International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.4, No.9, September 2015 DOI:10.15693/ijaist/2015.v4i9.24-29

An implementation of Hybrid classifier for IRIS and FACE recognition

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***Abstract*- Biometric object recognition system developed with its more improve technique for face and iris based biometric object detection perform. Given model incorporated by three stages of processing. Which are Feature extractions, Learning on feature & The recognition objects or classification of objects. Linear Discrimination Analysis (LDA) is used for feature extraction. which is a multimodal or multiple posed is learning technique used to enhance the extracted features and to identify with given simple data classification KNN classifier is also used. The effectiveness and accurate classification of result for the proposed biometric object recognition system shows the obtained data. That is adoptable for both Iris and face base recognition.**

***Keywords*- Biometric, Gabor Filter, LDA, KNN, ROC, CMC, EPC.**

I. Introduction

The domain of machine learning and data analysis is frequently used in various real world applications. Some of them are used for providing ease in minimizing the amount of data during intelligence system development and some of them are used for directly producing the outcomes to the applications. Among them the recognition and classification is a classical issue of machine learning.

In this presented work the authentication and security is investigated. There are a problem persist of using the passwords in traditional methods. Security mechanism is the traditional approach of password and it can be breakable through the password cracking and brute force attacks. Therefore for securing more privacy and security trust biometric technology are utilized. There are more techniques using biometric security approaches are available like as face recognition, IRIS recognition and figure prints.

In this paper an effort is made to discover a strong solution for combining the two different approaches namely face recognition and the IRIS recognition. Additionally the simulation of the proposed approach is performed on the MATLAB based implementation. For experimentation and the results evaluation the UBIRIS [1] and ORL [2] databases are used where the UBIRIS is a IRIS recognition data set and the ORL is a face recognition data base. These datasets contains a lot of different poses for the given single class.

In further sections the literature collection, implementation and results analysis is provided.

II. Background

This section provides the study of various approaches and algorithms that recently developed.

The recent efforts on face recognition technique introduce the problem of face spoofing. That is a bypass authentication technique by a photo/video/mask of a person in front of recognition system. The liveness of that person helps to identify the actual system user. Therefore, ***Avinash Kumar Singh et al [3]*** propose a liveness detection scheme. The liveness is added as additional security before face recognition. The Iiveness utilizes face macro features, such as eye and mouth movements and also observing user's response. The reliability of liveness is tested by placing several types of spoofing attacks like photograph, videos, etc. In all types of attacks have been prevented by the system. Experimental performance show that system is able to detect the Iiveness. consequently resultant unrecognized or misclassified by the face recognition module. An experimental test performed on 65 persons of Essex face database.

An automatic face recognition or facial expression recognition has concerned researchers. ***Anagha S. Dhavalikar et al [4]*** an Automatic Facial Expression Recognition System proposed. This method has three stages: (a) face detection, (b) feature extraction and (c) facial expression recognition. The first phase of face detection includes skin color finding using YCbCr color model, lighting compensation for getting uniformity on face and morphological operations for retaining the required face portion. The output of the first phase is used for extracting facial features such as eyes, nose, and mouth using Active Appearance Model. Lastly, automatic facial expression recognition, involves simple Euclidean Distance method. Based on minimum Euclidean distance, output image expression is decided. True recognition rate of this approach is 90% - 95%. Additional modification of this method is required using Artificial Neuro-Fuzzy Inference System. This non-linear recognition system provide recognition rate of approximately 100%.

2DPCA is one of the most essential face recognition method, it is relatively responsive to substantial variations in light direction, face pose, facial expression. In order to improve the recognition performance of traditional 2DPCA , a new 2DPCA algorithm based on fuzzy set theory is proposed by ***YUAN Wei [5]***.The given fuzzy system is termed as2DPCA(F2DPCA). This method apply fuzzy K-nearest neighbour, to compute membership degree matrix of training samples. The average of fuzzy means is then incorporate into the definition of general scatter matrix with anticipation that helps improve classification result. The experiments on ORL, YALE and FERET face databases show that the method can enhanced classification rates and minimize compact sensitivity to variations between face images caused by changes in illumination, face expression, face pose.

