Face Recognition System Using Principal Component Analysis

Ms. Birunda Antoinette Mary J[1], Ms. Ramya S[2]
Assistant Professor[1],Final Year M.Sc IT[2]
Department of Computer Science[1,2]
Stella Maris College[1,2]
ramyasrinivasagam@gmail.com[1], birunda78@gmail.com[2]

Abstract: An image is a depiction that can be generated, duplicated and saved in any electronic form. Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. Image processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. Human face recognition plays an important role in all sectors. Many fraudulent and crime activities are detected using the human face. Many methods are used for maintaining the security like credit cards, pin numbers, smart cards etc. But sometimes it fails. Principal component analysis is the method used in this paper. PCA is used for dimensionality reduction. It is one of the robust and reliable form of recognition. The mean, covariance, Eigen faces, Eigen vectors and Euclidian distance are selected by PCA calculating the nearest face or nearest value. The database is prepared with different images and the image that is given as input is compared with the database image. The similarity between the two images is found.

Keywords: Principal Component Analysis, Eigen Faces, Eigen Vectors, Euclidean Distance

1. INTRODUCTION

Face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time. Law enforcement may also use mobile devices to identify people during police stops. Face recognition has been used in airports, at border crossings, and during events such as the Olympic Games. Face recognition may also be used in private spaces like stores and sports stadiums, but different rules may apply to private sector face recognition.

This paper uses Principal Component Analysis (PCA) algorithm to reduce the dimensionality. The mean, covariance, Eigen faces, Eigen vectors, Euclidian distance is calculated and the shortest distance is found for the images. Then the two matching image is fetched from the database and the match is displayed.

The software used for this research is MATLAB R2013a. The name MATLAB stands for Matrix Laboratory. MATLAB is a high performance language for technical computing. It integrates computation, visualization and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning.

2. LITERATURE REVIEW

"Face Recognition using Principle Component Analysis Method" by Neelam Mahale [1] discusses about the Face Recognition using PCA Algorithm. The face is recognized based on some similarity measures. The mean and Standard deviation is calculated and the shortest distance is found between the images. The feature extraction algorithm is used to extract the specific features from the person and then the match is found. The features from global appearance are extracted using PCA and ICA. The features from local regions are extracted using LFA and Gabor Wavelet. The similarity measures are calculated using Euclidean distance, neural networks, Elastic Graph Matching and Template Matching. The PCA has low computational complexity, better recognition accuracy, low memory demands.

"Face Recognition using Principle Component Analysis in MATLAB" by Prabhjot Singh [2] talks about the Viola Jones Algorithm and Principal Component Analysis for removing the background from the image for face recognition. A self-prepared database is used. The Eigen faces and the Eigen vectors are selected by PCA calculating the nearest distance. The author also says that the complete removal of illumination is achieved by PCA Algorithm. In face localization, the central task is to find the face location and sizes of a well-known number of faces, whereas in the face detection purposed by viola jones emphasis on detection of the frontal face from the given input.

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"PCA Based Face Recognition and Facial Expression Identification System" by Nagarjun Singh, Pradeep [3] says that PCA is a very effective algorithm used for face recognition and facial expression detection. The preprocessing is done and the images are trained used the training algorithms and then the trained images are tested for accurate results. In preprocessing the images are resized from 256*256 pixels to 280*180 pixels. The three main components of this system are: Feature Extraction, PCA and Euclidean Distance Classifier. This system recognizes expression of the seven basic emotions namely happy, disgust, neutral, anger, sad, surprise and fear.

"The Research of Face Recognition Method Based on Sparse Representation and Feature Selection" by Yi Xu, Jun-Cheng Li [4] talks about the Fast Decomposition Gradient Projection Algorithm in solving sparse representation. Sparse Representation can effectively reduce the quantization error and improve the performance of sparse coding in face recognition. The sparse representation method saves the memory consumption and significantly improves the efficiency of the solution of the problem of large scale sparse representation. It ultimately improves the robust face recognition accuracy and efficiency. Due to the high frequency sub bands of wavelet it can catch small details and low frequency subband well said contour information.

"PCA Algorithm for Human Face Recognition" by Rahul, Ohol [5] discusses about the different steps used in PCA Algorithm for Face Recognition. The images are tested first and then the rest of the images are tested. The mean, covariance, Eigen faces and Eigen vector are calculated and then the shortest distance is found between the images and the match is declared based on the shortest distance. The recognition can be done from the input images or from the database image. The author also says that PCA improves the quality of the image. The results obtained by PCA are good.

