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Face recognition using image processing for visuallychallenged

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ABSTRACT

In this paper the face recognition is done for the visually challenged people. Visually challenged people faces lot of problems in day to day life. Our goal is to make them lead a life which is of security and safety for their own wellbeing. This makes them confident to lead their life normally. The face detection helps them to recognize faces of people known to them within a certain distance. This paper reduce the difficulty in identifying face of the person used. The face recognition is done using the haar feature base cascade classifiers using Eigen face algorithm. In addition to the face recognition this paper also enhances the process by providing audio output through the e speak software which converts the text to speech. The whole process is designed to run efficiently on a raspberry pi B+ module on opencv platform

Key Words: Principle component analysis (PCA), Linear Discriminantanalysis (LDA), Hue saturation level (HSV), Printhouse colour concept (PCC)

INTRODUCTION

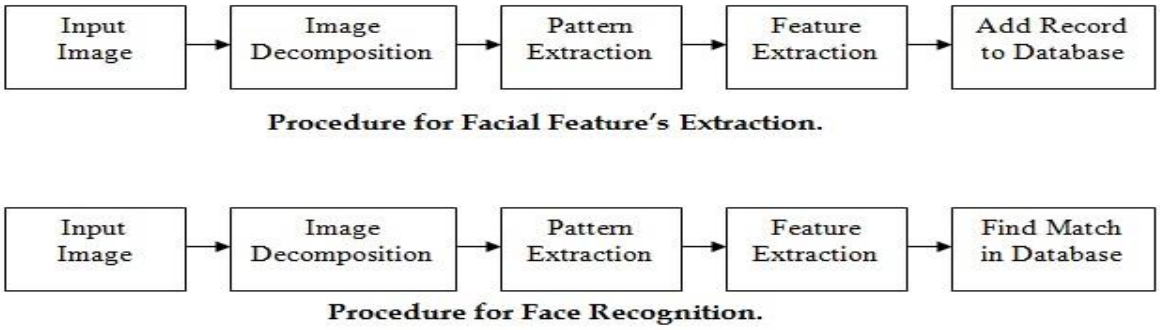


Fig.1.Basic block diagram of face recognition

Over the years much advancement in technology for the visually impaired people has been developed. The image analysis and detection has been very significant in various applications. The face recognition system has been widely developed in several government sectors across the globe. It can be also used in terrorist screening where the database of the terrorist can be fed to check whether the person which is being screened is the suspect.

This paper provides the real time application of face which will be very useful for the blind people. Several face recognition algorithm and various techniques has been employed in numerous processes. The face recognition is considered to be a very tough process. The existing face recognition system runs on MATlab platform which is not an open source software and is less portable. The PCA technique employed with Eigen face algorithm is widely used. The disadvantages that occur with the usage of PCA technique has been overcome by Haar cascade classifier.

Open cv software is an open source software which is being used to run this project efficiently. Raspberry pi B+ is a prototype which is used to execute the algorithm. We chose this platform because it is cost effective and the size of the prototype is also very small compared to other prototypes. The open cv software has pre-defined algorithms in it. Those algorithms can work on the normal feature detection and the color detection. But when we use the haar cascade algorithm in the open cv software we can get more accurate results in a faster time period.

Fig.2.Raspberry PI B+ Module

Audio output is designed for the visually challenged people. The audio output is generally fed to an ear phone through which the color and the face is recognized and the output is given through the earphone. The raspberry pi B+ module is used to run the open cv software. This module works on a 30Mhz processor. It can be charged using a normal mobile phone charger. This module is preferred because it is lesser in dimension and more over it is portable for the visually challenged. Many applications have been in use in various fields. Most vivid uses in governmental projects and purposes are given below.

