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Comparative Assessment of Performance of LDA, LR and SVM in the Application of Face Detection

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***Abstract*—** In biometrics research face detection and recognition is a very popular topic and it has distinct advantages because of its non-contact process. This type of technology extensively draws attention due to its huge application and market value. like video surveillance system for detecting suspicious object. Face based recognition system is more popular over other biometrics because of its uniqueness. Face recognition is very difficult task because human face is a dynamic object and has variability in its appearance. So, here accuracy and speed of recognition is Min issue. The purpose of the paper is correctly recognized a person from an image face or a video. To correctly identify a person we have used three techniques: Linear discriminant analysis (LDA), Logistic Regression (LR) and support vector Machine (SVM) techniques with Principle Components Analysis (PCA) which extract the features and reduce dimensionality. The LDA and LR technique produce more accurate result compare to other methods. This paper achieved 93% successful recognition rate for recognizing different face database.

***Keywords*—** Face detection, Face Recognition, PCA, SVM, LDA, and LR.

I. INTRODUCTION

Face recognition and detection technique has received immense attention as one of the most significant applications of image detection.The human face is very vital objects in an digital image or video. This is a current area of research in pattern recognition and image processing. It's include wide range of application like identity verification, video-surveillance, facial expression extraction, advanced human and computer interaction, computer vision, criminal identification, biometric, access & Security, payment and camera surveillance etc. Face recognition was introduced by Woodrow Wilson Bledsoe in the 1960s [08]. Bledsoe developed a device which classifies photos of faces by hand using what's known as a RAND tablet. Now the recognition system is being modified and optimized. This technology becomes mature and popular because it is widely used in human daily life. It has been extensively used for forensics by law enforcement, fraud detection, ATM services and military professionals. In fact, after killing laden in U.S raid this facial recognition system was used to help confirm the identity of Osama bin Laden. The face recognition system is also used for mobiles device security.

This technique is one of the best and significant applications of image analysis and algorithm-based understanding. A general description of the face recognition problem can be represented as follows: given still or video images of a scene, identify or authenticate one or more persons in the scene using a stored database of faces.

This technique is used for authenticating a person from an image or video. The purpose of this article is to provide a better and easier recognizing technique when user authentication needed. For correctly identify a person we have used three techniques: Linear discriminate analysis (LDA), Logistic Regression (LR) and support vector Machine (SVM) techniques with Principle Components of Analysis (PCA) which extract the features and reduce dimensionality. The LDA and LR technique produce more accurate result compare to other methods. This paper achieved 93% successful recognition rate for recognizing different face database.

II. LITERATURE SURVEY

R. Brunelli et al. [01] proposed a work whose main purpose is to compare two simple general strategies on a common database of 47 people. They have developed two new algorithms; one is based on computation of a set of geometrical features and second one based on almost grey level template matching.

K.J. Wang et al. [2] have compared the face recognition performance for five different methods. Firstly, he

investigates the SVD of the face image then implements the methods of face recognition with DCT. Secondly, implement face recognition approach with the help of DTC directly with one training data. Thirdly, use DCT to generate some low-frequency matrices in frequency domain. Then, 2DPCA used for face recognition. Finally, he has used DCT to generate some low-frequency matrices in frequency domain and use DCT to do face recognition.

Han Bing et al. [03] worked on Adaboost algorithm and ASM algorithm, which showed AdaBoost algorithm, has a better robustness and detection performance. AdaBoost algorithm used to detect face images or video stream. ASM algorithm used to detect faces more accurately.

Mrs. Madhuram et al. [04] performed a work on face detection and recognition using opencv. This is used to recognize human faces. The images of the persons defined and trained before recognizing.

G. Gibert et al. [05] propose a new method to detect faces in a video stream based on the detection of heart rate. Images are split into small regions of interest. For each region, heart rate is estimated.

R. Niese et al. [06] proposed a new method based on geometric and transient optical flow features. Here, photogrammetric techniques are used to extract three-dimensional (3-D) features from every image frame. This is regarded as a geometric feature vector.

