Study of biometric technology in Face recognition and its approaches

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Abstract: The biometric is the study of physical or behavioral Characteristics used for the identification of a Person. Facial recognition system (FRS) is the fastest growing biometric technology today. In this paper, a survey is being done on the techniques used for face recognition and compared with face recognition done with the histogram equalization. Results obtained with these techniques are more accurate and robust. Results are compared at the end of the paper. Algorithm is tested and check on the ORL database as well as images taken outside from the database. Tables regarding recognition rates are compared for PCA, LDA and Histogram Equalization.

Keywords–PCA-Principal component analysis, LDA- Linear Discriminant Analysis, Histogram, Eigenfaces, Eigenvalues, Biometrics.

I. INTRODUCTION

The term Biometrics is becoming highly important in computer security world. The human physical characteristics like fingerprints, face, hand geometry, voice and iris are known as biometrics. These features are used to provide an authentication for computer based security systems. The identification of a person is becoming Highly important as the ID cards, punch, secret Password and PIN are used for personal Identification .The ID can be stolen; passwords Can be forgotten or cracked. The biometrics Identification overcomes all the above. Additional Security barriers can be provided using any one of the biometrics features . Facial recognition system (FRS) is the fastest growing biometric technology today and probably the most controversial. Despite the underlying issues about practical usefulness of FRS, law enforcement and military-based facial identification system have been implemented for several years without arousing controversy due to the reason that these system proves to be quite useful and successful in achieving a specific objective and that the public sector is unaware of their use. Many people remain skeptical to the widespread use of the system in public areas and security. The FRS is not a facial verification system, but a system that strives to identify the individual by performing a "one-to-many"search . This system operates by taking the facial input of a subject, generates a template, compares this template to a biometric database and then provides a list of potential candidates as an output. FRS captures an image of a person's face; this image is then compared to a database of facial images. FRS technology is based on Eigenface (standardized faced ingredients) algorithm; an algorithm that maps the characteristics of a person's face into a multi-dimensional face shape. This makes law enforcers proactively identify and monitor persons of interest. The main idea of FRS is recognized and apprehends dangerous criminals or terrorist even before they act. FRS transforms the standard surveillance video camera system into a proactive tool for crime prevention.
Face recognition is a task humans perform remarkably easily and successfully. This apparent simplicity was shown to be dangerously misleading as the automatic face recognition seems to be a problem that is still far from solved. In spite of more than 20 years of extensive research, large number of papers published in journals and conferences dedicated to this area, we still can not claim that artificial systems can measure to human performance. Automatic face recognition is intricate primarily because of difficult imaging conditions (lighting and viewpoint changes induced by body movement) and because of various other effects like aging, facial expressions, occlusions etc. Researchers from computer vision, image analysis and processing, pattern recognition, machine learning and other areas are working jointly, motivated largely by a number of possible practical applications. A general statement of the face recognition problem (in computer vision) can be formulated as follows: Given still or video images of a

scene, identify or verify one or more persons in the scene using a stored database of faces. Face recognition is one of the most active and widely used technique [1,2] because of its reliability and accuracy in the process of recognizing and verifying a person's identity. The need is becoming important since people are getting aware of security and privacy. For the Researchers Face Recognition is among the tedious work. It is all because the human face is very robust in nature; in fact, a person's face can change very much during short periods of time (from one day to another) and because of long periods of time (a difference of months or years). One problem of face recognition is the fact that different faces could seem very similar; therefore, a discrimination task is needed. On the other hand, when we analyze the same face, many characteristics may have changed. These changes might be because of changes in the different parameters. The parameters are: illumination, variability in facial expressions, the presence of accessories (glasses, beards, etc); poses, age, finally background. We can divide face recognition [4,5] techniques into two big groups, the applications that required face identification and the ones that need face verification. The difference is that the first one uses a face to match with other one on a database; on the other hand, the verification technique tries to verify a human face from a given sample of that face.

Problems. Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low intrusiveness. It has the accuracy of a physiological approach without being intrusive. For this reason, since the early 70's, face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision. Numerous algorithms have been proposed for face recognition; While network security and access control are it most widely discussed applications, face recognition has also proven useful in other multimedia information processing areas. Face recognition techniques [3] can be used to browse video database to find out shots of particular people. Also for face images with a compact parameterized facial model for low-bandwidth communication applications such as videophone and teleconferencing. Recently, as the technology has matured, commercial products have appeared on the market. Despite the commercial success of those face recognition products, a few research issues remain to be explored.

