Eigenface Algorithm Based Facial Recognition

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Abstract---Eigenface approach was developed by Sirovich and Kirchy in 1987 and later on Marthew and Alex work on it and used in facial recognition. Eigenfaces thinks image set as 2-D and assumes that at the time of recognition the face of the image should be kept straight and frontal.For this eigenfaces are calculated using principal component analysis . For this we calculate eigenvectors and eigenvalues. To calculate eigenvectors and values we need to have training sets of images which then differentiate input signals from noisy signals. After calculating eigenvectors we chose component and form a feature vector. Eigenvectors with highest eigenvalues is chosen as principal component of data set and then we get ghost like images which we called as eigenfaces.

***Key words*:-** Eigenfaces, PCA, Eigen vectors Eigenvalues, training sets, feature vector.

I. INTRODUCTION

Eigenfaces uses coding and decoding of facial images. Eigenface approach was developed by Sirovich and Kirley in 1987 and later Mathew turk and Alex peterland used in facial classification.It uses set of eigenfaces and eigenvalues then it used these values for face recognition. It assumes faces as 2-D and assumes that at the time of recognition the faces of the image should be kept straight and frontal so that it can log in into the system.

The main task of this is to distinguish input signals or Image sets from noisy signals that corrupts the data .It uses an approach in which it transforms face images into a set of basis faces called principal component of face images. For this we need to calculate eigenvectors and eigenvalues which are calculated using training sets of face images training set are the initial set of face images. Then we calculate weights on each image .

Eigenvectors charactreize the variation between various face images.Then the one with highest eigenvalues would be chosen and called as principal component of face image. Then these look as ghost like images called eigenfaces. The number of eigenface is equal to number of images in training set.

II. BASICS OF FACIAL RECOGNITION

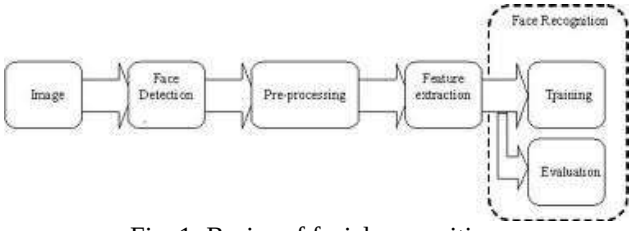

Fig. 1: Basics of facial recognition

- Face detection or acquistion: This is the starting phase of recognition process. In this the user is asked to represent a face recognition system in module.
- Preprocessing: In this face images are normalised or enhanced to increase recognition performance of the system. In this we work on illumination, histogram,background removal, translational and rotational normalization.
- Feature extractor: Face image is presented to feature extraction module in order to find features that are used for classification.
- Classification module: With the help of pattern classifier , extracted features of face image is compared with one stored in face library of training sets.
- Training set: These sets are used during learning phase of recognition process.
- Face library or face database: After being classified as known or unknown face images would be added to standard library along with their feature vectors.

III. GENERAL WORKING OF EEIGENFACE ALGO

- Firstly get sample images or pictures of people you want to recognise.
- Get training set of these images . Training set should be taken under the same lighting conditions . They must be resampled to the same pixel resolution.Each image must be treated as one vector.
- Subtract the mean: The average image has to be calculated and then subtracted from each original image.
- Calculate the eigenvectors and eigenvalues of covariance matrix.
- Choose the principal components
- Now from these sample images or pictures, classify new image

IV. EIGENVECTORS & EIGENVALUES

All vectors change direction when multiplied by A. Certain exceptional vectors x are in same direction called eigenvector.

Ax=$x

Where $ is eigenvalue of A.

Eigenvalue tells whether special vector x is stretched or shrinked or reversed or left unchanged when multiplied by A.

A. Properties Of Eigenvectors:

- They can be determined only for square matrices
- All eigenvectors are perpendicular to each other.
- Eigenvectors with distinct eigenvalues are linearly independent.
- A has n eigenvalues but some may be complex numbers and some eigenvalues may be repeated.
- .If A contains only real numbers then its complex eigenvalues must occur in conjugate pairs.

– .If no eigenvalues of A is repeated then A is diagnozable.
– They have n eigenvectors corresponding to n*n matrix.

According to the figure we start with the training set and then we calculate weightsW, and then we calculate average distance when the distance is closed to 1 it is known face otherwise unknown face and then the values are stored in the database.

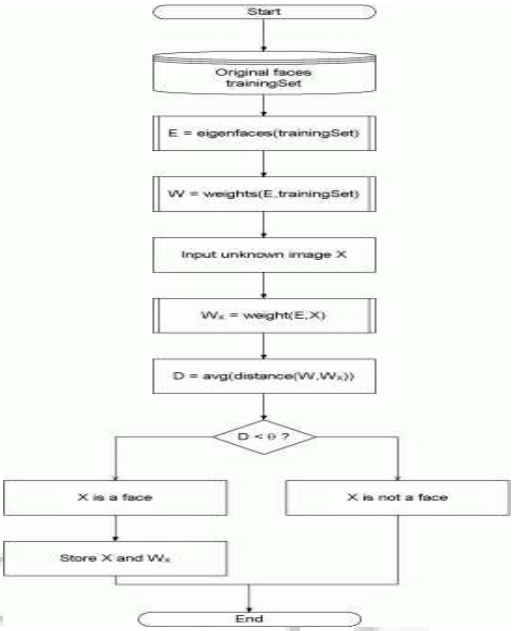

Fig. 2:

V. Steps For Generate Eigenface With PCA

PCA is a mathematical procedure that uses orthogonal transformation to convert a set of values of faceimages into eigenfaces called principal components. The number of principal component is always less than or equal to number of original variables.

– Step1:Get training set of data. In this step the training set should be kept ready for processing.
– Step2: Represent each image as a vector
– Step3:Find average face vector and then subtract the mean

$$m = \frac{1}{N}\sum_{i=1}^{N}\vec{x}_i,$$

[redacted]

Average matrix has to be calculated and then subtract from original face and result stores in database.

– Step4: Calculate covariance matrix

$$\text{cov}\, j = \left(x_j - \mu_j\right)\left(x_j - \mu_j\right)^{\mathrm{T}}$$

Covariance matrix is calculated and then we proceed to next step

– Step5: Calculate eigenvectors and eigenvalues of covariance matrix eigenvectors u and x are calculate

All eigenvectors are perpendicular to each other .the largest eigenvalue chosen closest to 1.

– Step6: Choosing component and forming a feature vector

From M eigenvectors only M" should be chosen with highest eigen values and is treated as principal component of data set

After eigenfaces are determined the training phase of algo is finished.

VI. Conclusion

We are currently expected that the face images we have taken should be kept straight and frontal according to eigen faces. Other than full frontal view we have to find training set of each images and then find eigenvector and eigenvalues.The one with highest eigenvalue would be chosen and taken as principal component of that image we have to find eucledian distance too eucledian distance tells us how close the input image is from the images on our training set . Based on this we can find whether face is a known face or unknown face.When an image is closed to face like but do not classify as familiar face it is labelled as unknown Face.

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