

## **Portable Computer Vision Based Assisting Device For The Visually Impaired People**

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### **Abstract**

This project presents a complete aid to the visually impaired people. The application deals mainly with face detection and recognition for the blind user helping them to survive independently in their house . In this project we are using a Raspberry pi B+ module and a Raspberry pi camera module which is of 5MHz is found to be interfaced in the processor by using a camera serial interface cable. The process works in such a way that when the webcam is displayed it first searches for a face to check whether it is a human being or an object. Then it process to check for the eyes . The eye search region is one of the important criteria for face detection . Once the eyes are detected it then starts collecting the samples for training and all these files are found to be saved properly. When the collection process is over the final step will be to recognize the face. So when an input image is applied it checks for the above criteria and it predicts the name of the person through a spoken message . This spoken message can be known to the blind user by wearing a headset so if it is a known user it will tell the name of the person suppose if it is an unknown user it alerts the person by telling that it is an unauthorized person.

**Index Terms:** visually impaired, images, detection, recognition.

### **Introduction**

People with blindness face a lot of difficulties and challenges in order to meet their daily needs. There are lot of assistive technology and devices that are been introduced for people with visual impairments. [1][2]A wide variety of compute vision based assistive devices have been introduced These devices pay more attention towards navigating path for blind , obstacle detection as well as the mobility detection. There are several voice modules which reads the output in the form of voice and conveys the

message to the blind user which includes the [3] Optical character Recognition and Speech Synthesis .optical character recognition involves recognizing text from images such as traffic signal signs. Speech synthesis involves a text which is in digital format is converted to voice and played in the form of audio. And also that technology has played a vital role in improving access for the visually impaired people. Because the web access technology enables the user to have good communication with people[4][5][6].As known people with visual disabilities face a lot of difficulties and challenges in their daily routine. Among the many challenges one such challenge is the difficulty that is found in accessing the known individuals in their daily routine. The visually impaired people who live in apartment or building face the problem of security because they are not able to identify who is at the door. Furthermore the capability to determine whether it is a friend or a stranger can be accessed only from a security point of view. But there are lot of difficulties faced when implementing face recognition which includes changes in facial orientation , changes in facial expressions, changes in hair and hair styles are some examples. So considering all these criteria an algorithm has to be defined. Though face recognition has been operating continuously in an static intensity basis . [7]Due to the advancements in the field of technology and research more attention has been paid in capturing images from video. In recent days face detection and recognition has been paid more attention over the last few years due to it varied application in various domains. In this project we have mainly focused on the application of face detection and face recognition for the visually impaired people. There are lot of added advantage in this application which includes no need assistance for the visually impaired people. It creates an independence for them to be very safe at home . Though they are physically blind but their sense of hearing is very sharp which is an added advantage for them. So they will be easily able to identify whether it is a known user or an unknown user. Section II describes the software and hardware tools. Section III describes the methodology and Section IV explains the applications and Section V concludes the paper.

## **Software and Hardware Components**

The software components used are :

- Raspbian Linux os.
- Putty software.
- Opencv programming language

The hardware components used are :

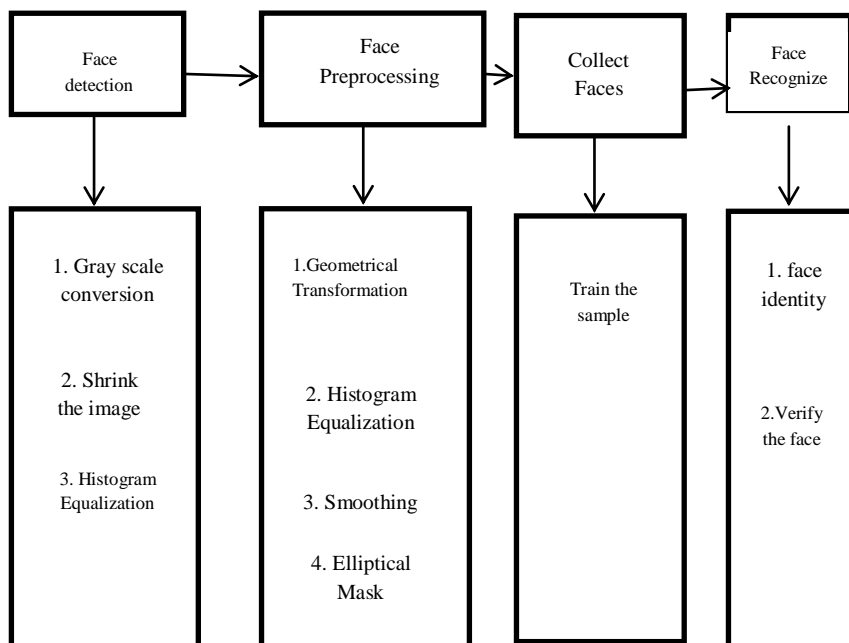
- Raspberry pi B+ module.
- Raspberry pi camera module.
- Wifi.
- Power supply cable.