Yi Xiang et al. [07] worked on weak classifier that comes with the False Rejection Rate (FRR) to significantly reduce the False Acceptance Rate (FAR).

III. METHODOLOGY & IMPLEMENTATION

A. Database of Faces

1) Olivetti Research Laboratory (ORL) Database

Olivetti Research Laboratory (ORL) dataset contains a set of face images. This face images were taken between APRIL 1992 and April 1994 at AT & T laboratories. In ORL Dataset ten different images were used and each of images has 40 distinct subjects. The images were taken at different times. Then varying the lighting, facial expressions and facial details. In ORL dataset all the images were taken against a black background. All the files in ORL dataset are in PGM format. The size of each image is 92x112 pixels and which quantized to 256 grey levels per pixel. This is stored as unsigned 8-bit integers. The loader convert these to floating point values and interval is [0, 1]. Example, images corresponding to one individual are shown in the figure 1.

Figure 1. ORL Face Datase

2) Customized Face Database

We generate our own dataset of faces of different person. In this dataset, we are capturing 21 images of each object in grey format. The images are taken in different time. The images are including different facial expression i.e. open and closed eyes, smiling and non-smiling and including different specifications. All images have black background. Here, we have used a total of 84 images as per the face id.

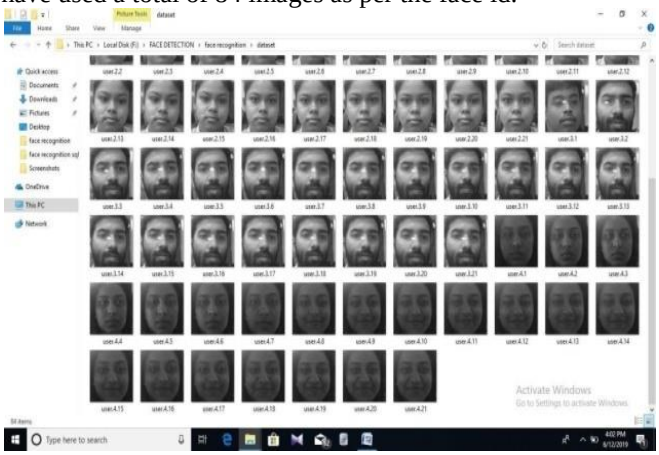

Figure 2. Customized Face Database

B. PCA (Principal Component Analysis)

The Principal Component Analysis (PCA) is a very popular technique that has been used in image recognition and compression. This method used for large dimensionality reduction of the data space, feature extraction, redundancy removal, data compression and prediction. This is a statistical method of factor analysis. Face dataset consists of same data. PCA matching this to features vector and then eliminate this same data and extract the essential data of the face image from the dataset. This method has huge function to identifying the exact image. PCA have a mathematical process which transforms a number of possibly correlated variables into a number of uncorrelated variables called principal components. This is related to the original variables by an orthogonal transformation. In this orthogonal transformation the first principal component has high

variance t and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to the preceding components.

PCA can do something in the linear domain; applications having linear models are suitable, such as signal processing, image processing, system and control theory, communications, etc [09]. Face recognition has many applicable areas. This is called eigenspace projection. Eigenspace is calculated by identifying the eigenvectors of derived from a set of facial images. The main advantage of PCA is the Eigen Face approach. Eigen Face helps reducing the size of the database which is required for recognition of a test image. The trained images stored as their weights which are found out projecting each and every trained image to the set of Eigen Faces obtained.

The face recognition involves the following operations:

- Initially required set of N face images which is called training images.
- From the training set next calculate Eigen Face and keep the M images which have the highest Eigen values. These M images identified as "face space". If 10 new faces are entered in the dataset, then the "Eigen Faces" updated and recalculated the Eigen value accordingly.
- Calculate the corresponding M dimensional weight space and projecting their face images onto the "facespace".
- Calculate a set of weights projecting the input image to the M "EigenFaces".
- Checking the closeness of the image to the "face space" to determine whether the image is a face or not.
- If it is close enough classify the weight pattern .Then check this is a known person or an unknown based on the Euclidean distance measured.
- If it is close enough then the recognition successful.