Table.1.Face recognition system applications

Enterprise security	Computer access control
Government events	Terrorist screening
Immigration	Illegal immigration detection
Casino	Filtering VIP's
Toy	Intelligent robotics
Vehicle	Safety alert system

Prior Work: Enumerous robust algorithms have been developed and they have claimed to have accurate performance to tackle face detection and recognition problems. These algorithms are the most successfully and widely used for face detection and recognition. The algorithms are as follow:

- Principle Component Analysis (PCA)
  - a.Eigenface
- Linear Discriminant Analysis (LDA)
  - a.Fisherface
- Skin colour algorithm
  - A.Red-Green-Blue (RGB)
  - b.YCbCr (Luminance -Chrominance)

C.Hue-Saturation Intensity (HSI)

- Wavelet algorithm
  - a.Gabor Wavelet
- Artificial neural networks algorithm
  - a.Fast Forward
  - b.Back Propagation
  - c.Radial Basis Function (RBF)

Principle Component Analysis (PCA): PCA is a method in which is used to simplify the problem of choosing the representation of any eigen values and its corresponding eigen vectors to get a consistent representation. It can be obtained by diminishing the dimensional space of the representation. To obtain fast and robust object recognition, the dimensional space has to be reduced. On the whole, PCA also retains the original information of the data. Eigen face based algorithm applies on the PCA basis.

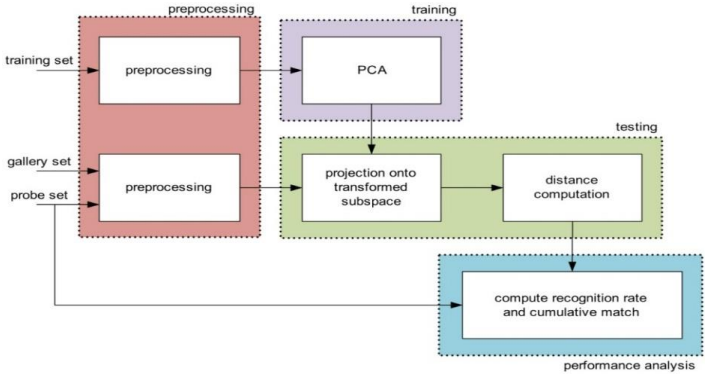


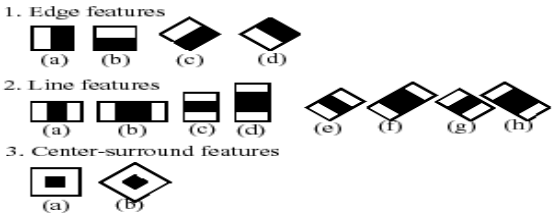
Fig.3.Principal Component Analysis

Eigenface based algorithm: Eigenface based approach is one of the most widely used method for face detection. According to the proposed Pavanet al., eigenface is known due to its simplicity, less sensitive in poses and better performance involving small databases or training sets. This approach uses the presence of eyes, nose and mouth on a face and relative distances among these objects. This characteristic feature is known as Eigenface. This facial feature can be extracted by using a mathematical tool called Principle Component Analysis (PCA). By using PCA, any original image from the training set can be reconstructed by combining the Eigenfaces. Generally, a face is classified as itself by calculating the relative distance of the among the features which form the Eigenfaces.

Linear Discriminant Analysis (LDA): LDA is also known as Fisher's Linear Discriminant (FLD) [Cristinacce.D].It drastically reduces the dimension space by using the FLD technique. FLD technique uses in-class information, reducing variation within each class and increasing class separation within the features specified.

Fisherface based algorithm: The Fisherface approach is also one of the most widely and commonly used methods for feature extraction in facial images. This approach tries to find the projection direction in which, images belonging to different kinds of classes are separated maximally. According to Shang-Hung Lin, Fisherface algorithm is the refinement of the eigenface algorithm to cater the illumination variation in it. Bulhumeur reported that Fisherface algorithm also performs better than eigenface in a circumstance where the lighting condition is varied.The above mentioned approach requires several training images for each face. Therefore, it cannot be implied to the face recognition applications where only one captured or stored image per person is available for training.

