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Face Recognition System Using PCA

M.V.N.R. Pavan Kumar[1], Shaikh Arshad A.[2], Katwate Dhananjay P.[3],Jamdar Rohit N.[4]
Department of Electronics and Telecommunication Engineering [1,2,3,4], LNBCIET, Satara-415020 [1,2,3,4]
Email:pavankumarmvnr@gmail.com[1]

Abstract-Face Recognition is one of the most successful Challenging applications in the field of computer vision and pattern recognition. Generally there are two types of recognitions such as intrusive recognition means that the user aware about the recognition i.e., Palm print recognition; the users have to place their palm in the scanner, where as face recognition is non-intrusive, with out user co operation it can able to recognize the person as authenticated person or not. The applications of face recognition are time attendance system, visitor management system and access control system, etc. the face recognition gives efficient performance under the controlled environment. But still we have the unsolved problems in real time applications. The dimensionality reduction is a most important task in the field of face recognition. In this paper, it proposed all the recent emerging techniques of feature extraction process in the dimensionality reduction.

Index Terms- Face Recognition; Dimensionality Reduction; Feature Extraction; Feature Selection; Linear Methods; Non Linear Methods.

1. INTRODUCTION

Face recognition is the most challenging work for the research persons from the year of 1990's.The researchers gave satisfactory results for the still images i.e., images are taken under the controlled conditions. If the image contain the problems like illumination, pose variation, aging, hair inclusion then the performance of the recognition process leads to poor. Most of the researchers are concentrating on the real time applications. Many surveys are carried out on the topic of face recognition [1-6] they specify various existing techniques for feature extraction and the face recognition process. Generally face recognition is classified as the process of face detection, feature extraction and face recognition. Image preprocessing work as removing the background details and normalize the image by rotation, scaling, resizing of the original image is carried out before the face detection process. The face detection is to detect the face from the normalized image, then the feature extraction process is used to extract the features from the detected face and finally the face recognition process is to recognize the face. Face recognition is as old as computer vision, both because of the practical importance of the topic and theoretical interest from cognitive scientists. Despite the fact that other methods of identification (such as fingerprints, or iris scans) can be more accurate, face recognition has always remains a major focus of research because of its noninvasive nature and because it is people's primary method of person identification. Face recognition technology is gradually evolving to a universal biometric solution since it requires virtually zero effort from the user end while compared with other biometric options. Biometric face recognition is basically used in three main domains: time attendance systems and employee management; visitor management systems; and last but not the least authorization systems and access control systems. Traditionally, student's attendances are taken manually by using attendance sheet given by the faculty members in class, which is a time consuming event. Moreover, it is very difficult to verify one by one student in a large classroom environment with distributed branches whether the authenticated students are actually responding or not. The present authors demonstrate in this paper how face recognition can be used for an effective attendance system to automatically record the presence of an enrolled individual within the respective venue. Proposed system also maintains a log file to keep records of the entry of every individual with respect to a universal system time.

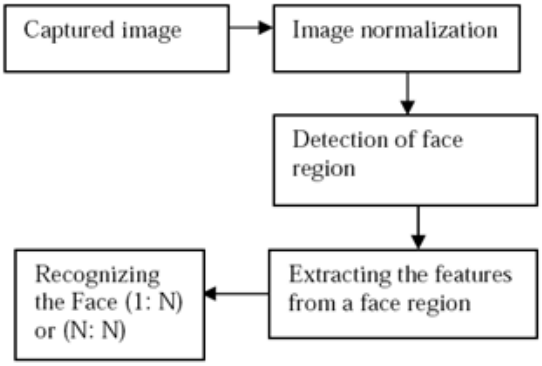

Fig.1. Process for face recognition

2. BACKGROUND AND RELATED WORK

The first attempts to use face recognition began in the 1960's with a semi automated system. Marks were made on photographs to locate the major features; it used features such as eyes, ears, noses, and mouths. Then distances and ratios were computed from these marks to a common reference point and compared to reference data. In the early 1970's Goldstein, Harmon and Lesk[2] created a system of 21 subjective markers such as hair colour and lip thickness. This proved even harder to automate due to the subjective nature of many of the measurements still made completely by hand. Fisher and Elschlagerb[3] approaches to measure different pieces of the face and mapped them all onto a global template, which was found that these features do not contain enough unique data to represent an adult face. Another approach is the Connectionist approach [4], which seeks to classify the human face using a combination of both range of gestures and a set of identifying markers. This is usually implemented using 2-dimensional pattern recognition and neural net principles. Most of the time this approach requires a huge number of training faces to achieve decent accuracy; for that reason it has yet to be implemented on a large scale.

The first fully automated system [5] to be developed utilized very general pattern recognition. It compared faces to a generic face model of expected features and created a series of patters for an image relative to this model. This approach is mainly statistical and relies on histograms and the gray scale value.

