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Iris Detection Method for Biometric Identification System

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***Abstract*— — In this paper, we propose an efficient technique for personal identification by analyzing iris patterns that have a high level of stability and uniqueness. With the increasing emphasis on protection, automated personal identification based on biometrics, has been receiving extensive awareness over the past decade. The iris is, due to its unique biological properties, are extremely suited for identification. It is protected from the surroundings, stable over time, unique in shape and contains a high amount of discriminating information. This paper includes image acquisition, the preprocessing method, segmentation, feature extraction and detection. This paper focuses a new method of iris detection from an iris sequence. We first evaluate the quality of each image in the input sequence and select a clear image from such a sequence for consequent detection. The results show that the proposed method outperforms the current methods both in terms of accuracy with low EER and response time. Experiments are performed using iris images obtained from CASIA and MATAB application which is easy and efficient tool in image detection.**

Keywords— Iris detection; biometrics; segmentation; feature extraction; EER.

I. Introduction

The traditional methods for personal identification are based on a physical key, ID card, a secret password etc. In these methods, the keys may be lost, ID cards may be forged and passwords may be forgotten. The recent advances of information technology and increasing condition for the security have led to a rapid improvement of intelligent personal identification methods based on biometrics. Biometrics is the automated use of physiological or behavioral characteristics to accurately identify each subject. Biometric authentication requires only a few seconds and it is able to compare thousands of records per second. The fingerprint, facial, iris, hand-scan etc are considered as the physiological biometrics and voice, signature, etc are considered as the behavioral biometrics. Of all these biometric features, fingerprint authentication has received considerable attention and has been successfully been used in law enforcement applications. Face detection and voice detection have also been widely studied over the last 25 years.

The human iris, an annular part between the pupil (generally, appearing black in an image) and the white sclera .The probability of finding two irises is close to zero. Therefore the iris detection method is very reliable and stable and could be used in most secure places. Many applications that require some degree of confidence regarding the personal identification of the people involved, such as banking, computer network access, or physical access to a secure facility, are moving away from the use of paper or plastic identity cards, or alpha-numeric passwords. These methods are too easy to defeat. Since the iris is an externally visible organ, iris based personal identification methods can be non-invasive to their users which is of great significance for practical applications.

A variety of iris detection approaches were proposed that can be broadly classified in three categories. These categories are: (1) texture based, (2) appearance based and (3) feature based extraction. This paper proposes feature-based extraction techniques that use local variations, which are characterized by the appearance and disappearance of an important image structure. Principal Component Analysis (PCA), attempt to use classical statistical approaches to extract iris features. The PCA is superior in image construction, because it can control construction errors by selecting the cumulative variance. We propose a method which detects the exact location of iris boundaries regardless to head tilt, existence of other part of faces and existence of noise in the input image. Compared to the finger print, iris is protected from the external environment behind the cornea and the eyelid. The small scale redial features of the iris remain stable and fixed from about 1 yr of age throughout the life. The procedures can be viewed as depicted in Fig 1.

II. IMAGE ACQUISITION

It is a process to capture a sequence of iris images using a specifically designed sensor. Since the iris is fairly small (its diameter is about 1cm) and dark, and exhibits more abundant features under infrared lighting, capturing iris images of high quality is one of the challenges for practical applications. In order to accomplish this, a CCD camera can also be used. The resolution is set to 640x480, the type of the image to jpeg, and the mode to white and black for larger details. The camera is situated normally between half a meters to one meter from the subject. (3 to 10 inches) .The CCD-cameras job is to take the image from the optical method and convert it into electronic data. The iris image by a monochrome CCD (Charged couple Device) camera is found and the values of the dissimilar pixels out of the CCD chip are transferred. The voltage from the CCD-chip is read out. Thereafter the signals of each data are amplified and sent to an ADC (Analog to Digital Converter). Fortunately much work has been done on iris image acquisition which has made non-invasive imaging at a distance possible. When designing in image acquisition apparatus, three main aspects namely the lightning method, the positioning method and the physical capture method has to be considered. The first time an individual uses biometric method is called an enrolment. During enrolment, the iris information from an individual is stored. In subsequent uses, the pattern is compared with the existing templates and provides the authentication.

