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RESEARCH ARTICLE

An Efficient Face Recognition using PCA and Euclidean Distance Classification

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Abstract— ***Person identification using face is very exigent and knotty problem. Recognition of a person from an arbitrary perspective is crucial requirements for security measures and access control. Recognition of a particular face can be helpful for lots of problems like person – computer interaction, criminal detection, etc. The current system has more calculation due to upper dimensionality and not more effectual as well. Thus, instead of acquiring the face vectors with high dimensionality it is better to use face vectors with lower dimensionality. This implemented face recognition system is easy and comparatively simple to recognize the faces from videos taken from a distance and web cams. The improved PCA algorithm takes out facial features and classification is performed by minimum distance classification.***

Keywords— ***face recognition, PCA, minimum distance classification, criminal detection, face vectors***

I. INTRODUCTION

Face recognition system is a component of the facial image processing and their importance in a research area has increased recently. Face recognition systems is generally applied and favored for populace and security cameras. These systems can be used for crime prevention, video surveillance, and other security activities. Face recognition is difficult perform due to effects of lighting and imaging condition. Recognition system includes face detection and recognition and classification techniques.

II. LITERATURE SURVEY

Many research works have been done on the face recognition. Works can be divided into two parts: Detection and Recognition.

A. Face Detection

The first part of system is face detection. The output of the detection is the location of the face. Face detection techniques used in the literature are difficult to categorize, since most of the algorithms are grouping of methods

for detecting faces to amplify the accuracy of the system. Detection techniques can be classified into two groups as Knowledge-Based techniques and Image-Based techniques. Methods for face detection are given in Fig. 1.

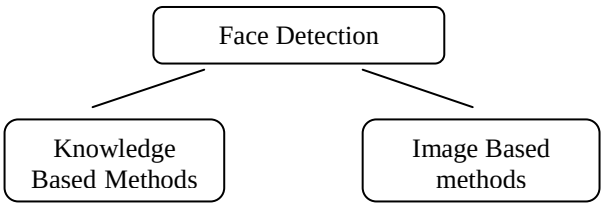

Fig. 1 Types of face detection techniques

Knowledge-based techniques used are Facial Features, Template Matching and Skin Color are used to locate eyes, mouth, nose or other facial features detect the faces. Skin Color or Facial Features are used to find eyes, nose, mouth and other facial features to detect the face. Color of the skin is dissimilar to other colors and it is unique. Its characteristics do not change with respect to pose variation. Face has unique features to differentiate from other objects and therefore, a pattern can be generated to check and detect faces. Facial features are essential information for individual faces and standard images can be generated in sequences. Image-Based methods used training methods to make decision between face and non-face images. These methods used multiple images of face and non-face and trained to boost the accurateness of the system. EigenFace, Neural Networks and SVM are different methods that are used face detection.

B. Face Recognition

Face recognition is the second step of the face recognition system. 2D or 3D image can be used to recognize. But, both techniques have limitations.

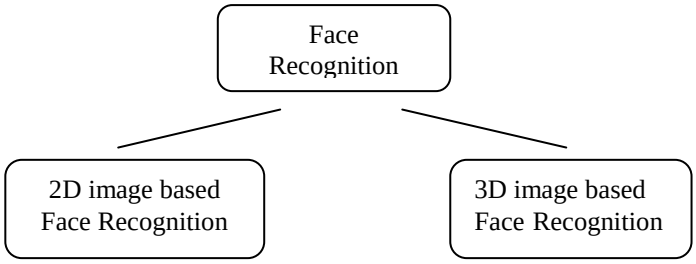

Fig. 2 Face Recognition Methods

Neural Networks and Linear and Nonlinear Projection methods have been used to recognize 2D face image. Different Neural Network approaches are RBNN, FFNN, Multi Layer Cluster NN and BPNN. Different 3D recognition methods are Corresponding Point Measure, Average Half Face and 3D Geometric Measures

III. PROBLEM STATEMENTS

Person recognition is a challenging problem in the field of image processing. Images, acquired from different sources may be sensitive to noises and lighting conditions. Detection of face from noised and low resolution is difficult task. Also, dimensionality of acquired image may be very large. To solve these problems, there is need to perform some preprocessing techniques. Preprocessed images are helpful to get better accuracy and to improve performance of the system.

IV. METHODOLOGY

The task in this project is to extract the relevant information in a face image, train it as powerfully as possible. Then, take a new face image, extract features of new face image and match up its feature with the features of trained face images. Methodology used to complete these tasks, can be classified in techniques used to perform individual part of the system.

