DEVELOPMENT OF BIOMETRIC FACE RECOGNITION SYSTEM

Dr. R. L. Telgad

1 Asst. Prof. Dept. of Computer Science, Shri Vyankatesh College, S.G. B. A. University, Amravati, Maharashtra

ABSTRACT

The proposed system develops the face recognition system by using Principal Component Analysis (PCA) Algorithm PCA relies on the singular value decomposition (SVD) of rectangular matrices and the Eigen-decomposition of positive semi-definite matrices. It is decided by the Eigen values and eigenvectors. Numbers make up eigenvectors and eigen values. as well as the vectors connected to square matrices. Together, they offer the Eigen-decomposition of a matrix, which examines its structure, including any cross-product, correlation, or covariance matrices. In practice, PCA is relatively easy to perform. An m n matrix, where m is the number of measurement kinds and n is the number of trials, should be used to organize a data set. For each measurement type, subtract the mean, or row xi. Determine the SVD or the covariance's eigenvectors. It was discovered that PCA had a variety of fascinating uses. For Face Biometric system we used The P.C.A. (Principal Component Analysis) based feature extraction system and Euclidean distance matcher. T*he accuracy for the face modality is 90 .4% and FAR is 5.06 % FRR is 7.09%. The Recognition rate is also improved using advanced pattern recognition and NN techniques, which will be studied in future.*

Keyword: - *Face recognition Techniques, Face Detection, Feature Extraction, Principal Component Analysis (PCA)*

---

1. INTRODUCTION

One of the most used biometric identification methods from the last 17–18 years is face recognition. The oldest and most well-known method for analysing multivariate data is principal component analysis. Pearson (1901) initially used the term, and Hotelling independently developed it (1933). Prior to the development of electronic computers, it was not commonly recognized or employed, like many other multivariate methods, but it has since is now deeply ingrained in almost all statistical software programmes. Principal Component Analysis (PCA) is the common name for a method that reduces a large number of potentially associated variables to a smaller set of variables known as principal components by applying complex mathematical principles. Multivariate data analysis is where PCA's roots are, although it has many other uses as well. One of the most significant outcomes from applied linear algebra, and possibly the most significant, is PCA. Pattern recognition and image analysis are successfully applied in face recognition. Verification and identification are the two primary functions of a face recognition system. The two most widely used methods for identifying faces are (A) based on the position and shape of facial features like the eye, brow, nose, lips, and chin, as well as their spatial relationship, or (B) based on an overall analysis of the face image that represents a face as a weighted combination of a number of canonical faces. [1] The first phase in face recognition, the precise detection of human faces in random settings, is the process that needs to be focused on face detection. Human faces are very similar in terms of their size, aspect ratio, and location of the primary features, but they can differ greatly in specifics depending on the person, their gender, their race, or their attitude. The face detection process binds with the human face's angular features. The technique for detection uses a straightforward feature. Because features can be utilized to represent both statistically close facial information and tangentially related background data sample images, features are given more weight in this research than numerical pixels. The features can be conceptualized in their most basic form as pixel intensity set estimations. This is where the sum of the luminance of the pixels in the white region of the feature is subtracted from the sum of the luminance in the remaining gray section. [2].

2. LITERATURE REVIEW:

In 1991, Turk and Pentland discovered that while using the eigen faces techniques, the residual error could be used to detect faces in images Although the approach was somewhat constrained by the environmental factors, the nonetheless created significant interest in furthering automated face recognition technologies.

the PCA method is used for dimension reduction for linear discriminate analysis (LDA), generating a new paradigm, called fisher face. The fisher face approach is more insensitive to variations of lighting, illumination and facial expressions. However, this approach is more computationally expensive than the PCA approach[3].

2.1. Face Detection Techniques:

As the name suggests, it is the detection of the face. In this phase, faces are detected in the image. To detect the face from the image there are four methods which is as follow:

2.1.1 Knowledge-based Method

The rule-based method uses the knowledge of human to get the information about the typical face. Usually, the rules capture the relationships between facial features to design the location of the features in the face[4].

2.1.2 Template Matching Method

In this, several standard patterns of a face are stored in the database or the system to describe the face as a whole or the facial features separately. The link between an input image and the stored patterns are evaluated for detection. These methods have been used for both face localization and detection [5].

2.1.3 Appearance based Method

In contrast to template matching, the models are learned from a set of training images which should capture the representative variability of the appearance face. These learned models are then used for detection and are mainly designed for face detection [6].