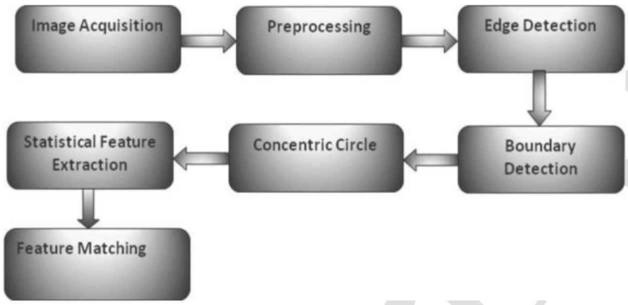

Fig. 1 Block diagram of the designed method

III. PREPROCESSING

An iris image contains not only the region of interest but also some unwanted parts such as eyelid, pupil, etc. Before feature extraction, the original image needs to be preprocessed to localize iris, normalize iris, and to reduce the pressure of non uniform illumination. In the preprocessing stage, the images are transformed from RGB to gray level. As shown in the fig.2, the part of the image that extends from inside the limbus to outside the pupil are detected. Enhancement in the original iris image can be reached by histogram equalization shown in fig.3.This equalization method can be used with default threshold value to obtain gradient image. Pixels located in the pupil region are always dark, and so their values are close to zero. So the minimum of histogram shows the line that has the lowest number of dark pixels which could be the diameter of the inner boundary circle. The intersection of this line and the output of horizontal histogram show the approximate location of centre point. .

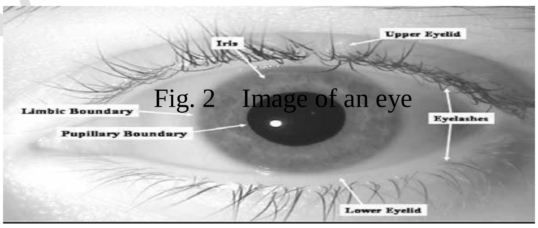

Fig. 2 Image of an eye

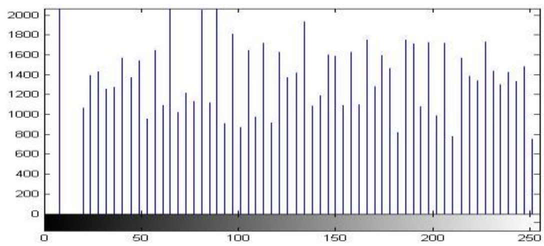

Fig. 3 Histogram of the image

A. Iris localization

The inner boundary and the outer boundary of an iris can be taken as circles. The eye is modeled by two circles, pupil and limbus, and two parabolas, upper and lower eyelids. The circles can be defined as

$$(x - x_i)^2 + (y - y_i)^2 = r_i^{\,2}$$

where (x_i, y_i) is the center and r_i is its radius (i = p, l; p---pupil and l---limbus)

But the two circles are usually not co-centric. Compared to the other part of the eye, the pupil is much darker. The inner boundary between the pupil and the iris is detected by means of thresholding. The best edge detection algorithm for detecting the outer boundary is canny edge detection. The exact parameters of these two circles are calculated by edge detection and hough transform as shown in Fig. 4. We perform these steps twice for a reasonably accurate estimate. These methods are more robust to noise and more likely to detect true weak edges. Iris images of lower quality are divided as defocused image, motion blurred image, and images occluded by eyelids and eyelashes. The pupil and eyelash regions have lower intensity values and reflection and eyelids have higher intensity values. A real part of Gabor filter captures the eyelash in spatial domain. To facilitate the subsequent processing, all kinds of noises are detected and the iris images are approximately segmented.

