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Analysis the Performance of Iris Recognition System by Using Hybrid Feature Extraction Methods and Matching By SVM Classifier

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Abstract— *In today's world, Iris recognition as physiological characteristics is one of the most reliable biometrics. It uses Iris of human eye plays an important role in accurate identification of individuals. Iris recognition system consists image acquisition, iris normalization, iris segmentation, features extraction and matching. Iris images are taken from CASIA iris VI database for study. In this paper we make a analysis the performance of iris recognition using combination of Haar transform, PCA and Block sum algorithm for iris verification to extract features on specific portion of the iris for improving the performance of an iris recognition system. The hybrid methods are evaluated by combining Haar transform and block sum algorithm. The classifier used in this paper is SVM classifier and decision taken by using FAR/ FRR and the experimental results show that this technique produces good performance on CASIA VI iris database.*

Keywords— ***Biometric, Iris Recognition, Haar transform, SVM, Block sum algorithm, PCA.***

I. INTRODUCTION

In recent years, we witnessed the more interest in replacing the traditional human identification methods with biometric technology. In traditional methods (e.g. ID cards and passwords), the identification tools can be easily stolen, shared or forgotten. Biometric technology involves in the use of unique characteristics for automatic identification or verification. These characteristics can be grouped into broad categories: behavioral and physiological. At present, iris is the most accurate and reliable one among the biometric traits. The developments in science and technology have made it possible to use biometrics in application where it is required to establish or conform the identity of individuals. Applications such as control, database access and financial services are some passenger control in airports, access control in restricted areas, border of the examples where the biometric technology has been applied for more reliable identification and verification.

In the field of financial services, biometric technology has shown a great potential in offering more comport to customers while increasing their security. As an example banking services and payments based on biometrics are going to be much safer, faster and easier than the existing methods based on credit and debit cards. Proposed forms of payments such as pay and touch scheme based on fingerprint or smart cards with stored iris information on them are the examples of such applications. Biometric systems are widely used for authentication, identification and verification of any individual. In terms of accuracy, face, fingerprint and iris based system are considered to be most effective. Since fingerprint of an individual changes over time and face recognition systems requires large database area and high matching time. They are considered infeasible for high accuracy, large size recognition application. Iris texture of an individual remains stable through life and can be encoded in small memory. These features make iris based recognition most accurate and reliable biometric identification available.

II.BASIC STEPS OF IRIS RECOGNITION SYSTEM

The iris is a thin circular diaphragm which lies between the cornea and the lens of the human eye. The front view of the iris shown in fig. 1.

Fig.1: a. Iris Diagram b. Iris Structure

The Basic steps of Iris recognition system are as shown in fig. 2.

Fig.2. Basic Steps of Iris Recognition System

2.1. Image Acquisition

Iris image acquisition is the first step in iris recognition. The small size of iris combined with the possibility of varying iris colors means a special camera must be used especially for people with darker colored irises. A good and clear image eliminates the process of noise removal and also helps in avoiding errors in calculation. This paper uses the image provided by CASIA database. These images were taken solely for the purpose of iris recognition software research and implementation.

2.2. Image Localization

The purpose of iris localization is to localize the eye image that

corresponds to an iris. The iris region, shown can be estimated by two circles. One is in the iris/sclera boundary that can be called the outer boundary and the other is sometimes called the iris/pupil boundary. The upper part of the iris area is mostly occluded by the eyelashes and eyelids.

2.3 Image Segmentation

Circular Hough Transform is employed to detect the inner and

outer iris boundary. Firstly, an edge map is generated using Canny edge detector. For the outer boundary, gradients are biased in the vertical direction. For the inner boundary, vertical and horizontal gradients are weighted equally. To find the centre coordinates of the pupil and iris, votes are cast in Hough space. For eyelids isolation, linear Hough transform is employed. A simple thresholding technique is used for isolating eyelashes since they are quite dark compared to the rest of the eye.

Fig.3 Iris Segmentation

2.4 Image Normalization

The normalization process will produce iris regions with

constant dimensions. Daugman rubber sheet model can be used for the iris normalization process. Centre of the pupil is considered as the reference point; radial vectors pass through the iris area. The radial lines around the iris region are called angular resolution. Since the pupil is non-concentric to the iris, a basic formula is required to rearrange points depending on the direction around the circle.

