RESEARCH ARTICLE OPEN ACCESS

Real Time Implementation Of Face Recognition System

Megha Manchanda
Department of ECE, MRIU, Faridabad

ABSTRACT
This paper proposes face recognition method using PCA for real time implementation. Nowadays security is gaining importance as it is becoming necessary for people to keep passwords in their mind and carry cards. Such implementations however, are becoming less secure and practical, also is becoming more problematic thus leading to an increasing interest in techniques related to biometrics systems. Face recognition system is amongst important subjects in biometrics systems. This system is very useful for security in particular and has been widely used and developed in many countries. This study aims to achieve face recognition successfully by detecting human face in real time, based on Principal Component Analysis (PCA) algorithm.
Index Terms – PCA, eigenvector, eigenfaces , covariance matrix, MATLAB

I. INTRODUCTION

Face is our primary focus of attention in social interactions; it plays a major role in conveying identity of a person. We can recognize thousands of faces learned throughout our lifetime and identify familiar faces at a glance after years of separation. Computational models of face recognition, in particular, are interesting because they can contribute to theoretical insights as well as practical applications. Face recognition system could be applied to a wide variety of problems, including criminal identification, security systems, image and film processing etc. Unfortunately, developing a computational model of face recognition is quite difficult, because faces are complex, multidimensional, and meaningful visual stimuli.

II. PRINCIPAL COMPONENT ANALYSIS

The Principal Component Analysis (PCA) is one of the most successful techniques that have been used in image recognition and compression. The purpose of PCA is to reduce the large dimensionality of data space to a smaller dimensionality of feature space. PCA can do prediction, redundancy removal, feature extraction, data compression, etc. Because it is a classical technique which can do something in the linear domain, applications having linear models are suitable, such as signal processing, image processing, system and control theory, communications, etc.

Face recognition can be categorized into face identification, face classification etc. The most useful applications contain crowd surveillance, video content indexing, personal identification, entrance security, etc. The main idea of using PCA for face recognition is to express the large 1-D vector of pixels constructed from 2-D facial image into the compact principal components of the feature space. This can be called eigenspace projection. Eigenspace is calculated by identifying the eigenvectors of the covariance matrix derived from a set of facial images (vectors). The details are described in the following section.

III. MATHEMATICAL IMPLEMENTATION OF PCA

A 2-D image can be represented as 1-D vector by concatenating each row/column into one single vector.

Taking an example:

$$x = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ \vdots \\ a_N \end{pmatrix} \xrightarrow{REDUCE \quad DIMENSIONALITY} y = \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ \vdots \\ c_K \end{pmatrix}$$

To reduce dimensionality of an image first mean of image is subtracted from each image

$$\overline{x} = \frac{1}{M}\sum_{i=1}^{M} x_i$$

Where, $\overline{x}$ is mean,

$$Subtract \quad the \quad mean : \Phi_i = x_i - \overline{x}$$

Then calculating covariance matrix,

$$C = \frac{1}{M}\sum_{i=1}^{M} \Phi_n \Phi_n^T = AA^T$$

Since the covariance matrix is square, we can calculate the eigenvectors and eigenvalues for a

matrix. These are rather important, as they tell us useful information about our data.
Let λ_i and μ_i be eigenvalues and eigenvectors.

And lastly, simplest method for determining which face class provides the best description of an input facial image is to find the face class *k* that minimizes the Euclidean distance. Ω describes the contribution of each eigenface in representing the facial image by treating the
eigenfaces as a basis set for facial images.

$$\in_k = \left\| \left(\Omega - \Omega_k \right) \right\|$$

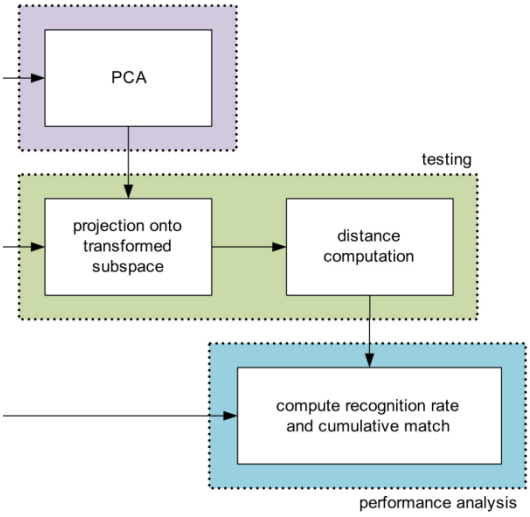
Ω_k is vector describing the k^{th} face class. If $\in_k$ is less than some predefined threshold θ, a face is classified as belonging to the class k.