Firoz Mahmud et al [6]discussed an approach to recognize a face using PCA based Genetic Algorithm. Facial image analysis plays an significant role in automatic face recognition. The PCA is applied to extract features from images with the help of covariance analysis to produce Eigen components of the images and decrease the dimensionality. Genetic Algorithm provides the optimal solutions from the generated large search space. For our experiment we used Japanese Female Facial Expression (JAFFE) face database and result shows 96% accuracy of recognition.

Yong Xu et al [7] improve the least squared error algorithm for classification by modifying classification rule. Differing from traditional MSE algorithm that first obtains mapping that can best transform the training sample into its class label and then exploits the obtained mapping to predict the class label of the test sample. The modified minimum squared error classification algorithm simultaneously predicts the class labels of test and training samples and combines the predicted results to classify the test sample. Besides this paper, first time proposes the idea to take advantage of predicted class labels of training samples for classification of test sample.It devises aweighted fusion scheme to fuse the predicted class labels of training and test sample. They also interpret rationale of MMSEC. As MMSEC generalizes better than conventional MSE, it can lead to more robust classification decisions. The face recognition experiments show that MMSEC does obtain very promising performance.

George D.C. Cavalcanti et al [8] proposes two feature extraction technique that minimizes the effects of distortions in illumination, rotation and, head pose in automatic face recognition systems. The proposed techniques are Modular Image Principal Component Analysis and weighted Modular Image Principal Component Analysis. Both techniques are based on PCA and use modular image decomposition to minimize local variation. Also, the covariance matrix is calculated directly from the original image matrix. This strategy generates a smaller matrix compared with traditional PCA and reduces the computational effort. MIMPCA assumes that parts of the face are more discriminatory than others, so a Genetic Algorithm is used to obtain weights for each region in the face image. The proposed techniques are compared with Modular PCA and two-dimensional PCA using three well-known databases, showing better results.

III. ALGORITHM STUDY

This section includes the description of the different algorithms that are used to develop the proposed classifier.

A. Linear Discriminant Analysis (LDA)

Basically the linear transformation such that feature clusters are find the LDA are most separable after the transformation. This can be achieved through scatter matrix analysis [9]. For an N-class problem, the between and within class scatter matrices Sb and Sw are defined as:

$$s_b = \sum_{i=1}^{N} P(C_i)(\mu_i - \mu)(\mu_i - \mu)^T = \emptyset_b \emptyset_b^T$$

$$s_w = \sum_{i=1}^{N} P(C_i) = \emptyset_w \emptyset_w^T$$

Where$P(C_i)$ is the prior probabilityof class C_i and usually is assigned to $\frac{1}{N}$ with the assumption of equal priors; μ is overall mean vector; Σi is the average scatter of the sample vectors of different classes C_i around their re-presentive mean vector μ_i:

$$\sum\nolimits_i = E[(x - \mu_i)(x - \mu_i)^T]C = C_i$$

The class separability can be measured by a certain criterion. A commonly used one is the ratio of the determinant of the between-class scatter matrix of the projected samples to the within-class scatter matrix of the projected samples:

$$\tau(A) = \arg max \frac{|As_b A^T|}{|As_w A^T|}$$

Where A is an m n matrix with (m X n). A solution to the optimization problem is to solve the generalized eigen value problem:

$$s_b A^* = \lambda s_w A^*$$

For classification, the linear discriminant functions are:

$$D_i(X) = A^{*T}(X - \mu_i), i = 1, 2, \dots, n$$

A solution is to compute the inverse of Sw and solve a Eigen problem for matrix $s_w^{-1} s_b$. But this method is numerically unstable because it involves the direct inversion of a likely high-dimensional matrix. The most frequently used LDA algorithm in practice is based on simultaneous diagonalization. The basic idea of the algorithm is to find a matrix A that can simultaneously diagonalize both Sw and Sb, i.e.,