1. Raspbian Linux : There different types of linux operating system. But the Raspbian is a free operating system based on Linux and is optimized for Raspberry pi.

2. Putty software : The putty is a teletype writer which is mainly used in linux system. The advantage is that multiple users can login at the same time when comparing to that of windows.
3. Opencv Programming Language : Open cv stands for open source computer vision. Opencv supports C,C++,Java, Android . In this project we are using c++ programming language and the coding is executed in Visual Studio.
4. Raspberry pi module : The Raspberry pi is a credit card size board which was developed by the Raspberry pi foundation .There are different types of modules used in raspberry pi namely module A,A+,B,B+. In this project we are using module B+. The module B+ supports a lot of features comparing to other modules namely it uses out a Micro SD card of 8GB. And also it consumes very low power.
5. Raspberry pi camera module :The raspberry pi camera module used is of 5MHz pixel. It is connected to the processor via a csi cable ie camera serial interface cable.
6. SD card : SD stands for secure digital. The micro SD card is a kind of removable flash memory used for storing a large amount of information. These types of cards are mostly used in mobile phones.
7. Power Supply : It uses 5v power.

### Methodology

This project is mainly split into 4 main blocks namely face detection, face preprocessing, collect faces and face recognition. The block diagram is shown below.



**Block Diagram**

**Description:**

1. Face Detection - It is the process of locating a face in an image. It checks whether it is an human face or an object.
2. Face Preprocessing -It is the process of adjusting the face image and that the images are placed in the correct size and position.
3. Collect Faces - It is the process of saving all preprocessed images and giving them training to recognize the person.
4. Face Recognition - It is the process of recognizing the person face.

**Face Detection**

Face detection is the process of locating the face in an image. There are many different algorithms that are applied for face detection which includes the Viola Jones Algorithm, Haar based classifier and the linear binary pattern classifier. The haar based classifier works well for most of the frontal faces especially for the eye region . Whereas the linear binary pattern classifier is same as that of the haar based classifier but that it makes use of histogram pixel intensity comparison.

So in this project we have applied the haar based classifier for face detector . The Face Detection can detect N number of images at a time.

It is necessary to check the following parameters for proper face detection.

1. Gray scale conversion : According to haar cascade classifier it does not except color image so if it is a color image it is necessary to convert to grayscale using the command `cvtColor ()`
2. Shrink the camera image: The speed of face detection depends on the size of the input image if the size is not proper it is necessary to shrink the image to a proper size using the command `resize()`. Here in this project we have applied the camera width and height in the ratio of 640\*480 pixel size. Suppose if the size of the image is of not proper size then it is necessary to shrink the camera image and in that case we need to divide the width to height ratio by two so it becomes 320\*240 pixel size.
3. Histogram equalization: This parameter is required to improve the contrast and brightness of an image command used is `equalizehist()`.

**Face Preprocessing**

As Known face recognition is extremely to lighting conditions ,changes in facial expressions, changes in hair and hair styles. But the preprocessing technique will help to solve all these problem . The preprocessing technique will take care of all the above criteria.

Instead of detecting all the facial features such as the ears, nose, mouth etc .here for simplicity we use the eye detection. The haar cascade works for mainly the frontal faces than compared to side view faces . The eye detection works for the following three stages namely. Eyes open, Eyes closed, and for people wearing glasses

It is necessary that once the face is detected it must check for both left and right eyes. In opencv programming language we have predefined commands for eye detection namely.

- a) For eyes open - haarcascade\_mcs\_lefteye.xml
- b) For eyes closed - haarcascade\_lefteye\_2splits.xml
- c) For wearing glasses - haarcascade\_eye\_tree\_eyeglass.xml.

Once the eyes are detected it is necessary to perform preprocessing. For preprocessing a set of criteria has to be satisfied.

- a) Geometrical Transformation.
- b) Histogram Equalization.
- c) Smoothing.
- d) Elliptical Mask

#### *A. Geometrical Transformation :*

The Geometrical Transformation involves the following steps.

1. Rotate-Rotating the face is required so that the 2 eyes are horizontal
2. Scaling-scaling is required so that the distance between the eyes are same.
3. Translate-Translating the face is required so that the eyes are centered horizontally.
4. Crop-Cropping is necessary so that the other facial features are neglected.