Proposed project: The core basis for Haar classifier object detection is the Haar-like features. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the areas. Two or three adjacent groups with a relative contrast variance form a Haar-like featureFirst we need to load the required XML classifiers.



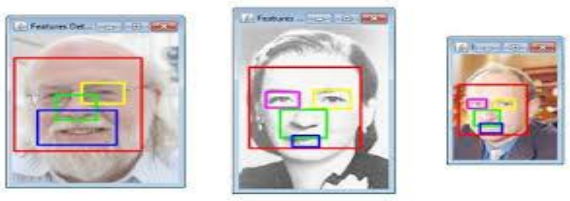


Fig.4.Common Haar features **Fig.4.Common Haar features**

Haar-cascade Detection in OpenCV: OpenCV comes with a trainer as well as detector. OpenCV already contains many pre-trained classifiers for face, eyes, smile etc. Those XML files are stored in opencv/data/haarcascades/ folder.

Steps to create face and eye detector with OpenCV

- Load the required XML classifiers.
- Then load our input image (or video) in grayscale mode.
- Find the faces in the image.
- If faces are found, it returns the positions of detected faces as Rect(x,y,w,h).

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- Once these locations are obtained, create a ROI for the face and apply eye detection on this ROI

To create a set of eigen faces:

1. Prepare a training set of face images. The pictures constituting the training set should have been taken under the same lighting conditions, and must be normalized to have the eyes and mouths aligned across all images. They must also be all re sampled to a common pixel resolution ($r \times c$). Each image is treated as one vector, simply by concatenating the rows of pixels in the original image, resulting in a single row with $r \times c$ elements. For this implementation, it is assumed that all images of the training set are stored in a single matrixT, where each column of the matrix is an image.
2. Subtract the mean. The average image has to be calculated and then subtracted from each original image in T.
3. Calculate the eigenvectors and eigen values of the covariance matrixS. Each eigenvector has the same dimensionality (number of components) as the original images, and thus can itself be seen as an image. The eigenvectors of this covariance matrix are therefore called eigen faces. They are the directions in which the images differ from the mean image. Usually this will be a computationally expensive step (if at all possible), but the practical applicability of eigen faces stems from the possibility to compute the eigenvectors of S efficiently, without ever computing S explicitly, as detailed below.
4. Choose the principal components. Sort the eigenvalues in descending order and arrange eigenvectors accordingly. The number of principle components k is determined arbitrarily by setting a threshold ε on the total variance. Total variance v = n*(λ1+ λ2+…+ λn), n= number of data images.

$$\frac{n(\lambda_1 + \lambda_2 + \ldots + \lambda_k)}{v} > \epsilon$$

k is the smallest number satisfies : These eigen faces can now be used to represent both existing and new faces.