II. RELATED WORK

Much of the work in computer recognition of faces has focused on detecting individual features such as the eyes, nose, mouth, and head outline, and defining a face model by the position, size, and relationships among these features. Such approaches have proven difficult to extend to multiple views and have often been quite fragile, requiring a good initial guess to guide them. Research in human strategies of face recognition, moreover, has shown that individual features and their immediate relationships comprise an insufficient representation to account for the performance of adult human face identification [6]. Nonetheless, this approach to face recognition remains the most popular one in the computer vision literature.

Bledsoe [6,7] was the first to attempt semi-automated face recognition with a hybrid human-computer system that classified faces on the basis of fiducially marks entered on photographs by hand. Parameters for the classification were normalized distances and ratios among points such as eye corners, mouth corners, nose tip, and chin point. Later work at Bell Labs developed a vector of up to 21 features, and recognized faces using standard pattern classification techniques.

Fischler and Elschlager [8], attempted to measure similar features automatically. They described a linear embedding algorithm that used local feature template matching and a global measure of fit to find and measure facial features. This template matching approach has been continued and improved by the recent work of Yuille and Cohen [9]. Their strategy is based on deformable templates, which are parameterized models of the face and its features in which the parameter values are determined by interactions with the face image.

Connectionist approaches to face identification seek to capture the configurationally nature of the task. Kohonen [10] and Kononen and Lehtio [11] describe an associative network with a simple learning algorithm that can recognize face images and recall a face image from an incomplete or noisy version input to the network. Fleming and Cottrell [12] extend these ideas using nonlinear units, training the system by back propagation.

Others have approached automated face recognition by characterizing a face by a set of geometric parameters and performing pattern recognition based on the parameters. Kanade's [13] face identification system was the first system in which all steps of the recognition process were automated, using a top-down control strategy directed by a generic model of expected feature characteristics. His system calculated a set of facial parameters from a single face image and used a pattern classification technique to match the face from a known set, a purely statistical approach depending primarily on local histogram analysis and absolute gray-scale values

III. TECHIQUES USED FOR FACE RECOGNTION

PCA- Principal component analysis

The Principal Component Analysis (PCA) is one of the most successful techniques that have been used in image recognition and compression. PCA is a statistical method under the broad title of factor analysis. The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature space (independent variables), which are needed to describe the data economically. This is the case when there is a strong correlation between observed variables. The jobs which PCA can do are prediction, redundancy removal, feature extraction, data compression, etc. Because PCA is a classical technique which can do something in the linear domain, applications having linear models are suitable, such as signal processing, image processing, systemand control theory, communications, etc.:PCA computes the basis of a space which is represented by its training vectors. These basisvectors, actually eigenvectors, computed by PCA are in the direction of the largest variance of the training vectors. As it has been said earlier, we call them eigenfaces. Each eigenface can be viewed a feature. When a particular face is projected onto the face space, its vector into the face space describe the importance of each of those features in the face. The face is expressed in the face space by its eigenface coefficients (or weights). We can handle a large input vector,facial image, only by taking its small weight vector in the face space. This means that we can reconstruct the original face with some error, since the dimensionality of the image space is much larger than that of face space. Problems arise when performing recognition in a high-dimensional space (curse of dimensionality).Significant improvements can be achieved by first mapping the data into a *lower-dimensional sub*-space.The goal of PCA is to reduce the dimensionality of the data while retaining as much as possible of the variation present in the original dataset.

$$x = \begin{bmatrix} a_1 \\ a_2 \\ \dots \\ a_N \end{bmatrix} --> reduce\ dimensionality --> y = \begin{bmatrix} b_1 \\ b_2 \\ \dots \\ b_K \end{bmatrix} \quad (K << N)$$

LDA- Linear Discriminant Analysis

Linear Discriminant Analysis, shortly LDA, deals with the sequence $X = [x1; : : : ; xL]$ of multidimensional data vectors. LDA attempts to find a linear transformation for the learning sequence which gives the best separation for classes. The measure of separation is based on data variances in each class and for class means, too. Perform dimensionality reduction while preserving as much of the class discriminatory information as possible.Seeks to find directions along which the classes are best separated.Takes into consideration the scatter within-classes but also the scatter between-classes.More capable of distinguishing image variation due to identity from variation due to other sources such as illumination and expression

Histogram equilization

Histogram equalization is applied in order to improve the contrast of the images. The peaks in the image histogram, indicating the commonly used grey levels, are widened, while the valleys are compressed.

