International Journal of Engineering and Techniques - Volume 3 Issue 4, July-Aug 2017

RESEARCH ARTICLE OPEN ACCESS

Personal Identification with Human Iris Recognition Based on EMD

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Abstract:

Iris recognition is an invasive biometric technique used to identify human being. Iris is defined as annular region between pupil and sclera of human eye which exhibits extraordinary texture that is unique for each individual. Hence, imposes various challenges in accurate iris segmentation and feature extraction techniques to provide many opportunities for researchers in pursuing their research work in this area. The iris is a stable biometric trait that has been widely used for human recognition in various applications. However, deployment of iris recognition in forensic applications has not been reported. A primary reason is the lack of human friendly techniques for iris comparison. To further promote the use of iris recognition in forensics, the similarity between irises should be made visualizable and interpretable. Building on this framework, we propose a new approach for detecting and matching iris for personal identification process. we adopt a matching model based on the Earth Mover's Distance (EMD). Our approach outperforms the known visible-feature-based iris recognition method on three different data sets. In particular, our approach achieves over 22% higher rank one hit rate in identification, and over 51% lower equal error rate in verification. In addition, the benefit of our approach on multi-enrollment is experimentally demonstrated.

Keywords — **Human Identification, biometrics, Iris, forensics, visible feature.**

I. INTRODUCTION

Biometrics [1] refers to automatic identity authentication of a person on a basis of one's unique physiological or behavioral characteristics. To date, many biometric features have been applied to individual authentication. The iris, a kind of physiological feature with genetic independence, contains extremely information-rich physical structure and unique texture pattern, and thus is highly complex enough to be used as a biometric signature. Statistical analysis reveals that irises have an exceptionally high degree-of-freedom up to 266 (fingerprints show about 78) [1], and thus are the most mathematically unique feature of the human body; more unique than fingerprints. Hence, the human iris promises to deliver a high level of uniqueness to authentication applications that other biometrics cannot match. Several hundred millions of persons in several countries around the world have been enrolled in iris recognition systems for convenience purposes such as passport-free automated border-crossings, and some national ID programs. A key advantage of iris recognition, besides its speed of matching and its extreme resistance to false matches is the stability of the iris as an internal and protected, yet externally visible organ of the eye. The given figure shows the image of iris. John Daugman developed and patented the first actual algorithms to perform iris recognition, published the first papers about it and gave the first live demonstrations, the concept behind this invention has a much longer history and today it benefits from many other active scientific contributors. In a 1953 clinical textbook, F.H. Adler [2] wrote: "In fact, the markings of the iris are so distinctive that it has been proposed to use photographs as a means of identification, instead of fingerprints." Adler referred to comments by the British ophthalmologist J.H. Doggart, [3] who in 1949 had written that: "Just as every human being has different fingerprints, so does the minute architecture of the iris exhibit variations in every subject examined. [Its features] represent a series of variable factors whose conceivable permutations and combinations are almost infinite."