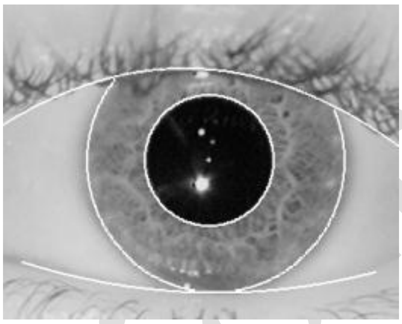

Fig. 4 Localized Image of an eye

IV. SEGMENTATION

The image obtained after separating the iris part from the eye image was filtered to reduce the effects of noise. The iris inner and outer boundaries are located by finding the edge image using canny edge detector and the circles in the edge image are found using Hough transform. As shown in Fig. 5, the next stages involves the finding the intensity gradient of the image, adjust the gamma correction to control the overall brightness, applying non maxima inhibition to suppress any pixel value that is not considered to be an edge. Irises from different people may be captured in different size and the size may change due to illumination variations and other factors. For the purpose of achieving more accurate detection results, it is necessary to compensate for iris deformation.

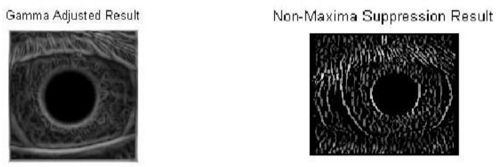

Fig 5 Gamma adjustment & non-maxima suppression result

B. Iris Normalization

To enable the generation of iris code and their comparisons, the segmented iris region has to be normalized since variations in the eye, like optical size of the iris, position of the pupil in the iris, and the iris orientation change person to person. It normalizes the iris of different sizes to the same size. This is done by unwrapping the iris and converting it into its polar equivalent as shown in Fig. 6. The normalization reduces iris distortion caused by the pupil and simplifies subsequent processing.

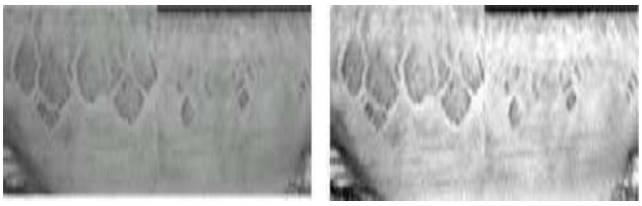

Fig. 6(a) Normalized Image (b) Enhanced image

C. Image Enhancement

The normalized iris image has low contrast and has non uniform brightness caused by the position of light sources. In Fig. 6 (a), the size of the normalized image is 64×300. The areas just at the top and bottom of the iris are often hidden by eyelashes and/or eyelids; therefore, only the iris image data from the right side [45° to 315°] and the left side [135° to 225°] are transformed into a polar coordinate method. It is necessary to develop the contrast of the normalized iris image for iris feature extraction. A histogram stretching method is used to obtain a well distributed iris image shown as enhanced image in Fig. 6 (b).

V. FEATURE EXTRACTION

The iris provides abundant information that can capture local underlying features in an iris. Most of the researchers have proposed wavelet approaches in order to capture local iris features. In our case we have proposed the method of extracting statistical features taking the correlation between the adjacent pixels. After edge detection, we get the inner and outer edge of the iris. The Hough transform is used to isolate the quality of a particular shape within an image. It is used for detection of regular curves such as lines, circles, ellipses, etc. The main advantage of Hough transform technique is that it is tolerant of gaps in feature boundary descriptions and relatively unaffected by image noise. The Hough transform is computed by taking the gradient of the original image and accumulating the non-zero point from the gradient image into every point that is one radius distance away from it. The peak in the transformed image corresponds to the centers of circular features of the given size in the original image. Once a peak is detected and a circle is found at a particular point, nearby points are excluded as possible circle centers to avoid detecting the same circular features repeatedly.