C. SVM

SVM is mainly used for classification or detection of different faces from digital images or videos [10]. SVM takes the data as an input and outputs line. If possible separates those classes. This SVM classifier is a linear model for classification and regression problems [11-12]. It helps to solves linear and non-linear problems. This is work for many real problems. SVM algorithm creates a hyper plane which helps to separates the data into classes. SVM is a classification procedure illustrated by Vapnik in 1992[13]. This classifier is mainly used in bioinformatics. Also it has some other applications because of its high accuracy, and another characteristic is process high dimensional data such as gene expression. It is associated with the kernel procedure. A kernel procedure data exposes through dot-products. This function calculates a dot product in possibly high dimensional facial components space. The fundamental characteristics of SVM are to develop non-linear classifier. SVM has utilization of portion capacities. The form of SVM in bioinformatics is protein Structure like DNA or protein. This classifier has performed incredibleness in the field of machine learning. Classification is obtained by understanding a linear or non-linear partition surface in the information space.

SVM Algorithm -

Identify a violating point from the dataset.

- After identifying the Violator point the dataset will be added to the candidate set.
- It may take place if adjoining of the violating point as a Support Vector may be prevented by other candidate Support Vectors which are already present in the set.
- Same Steps repeated if the Violating points are eliminated.

D. Linear discriminant Analysis (LDA)

In pattern recognition Linear Discriminant is a "classical" technique. It is used to find a linear combination of features which separate two or more classes of objects [15]. This combination used as a linear classifier or, for dimensionality reduction. In face recognition model, each face is represented by a large number of pixel values. Linear discriminant analysis is mainly used here to reduce the number of features. Each of the new dimensions is a linear combination of pixel values, which form a template. The linear combinations find out by using Fisher's linear discriminant. This are called Fisher faces. Whereas LDA doesn't change the location .It only provides more class reparability and draws a decision region between the given classes.

Data sets can be transformed and test vectors can be classified by two different transformation.

- Class-dependent transformation: This type of technique at first maximizing the ratio of between class variance to within class variance. The main purpose is to maximize this ratio. The type of approach includes two optimizing criteria for transforming the data sets independently.
- Class-independent transformation: This transformation maximizes the ratio of overall variance to within class variance. This is used only one optimizing criterion to transform the data sets. In this type of LDA, each class is considered as a separate class against all other classes.

E. Logistic Regression Analysis

Logistic regression is one kind of linear regression. This is adding a layer of function on the results of the mapping feature. In the development of new models and also in the testing of existing instruments Logistic regression has emerged as the conventional statistical technique. It has many applications in the fields of psychiatry and psychology. Logistic regression is used to predict the probability and also used for classification. By using logistic function, Logistic regression can classify individuals in the target categories.

IV. RESULTS AND DISCUSSION

Here we use support vector Machine (SVM) techniques with Principal Components of Analysis (PCA) which extract the features and reduce dimensionality. Also, we have used LDA and LR method. We include three parts in this system – Detection module, training module and recognition module. In this paper we have used 70% training data and 30% test data. Using 70% of training data we have designed the model. 30% test data we have applied on that model.

Table 1. Type Styles

Database Used	**Methods**	**Accuracy Rate %**
ORL	SVM classifier using PCA	92%
ORL	LDA	93%
ORL	LR	93%

According to the above result we get 92% accuracy Rate by using PCA method.
Also we can see, by using LDA and LR method we have got same accuracy rate 93%.
According to the above results, Linear Discriminant Analysis (LDA) and Logistic Regression (LR) seem to have the best performances compare to other method.

V. CONCLUSION

We used the Principal Component Analysis with Support Vector Machine method for the dimensionality reduction and due to that it will increase the computational efficiency. This method produces 92% accuracy. LDA and LR method produces 93% accuracy. As future direction, different methods can be applied and may be compared with this result.

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