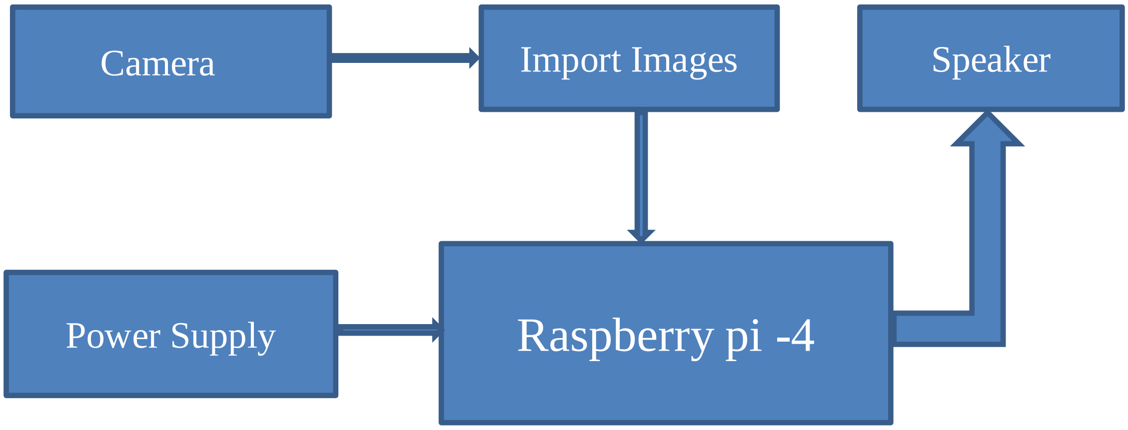


Fig: Block diagram of Smart Assistive System For Visually Impaired People Using Digital Image Processing

The Smart Assistive System For Visually Impaired People Using Digital Image Processing with a camera, a Raspberry Pi 4B and a loudspeaker. The system uses object recognition and face recognition algorithms to provide comprehensive information to visually impaired people. The camera takes pictures of its surroundings, which are processed by the Raspberry Pi using computer vision algorithms. Object recognition identifies and locates objects in an image, while face recognition recognizes and identifies people. The system then gives the user audio feedback through a speaker, giving them a better understanding of their surroundings and increasing their independence.

METHODOLOGY

The scheme which we implemented in our research work is briefly explained in following steps

Step 1: Intially Import Libraries to Raspberry Pi Board Raspberry pi is the main processer of the Project

Step 2: Connect camera module to Raspberry Pi. Camera is used to take the pictures from the outside world

Step 3: Create a data set and train the data set using Haar classifier It classify the Similarities of the face

Step 4: Detect faces with the Viola-Jones algorithm and identify faces with the LBPH algorithm

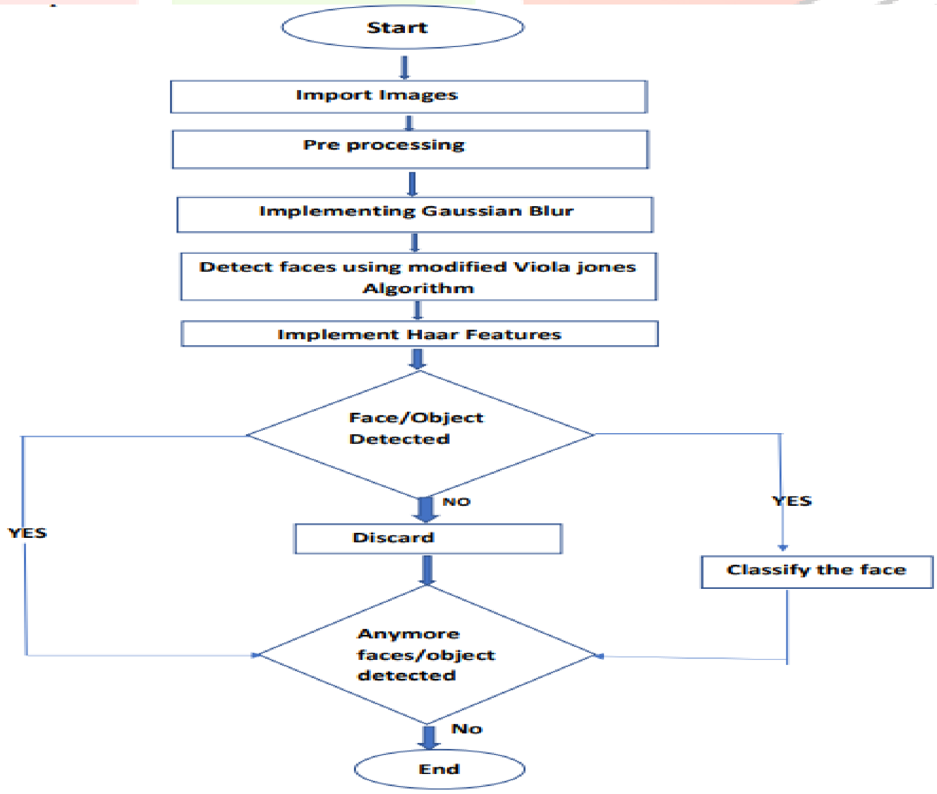
Step 5: Create a data set of objects and train the data set to the processor