A. Extraction of Statistical Features

Using the center of the pupil and inner edge, we can draw various sizes of lines like concentric circles with which the statistical features are computed. The statistical features considered in this paper for iris detection process shown in Fig. 7 are

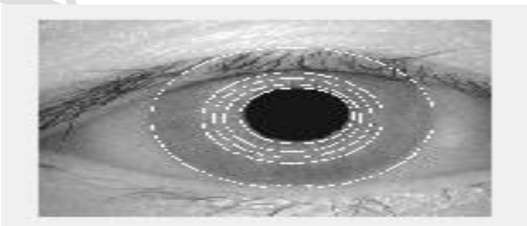

Fig. 7.Feature extraction along the circular shapeof an iris

MEAN:

$$\overline{X^c} = \sum_{i=1}^{N^c} X_i^c,\ c = \overline{1,C}$$

C= Number of circles in the segmented iris,

X_i^c = intensity value of the ith pixel of the cth circle VARIANCE:

$$S^{c^2} = \frac{1}{N^c - 1}\sum_{i=1}^{N^c}(X_i^c - \overline{X_i^c})^2$$

N^c = No. of pixels along the cth circle

STANDARD DEVIATION :

$$d = \sqrt{\frac{1}{N^c - 1}\sum_{i=1}^{N^c}(X_i^c - \overline{X_i^c})^2}.$$

PIXEL CORRELATION :

R= *corrcoef (X)* returns a matrix R of correlation coefficients calculated from an input matrix *X* whose rows are observations and columns are variables. The matrix is related to the covariance matrix *C= cov(X)* by

$$R(i,j) = C(i,j) / \sqrt{(C(i,i)C(j,j))}$$

These extracted features are stored in the database for the identification process. The image is seen as a feature vector

$$\vec{F}_c, c = \overline{1, C}$$

having desired number of circles as

$$\vec{F}_c = (X^c, M^c, S^c, d^c, ..), c = \overline{1, C}$$

Where

C = Number of circles in the segmented iris X^c = Mean of the Cth circle
S^c = Variance of the Cth circle

d^c = Standard deviation of the Cth circle M^c = Mode of the Cth circle

VI. FEATURE MATCHING

After the extraction process, the iris code matching task is performed by pairing the iris code extracted from the input and the template iris images. In iris matching we use an efficient method taking the Hamming Distance between the two feature vectors. The distance between the two featured vector are calculated by

$$D(F_c, F_c^i), i = \overline{1, N}$$

Where
F_c = Feature of the input pattern

F_c^i = Feature of the ith pattern from the database N = Number of patterns in the database

In such a process, there is a most similar pattern which is assigned as i^* , to the database pattern. i^* is the pattern which has a minimum distance value of D_i*

$$D_{i^*} = \min D_i(F_c, F_c^i).\ i = \overline{1, N}$$

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This enables the comparison of two iris patterns based on the idea that the greater the Hamming Distance between the two feature vectors, greater the difference between them. Two similar iris will fail in this test since the distance between them will be approximately zero.

The Hamming Distance was originally conceived for detection and correction of errors in Digital communication. It is defined as the number of bits that are different between two bit vectors. The Hamming Distance between the two Boolean vectors is given by

$$HD = \frac{1}{N}\sum_{j=1}^{N} C_A(j) \oplus C_B(j)$$

where C_A and C_B are the coefficients of the two iris images and N is the size of the feature vector.

$\oplus$ is the Boolean operator that gives a binary 1 if the bitsat position j in C_A and C_B are different and 0 if they are similar.

The minimum distance determines the input pattern which is the most similar to the database pattern.

VII. PERFORMANCE METRICS

The performance of the biometric method is described by the two error rates: FAR and FRR. False Accept Rate (FAR) is the probability that the method inaccurately matches the input pattern to a non- matching pattern in the database. It measures the percent of invalid inputs which are incorrectly accepted. False Reject Rate (FRR) is the probability that the method fails to detect a match between the input pattern and a matching pattern in the database. It measures the percent of valid inputs which are incorrectly rejected. Equal Error Rate (EER) is the rate at which both accept and reject errors are equal. In general the device with the lowest EER is most accurate which is shown is Fig. 7. The operating point where FAR and FRR are equal corresponds to the Equal Error Rate (EER) that measures the overall performance of the biometric method. It also corresponds to the threshold at which the FAR is equal to FRR.