$$As_w A^T = I$$

$$As_b A^T = \Lambda_i$$

Where Λ is a diagonal matrix with diagonal elements sorted in a decreasing order. If we want to reduce dimension of the matrix from n to m, we can simply use first m rows of A as the transformation matrix, which corresponds to the largest m Eigen values of Λ. The simultaneous diagonalization algorithm also involves inversion of matrix. To our knowledge, most algorithms require that the within-class scatter matrix be Sw non-singular, because the algorithms

International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
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diagonalize Sw first. Such a procedure breaks down when the within-class scatter matrix Sw becomes singular. This can happen when the number of training samples is smaller than the dimension of the sample vector. This is the case for most face recognition tasks. For example, a small size of image of 64x64 turns into a 4096-dimensional vector when vectorized [10].

B. K-nearest neighbour

The KNN algorithm is used to calculate the similarity between a query and a set of data in a given database. This technique usages distance function d(m, n) to find similarity and dissimilarity, let m, n are two sequences of data such that [11].

$$M = \{m_1, m, m_3, \ldots\}$$

$$N = \{n_1, n, n_3, \ldots\}$$

Thus distance can be measured using the following two methods:

1. Absolute distance:

$$d_A(m,n) = \sum_{i=1}^{N} |m - n_i|$$

2. Euclidean distance:

$$d_A(m,n) = \sum_{i=1}^{N} \sqrt{m_i^2 - n_i^2}$$

The distance between two sequences is scaled between 0 and 1. And can be used with standard deviation:

$$\mathbf{m}' = \frac{m - \overline{m}}{\sigma(m)}$$

Additionally the un-scaled value of features is computed by the following formula:

$$\overline{m} = \frac{1}{N} \sum_{i=1}^{N} m_i$$

The standard deviation of these values is computed as:

$$\sigma(m) = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (m_i - \overline{m})^2}$$

KNN algorithm is summarized as:

1. The output values of K nearest neighbours in a query sequence S is defined by a vectorv = $\{v_1 \ldots\ldots v_k\}$ by a loop K times:
   a. The next sequence Sq_iin database is evaluated each time, where I is iteration within a given sequence {1……L}
   b. If S is not set or s < d (s, Sq_i): s←d (s, Sq_i), t ←Out_i
   c. Loop until end of database.
   d. Store output into a vector.
2. Calculate mean output using:

$$\bar{v} = \frac{1}{K} \sum_{i=i}^{K} v_i$$

3. Return v as output

IV. PROPOSED WORK

The proposed work is intended to develop a classification technique which can be used with the face recognition and for iris recognition also. Therefore architecture for training and testing of the proposed system is provided.