Step 6: Detection and identification of objects by using tensor flow object detection API

Step 6: Connect the speaker to the Raspberry Pi via the audio jack or Bluetooth

Step 7: Integrate the both modules Face Recognition and Object Recognition

Flow chart



First import the images into the system.
Apply image preprocessing techniques.
Run the images through the Viola-Jones algorithm.
Detect faces with this algorithm.
When the facial features are recognized by the algorithm image and then classify it as a face.
If facial features are not recognized, discard said picture.

Check if there are faces in the image.
If other facial features are found, rate each them as an image, and the remaining steps above.
When there are no more facial features then exit the program

Algorithms

Viola-Jones Object Detection Framework which. The was introduced in 2001 by Paul Viola and Michael Jones, The can be trained to recognize a variety of object types. The detection framework looks for features that include the following sums of image pixels within rectangular areas. purple & The Jones functions are generally more complicated because rest on more than one rectangular region. Value Each feature corresponds to the sum of the pixels within the normal squares less than the pixel density of shaded squares. This type of rectangle operation is primitive. That too Scheme is suitable for both vertical and horizontal properties, but with is a much coarser answer. Viola Jones' algorithm is used with a slight modification, and offers many best results. The framework described has achieved remarkable results thanks to its implementation and integration in Open CV. Cascade classifier used The effectively combined these features. The frames are in good condition to detect all parts without significant errors. However, it should be noted that something more is required at this level time to process them, so you need to reduce the time latency and load on our CPU. This is important for Development of the sensor as it would be used visually impaired. To improve our idea, let's classify functions selected from AdaBoost For, for which we chose a series of horizontal lettering borders features and line features. Then we polished them for a strong rating. This is necessary because when many weak classifiers are used for face recognition, we combine all these weak classifiers and make it a powerful classifier. This in turn led to better accuracy and better results.
This algorithm is divided into four steps.

- Hair function selection
- Creation of an integral image
- Adaboost training
- Cascade Classifier

Hair function selection

All human faces share common features.You can use the. Human Faces feature to customize these patterns. Have some characteristics like a darker eye area compared to upper cheeks and bridge of nose are whiter than your eyes. Many features combine to form corresponding facial features such as eyes, mouth and nose and their values are defined by direct pixel intensity gradients.

$$\mathrm{F(Haar)} = \sum \mathrm{F_{White}} - \mathrm{F_{Black}}$$

where F_{White} represents pixels in white area and F_{Black} represents pixels in black

Creation of an integral image

An integral image is an image representation that analyzes the properties of a rectangle in real time and offers a performance advantage over more general versions. Because the rectangular face of any object is always adjacent to at least one other rectangle; Each two-rectangle element, each three-rectangle element, and each four-rectangle element can be derived from six array references, eight array references, and nine array references, respectively

Adaboost training

This approach creates a strong classifier by combining weighted simple weak classifiers in a linear way

A Cascade Classifier is a multi-stage classifier that is capable of fast and precise detection. Each stage consists of a strong classifier that is produced by the Ada Boost Algorithm. The number of weak classifiers in a strong classifier grows as it progresses through the stages sequential (stage-by-stage) evaluation is performed on an input. If a classifier for a given step returns a negative test, the input is automatically removed. If the result is favorable, the input is passed on tithe next stage.