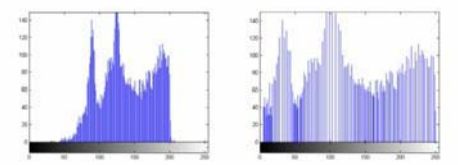

FIGURE 2**:** the histogram of an image before (left) and after (right) the histogram equalization.. the histogram on the left is before histogram equalization (between 6-250) is applied and the one on the right is after histogram equalization is applied. histogram equalization is applied to databases automatically

Histogram Method used for Face Detection

As per [16], RGB color space is commonly used in image processing because of its basic synthesis property and direct application in image display. According to the requirements of different image processing tasks, RGB color space is often transformed to other color spaces. From a visual perception's point of view, hue, saturation and value are often employed to manipulate color, such as de-saturation or change of color fullness. When the color is quantized to a limit number of representative colors, one will have to deal with two problems. The first is how to best match the distance [18] of data representation to human perception. It is desirable that numerical color distance is proportional to perceptual difference. The second problem is how to best quantize the colors such that the reproductions from these quantized colors is the most faithful to the original. In this work, we adopt a perceptually

meaningful color space, the HMMD color space, and used a carefully worked out quantization scheme of the MPEG-7 standard .

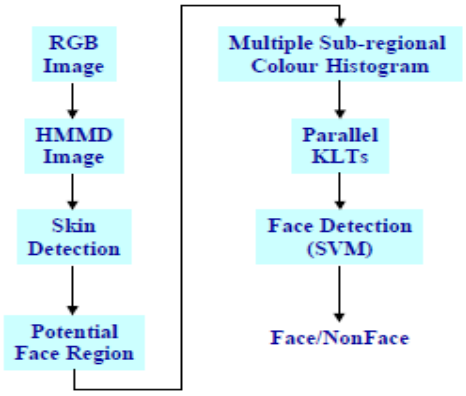

Figure 3: schematic of the new face recognition/detection method

IV. PROPOSED METHOD

Recognizing objects from large image databases, histogram based methods have proved simplicity and usefulness in last decade. Initially, this idea was based on color histograms .This algorithm presents the first part of our proposed technique named as "Histogram processed Face Recognition" as compared to detection use in [16].Histogram techniques are well designed for face detection [15] .But in this case we apply histogram calculation for face recognition .The algorithm given below worked for face recognition with success rate of 95%. For training, grayscale images with 256 gray levels are used. Firstly, frequency of every gray-level is computed and stored in vectors for further processing. Secondly, mean of consecutive nine frequencies from the stored vectors is calculated and are stored in another vectors for later use in testing phase. This mean vector is used for calculating the absolute differences among the mean of trained images and the test image. Finally the minimum difference found identifies the matched class with test image. Recognition accuracy is of 95 in our case.

Total Number of Images	**Numberof Training Images (per indivisual)**	**Number of Test Images (per indivisual)**	**Success rate**
400	1	9	To be find
400	5	5	To be find
400	9	1	To be find

V.CONCLUSION

In this paper, we achieved our purpose in developing a system in which faces recognition has been made more accurate and robust using histograms instead in case of using PCA and LDA technique . Hence we conclude that results obtained from the histogram equilisation and eigenvaalues retrieves better results that other techniques. Roc and result verify that the face recognition is more accurate and robust and even if we take a picture outside the database results are shown more clearer .In futue work can be done on the neural network in which more than one image can be accurately recognized

Face recognition using histogram equalization Using this methodology, we propose a method of face detection using histogram equalization which is efficient in the following manner

- To propose an algorithm for which provides better results than other techniques like LDA, PCA.
- Proposed method should work for ORL database as well as outside databases.
- Robustness and accuracy is being focused.

Comparison with LDA and PCA

Size of block	Sample 1	Sample 2	Sample 3	Sample 4
2*2	86.77	90.4	94.3	96.48
3*3	86.52	89.12	94.23	95.94

Figure4: recognition rates with different block sizes of Line-based LDA .

Size of block	Sample 1	Sample 2	Sample 3	Sample 4
2*2	85.97	89.65	93.60	95.68
3*3	85.55	89.05	92.72	95.03

Figure4: recognition rates with different block sizes of Line-based PCA

Sr.No	No. of Training image	Number of test database	Success rate	Result
1	9	1	100%	Matched
2	5	5	100%	Matched
3	4	6	70%	Lesser Efficient
4	9	Outside from database	100%	Matched

Figure4: recognition rates with Histogram Equilization

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