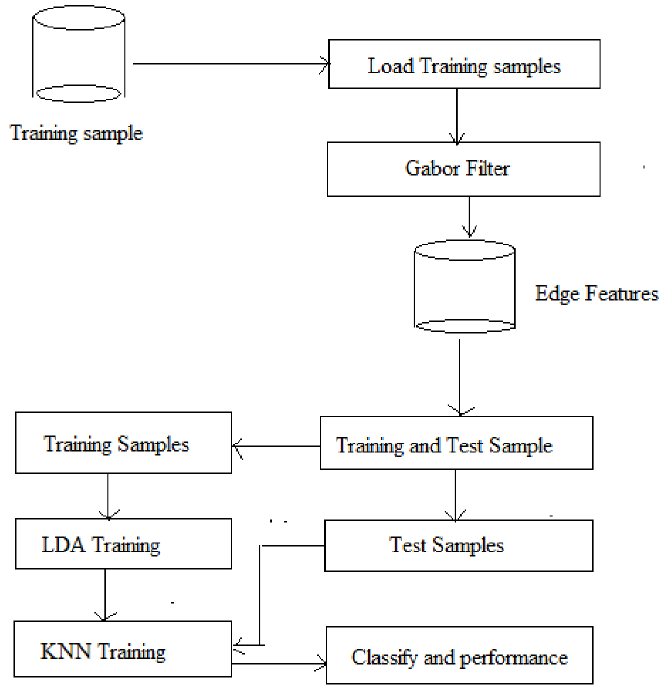

Figure 1: Proposed model

The proposed architecture of the proposed object recognition process is given using figure 1. In this diagram the training samples are produced, these samples are first load on the system memory. Additionally using the Gabor edge detection filter is applied on the loaded images. In next process the training input samples are divided into train and test samples. Therefore 70% samples of input are grouped as the training purpose and for testing the remaining 30% samples are preserved separately. The training samples are first the processed using the LDA technique. The LDA returns the features of input training samples. The returned feature vector is used with the KNN algorithm to classify them, and to prepare the data model. The trained KNN model is utilizes the Test samples to compute the classification performance. The estimated performance is described in the further section.

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V. RESULTS ANALYSIS

This section provides the analysis of obtained results and performance of the system implemented for face and IRIS recognition.

A. ROC (Receiver Operating Characteristic)

ROC analysis provides the technique to select optimal patterns and to discard suboptimal ones from the current context or the available class distribution.

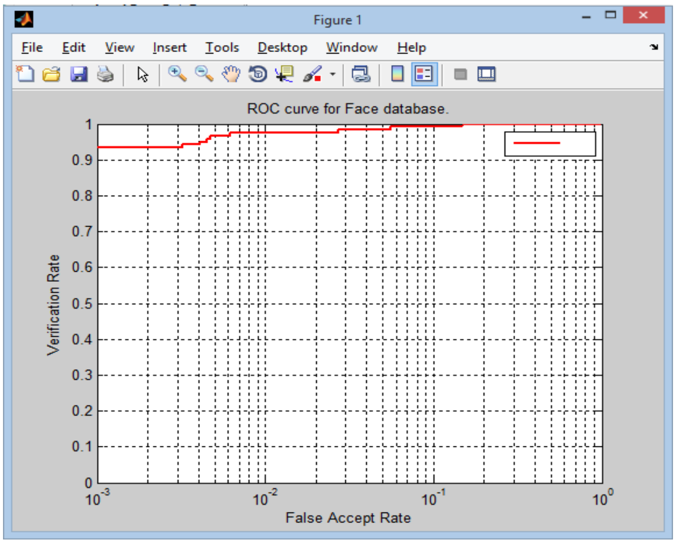

Figure 2 ROC for Face recognition

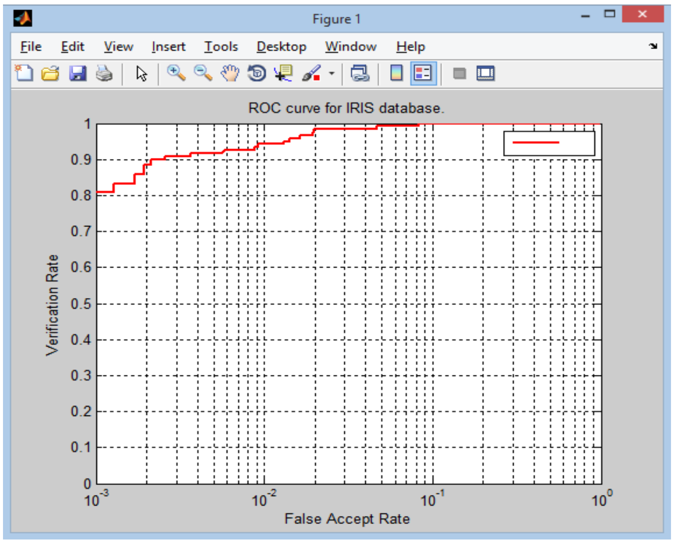

Figure 3 ROC for IRIS recognition

The ROC curve for the proposed system is given the figure 2 shows the ROC for face detection and for IRIS recognition the figure 3 shows the performance. In order to represent the performance of the system X axis shows the false accept rate and the Y axis contains the verification rate of the input patterns. According to the obtained performance of system the face recognition rate for the classification is higher as compared to IRIS classifier.