2.1.4 Block rank patterns

In this, a block rank pattern is generated by dividing two gradient magnitude images into nine(3×3) blocks and then a face is roughly detected by these 3×3 block rank patterns generated from the gradient magnitude images[7]

2.2 Feature Extraction

It is the extraction of features like eyes, nose and lips from the face which can be used further to differentiate people from each other. The approaches for face extraction are:

2.2.1 DCT (Discrete Cosine Transform)

The Discrete Cosine Transform expresses a sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. Therefore, it can be used to transform images, compact the variations and allows an effective dimensionality reduction. They have been widely used for data compression.

2.2.2 Gabor Filter

A set of Gabor filters with different frequencies and orientations may be useful for extracting important features from an image. They have been widely used in pattern analysis applications.

2.2.3 PCA (Principle Component Analysis)

Principle Component Analysis is a mathematical procedure that performs a dimensionality reduction by extracting the principle components of the multi-dimensional data. It is based upon Eigenvector and a linear map. The cases, an artificial neural network is an adaptive system that changes its structure based on external or internal information that flows through the network.

2.2.4 SOM (Self-Organizing Map)
Self-Organizing Map (SOM) belongs to the competitive learning networks. It is a kind of a neural network which is trained by using unsupervised learning to produce a two dimensional (2-D) representation of the input space of the training samples. [3.]

3. PROPOSED METHODOLOGY:
The following figure shows the methodology for the face recognition system:

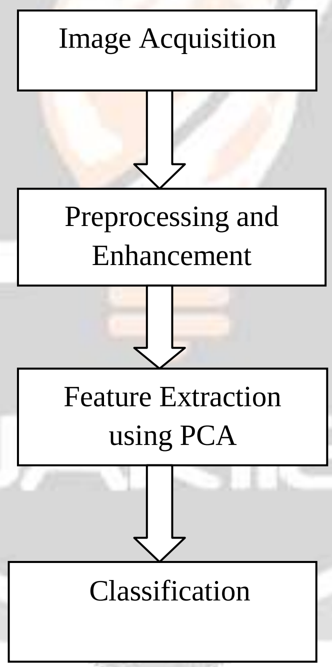

Fig 1 Proposed System

3.1 Image acquisition:
For fingerprint recognition system, FVC2004 database and KVK database is taken for developing the Biometric system.

3.2 Preprocessing and Enhancement

Image enhancement is used to make image clear which is very easy to handle and can operate easily for further operation. Basically face image may have noise. The Image enhancement step is basically designed to reduce this noise and Gaussian filter is used to reduce the noise.

3.3 Feature Extraction using PCA

Principal component analysis is a method that reduces the dimensionality of data by performing an analysis of covariance between factors. As such, it is suitable for multivariate data, such as a large experiment containing a huge amount of data. PCA is an unsupervised technique and as such does not include data label information. PCA is mathematically defined as an orthogonal linear transformation [9] that transforms the data into a new coordinate system such that the largest variance in any projection of the data is on the first coordinate (called the first principal component), which is the second most big variance on the second coordinate and so on. Define a data matrix with zero empirical means, where each n row represents a different copy of the experiments and each m column represents a particular type of data.

$$X = W\Sigma VT \quad (1)$$

where m × m matrix, W is the matrix of Eigen vectors of XXT, matrix Σ is an m × n rectangular diagonal matrix with non negative real numbers on the diagonal, and the n × n matrix V is the matrix of Eigen vectors of XTX .The PCA transformation that preserves dimensionality is then given by (3).

$$YT = XTW=V\ T\ WT\ W = V\ T \quad (2)$$

V is not uniquely defined in the usual case when m < n − 1, but Y will usually still be uniquely defined. Since W is an orthogonal matrix, each row of YT is simply a rotation of the corresponding row of XT. The first column of YT is made up of the "scores" of the cases with respect to the "principal" component; the next column has the scores with respect to the "second principal" component, and so on. For reduced dimensionality representation, project X down into the reduced space defined by only the first L singular Vectors, WL.

$$Y = WLT\ X <= L = LV\ T \quad (3)$$

Where with IL Xm the L.m rectangular identity matrix. The matrix W of singular vectors of X is equivalently the matrix W of Eigen vectors of the matrix of observed covariance as in (4)

$$C =XXT, X.X\ T = W\ T\ WT \quad (4)$$

The first principal component corresponds to a line that passes through the mean and minimizes the distance of the points of the line. Similarly, the second principal component corresponds to the same concepts and is subtracted from the points. PCA is used to reduce the dimension. PCA differs in that it is an optimal orthogonal transform to preserve the subspace with the largest "variance" (using the orthogonal transform) of much of the variance down to the first pair of dimensions. are usually small and can be lost with minimal data loss. PCA is often used for dimensionality reduction in this way. PCA has a variance of , which is the optimal orthogonal transformation to preserve the subspace where has the largest "variance". PCA, also known as the Karhunen-Loeve expansion, is a classic feature extraction and data representation technique, and this technology is widely used in the areas of pattern recognition and computer vision [8]. Principal component analysis is proposed by Turk and Pent land in 1991, which is often used for extracting features and dimension reduction. The PCA face recognition algorithm is used to extract the Eigen vectors of the face images. In mathematical terms, we wish to find the principal components of the distribution of faces, or the Eigen vectors of the covariance matrix of the set of face images, treating an image as a vector in a very high dimensional space [10].We used PCA for feature extraction.

