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Iris Recognition Using Gabor Wavelet

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Abstract

The iris recognition is a kind of the biometrics technologies based on the physiological characteristics of human body, compared with the feature recognition based on the fingerprint, palm-print, face and sound etc, the iris has some advantages such as uniqueness, stability, high recognition rate, and non-infringing etc. In order to guarantee the recognition rate, reduce the complexity of the iris recognition methods and improve efficiency as far as possible this article proposes an iris recognition method based on the optimized Gabor filters. the traditional iris recognition is using Gabor wavelets features; the iris recognition is performed by a 256-byte iris code, which is computed by applying the Gabor wavelets to a given area of the iris. Here for And for segmentation of iris image is based on Daugman's method using integrodifferential operator Finally, sorts the different iris patterns by improved Hamming distance method and gives the recognition results.

1. Introduction

Iris recognition is a biometric-based method of identification. This method has many advantages, such as unique, stability, can be collected, nonaggressive, etc. The iris recognition's error rate is the lowest in most biometric identification method. Now many research organizations at home and abroad spend a lot of time and energy to do research of iris recognition [13].

Biometric recognition refers to the process of matching an input biometric to stored biometric information. In particular, biometric verification refers to matching the live biometric input from an individual to the stored biometric template about that individual [1]. Examples of biometrics include face images, fingerprint images, iris images, retinal scans, etc. Thus, image processing techniques prove useful in the biometric recognition. The field of biometrics utilizes computer models of the physical and behavioral characteristics of human beings with a view to reliable personal identification. The human characteristics of interest include visual images, speech, and indeed anything which might help to uniquely identify the individual.

Most current authentication systems are password based making them susceptible to problems such as forgetting the password and passwords being stolen. One way to overcome these problems is to employ biometrics (e.g., fingerprints, face, iris pattern, etc.) for authentication. Another important application is to match an individual's biometrics against a database of biometrics. An example application of biometric identification is the matching of fingerprints found at a crime scene to a set of fingerprints in a database [11]. Authentication problem has narrower scope, but the matching technologies are applicable to both verification and identification problems [10]. Many biometric sensors output images and thus image processing plays an important role in biometric authentication. Image preprocessing is important since the quality of a biometric input can vary significantly. For example, the quality of a face image depends very much on illumination type, illumination level, detector array resolution, noise levels, etc [3]. Preprocessing methods that take into account sensor characteristics must be employed prior to attempting any matching of the biometric images. The use of biometric systems has been increasingly encouraged by both government and private entities in order to replace or increase traditional security systems.

The word iris is generally used to denote the colored portion of the eye. It is a complex structure comprising muscle, connective tissues and blood vessels. The image of a human iris thus constitutes a plausible biometric signature for establishing or confirming personal identity [6]. Further properties of the iris that makes it superior to finger prints for automatic identification systems include, among others, the difficulty of surgically modifying its texture without risk, its inherent protection and isolation from the physical environment, and it's easily monitored physiological response to light [5]. Additional technical advantages over fingerprints for automatic recognition systems include the ease of registering the iris optically without physical contact beside the fact that its intrinsic polar geometry does make the process of feature extraction easier [4].

Boles and Boashash [2] proposed a novel iris recognition algorithm based on zero crossing detection of the wavelet transform, this method has only obtained the limited results in the small samples, and this algorithm is sensitive to the grey value changes, thus recognition rate is lower. In another method followed by Jie Wang [7] the iris texture extraction is performed by applying wavelet packet transform (WPT) using Haar wavelet. The iris image is decomposed in to sub images by applying WPT and suitable sub images are selected and WPT coefficients are encoded. One more technique to extract the feature is Haar wavelet decomposition. Tze Weng Ng, Thein Lang Tay, Siak Wang Khor [8], has proposed Haar wavelet decomposition method for feature extraction. It acquires an accuracy using complex neural network matching method. Coefficients obtained from the decomposition of are then converted to binary codes to be used on calculation of hamming distance for matching purpose. Zhonghua Lin, Bibo Lu [9], has proposed iris recognition based on the optimized gabor filters. The recognition rate is high, the recognition speed is guaranteed. Iris recognition will need in future for security.

2. CASIA Database

The data samples used in our experiments were taken from the Chinese academy of Sciences (CAS) [13]. Iris recognition has been an active research topic in recent years due to its high accuracy. There is not any public iris database while there are many face and fingerprint databases. Lack of iris data for algorithm testing is a main obstacle to research on iris recognition. To promote the research, National Laboratory of Pattern Recognition (NLPR), Institute of Automation(IA), Chinese Academy of Sciences(CAS) will provide iris database freely for iris recognition researches.