B. CMC (cumulative match characteristic)

Method of measure accuracy for a biometric system in the closed-set is given by the CMC curve. In this approach the templates or query patterns are compared and ranked based on their similarity. The CMC shows how the biometric pattern appears in the ranks, based on the match patterns.

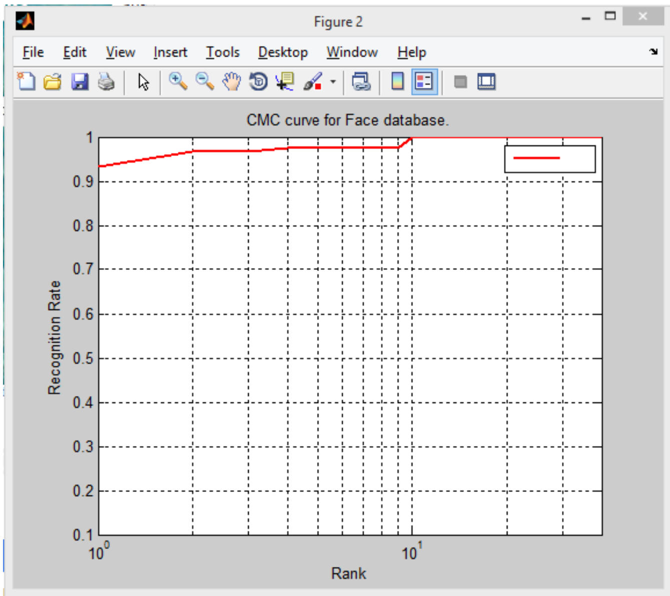

Figure 4 CMC for Face recognition

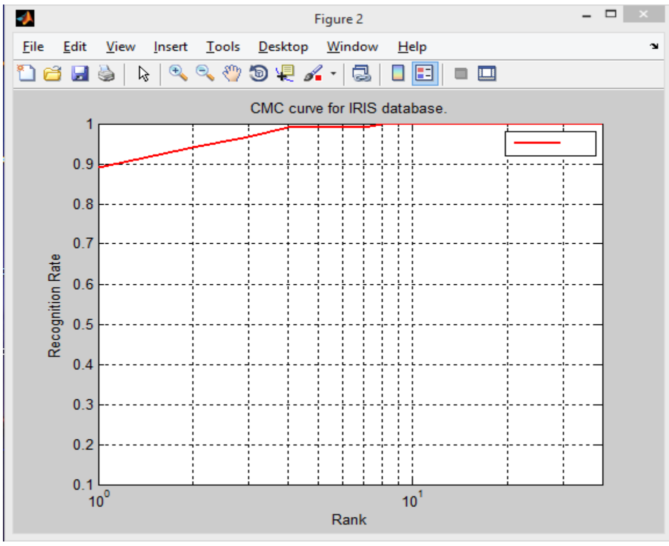

Figure 5 CMC for IRIS recognition

The Performance of face recognition show in figure 4 and figure 5 shows the performance of IRIS recognition. According to the obtained results the accuracy of both the systems are adoptable. But the comparative performance of the proposed model is much accurate for face recognition as compared to IRIS recognition. Thus the method is much adoptable for face recognition.

C. EPC (Expected Performance Curves)

Expected Performance Curves (EPC) really reflects the expected (and reachable) performance of systems.

