

Face Recognition of Criminals for Security using Principal Component Analysis

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Abstract - This paper consists of construction of a system which is used for face recognition based on Principal Component Analysis. The purpose of face recognition is to identify criminals who generate fake identifications with the use of evolving technology and cross borders. This system is made to install in airports specially to catch criminals of this kind. The algorithm used here does dimensionality reduction. By processing the images in the training set, different eigen faces are generated. Similarly, we generate an eigenface from the test input and by measuring the Euclidean distance between the test image eigenface and training eigenface, we determine the criminal by checking the minimum distance.

Keywords- Criminals, Airports, PCA, eigen value, eigen vector, Euclidean distance

I. INTRODUCTION

With the years rolling on, the crime rate in the world has been increasing tremendously. Although various methods have been proposed and implemented, a complete balance is not been done. The Crime Investigation Department completely gathers information about these criminals and catches them. As known some of them remain unclosed for years. On taking images from the clues collected, we can gather images of criminals. Along with that, images all those criminals who escape from prisons can also be added into set. With people showing greater attention to technology these days, generating a fake identification is too easy. These criminals started crossing seas in order to escape from the crimes they committed. To identify them and to reduce the crime rate in the world, we have developed a simulated model. The programming language used for this system is Matlab.

From the previously developed systems, the accuracy of this system has been improved and an alarm is attached to the system that buzzes immediately after a matching image is found so that the criminal can be trapped.

II. LITERATURE REVIEW

XueMei Zhao, and ChengBing Wei, 2017 used LBPH algorithm to identify a person from database of faces. Firstly, we need to convert the image to grey level image and for every pixel we need to find its LBP value. For this

an image is divided into (3 x 3) matrix which unique features are extracted from every part. For each neighbor of the central value, we set a new binary value. If the value of any neighboring part is greater than the threshold value the "1" is put up otherwise "0" is put on the new matrix. At the end all of them are concatenated and converted to decimal value which is actually a pixel from the original image [1].

FZ Chelali, 2009 proposed face recognition system by using Linear Discriminant Analysis which helps in reducing dimensionality of faces. It calculates the discriminant of features in each face and it forms classes of them [2]. Yu, H., & Yang, J, 2001 used LDA to find a linear transformation such that feature clusters are most separable after the transformation. This can be achieved through scatter matrix analysis [3].

Liton Chandra Paul, Abdulla Al Suman (2012) used PCA which deals in reducing the dimension size of an image greatly in a short period of time. It is efficient in processing time and storage, the accuracy of PCA is also satisfactory (over 90 %) with frontal faces. On an experiment, Principal component analysis was shown best of both LBPH and Fisher face as an experiment performed on two computers with different platforms (Intel 2.7Ghz with 4GB RAM and 1GHz processor with 512MB RAM) PCA showed best results in 1.91sec on Intel and 30.65sec on ARM which proved ideal [4].

III. METHODOLOGY

We propose a face recognition system based on PCA and Euclidean distance. Principal Component Analysis is a suitable strategy for face recognition because it identifies variability between human faces, which may not be immediately obvious. Principal Component Analysis (hereafter PCA) does not attempt to categorize faces using familiar geometrical differences, such as nose length or eyebrow width. Instead, a set of human faces is used to determine which 'variables' account for the variance of faces. In face recognition, these variables are called eigen faces because when plotted they display an eerie resemblance to human faces. Although PCA is used extensively in statistical analysis, the pattern recognition community started to use PCA for classification only relatively recently. As described by Johnson and Wichern

(1992), 'principal component analysis is concerned with explaining the variance- covariance structure through a few linear combinations of the original variables.' Perhaps PCA's greatest strengths are in its ability for data reduction and interpretation. For example, a 100x100 pixel area containing a face can be very accurately represented by just 40 eigen values. Each eigen value describes the magnitude of each eigen face in each image. Furthermore, all interpretation (i.e. recognition) operations can now be done using just the 40 eigen values to represent a face instead of the manipulating the 10000 values contained in a 100x100 image. Not only is this computationally less demanding but the fact that the recognition information of several thousand. The main obstacle for a face recognition system is of effective feature extraction. The proposed system makes use of the Eigenface method is information reduction for the images. There is plethora of information present even in a small face image. So, it becomes necessary to extract a face image so as to effectively represent face images rather than images in general. 'base faces are generated and then the image being analyzed can be represented by the system as a linear combination of these base faces. A simple Euclidian distance measure used for classification. The proposed system makes use of Principal Component analysis for feature extraction and various distance classifiers such as the Euclidian distance. This technique involves creating the 'eigen faces' then projecting training data into face-space to be used with a predetermined classification method and evaluation of a projected test element by projecting it into face space and juxtaposing it with training data.

Steps involved in face recognition system are:

A. Preparing training dataset

In this set images of all criminals are added to the dataset. It includes various instances of every criminals from different angle and different lighting conditions. These images can be captured by using webcam or from a video. These variations will improve the efficiency of the system and will provide more accurate results.

B. Calculating Mean

Before applying PCA we need to normalize the data because there are various similar features in all images. Comparing these features will further increase the processing time. Therefore, we compare principal components of images.

C. Subtracting the mean from every image

In this step the mean that is obtained in previous step is subtracted from every image. The result obtained is then used for calculating the feature vector.

A. Calculate covariance matrix

The covariance matrix of image is calculated by multiplying the matrix with its transpose.