Fig.4. Daugman Rubber sheet model

2. 4. Feature Extraction

Feature extraction identifies the most prominent features for classification Iris provides abundant texture information. A

feature vector is formed which consists of the ordered sequence of feature extracted from the various representation of the iris images. Some of the features are X-Y coordinates, radius, shape & size of the pupil and ratio between average intensity of two pupils. Here we have taken three algorithms for feature

extraction.

2.4.1. Feature Extraction with Principal Component

Analysis.

The aim of feature extraction is to find a transformation from an n-dimensional observation space to a smaller m dimensional feature space. Main reason for performing feature extraction is to reduce the computational complexity for iris recognition. Most existing iris recognition methods are based on the local properties such as phase, shape, and so on. However, iris image recognition based on local properties is difficult to implement. Principal component analysis can produce spatially global features. The original data are thus projected onto a much smaller space, resulting in data reduction.PCA was invented in

1901 by Karl Pearson. Principal component analysis (PCA) is a classic technique used for compressing higher dimensional data sets to lower dimensional ones for data analysis, visualization, feature extraction, or data compression. PCA involves the calculation of the eign value decomposition of a data covariance matrix or singular value decomposition of a data matrix, usually after mean entering the data for each attribute.

2.4.2. Feature extraction using Block sum

Normalized iris image is used for features extraction. Overall feature extraction processing is as following :

X =X1+X2+...+X5/5

1) First calculate the average 5

2) Calculate cumulative sum from 0: S0 = 0

3) Calculate the other cumulative sums by adding the difference between current value and the average to the previous sum,
i.e., Si = Si ± l + (Xi -X) for i = 1,2,..., 5. (2)

After calculation cumulative sums, iris codes are generated for each cells using following algorithm after obtaining MAX and MIN values among cumulative sums. if Si located between MAX and MIN index if Si on upward slope set cell's iris code to "1" if S5 on downward slope x set

cell's iris code to "2"

else set cell's iris-code to "0"

This algorithm generates iris codes by analyzing the changes of grey values of iris patterns. Upward slope of cumulative sums means that iris pattern may change from darkness to brightness. Downward slop of cumulative sums means the opposite change of upward slope.

2.4.3. Feature extraction using Haar Transform

This sequence was proposed in 1909 by Alfréd Haar. Haar used these functions to give an example of a countable ortho normal system for the space of square-integral functions on the real line. The study of wavelets, and even the term "wavelet", did not come until much later. The Haar wavelet is also the simplest possible wavelet. The technical disadvantage of the Haar is that it is not continuous, and therefore not differentiable. This property can, however, be an advantage for the analysis of signals with sudden transitions, such as monitoring of tool failure in machines.

2.4.4. Feature extraction using Hybrid Algorithm:

By studying above algorithm we have used here the combination of Haar transform and Block sum algorithm. The

algorithm that we have used for our study on iris recognition is as given below:
1. Creation of feature vector database

1.1. Read the database image.

1.2. Extract the Red, Green and Blue component ***of*** that image.

1.3. Apply Haar transform and Block sum algorithm the Red, Green and Blue components of the image . This is the Feature Vector (FV) of that image.
1.4. Repeat steps 1 through 3 for every database image.

2. Testing phase

2.1. Read the Query image.

2.2. Repeat step 1.2 and 1.3 for the query image so as to obtain its Feature Vector.

2.3. For every Database image „i" and a Query image "q" the Mean Squared Error (MSE) is calculated using Equation
2.4. The trainee image with the least MSE is declared as the identified user.

2.5. Repeat steps 2.3 and 2.4 decreasing the value of M gradually from 128 to 1 and record the error obtained in user identification for every fraction of the original feature vector.

2.5. CLASSIFICATION (MATCHING)

Classification is the problem of identifying which of the set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations whose category membership is known. For the purpose of matching or classification, various methods are used viz. Hamming Distance [14], Weighted Euclidean Distance, Normalized Correlation, Support Vector Machine (SVM) and Artificial Neural Network (ANN). In this paper, SVM and ANN are used as a classifier for pattern classification to identify individual's identity based on Iris code.