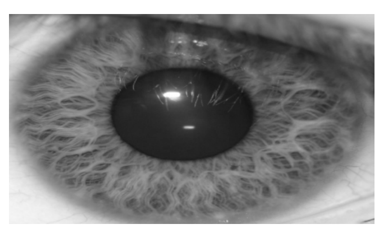

Fig .1 Image of iris

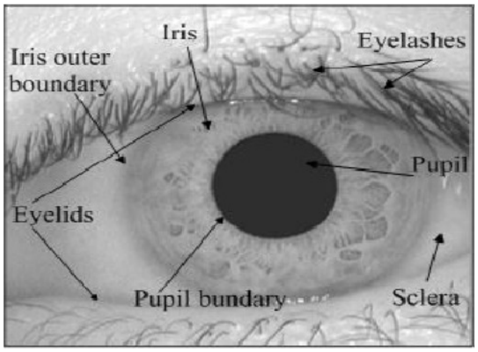

Fig. .2 External anatomy of iris

II. LITERATURE SURVEY

Hamel Patel [1] presented novel and efficient approach of partial iris based recognition of human using pupil circle region growing and binary integrated edge intensity curve which defeats the difficulties of eyelids occlusions. The experimental results are obtained on CASIA database version-1 and show good performance with EER of 5.14%. The advantage of the proposed approach is its computational simplicity and good recognition accuracy as it avoids the eyelids portion from the iris region for further processing. Libor Masek [2] proposed model consists of an automatic segmentation system that is based on the Hough transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. The extracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies. Finally, the phase data from 1D Log-Gabor filters was extracted and quantized to four levels to encode the unique pattern of the iris into a bit-wise biometric template. The Hamming distance was employed for classification of iris templates, and two templates were found to match if a test of statistical independence was failed. The system performed with perfect recognition on a set of 75 eye images; however, tests on another set of 624 images resulted in false accept and false reject rates of 0.005% and 0.238% respectively. Therefore, iris recognition is shown to be a reliable and accurate biometric technology.

Khin Sint Sint Kyaw [3] it is focusing on image segmentation and statistical feature extraction for the iris recognition process. They are using straight forward approach for segmenting the iris patterns. Their method determines an automated global threshold and pupil centre. Hao Meng and Cuiping Xu [4] proposed an effective method for feature extraction and code matching of iris. On the texture feature extraction, the transform of the Gabor wavelet is introduced. Dividing the frequencies of Gabor into two bands, different Gabor scale parameters are selected in every band and the appropriate location parameter are chosen. In order to resolve the effects of iris image rotation on the result of iris recognition, the binary iris code are achieved must be compared using the method of shifting in a fixed length. Experimental result shows that the iris recognition method proposed have better performance.

Chintan K.Modi [5] gives model of segmentation of dental X-ray image helps to find two major regions of dental X-ray image: 1) gap valley, 2) tooth isolation. Dental radiography segmentation is a challenging problem because of intensity variation and noise traditional model make use of gray and binary intensity integral curves. Using these curves the regions of gap valley and tooth isolation are extracted. They proposes a novel model of finding ROI for both gap valley and tooth isolation using binary edge intensity integral curves. The proposed algorithm uses region growing approach followed by canny edge detector. It automatically finds the ROI both gap valley and tooth isolation in 83% dental radiograph images without rotation.

Tze Weng Ng [6] proposed an iris recognition system using a basic and fast Haar wavelet decomposition method to analyze the pattern of a human iris. This system has two main modules, which are the feature encoding method and iris code matching modules. Among all feature extraction methods, Haar wavele decomposition is chosen for its computational simplicity and speed in filtering the iris pattern. In the feature extraction module, unrolled iris images are filtered using high pass filter and low pass filter for four times to produce the corresponding coefficients. Subsequently in the second module, hamming distance between iris codes is calculated to measure the difference between the query iris image and the iris image in the database. Iris recognition is then performed by matching the iris pair with the minimum hamming distance. This system is tested with iris 450X60 pixels iris images from the CASIA iris database and the recognition of 98.45% is achieved.

Ashish kumar Dewangan [7] presented his work by developing an 'open-source' iris recognition system in order to verify both the uniqueness of the human iris and also its performance as a biometric. For determining the recognition performance of the system one databases of digitized grayscale eye images were used. The iris recognition system consists of an automatic segmentation system that is based on the Hough transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. The extracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies. Finally, the phase data from 1D Log Gabor filters was extracted and quantized to four levels to encode the unique pattern of the iris into a bit-wise biometric template. The Hamming Distance was employed for classification of iris templates, and two templates were found to match if a test of statistical independence was failed. Therefore, iris recognition is shown to be a reliable and accurate biometric technology.

Asheer Kasar Bachoo [8] it focuses on a common yet difficult problem-segmentation of eyelashes from iris texture. Tests give promising results when using grey level co-occurrence matrix approach.