3. SYSTEM OVERVIEW

The present authors used the eigenface approach for face recognition which was introduced by Kirby and Sirovich in 1988 at Brown University. The method works by analyzing face images and computing eigenface [8] which are faces composed of eigenvectors. The comparison of eigenface is used to identify the presence of a face and its identity. There is a five step process involved with the system developed by Turk and Pentland [1]. First, the system needs to be initialized by feeding it a set of training images of faces. This is used to define the face space which is set of images that are face like. Next, when a face is encountered it calculates an eigenface for it. By comparing it with known faces and using some statistical analysis it can be determined whether the image presented is a face at all. Then, if an image is determined to be a face the system will determine whether it knows the identity of it or not. The optional final step is that if an unknown face is seen repeatedly, the system can learn to recognize it.

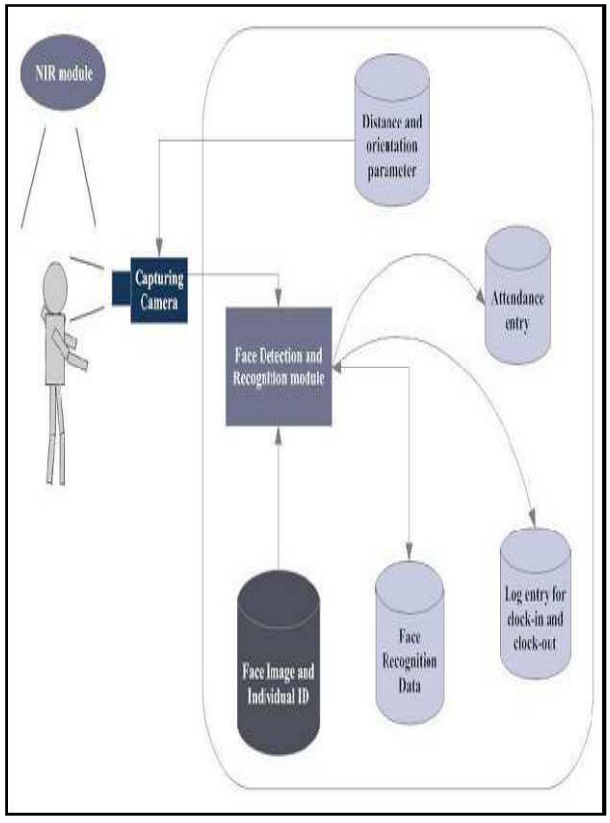

Fig.2 Overview of face recognition system

3.1. PCA (Principal Component Analysis)

PCA method has been widely used in applications such as face recognition and image compression. PCA is a common technique for finding patterns in data, and expressing the data as eigenvector to highlight the

similarities and differences between different data [6]. The following steps summarize the PCA process:

1. Let *{D1,D2,…DM}* be the training data set. The average
Avg is defined by:

$$Avg = \frac{1}{M} \sum_{i=1}^{M} Di \quad \text{…….. Eq (1)}$$

2. Each element in the training data set differs from *Avg* by the vector *Yi=Di-Avg*. The covariance matrix *Cov* is obtained as:

$$Cov = \frac{1}{M} \sum_{i=1}^{M} Yi.Yi^{T} \quad \text{……. Eq (2)}$$

3. Choose M' significant eigenvectors of *Cov* as *EK's*, and compute the weight vectors *Wik* for each element in the training data set, where *k* varies from 1 to M'.

$$W_{ik} = E_k^T.(D_i - Avg), \forall i,k \quad \text{……Eq (3)}$$

4. SYSTEM IMPLEMENTATION

The proposed system has been implemented with the help of three basic steps: **A**. detect and extract face image and save the face information in an xml file for future references .**B**. Learn and train the face image and calculate eigenvalue and eigen vector of that image. **C.** Recognise and match face images with existing face images information stored in xmlfile [1].Request matching. adding new faces to database