IV. IMPLEMENTATION AND RESULT

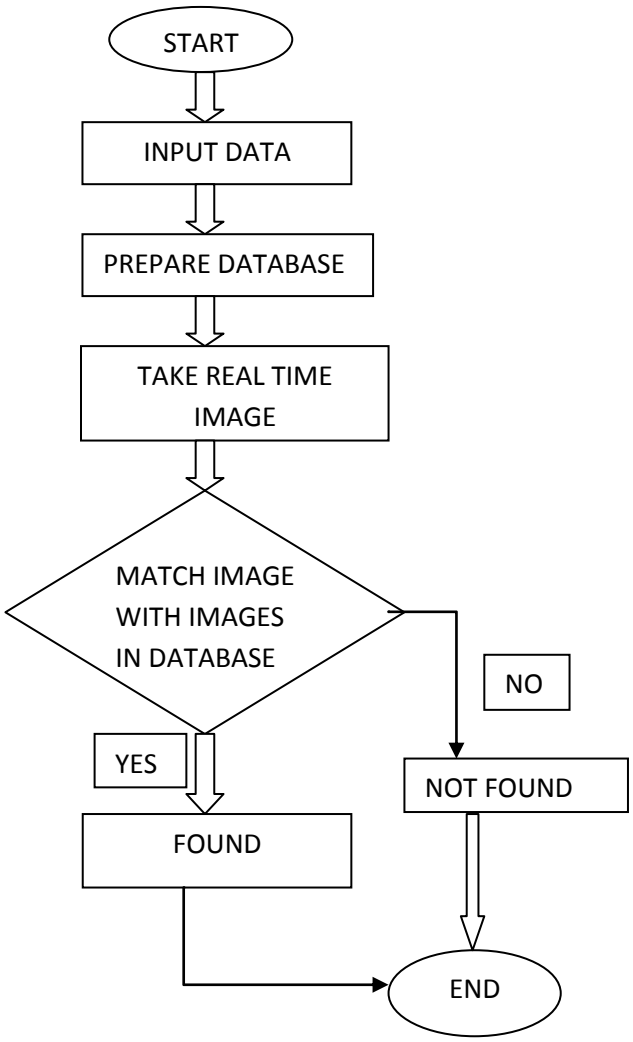
The entire sequence of training and testing is sequential and can be broadly classified as consisting of following steps:
1. Database Preparation
2. Loading of Database
3. Testing

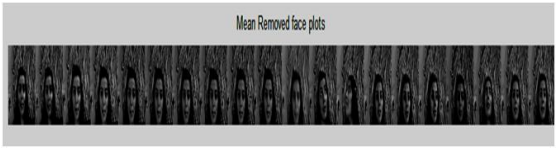
Database is build which contains only 20 subject's images, has been performed to ensure how well the eigenface system can identify each individual's face. The system has been implemented by MATLAB.

The result was very successful given. Every test image was correctly classified. When two unknown faces are input to the system, the threshold is larger than the predefined threshold and a error message occurs that face doesn't match.

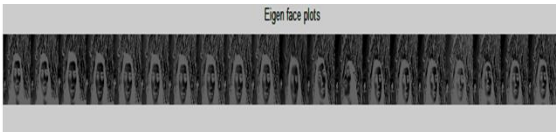


The steps are shown below

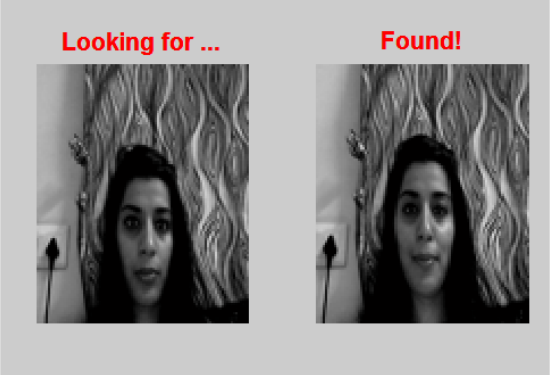




Images shown are those from which mean value is being subtracted



Above shown is output of eigenface plot of the dataset obtained.



Above shown is the result image being matched when the predefined threshold is met and hence the images match and desired output is obtained.

V. CONCLUSION

An algorithm for real-time human face tracking is implemented. The face detection is accomplished regardless of the viewpoints no matter it is a front view or a side view. However, the bottleneck of this algorithm consists in the resolution of camera and lighting conditions. PCA is considered to be efficient algorithm.

REFRENCES

[1.] Turk, M., Pentland, A.: *Eigenfaces for recognition*. J. Cognitive Neuroscience 3 (1991) 71–86.
[2.] Belhumeur, P.,Hespanha, J., Kriegman, D.: *Eigenfaces vs. Fisherfaces: recognition using class specific linear projection*. IEEE Transactions on Pattern Analysis and Machine Intelligence 19 (1997) 711–720.
[3.] Martinez, A. Kak, "PCA versus LDA", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 23, no. 2, pp. 228-233, 2001.
[4.] D. Zhang, Z.-H. Zhoua, and S. Chen, "Diagonal principal component analysis for face recognition," Pattern Recognition, Vol.39, pp.140-142, 2006.
[5.] Robinson P.E., "Comparison Of Principal Component Analysis And Linear Discriminant Analysis For Face Recognition" IEEE Trans Image Processing, Vol. 16, Pp. 212-220, 2007.
[6.] Satonkar Suhas, Kurhe Ajay, Dr.Prakash Khanale B"Face Recognition Using Principal Component Analysis and Linear Discriminant Analysis on Holistic Approach in Facial Images Database" IOSR Journal of Engineering Vol. 2, Issue 12 (Dec. 2012).
[7.] Haitao Zhao, Pong Chi Yuen ,Kwok, J.T. "Anovel incremental principal component analysis and its application for face recognition".
[8.] Face Recognition Using Adaptive Margin Fisher's Criterion and Linear Discriminant Analysis (AMFC-LDA)