3. OBJECTIVE OF THE RESEARCH

The main objective of this research is to find the faces which are similar using PCA Algorithm.
The following are calculated in order to find the match:
- Mean of the images
- Formation of covariance matrix
- Calculate Eigen values and Eigen vectors
- Projection of face class images
- Initialization of input images
- Classification of input images
- Face Recognition

4. RESEARCH METHODOLOGY

The methodology of the paper is analytical and descriptive. The research is done using secondary dataset of face images. The training database contains 190 images of 38 persons (5 images per each person), a test database has 40 images of different individuals (38 known and 2 unknown).

4.1 EXISTING SYSTEM
The existing system is built by considering the Facial Expressions of the person. All the steps in PCA are used. The system is purely designed using PCA algorithm. The existing system has used sparse representation for finding the similarity. The feature extraction is done using local feature analysis, discriminant analysis and local principal components. This process is performed by representing the RGB color channel as a three indexed data vector separately: red, green and blue channel. The system that used color information proposes the use of non-negative matrix normalization with color channel encoding.

4.2 PROPOSED SYSTEM
System Architecture
This section describes Face Recognition System architecture. The system is composed of Preprocessing, Principal Component Analysis, Viola Jones Algorithm for Feature Extraction and Euclidean classifier to find the similarity between the two images.
Input Image->Preprocessing->Feature Extraction->Classifier->Similar Image
Preprocessing
In preprocessing the images are converted into gray scale image and then the different colour channels are obtained. The histogram for the image is drawn. The Thresholding is done to the image.
Feature Extraction
Feature Extraction is a process of extracting specific features from the image to find the similarity.This is done using viola jones algorithm.
Classifier
The Euclidean Distance Classifier is used to find the similarity between the images by calculation the Euclidean score of the image.

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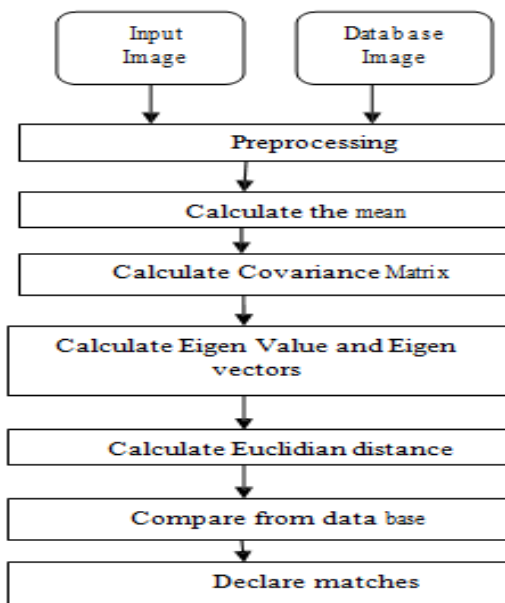
4.3 FLOW OF PCA

Calculating the Mean

Fig. 2 Flow of PCA

The mean image is a column vector. The distance is calculated by subtracting the mean image from the face image. The shortest distance is considered. The two images of the same person has more or less the same mean.

Formation of Covariance matrix

The covariance of the matrix is the second step in face recognition. The formula for calculating the covariance is,

Calculate Eigen values and Eigen vectors

The Eigen values and Eigen vector calculation is the third step in face recognition. The concept of eigenvalues and eigenvectors extends naturally to arbitrary linear transformations on arbitrary vector spaces.
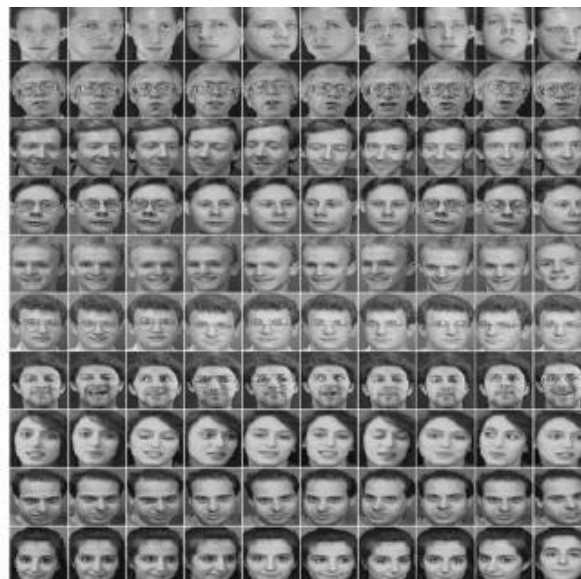
4.4 DATASET OF FACE IMAGES


5. EXPERIMENTAL RESULTS

We used MATLAB R2013a to implement all the experiments of Principal Component Analysis on different face images.