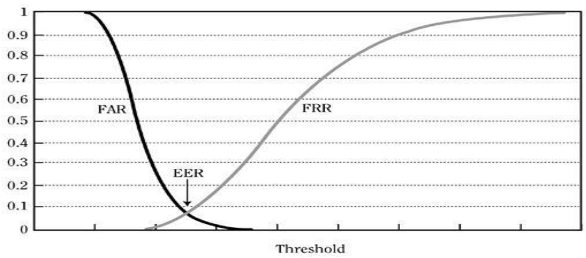

Fig. 7 FAR-FRR Diagram

VIII. BIOMETRIC COMPARISON

The comparisons of various biometric technologies based on the perception of authors are given in Fig. 8.

Factors → / Biometric identifier ↓	Universality	Distinctiveness	Permanence	Collectable	Performance	Acceptability	Circumvention
Face	H	H	M	H	L	H	H
Fingerprint	M	H	H	M	H	M	[illegible]
Hand geometry	M	M	M	H	M	M	M
Iris	H	H	H	M	H	L	L
Keystroke	L	L	L	M	L	M	M
Signature	L	L	L	H	L	H	H
Voice	M	L	L	M	L	H	H

H-High L-Low
M-Medium

Fig. 8 Comparison of various Biometric Technology

High, Medium and Low are denoted by H, M and L respectively. Universality (do all people have it?), Distinctiveness (can people be distinguished based on an identifier), permanence (how permanent are the identifiers?), and collectable (how well can the identifiers be captured and quantified?), performance (matching speed and accuracy), acceptability (willingness of people to accept), and circumvention (ease use of a substitute) are attributes of biometric method.

The iris biometric is the most preferred biometric for the method of authentication. The two primary reasons are, it operates accurately regardless of environmental conditions, and it does not require the user to have physical contact with the reader that is safer (no transmission of germs) for users. Its greatest strength lay in the FAR and FRR.

IX. RESULT

Based on the analysis, identification and verification are the two main goals of security method. Verification is one to one search and identification is one to many searches. The performance results are based on the equal error rate and accuracy. This method achieves an overall efficiency accuracy of 97% by testing in two modes: verification and identification. For each iris pattern, several patterns are randomly selected for training and rest for testing. The search engine can perform about 100,000 full comparisons between different iris per second because of efficient execution of matching process.

X. CONCLUSION

Iris detection technology provides unparalleled accuracy and speed. In this paper, an efficient method for personal identification and verification with iris patterns are presented. It has been field proven in very challenging surroundings like military process, National ID program & patient identification. This paper has improved the performance of iris detection with various statistical features. The comparisons of iris patterns are done by using Hamming Distance. The results show that the iris detection methods are the leading technology in biometric identification. Such comparison and analysis will be helpful to additional improvement of the accuracy and performance using neural networks.

References

[1] L. Ma, Y.Wang.T. Tan. “Iris detection using circular symmetric filters.” National Laboratory of Pattern Detection, Institute of Automation, Chinese Academy of Sciences, 2002

[2] Y.Zhu, T. Tan, and Y. Wang, “Biometric Personal Identification Based on Iris Patterns”, International Conference on Pattern Detection (ICPR’00)-volume2.p.2801, Sept. 2000

[3] Tisse C.L.;Martin L.;Torres L.;Robert M.,”Person Identification Technique Using Human Iris Detection”,St Journal of Method Research, Vol.4,pp.67_75,2003 [4]Daugman, J,”High Confidence Visual Detection of Persons by aTest of Statistical Independence, “IEEE

[4] Transactions on pattern analysis and Machine intelligence, vol. 15, no. 11, November 2, June 2001, pp. 1148-1161.

[5] Gonzalez,R.C., Woods,R.E,Digital Image Processing, 2nd ed., Prentice Hall (2002)

[6] Lim, S.,Lee, K., Byeon, O., Kim, T, “Efficient Iris Detection through Improvement of Feature Vector and Classifier”, ETRJ Journal, Volume 23, Number 2, June 2001, pp. 61-70