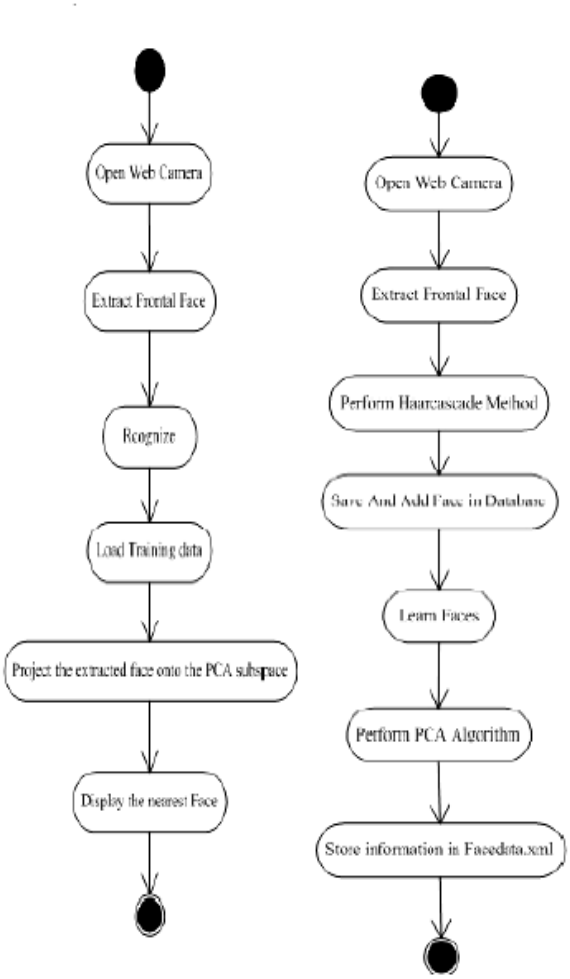

Fig.3 Flow Chart of face recognition system

At first, open CAM_CB() is called to open the camera for image capture. Next the frontal face [2] is extracted from the video frame by calling the function Extract Face (). The Extract Face () function uses the Open Cv Haar Cascade method to load the haar cascade_ frontalface_alt_tree.xml as the classifier. The classifier outputs a "1" if the region is likely to show the object (i.e., face), and "0" otherwise. To search for the object in the whole image one can move the search window across the image and check every location using the classifier. The classifier is designed such a manner that it can be easily "resized" in order to be able to find the objects of interest at different sizes, which is more efficient than resizing the image itself. So, to find an object of an unknown size in the image the scan procedure is done several times at different scales. After the face is detected it is clipped into a gray scale image of 50x50 pixels.

5. RESULT

The result with the 30 test images was not 100% accurate but it gave some good matching with almost 28 images. Accuracy Implementing PCA in the Face recognition on MATLAB, we got nearly 87. 09 %.

$$\%\text{Accuracy} = \frac{noofmatche\,dim\,age}{count} * 100$$

. Eq(5)

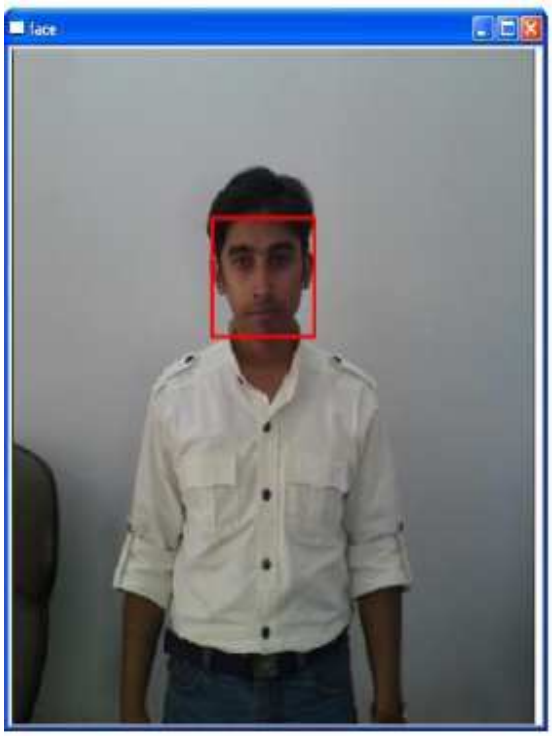

Fig.4 Test image

Fig.5 Result image

6. LIMITAITIONS

1. The images of a face, and in particular the faces in the training set should lie near the face space.
2. Each image should be highly correlated with itself.

7. SCOPE AND IMPROVEMENT

Further changes in the algorithm may lead to better accuracy. In addition, we can take some more distinct features to the training set of faces like length of forehead, chin positon etc. Facial recognition is still an ongoing research topic for computer vision scientists.

8. COMMERCIAL USE

1. Day Care: Verify identity of individuals picking up the children.
2. Residential Security: Alert homeowners of approaching personnel.
3. Voter verification: Where eligible politicians are required to verify their identity during a voting process. This is intended to stop 'proxy' voting where the vote may not go as expected.
4. Banking using ATM: The software is able to quickly verify a customers face.
5. Physical access control of buildings areas, doors, cars or net access.

9. FUTURE SCOPE

This project is based on eigenface approach that gives the accuracy maximum 92.5%. There is scope for future using Neural Network technique that can give the better results as compare to eigenface approach. With the help of neural network technique accuracy can be improved. The whole software is dependent on the database and the database is dependent on resolution of camera, so in future if good resolution digital camera or good resolution analog camera will be in use then result will be better. So in future the software has a very good future scope if good resolution camera and neural network technique will be used. Also a great deal of work has been saved by not building compact documentation for the software this area has been overlooked due to time constraints. Proper help for user is not being developed; the help messages for the same to the user can be developed in future, along with software documentation

10. CONCLUSION

1. We must choose some features of the sample face and create a database of the images. In our case, we have taken 57 face images.
2. Use of the Affine transform in finding the variables responsible for the same orientation, scaling and other feature variations for all the images.

3. The special features taken should be mapped in the window we are taking the face, it should include most part of the face rather than body.
4. Trained images should be mapped to smaller window.
5. Principal component Analysis can be used to both decrease the computational complexity and measure of the covariance between the images.
6. How PCA reduces the complexity of computation when large number of images are taken?
7. The principal components of the Eigen vector of this covariance matrix when concatenated and converted gives the Eigen faces.
8. These eigenfaces are the ghostly faces of the trained set of faces forms a face space.
9. For each new face(test face), 30 in our case, we need to calculate its pattern vector.
10. The distance of it to the eigen faces in the eigen space must be minimum.
11. This distance gives the location of the image in the eigen space which is taken as the output matched image.

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