LBPH Algorithm

LBPH, which stands for Local Binary Pattern Histogram. It is widely used in many applications like face recognition, image retrieval etc. because of its robustness to monotonic illumination changes and computationally simplicity. LBPH is based on LBP operator, which was firstly introduced by Ocala as a local texture operator. The operator labels any pixel of image (center pixel) by threshold it with the gray values of 3x3 squared neighborhood, and considering results as a binary string. This square LBP operator later extended by Ocala to any size circular neighborhood A center (BC, YC) pixel point on image be labelled as follows 1: where R defines the radius of circular neighborhood, P is the equally spaced sampling points on this circle and Pi refers to with neighboring pixel on circle and pc is the center pixel. S function denotes threshold operation which uses gray level intensity values of related pixels. It is 1 if s(pi-pc) is small or equal to 0, otherwise equal to 0

$$\mathrm{LBPH_{x,y,P,R}} = \sum_{\mathrm{i=1}}^{\mathrm{p=1}} 2^{\mathrm{i}} * \mathrm{s(pi - pc)}$$

From the image, the method is used, which returns a tuple iterator containing the row and column coordinates and the height and width of the faces. Based on the values, the face is cropped to be saved in the dataset folder and a rectangle is drawn to mark the face. The process starts with assigning each person a unique ID and ends with 40 photos of faces taken from different angles. All The images are scaled and pre-processed using a grayscale method to reduce color complexity. The dataset needs to be trained. When saving face images, a tracking number from 1 to 40 with a dot is provided, and images are spit to each image, formats and in this section stores features of individual facial images in XML format. Once the images are formed, each histogram represents each of them image of the training data set. To detect a person's face in a live video stream from a Raspberry Pi camera, simply compare the histograms and shift the image back to the closest histogram. The image processing system calculates the Euclidean distance between the two histograms using the LBPH algorithm.