B. Calculate Eigen Faces and Eigen Vectors

The eigen-vectors of every captured facial images are calculated. Eigen faces are the linear combination of eigen-vectors. Eigenface means the principal component of the stored data sets for the face images. By considering mathematically eigenvectors of covariance matrix of stored database are eigenfaces.

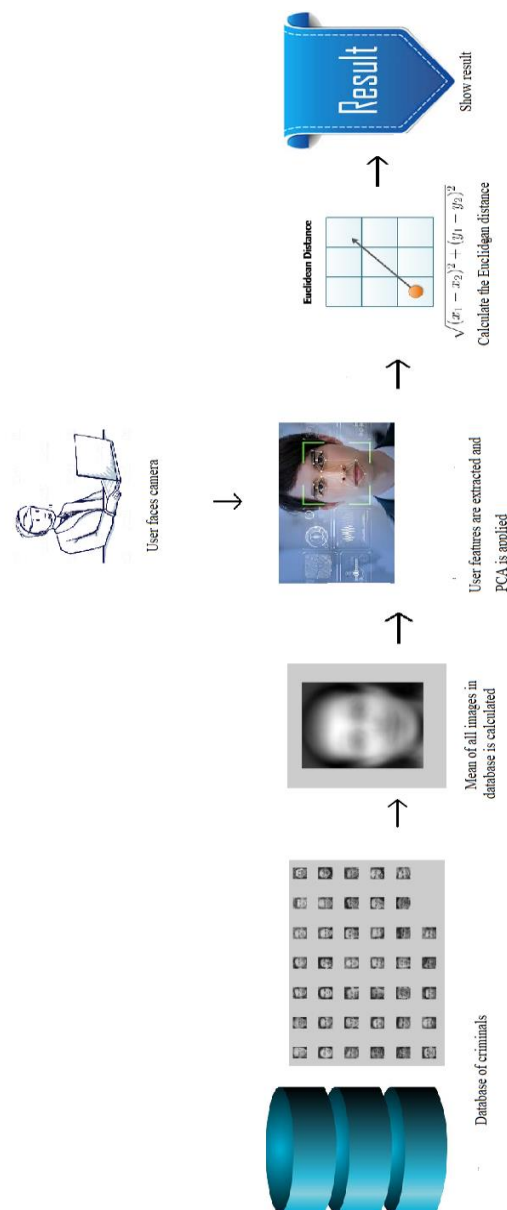
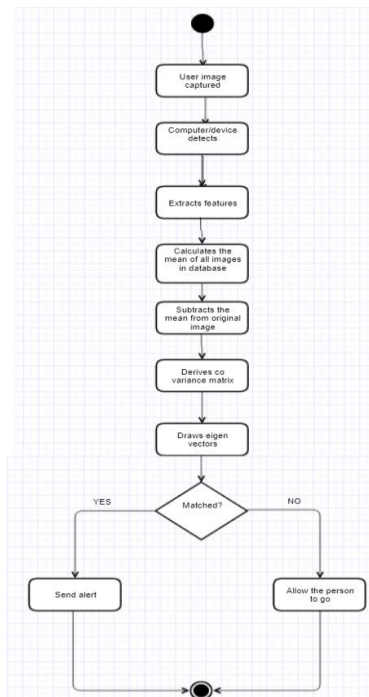


Fig: Architecture of Face Recognition System

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mathematically eigenvectors of covariance matrix of stored database are eigenfaces. These eigenvectors or eigenfaces represents the significant changes of the face images which help to recognize facial image. For classification of different facial images, weights of the eigenvectors are calculated. The Euclidian distance of new entered face is calculated, and is matched in the database with one having minimum distance [8].

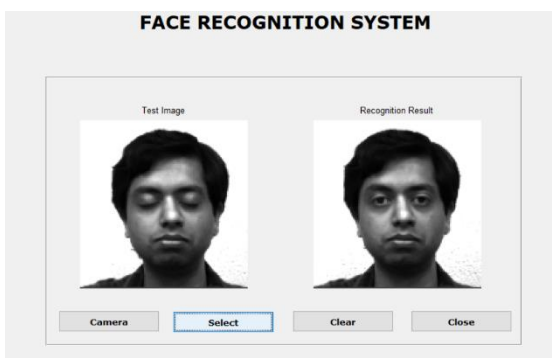
The figure describes the flow of the process in the form of flow graph. The entire process of PCA is been explained in the graph step wise. This is called the activity diagram.



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EXPERIMENTAL RESULT

On applying this algorithm that is by following all the steps laid out in the methodology, this system is designed and this is the generated output.



Even on changing the facial expression, the image still matches. The experiment comes with two ways of inserting images, through camera or one may browse. The above output is generated by browsing the image. The example of a real time output is as below



In the test image, we see that the face is too wide and close to the camera and clear with the features. But the image seen in the training side, is unclear and far from the screen. But due to faster computing and effective algorithm usage, we have generated the output quickly.

CONCLUSION

The system can recognize different faces that are either present in the database or taken real time. It is based on Principal Component Analysis and the quality of the processing is improved. Based on dimensionality reduction and identifying meaningful variables, recognition is done. The proposed system can clearly identify the images even is it's at a very far distance. In the upcoming years, the algorithm can be used in determining the gender of the person as well. It helps the criminals to be caught and this system can even be used by the places where the crowd is maximum all the time such as tourist spots.

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