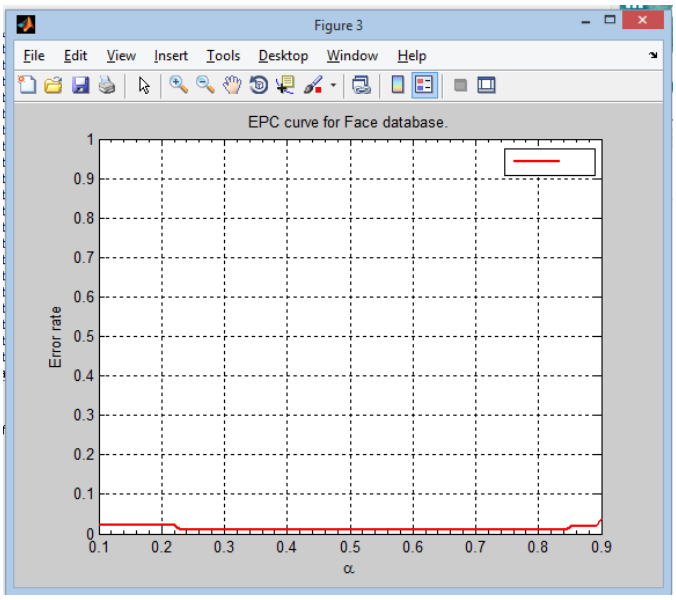

Figure 6 EPC for Face recognition

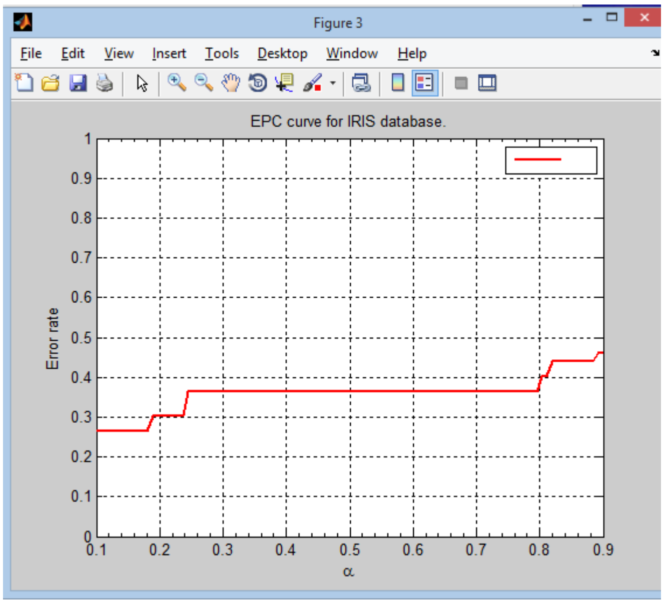

Figure 7 EPC for IRIS recognition

The obtaining performance of the system in terms of IRIS recognition and face recognition is given using figure 6 and 7. If the error rate of the classification is less than the performance is improving and providing more accurate classification rate that actually represents the error rate of the system. Thus the proposed model for IRIS and Face recognition is adoptable with the low error rate during the recognition task.

V. CONCLUSION AND FUTURE WORK

The proposed study is indented to obtained the solution for security using the biometric password based authentication system. Therefore a model for face and IRIS recognition is proposed and implemented using the MATLAB framework. Our method of recognition include the Gabor filter implementation. That responsible to extract the edge information form the input training samples. The edge property of the input samples is used to train the LDA and KNN algorithm. The KNN algorithm first prepares the training model for classifying the test samples. As the training of system is completed the data model can used for test. For that purpose the test samples are produced over the trained model which computes the performance matrix and their performance graphs. The evaluating result of the system is measured in terms of ROC, CMC and EPC curve basis. According to the proposed system performance the model provides much accurate classification rate for face recognition that is approximately between 93-97% and for IRIS recognition that provide the performance about 83-89%. Therefore model is adoptable for both the applications.

In near future the model is required to enhance for IRIS recognition accuracy to make more adoptable model for both kinds of object recognition. Additionally the given method is required to enhance with the real world face and iris recognition.

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