A. Methodology used for Face Recognition System

Face recognition system generally recognizes the faces form single source, either from still images or recoded videos. In this work, we can recognize the face image from multiple sources like still images, webcams and recorded videos. Face detection unit can detect single face as well as multiple faces detect face from different sources. Face recognition module; match up face contender with face images which are stored in the database and recognize the face contender.

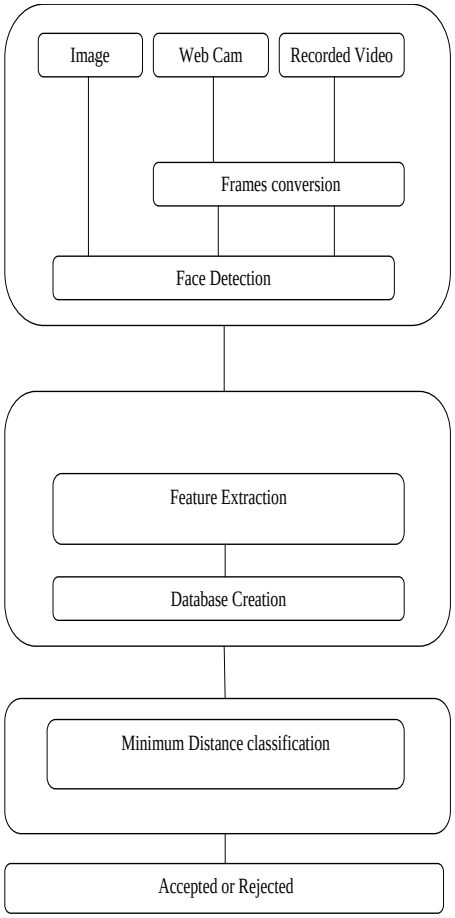

Fig. 3 Methodologies for Face Recognition

PCA method is used to extract features from face images. PCA calculates the Eigenvectors of the covariance matrix, and projects the unique features onto a lower dimensional feature. These Eigenvectors are also famous as Eigenfaces.

The advantage of the PCA method is that, reduce the dimension of the eigenvectors by some technique. To perform PCA some steps are undertaken. Assuming there are 'k' training images, denoted by M. M=1, 2, 3, 4….. k.

Step 1: Convert the 2D image vector in 1D image vector form.

Step 2: Calculate the average image vector from all trained images.

$$Avg = \frac{1}{k}\sum_{i=1}^{k} M_i$$

Step 3: Subtract the average image vector from each 1D image vector to get the unique image vectors. Resultant vectors are also known as normalized image vectors.

$$S_i = M_i - Avg$$

Step 4: Calculate a covariance Matrix.

$$C = \frac{1}{k}\sum_{i=1}^{k} S_i^T S_i$$

Step 5: Calculate Eigenvectors and Eigenvalues from the covariance Matrix.

Step 6: Choose a feature vectors. Only that eigenface should be selected, which have the maximum eigenvalues. The additional eigenvalues describes the features of a face images better.