$$D = \sqrt{\sum_{i=1}^{n} (hist1_i - hist2_i)}$$

RESULTS

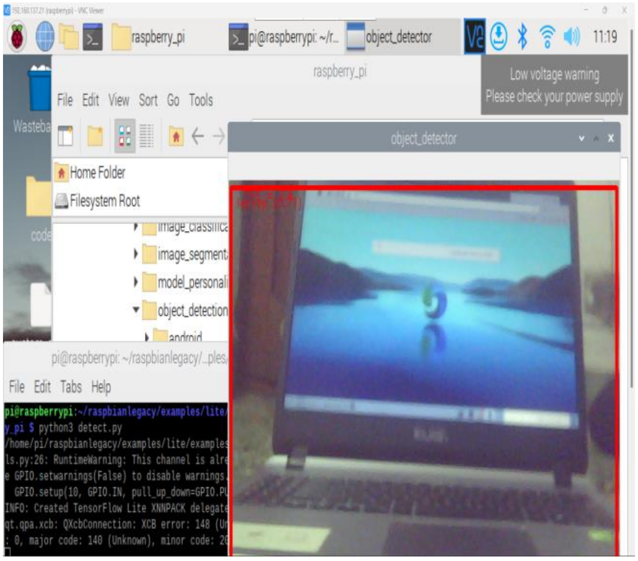


Fig: Object detection Output 1

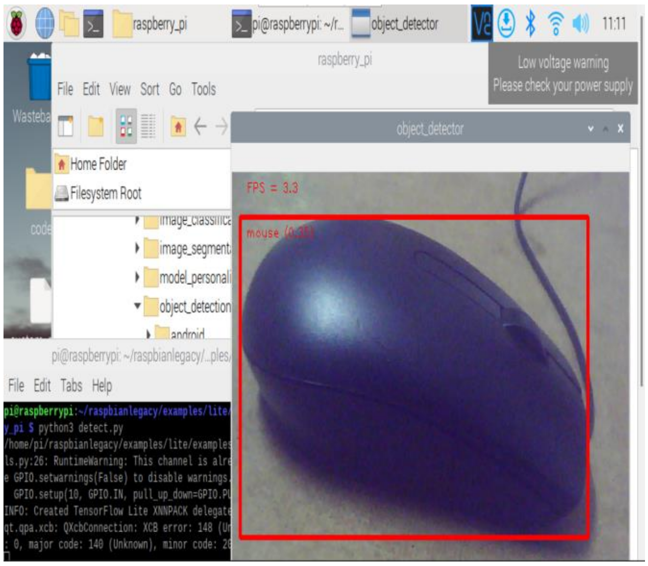


Fig: Object detection Output 2

The process of training an object detection model using the TensorFlow API begins with collecting and labeling the data. This involves collecting images of the object you want to detect and marking each image with bounding boxes around the object. After the data has been marked up, it needs to be prepared for use with the TensorFlow object tracking API. This involves converting the tagged data into API format, which involves creating a CSV file containing the image locations and labels, and a TF Record file containing the actual image data. Then select a pre-trained model in TensorFlow Model Zoo based on the detected object type. The selected model is then refined using the tagged data, adjusting the hyperparameters for optimal accuracy. Finally, the performance of the model is evaluated using a series of test images and the necessary modifications are made.

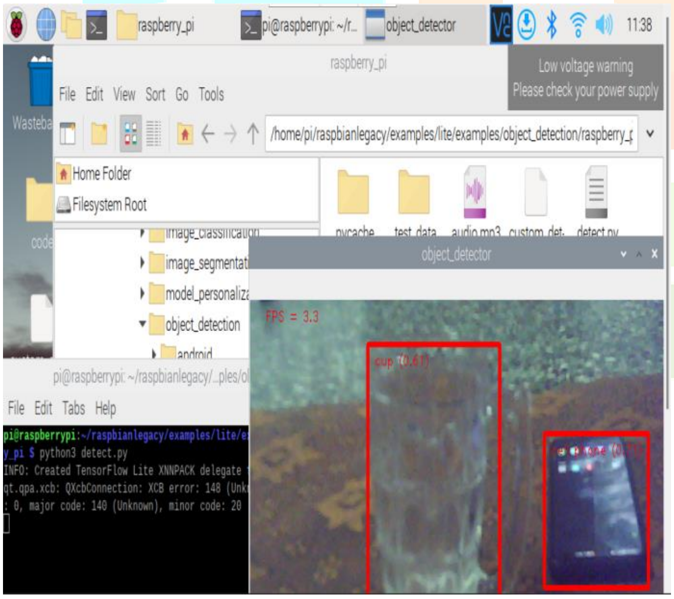


Fig: Object detection Output 3

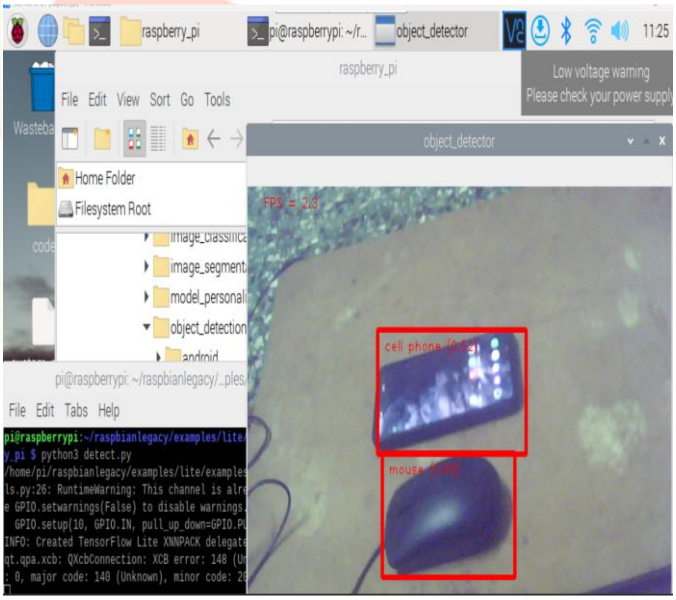


Fig: Object detection Output 4

Once the object detection model has been trained, it can be used to detect objects in images. To do this, the trained model must be uploaded to the system. The image can then be captured or uploaded to the system and pre-processed by scaling and normalization. The model can then be used to predict the bounding boxes and labels of the objects in the image. The expected boundaries can then be drawn on the image and the result displayed. The TensorFlow Object Detection API provides a powerful and comprehensive tool set for training and deploying object detection models. With the right coding and training, the API can accurately recognize a wide variety of objects in real-world environments, making it an invaluable tool for many different applications.

