FACE RECOGNITION SYSTEM BASED ON 2DFLD AND PCA

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Abstract— An automated system is used for fast human face recognition. The 2DFLD algorithm is tested on the various databases. PCA algorithm is tested on various databases. As the face system is totally non-intrusive, existing security of face recognition system are more effective without bothering the user in any way. The 2DFLD approach is compared with the standard PCA. The 2DFLD is used for recognizing face. In 2DFLD algorithm an optimal subset of features are used that gives a better results than PAC. The 2DFLD algorithm is faster as compare to PCA.

Keywords— Face recognition, Two-dimensional fisher's linear discriminate (2DFLD), Principal Component Analysis (PCA), Eigenface.

I. INTRODUCTION

In pattern recognition important and active topic is Face Recognition. It is also a key technology widely applied in computer vision. In ancient, face recognition is treated as a supervised learning, i.e., classifiers are trained by a set of prepared face images associated with Persons and then new face images are recognized by use of the classifiers. Real time face recognition for and complex real-world environments has garnered tremendous attention for student and give the attendance daily means online attendance system as well as security system based on face recognition. From last few decades, automated face recognition system is a big challenging problem and has gained much attention. There are many approaches in this field. Many algorithms proposed to identify and recognize human being face form given dataset. The recent development, fast processing capacity and high accuracy facilitated us in this face recognition field. The direction to include learning techniques in the complex computer vision technology the efforts are also going in. There are so many existing systems to identify faces and recognized them. But the existing automated face detection systems are not so efficient for identification and recognition [1]. A lot of research work is going in this direction to increase the visual power of computer and face recognition technologies. In the development of visual and vision system there are lots of scopes. But there are difficulties in the path such as high processing power for retrieval from a huge image database and development of efficient visual feature extracting algorithms [4].

As face system is totally non-intrusive, face recognition systems are a perfect enhancement to existing security systems. In many special aspects and cases of security requirements, face recognition affords significant advantages over traditional key based systems. In the cases like carjacking, the car will have a system for automatically recognizing the identity of its owner and other drivers which are designated to drive the car. The face system will instantly recognize the new driver as an unauthorized driver and can then disengage the transmission of the car. Face systems can also recognize a wide range of other security issues including anything that a normal camera system would be used for [2][3].

As image is a complex high dimension matrix and processing matrix operation is not so fast and perfect. Hence, this direction us to handle with a huge image database and focus on the new algorithms which are more real-time and more efficient with maximum percentage of accuracy. Efficient and effective recognition of human face from image databases is now a requirement. Face recognition is a biometric method for identifying individuals by their features of face. Applications of face recognition are widely spreading in areas such as criminal identification, security system, image and film processing. From the sequence of image captured by the capturing device, in our case camera, the goal is to find the best match in the database. Using pre-storage database it can identify or verify one or more identities in the scene. The general block diagram for face recognition system is having three main blocks, the first is feature extraction, second is classification and the third face recognition.

II. FACE RECOGNITION SYSTEMS

Face recognition system is used to determine the identity of a person based on sequence of his or her face.

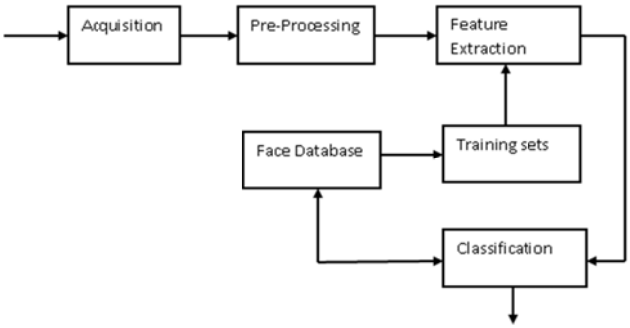

Figure 1.Face Recognition system Block Diagram

The block diagram contains of several modules like Acquisition, Pre-Processing, Feature Extractor, Training sets, Face Database, Classification. First is Image acquisition module is to seek and then extracts a region which contains only the face. Face detection is used to detect face and to extract the information related to facial features. The image will then be resized and corrected geometrically and it will eliminate the background and scene which are unrelated to the face so that it is suitable for recognition/verification. Main purpose of the preprocessing module is to eliminate or reduce some of the variations in face because of illumination. To improve the recognition performance of the system the image normalized and enhanced the face image. The preprocessing is crucial because robustness of a face recognition system greatly depends on it. System robustness against posture, scaling, illumination and facial expression is increased by using the normalization process. Main purpose of the feature extraction is to extract the feature information or vectors which represents the face [4]. The feature extraction algorithms used are Principal Component Analysis (PCA) [5] and Two Dimensional Fisher Linear discriminant (2DFLD). Training is a process of acquiring features from available training images and storing them in a knowledge base for the purpose of recognition an unknown future scene image. Given a set of samples of each class, PCA and 2DFLD is used for feature extraction [6]. The classification sub-module is to map the feature space of a test data to a discrete set of label data that serves as template. The classification techniques used is Nearest Neighbor Rule [31].

III. IMAGE FEATURE EXTRACTION

A.PCA (Principal Component Analysis):

Face recognition is one of the nonintrusive biometric techniques commonly used for verification and authentication. Local and global features based extraction techniques are available for face recognition. Global features extraction technique calculates co-variance matrix of inter images whereas auto-correlation matrix is computed in local features technique. PCA is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components [16]. In the PCA-based face recognition technique, the 2D face image matrices must be previously transformed into 1D image vectors. The resulting image vectors of faces usually lead to a high dimensional image vector space, where it is difficult to evaluate the covariance matrix accurately due to its large size and the relatively small number of training samples. PCA can be expressed in general as "a linear transformation of the image vector to the projection feature vector" as given below:

$$Y = W^T X \quad \ldots\ldots\ldots (1)$$

Where, W is the transformation matrix having dimension K x 1, Y is the K x N feature vector matrix and X is the higher dimension face vector obtained by representing all the face images into a single vector $X = \{x_1, x_2, \ldots, x_N\}$.