The training database contains 190 images of 38 persons (5 images per each person), a test database has 40 images of different individuals (38 known and 2 unknown). All photos have dimensions 92×112 and a dark homogeneous background and the subject is photographed in an upright, frontal position. The accuracy of the system was very good. The existing systems had some drawbacks which was solved in my system.

6. SYSTEM MODEL

3

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The system is designed with a set of input images. The images are converted into RGB color images and grayscale images. The histogram of the images is drawn.

GRAYSCAL   EIMAGE
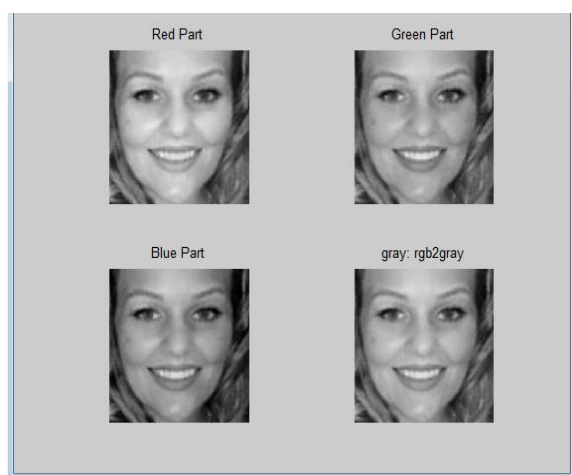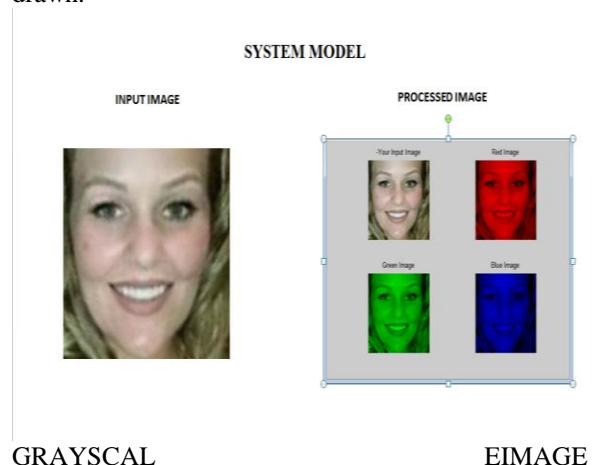

6.1 FACE CLASSIFIER

The face is classified based on their similarity measures. The image is trained by assigning a class number and then the next half of the images are used for testing.

6.2 FACIAL FEATURE DETECTION

The facial features are detected using the Viola-Jones Algorithm. The nose, eyes, mouth, eyebrows all are detected separately and the Euclidean score is calculated and if the Euclidean score is less than the Euclidean Threshold then the images are said to be similar, otherwise they are dissimilar.
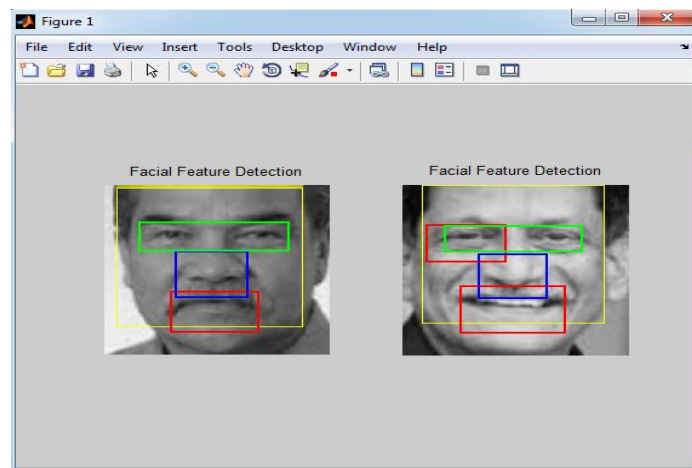
7. FUTURE WORK

The Face Recognition System can be used for Attendance Management. The camera can be fixed in the entrance so that it automatically captures the faces of the people entering. It can also be used for finding the faces of the criminals and allow the access of authorized people.

8. CONCLUSION

Finally the match is found by performing all these steps mentioned above. The input image is selected and the similar image is fetched from the database and the match is displayed. This is very important in today's world. Many fraudulent activities are taking place and unauthorized people are entering into the bank, schools, colleges etc. In order to reduce the crime this face recognition method has been implemented. PCA method is considered to be very efficient and effective.

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