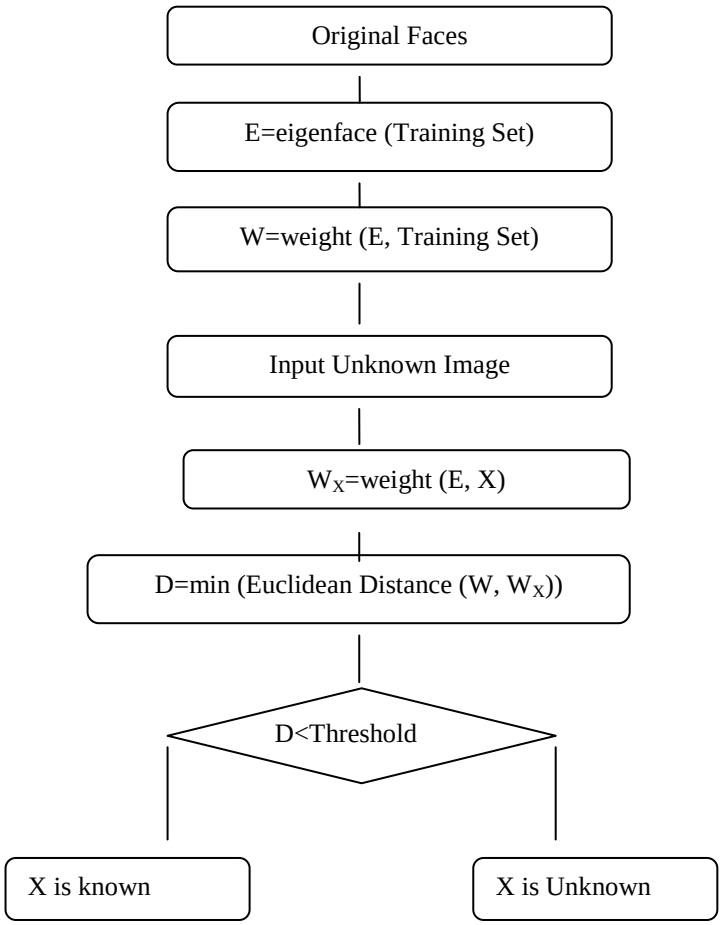

Fig. 4 Flowcharts for PCA Algorithm

B. Methodology used for classification

The task of the face classifier is to find out the most alike feature vector among the trained feature vectors of a given test images. Once the Eigenvectors of each face image are computed after that Eigenvector of the input face image is matched with each computed Eigenvectors and the weighted Euclidean distance between them is taken. The face image with the minimum Euclidean distance is preferred if their Euclidean distance is less than the threshold value. Tested face image get rejected otherwise. Euclidean distance can be calculated using formula:

$$d_x(x, w_k) = \sqrt{(x - w_k)^T (x - w_k)}$$

V. RESULTS AND DISCUSSIONS

The face recognition method is implemented with MATLAB 2012. Testing is performed with standard face database and acquired images as well. In this work, computer vision toolbox is used to detect. Methods used to detect face are based on Viola-Jones algorithm multiple faces from same image can also be detected using same Viola-Jones algorithm based method. Fig. 5 shows the multiple face detection in a single image.

Fig. 5 Multiple faces detection

Once the face is detected from images, cropped faces can be trained and store in database. Trained face images of 30 people are given in Fig. 6.

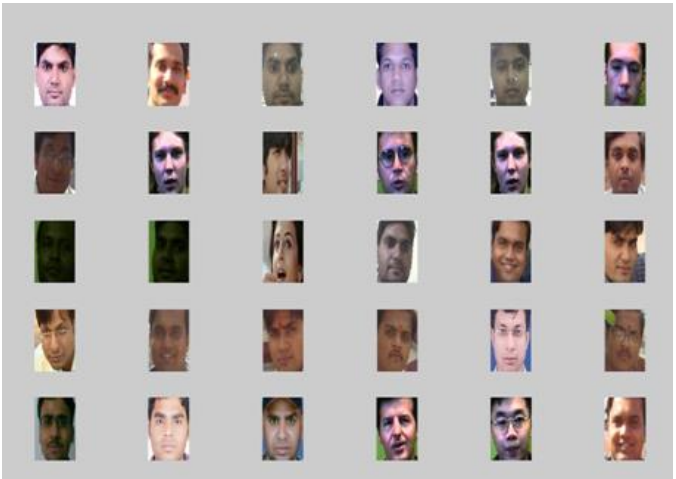

Fig. 6 Face imaged stored in database

In face recognition step, input test image is acquired. This input test image will be compared with the all face images stored into database. Initially, eigenfaces for all face images stored into the database are calculated. PCA algorithm is used to calculate the eigenface. After finding eigenfaces for trained face images, eigenface for input test face is also calculated. After that, Euclidean Distance is calculated from input test face to all trained faces. Face image with the minimum Euclidean Distance is selected as recognized face. Fig. 7 shows the bar chart for Euclidean distance for trained face images.

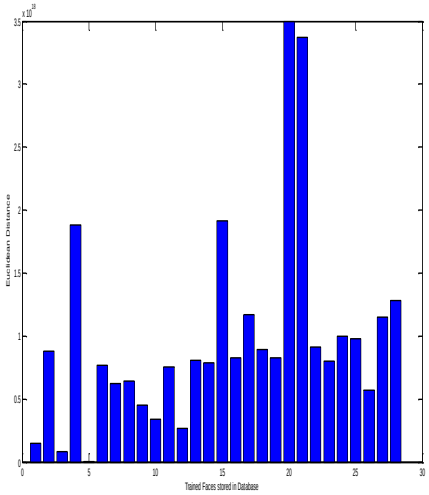

Fig. 7 Euclidean distance from test image to all trained face images.

VI. CONCLUSION AND FUTURE SCOPE

Although a basic PCA can increase the recognition accuracy for a face recognition system, still, there exists a limitation over PCA. For that reason, several issues is calculated and examined, in terms of the computational time complexity. This system successfully recognized the person and worked better with frontal view images. Applications of this system are person verification, video and other security activities.

In future face recognition system can be fused with other traits.

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