#### *B. Histogram Equalization:*

Once geometrical transformation is done it is necessary to perform histogram equalization on both left and right side of the face.

#### *C. Smoothing:*

Bilateral filter is helpful in smoothing because it helps to keep the edges sharp .To reduce the effect of pixel noise bilateral filter is used.

#### *D. Elliptical Mask:*

The shape of the preprocessed face is found to be in elliptical shape.

### **Collect Faces :**

This is one of the important step in face recognition. It is necessary for us to train the sample images and that a minimum of 20 to 30 samples has to be collected with varied facial expression. Once the face and the eyes are detected it starts collecting the samples and that it is necessary for us to save all these samples properly . If the files are not saved properly then there occurs exceptions. Because during the collecting state if the eyes are closed and during testing face if the eyes are open then it will not recognize the person properly. For Training the faces we have different algorithms used namely the Principal Component Analysis, Linear Discriminant Analysis. The Principal component analysis method is one of the methods that is applied for face recognition. In this method it tries to make a comparison of the same individual with varied facial features. But the drawback in this method is that it is insensitive to lighting variations. Whereas the linear discriminant analysis is another powerful technique for face recognition . In this method it tries to make a comparison showing variation in appearance of different individuals depending on their identity. And

moreover it is insensitive to lighting variations. So in this project we have applied the Linear discriminant analysis also known as the fisherfaces technique.

### Face Recognition :

The last step will be face recognition. It is the process of recognizing the persons face For Face Recognition it is necessary for us to follow the two methods.

- Face identification.
- Face verification.

Face identification : It is the process of identifying the person and predicting the persons name.

Face verification : It is checks whether the identified face matches with the training face.

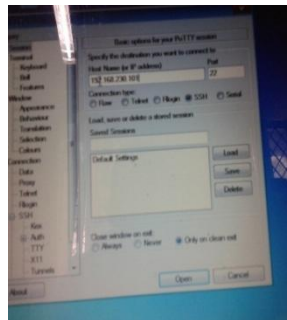
### Voice Module :

- In this project we are using a Text to Speech Software. Were the recorded voice is converted to wave file.
- Once the voices are all recorded it is played to the blind user by wearing a headset
- This voice will help the user to predict who the person is whether it is an authorized user or unauthorized user.

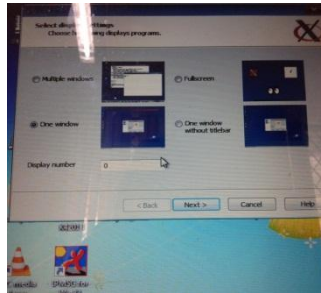
## Result Analysis



### Module Connection:



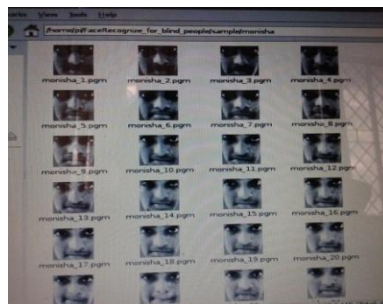
### Enable IP address



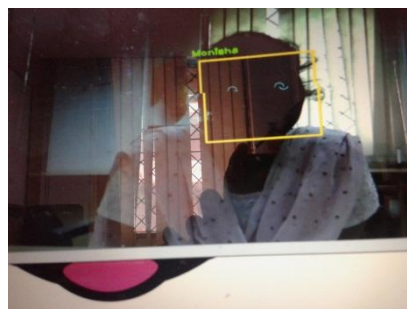
**Open Xming Window**



**Open the raspberry pi window**



**Collected and trained Faces**



**Recognized Face**

Here in this project we have first loaded the raspbianos and that we have installed opencv software and putty software . We need to first enable the putty software and that configure the IP address for the wifi connection. All the basic module connection step has to be done first then train a sample of 5 images with varied facial feature that we need to create a path were all these files are saved . All these steps are done under face detection from the webcam . Once the images are trained it is necessary that we need to compile the face recognition algorithm. The program is compiled and that if the person stands in front of the camera it detects the person and predicts the persons name which is played to the blind user through headset.

### **Applications**

The face recognition has played a vital role in various domains and also that it is useful for the visually impaired in various applications such as no need assistance in their room ,easily identify people in meetings conferences and also recognize people in classrooms colleges offices etc. In this way the blind people can survive independently like other individuals.

### **Conclusion**

Thus an algorithm for face detection and face recognition is designed and that the visually impaired can identify and recognize persons in real time .Thus this project can be further extended in future by using a sensor that detects only when the person is coming in front of the user once detected it can recognize the person and tell the name of the person. In this way the blind users can be very safe in places where they go.

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