Li Ma[9] it describes a new scheme for iris recognition from an image sequence. They first check the quality of each image in the input sequence and then select a visible iris image from such sequence for subsequent recognition. A bank of spatial filters is taken, whose kernels are suitable for iris recognition, is then used to capture local characteristics of the iris so as to produce the sensible texture features. Experimental results show that the proposed method has an encouraging performance. In particular, a comparative study of existing methods for iris recognition is conducted on an iris image database including 2,255 sequences from 213 subjects.

Wen-Shiung Chen[10] proposed system includes three modules: image preprocessing, feature extraction, and recognition modules. The feature extraction module adopts the gradient direction on wavelet transform as the discriminating texture features. The system encodes the feature to generate its iris feature codes using two efficient coding techniques: binary gray encoding and delta modulation. Experimental results show that the recognition rates up to 95.27%, 95.62% and 99.05% respectively, using different methods can be achieved.

III. PROPOSED SYSTEM

The basic steps of iris recognition are almost same in all developed methods. Our experiment consists of five major steps, graphically shown in fig. 2 and they are; iris image acquisition, segmentation, normalization, feature encoding and matching. The performance of iris recognition is highly dependent on the earlier stage; segmentation where the iris region of an eye image is located. The rest stages are normalization means converting the extracted iris area into constant rectangular dimension, and feature encoding which means creating a bit-wise template containing only the most discriminating features of iris. The input of the system is an eye image and the output is a template consisting of zero and one. And only these templates are considered in matching stage to classify an individual either as genuine or imposter.

There are two main tasks in our approach: iris detection and features matching. Features are extracted using morphological operation in a hierarchical manner. Human annotated training data is used to determine the major parameters, so that the detected face image features are similar to those obtained by human iris features.

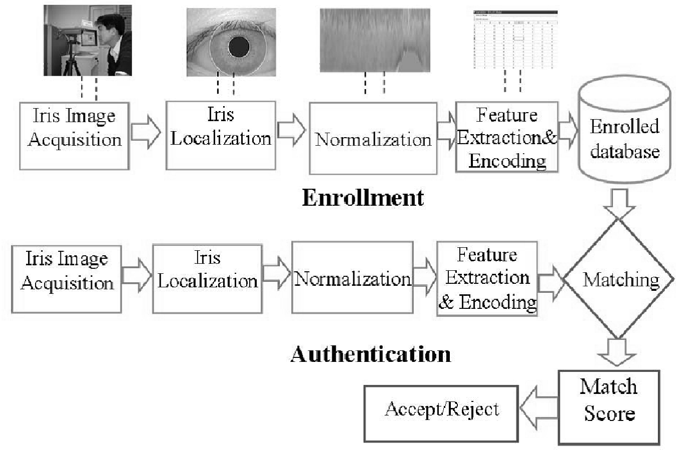

Fig. 3 A basic model for face recognition technique

IV. Implementation

a. *Modules Description*

1. *Input iris image is given:*
   In this module, iris image sample is passed as an input to the program. During the execution input iris is selected, and after that user is asked to select the corresponding face image for verification.
2. *Image is scaled:*
   During this operation image is scaled i.e. converts the intensity image to double precision, rescaling the data.
3. *Background is estimated using Gaussian convolution:*
   In this module we are estimating the background of an image using Gaussian filter. In this we going to create a filter by using the function by the name *fspecial***.**
4. *Smoothing is performed using Gaussian filter:*
   The resultant of the previous step is the filtered image. Once a suitable kernel has been calculated, then the Gaussian smoothing can be performed using standard convolution methods.
5. *Features are extracted using hierarchical morphological operations:*
   The operation starts with enhancing the contrast of the grey scale image by transforming the values. Feature extraction module where the acquire data is processed to extract feature vectors.
6. *For face image LDN features are extracted and combined with iris features*:
   Local directional number encodes the directional information of the face's textures in a dense way, producing a more discriminative code than current methods. We figure the structure of each micro-pattern with the support of a compass mask that extracts directional information, and encode such information using the well-known direction indices and sign .which allows us to distinguish among similar structural patterns that have different intensity transitions. Then we divide the face into several

regions, and take out the distribution of the LDN features from them. Then, concatenate these features into a feature vector, and we use it as a face descriptor. These collected face features are going to be combined with iris features.