B.2DFLD (Two Dimentional Fisher's Linear Discriminant):

Training is a process of acquiring features from available training images and storing them in a knowledge base for the purpose of recognition an unknown future scene image. Given a set of samples of each class, the 2DFLD approach extracts most informative features which could establish a high degree of 2DFLD feature extraction scheme outperforms the conventional PCA schemes not only in terms of the computational efficiency, but also in terms of the performance for face recognition [13].

1) An alternative Fisher criterion:

Project an *m*n* image matrix X onto an m-dimensional vector space through the transformation y=Xα, where α is an n-dimensional vector, and y the m-dimensional projected vector. Goal is to find the optimal projection direction α so that the projected vector in the m-dimensional pace reaches its maximum class separability. Suppose $\{X_i\}_{i=1}^{N}$ are the training images, which contain C classes (subjects), and the ith class *ci* has *ni*

samples[14]. The images, all *m*n* matrices, are projected into m-dimensional vector space yi = Xiα. In the projection space, the measure of the class separability of the projected images is calculated by

$$J(\alpha) = \frac{\alpha^T G_b \alpha}{\alpha^T G_w \alpha} \quad \text{……. (2)}$$

Where the measure J in Eq. (2) is also a well-known Fisher scalar for measuring class separability.

$$G_b = \frac{1}{N}\sum_{i=1}^{c} n_i \left(\overline{X}i - \overline{X}\right)^T \left(\overline{X}i - \overline{X}\right)$$

$$G_w = \frac{1}{N}\sum_{i=1}^{c}\sum_{j=c} \left(X_j - \overline{X}_i\right)^T \left(X_j - \overline{X}_i\right)$$

Where X and $\overline{X}_i$respectively, represent the global and the ith class mean images.

2) Two-dimensional FLD feature extraction:

The goal of our 2DFLD scheme is to find the optimal projection direction α in order to maximize (2). Obviously, the optimal projection direction α opt is the eigenvector corresponding to the maximum eigenvalue of the eigenstructure:

$$G_b\,\alpha = \lambda G_w \quad \text{……. (3)}$$

In practice, one optimal projective direction is not enough to extract sufficient discriminatory features. It is usually need to project the image data onto a set of orthogonal directions, namely, α1, α2… α k, which maximize the criterion. These projection directions can be selected as the k eigenvectors corresponding to the first k largest eigenvalues of the eigenstructure (3).

Suppose $(\alpha_i)_{i=1}^{k}$ are the optimal projective directions. Given an image X, all the projections of the image matrix in the k directions make up an mk-dimensional vector y, which is our 2DFLD feature vector [21].

$$Y^T = (Y_1^T, Y_2^T, \ldots., Y_K^T) = (\alpha_1^T, \alpha_2^T, \ldots., \alpha_K^T)X^T$$

IV. NEAREST NEIGHBOR RULE FOR FACES CLASSIFICATION

The nearest neighbor (NN) rule, first by Fix and Hodges (1951), is one of the oldest and simples pattern classification algorithms [31]. To identify the nearest neighbor of a query pattern, a distance function has to be defined to measure the similarity between two patterns. In the absence of prior knowledge, the Euclidean and Manhattan distance functions have conventionally been used as similarity measures for computational convenience.

Here, the distance between two matrices$Y = [Y_1, Y_2, \ldots, Y_d]$ and $B_i = [Y_1^{(i)}, Y_2^{(i)}, \ldots, Y_d^{(i)}]$ is defined by

$$d(Y, B_i) = \sum_{k=1}^{d} \left\| Y_k - Y_k^{(i)} \right\|_2$$

Where $\left\|Y_k - Y_k^{(i)}\right\|_2$ denotes the Euclidean distance between the two vectors Y_k and$Y_k^{(i)}$.

The Similarity Measure between two matrices, Y= [Y1, Y2,…,Yd] and $B_i = [Y_1^{(i)}, Y_2^{(i)}, \ldots, Y_d^{(i)}]$ is defined by

$$s(Y, B_i) = \frac{\sum_{k=1}^{d} Y_k^T B_k^{(i)}}{\sqrt{\sum_{k=1}^{d} Y_k^T Y_k}\sqrt{\sum_{k=1}^{d} B_k^{(i)} \left(B_k^{(i)}\right)^T}}$$

Suppose that the training samples are B1, B2… BM (where M is the total number of training samples), and that each of these samples is assigned a given identity (class)ω_k, given a test sample Y.

V. EXPRIMENTS

Figure 2.Some samples from Data base

Table 1 comparison of PCA and 2DFLD in terms of Average Recognition Rate

Extracting Features Methods	***The Average Recognition Rate %***
PCA	*90.27*
2DFLD	*97.33*

VI. CONCLUSION:

Face recognition technology is applied to automotive security. Because the face system is totally nonintrusive, it can therefore make an existing security system more effective without bothering the user in any way. Developing a robust and practical face recognition system for auto security is difficult task. The 2DFLD and PCA based system are performing better for face recognition. 2DFLD for image feature extraction presented, which outperform the features extracted by the PCA. Average recognition rate of 2DFLD is higher than PCA.

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