The algorithm is as follows.

The feature vector can get on the database with the following method. Suppose there are P patterns and each pattern has t training images of m x n configuration.

• The database is rearranged in the form of a matrix where each column represents an image.

• With the help of Eigen values and Eigen vectors covariance matrix is computed.
• Feature vector for each image is then computed. This feature vector represents matrices of the image. This matrix for whole database is then computed.
• Euclidean distance of the image is computed with the entire database.
• Image is identified as the one which gives least distance with the signature of the image to recognize [8].

4. CLASSIFICATION:

The Classification is done by using Euclidean Distance. The Euclidean Distance between the facial organs and other portions that have been discovered and Make a matrix of the Euclidean distances between any two places stated above, such as the centre of the left eye, right eye, nose, mouth, and face for both the query image and each target image. Select the Target Image Database containing set of images which are to be compared or matched

For face biometric system P.C.A. (Principle component Analysis) is used for feature extraction and the Euclidean distance matcher is used for matching of face modality. We used Face Detect and pose estimate the database of robotics csie for face Biometric system. For the experimental set up we used 200 images from each dataset. Following figure shows some images from Face Detect and pose estimate database of robotics csie.

5. CONCLUSIONS:

For Face Biometric system we used The P.C.A. (Principal Component Analysis) based feature extraction system and Euclidean distance matcher. The accuracy for the face modality is 90 .4% and FAR is 5.06 % FRR is 7.09%. The Recognition rate is also improved using advanced pattern recognition and NN techniques, which will be studied in future.

6. REFERENCES

[1]. Handbook of biometry – A.K.Jain, (Michigan State University ,USA), Arun A. Ross(West Virginia University, USA.
[2]. Rajeshwar Dass, Ritu Rani and Dharmender Kumar, "Face Recognition Techniques: A Review", International Journal of Engineering Research and Development,vol. 4, Issue no. 7, pp. 70-78, 2012
[3]. Richa1, Jagroop Kaur JosanInternational Journal of Science and Research (IJSR) ISSN (Online): 2319-7064
[4]. Shou-Jen Lin, Chao-Yang Lee, Mei-hsuan Chao, Chi-Sen Chiou, Chu-Sing Yang, „The Study And Implementation Of Real-Time Face Recognition And Tracking System‟, Proceedings of the Ninth International Conference on Machine Learning and Cybernetics, Qingdao, 11-14 July 2010.
[5]. Sarala A. Dabhade & Prof. Mrunal S. Bewoor „ Real Time Face Detection and Recognition using Haar - Based Cascade Classifier and Principal Component Analysis‟ International Journal of Computer Science and Management Research Vol 1 Issue 1 Aug 2012 ISSN: 2278-733X.
[6]. Yun-Hee Han,Keun-Chang Kwak,‖ Face Recognition and Representation by Tensor based MPCA Approach,2010 The 3rd International Conference on Machine Vision
(ICMV 2010)
[7]. Seema Asht, Rajeshwar Dass, Dharmendar, "Pattern Recognition Techniques", International Journal of Science, Engineering and Computer Technology, vol. 2, pp. 87-88, March 2012.
Ambika Ramchandra and Ravindra Kumar,"Overview Of Face Recognition System Challenges," International Journal of Scientific & Technology Research (IJSTR), vol. 2, issue 8, Aug.2013.
[8]Jian Wang, Jian Cheng, "FACE RECOGNITION BASED ON FUSION OF GABOR AND 2DPCA FEATURES", IN International Symposium on Intelligent Signal Processing and Communication Systems, December 2010, pp. 1-4.
[9]S. C. Dass, K. Nandakumar, & A. K. Jain, "A Principled Approach to Score Level Fusion in Multimodal Biometric Systems ", Proc. of Audio- and Video-based Biometric Person Authentication (AVBPA), Rye Brook, NY, 2005.
[10] Nicolas Morizet, Thomas EA, Florence Rossant, Frederic Amiel,Amara Amara, Revue des algorithmes PCA, LDA et EBGM utilises enreconnaissance 2D du visage pour la biometric Institute Superieur d'electronique de Paris (ISEP), Department d'electronique, 2007.