7. *Similarity measures are done using EMD method:*

EMD is a similarity measure for comparing multi-dimensional distributions. In our matching algorithm, we adopt a matching model based on the Earth Mover's Distance (EMD) [18]. This matching model is quite general. Specifically, to handle possible differences, our matching algorithm is able to establish correspondences between the detected features in two images, which can be one-to-one, one-to-multiple, multiple-to-one, or even multiple-to-multiple matching.

V. RESULTS

After implementing the proposed system using Matlab platform, the results obtained are as follows:

Fig.4 Image 1 Input iris image

In the output we going to pass input iris image (as shown in Image 1), and after that we going to pass face image for verification process

Image 2 shows the selected face image.

Image 3 shows the output of feature extraction process, where we have applied LDN method.

And finally to check the performance of the system the graphs have been drawn.

Fig.5Image 2 Input face image

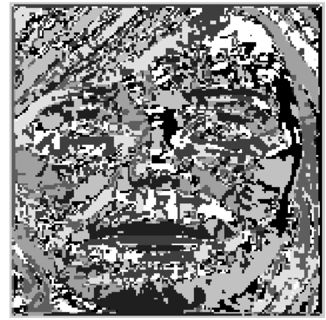

Fig.6 Image 3 Output of feature extraction

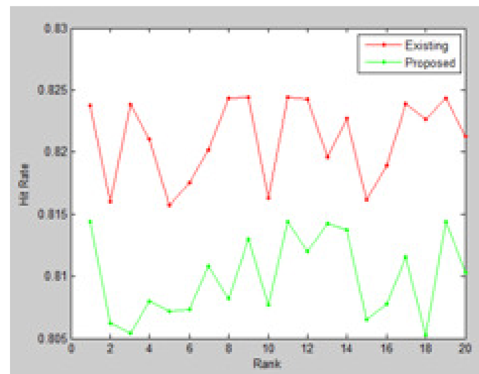

Fig.7 Image 4 the CMC curves of the identification results

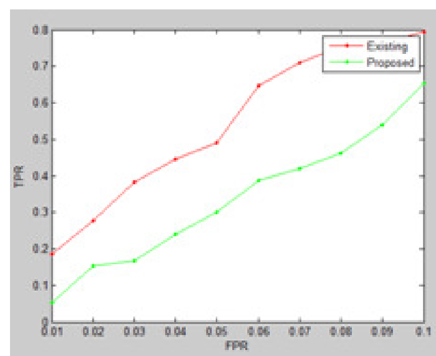

Fig.8 Image 5 the ROC curves of the verification results

VI. CONCLUSIONS

Nowadays to access the most of the highly secured places are controlled by human iris based verification technique because of its higher accuracy and robustness. In this paper, we present a new approach for detecting and matching iris for the human-in-the-loop iris biometric system. Our proposed approach produces promising results on all the three tested datasets, in-house dataset, ICE2005, and CASIA-Iris-Interval. Comparing to the known method, our approach improves the iris recognition performance by at least 22% on the rank one hit rate in the context of human identification and by at least 51% on the equal error rate in terms of subject verification. The experimental result for updated database showed better result both in segmentation and recognition. It was also observed that correct segmentation is the most vital phase of iris recognition technique. So special concern need to be given on iris image acquisition and segmentation. Finally it can be clarified that the significance of human iris as a person identification is highly acceptable and appreciable. Though the experiment was conducted in constrained database we are optimistic to consider more dynamic dataset for future work to evaluate its global performance. Nevertheless, our approach under the human in- the-loop iris recognition framework exhibits a promising application of the iris as a biometric trait in forensics.

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