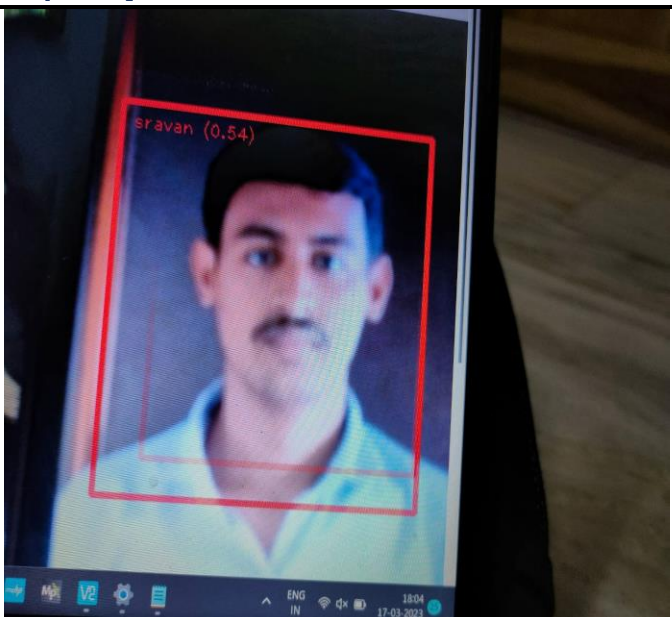


Fig: Face detection Output1

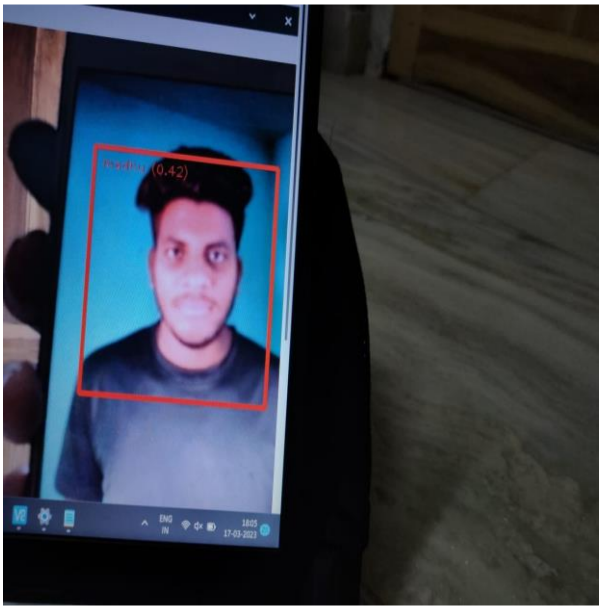


Fig: Face detection Output 2

The proposed Raspberry Pi-based device performs image processing to classify a person after training is complete. Using 8 megapixels with OpenCV, the system recognizes and stores facial images in a custom dataset. Based on the characteristics of each person's images obtained from the data training section, the LBPH algorithm detects faces in real time and plots individual and multiple recognition based on face classification. Efficiency and accuracy differ from one or more people in the background, person side view face.

FUTURE SCOPE

To extend this work, we plan to add a text-to-speech system and embed it with the GSM & GPS module so that blind person can actually hear the directions in form of voice From the google maps and navigation apps. For connecting the text-to-speech system with the cell phone, the user can use a paid application like the KNFB (Kurzweil — National Federation of the Blind) reader which can be used to convert text to voice. As we will see, researchers working in this field have yet to find effective, efficient, safe, and cost-effective technical solutions for both the outdoor and indoor guidance needs of blind and visually impaired people. So we can add the GPS module for blind person navigation monitoring.

CONCLUSION

The main purpose of this study is to produce a prototype that can We have projected a style on face recognition supported raspberry pi that is especially designed aiming visually impaired people. The system is develop in a way so that it can recognize faces to classify people, then fetch matched people's information stored in dataset and spell through a voice out using earphone or headset

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