Methods	FAR/FRR	Overall accuracy
Haar Transform	5/2	96%
PCA	4/4	96.3%
Block Sum	2.43/4	98%
Hybrid algorithm	5/4.5	98.9%

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important aspects for developing SVM as a classifier are determination of the optimal hyper plane which will optimally separate the two classes and the other is transformation of non-linearly separable classification problem into linearly separable problem. Linearly separable binary classification problem with no possibility of miss-classification data is shown in Fig. 5. Let a set of input feature vector and the class {xi, yi} where i =1,2,…,N and y =±1. The separating

hyper plane is,
w. x + b = 0
which implies
yi (w. xi . b) > = 1 , i= 1, 2,…N

Basically, there are numerous possible values of {**w**,b}

that create separating hyper plane. In SVM only hyper plane that maximizes the margin between two sets is used. The optimal hyper plane maximizes the sum of the distances to the closet positive and negative training patterns. The sum is called as margin [17]. For non-linear case, training patterns are constructed onto a high dimensional space using kernel functions. Most commonly used kernel functions are polynomial, sigmoid and Gaussian radial basis function. The SVM in general makes four possible decision in iris recognition; the authorized person is accepted, the authorized person is rejected, the unauthorized person (impostor) is accepted and the unauthorized person (impostor) is rejected.

label are x and y. The input feature vectors and the class label can be represented as

and low FAR is the main objective in order to achieve both high usability and high security of the system.
SVM use linearly separable and non- linearly separable data for classification of iris pattern. Feature vectors of 10 samples of 28 persons are transmitted to SVM for classification of iris pattern. SVM randomly selects the testing data. After comparison result is evaluated by FAR/ FRR. FAR/ FRR is decided either image is accepted or rejected. By using the hybrid classifier, the .recognition rate shown in Table 1.
Table1. Experimental Results

III. EXPERIMENTAL RESULTS AND COMPARISON.

Evaluating the performance of biometric algorithms is a difficult issue. For the purpose of comparison; we implement these methods according to the published papers. To compare their performance, the version the Chinese Academy of Science Institute of Automation (CASIA) version eye image database is used in this experiment. CASIA VI Iris Database contains 280 eye images from 28 individuals and every person has 10 images of eye. All experiments were performed by using MATLAB version R2012b on core processor. We use the usual method to locate and normalize iris regions and use the combination of three methods mentioned above to extract the feature. Therefore we only analyze and compare the accuracy and computational complexity of feature extraction. After feature extraction, we use SVM classifier for matching stage and result evaluated by FAR/ FRR. False Rejection Rates (FRR) is used to measure the rate of the system to reject the authorized person and False Acceptance Rates (FAR) used to measure the rates of the system to accept the unauthorized person. Both performances are can be expressed as:

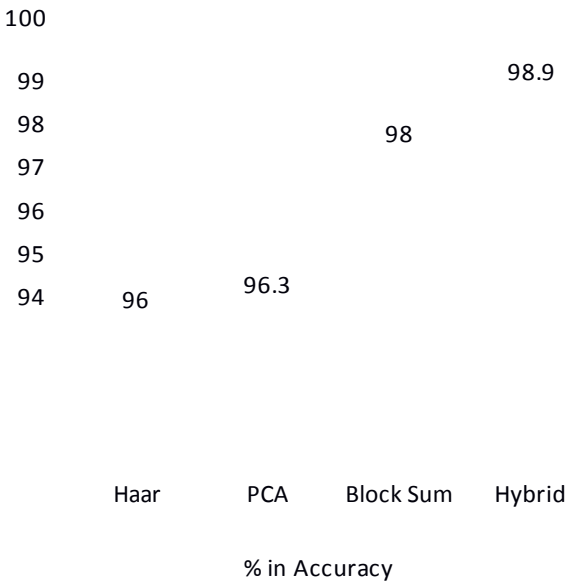

Fig.6. Accuracy of Haar, PCA, Block Sum and Hybrid algorithm

NFR is referred to the numbers of false rejections and NFA is referred to the number of false acceptance, while NAA and NIA are the numbers of the authorized person attempts and the numbers of impostor person attempts respectively. Low FRR

Fig.7. FAR/ FRR in Percentage (%) of Haar, PCA, Block Sum and Hybrid algorithm.

IV. CONCLUSION

In this paper, we have discussed feature extraction of iris recognition using Haar transform, PCA, Block sum algorithm with hybri algorithm. We have applied these transforms on the iris images for finding out the recognition rate. Results of this experiment have shown that the accuracy in recognition using hybrid algorithm is better than block sum, PCA and Haar transform. Also Hybrid classifier i.e. combination of SVM and FAR / FRR are used for matching either image is accepted or rejected. FAR and FRR in percentage with respective various methods as shown in graph. Thus proposed algorithm provides better accuracy and recognition rate.

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