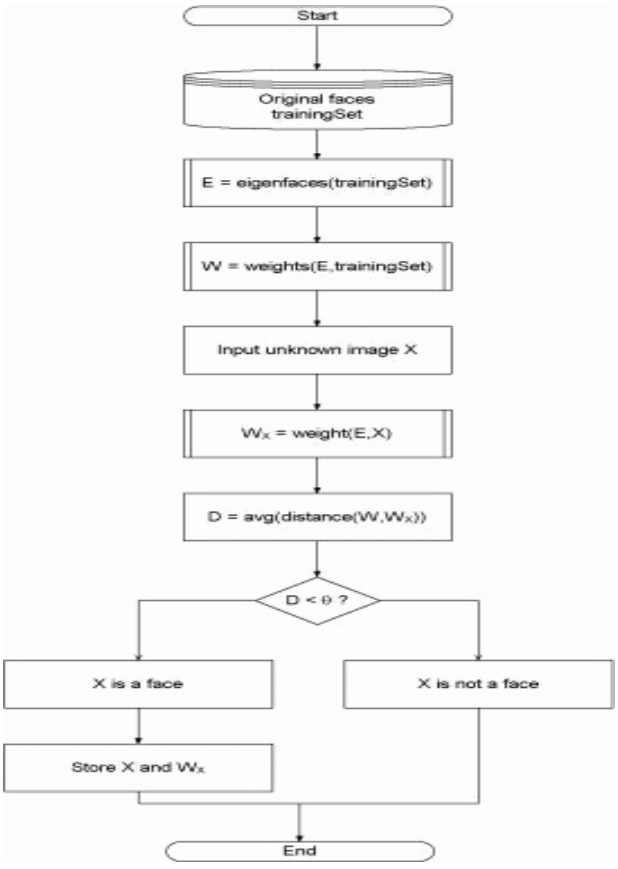

Fig 6 Flowchart of Eigenface Algorithm

RESULTS

Firstly in facial feature detection is detecting the face. This requires analyzing the entire image. The second step is using the isolated face to detect each feature. Since each portion of the image used to detect a feature is much smaller than that of the whole image, detection of all three facial features takes less time on average than detecting the face itself. Using a raspberry pi B+ processor to analyze a 320 by 240 image, a frame rate of 3 frames per second was achieved. Since a frame rate of 5 frames per second was achieved in facial detection only by using a much faster processor, regionalization provides a tremendous increase in efficiency in facial feature detection. Regionalization also greatly increased the accuracy of the detection. All false positives were eliminated, giving a detection rate of around 95% for the eyes and nose. The mouth detection has a lower rate due to the minimum size required for detection.

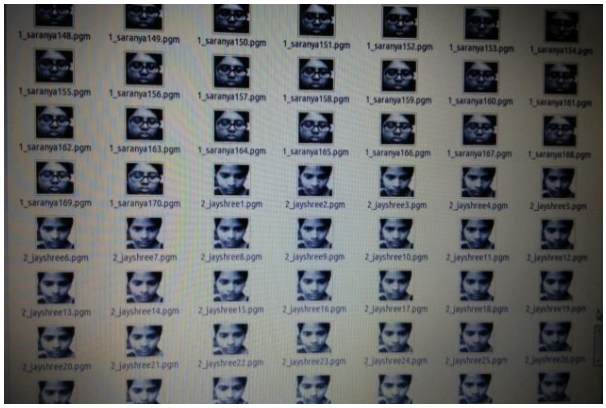

Fig.7.Training Images

Fig.8.Face Detection

FUTURE PLANS

With the detection of facial features, the next goal is to research the ability for more precise details, like some individual points, of the facial features to be gathered. Those will be use to differentiate general human emotions, like happiness and sadness and other emotions. Recognition of human emotions would require accurate detection and analysis of the various elements of a human face, like the brow and the mouth, to determine an individual's current expression. The expression can then be compared to what is considered to be the basic signs of an emotion in all human beings. This research will be used in the field human-computer interaction to analyze the emotions one exhibits while interacting with a user interface which was not yet experimented before in the world of science and advancement.

CONCLUSION

This paper gives a contribution for the development of new human-machine interfaces for mobile robots and autonomous systems, based on computer vision techniques. The article presented an approach for real-time face recognition and tracking which can be very useful in human robot interaction environment this system starts with a very fast real-time learning process and then allows the robot to follow the person and to be sure it is always interacting with the right one under a wide range of conditions including: illumination, scale, pose, and camera variation. The face tracking system works as a preprocessing stage to the face recognition system, which allows it to concentrate the face recognition task in a sub-window previously classified as face. This abruptly reduces the computation time. The introduction of a position predictive stage would also reduce the face search area driving to the creation of a robust automatic tracking and real-time recognition system. This paper also presents a Pre-Learnt User Recognition System which works in almost real-time and that can be used by the human to create a set of known people that can be recognized anytime. The processor has a certain number of people in the database and once a known face is found it can start following and interacting with it. Of course this system can also be used in security applications since it has the ability of tracking a set of known people

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