CASIA Iris Image Database (ver 1.0) includes 756 iris images from 108 eyes (hence 108 classes). For each eye, 7 images are captured in two sessions, where three samples are collected in the first session and four in the second session. CASIA Iris Image Database (CASIA-Iris) developed by our research group has been released to the international biometrics community and updated from CASIA-IrisV1 to CASIA-IrisV3 since 2002. CASIA-IrisV4 is an extension of CASIA-IrisV3 and contains six subsets. The three subsets from CASIA-IrisV3 are CASIA-Iris-Interval, CASIA-Iris-Lamp, and CASIA-Iris-Twins respectively. The three new subsets are CASIA-Iris-Distance, CASIA-Iris-Thousand, and CASIA-Iris-Syn. CASIA-IrisV4 contains a total of 54,601 iris images from more than 1,800 genuine subjects and 1,000 virtual subjects. All iris images are 8 bit gray-level JPEG files, collected under near infrared illumination or synthesized. The six data sets were collected or synthesized at different times and CASIA-Iris-Interval, CASIA-Iris-Lamp, CASIA-Iris-Distance, CASIA-Iris-Thousand may have a small inter-subset overlap in subjects. More than 3,000 users from 70 countries or regions have downloaded CASIA-Iris and much excellent work on iris recognition has been done based on these iris image databases. Although great progress of iris recognition has been achieved since 1990s, the rapid growth of iris recognition applications has clearly highlighted two challenges, i.e. usability and scalability. Most current iris recognition methods have been typically evaluated on medium sized iris image databases with a few hundreds of subjects. However, more and more large-scale iris recognition systems are deployed in real-world applications. Many new problems are met in classification and indexing of large-scale iris image databases. So scalability is another challenging issue in iris recognition.

3. Pre-Processing

Here consider iris pictures from CASIA database to preprocess & ICA use for feature extraction. And for segmentation Duagman's method is used. As shown in figure 1 is specimen image from database.

For segmentation purpose Daugman method is used, first consider histogram of specimen image for pupil centre, we get pupil localization in figure 2.

The result of segmentation of iris image by Daugman's method using integrodifferential operator is shown in figure 3.

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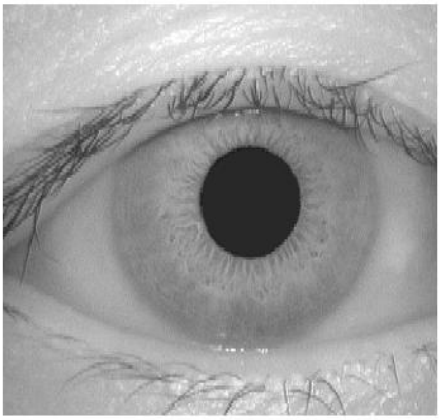

Figure 1. Iris Image

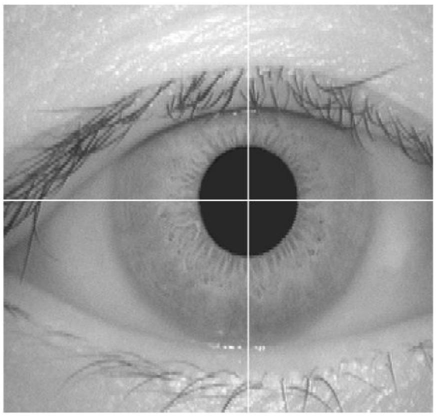

Figure 2. Pupil Localization

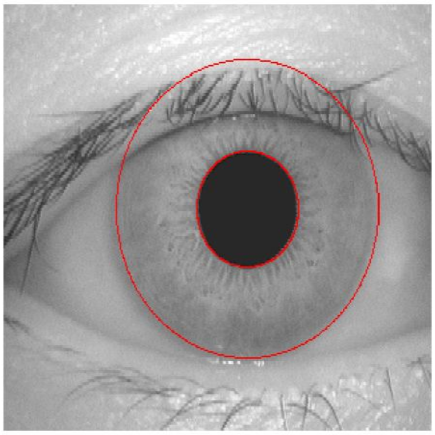

Figure 3. Segmented Image

4. Gabor Wavelet

The main idea of this method is that: firstly we construct two-dimensional Gabor filter, and we take it to filter these images, and after we get phase information, code it into 2048 bits, i.e. 256 bytes. In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. Frequency and orientation representations of Gabor filter are similar to those of human visual system, and it has been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The Gabor filters are self-similar – all filters can be generated from one mother wavelet by dilation and rotation.

Its impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions. The two components may be formed into a complex number or used individually.

Gabor filters are directly related to Gabor wavelets, since they can be designed for a number of dilations and rotations. However, in general, expansion is not applied for Gabor wavelets, since this requires computation of bi-orthogonal wavelets, which may be very time-consuming. Therefore, usually, a filter bank consisting of Gabor filters with various scales and rotations is created. The filters are convolved with the signal, resulting in a so-called Gabor space. This process is closely related to processes in the primary visual cortex. Jones and Palmer showed that the real part of the complex Gabor function is a good fit to the receptive field weight functions found in simple cells in a cat's striate cortex.

The Gabor space is very useful in image processing applications such as optical character recognition, iris recognition and fingerprint recognition. Relations between activations for a specific spatial location are very distinctive between objects in an image. Furthermore, important activations can be extracted from the Gabor space in order to create a sparse object representation.

Local regions of an iris are projected onto quadrature 2-D Gabor wavelets using equation(1).

$$h(R_e, I_m) = sgn\,(R_e, I_m) \int_\rho \int_\varphi I(\rho,\varphi) e^{-j\omega(\theta_0-\varphi)} e^{-(r_0-\rho)^2/\alpha^2} e^{-(\theta_0-\varphi)^2/\beta^2} \rho d\, \rho d\varphi \quad (1)$$

Where,

$h(R_e, I_m)$ is a complex-valued bit whose real and imaginary parts are either 1or 0 (sign) depending on the sign of the 2-D integral;

$I(\rho,\varphi)$ is the raw iris image in a dimensionless polar coordinate system that is size- and translation-invariant;

α and β are the multi scale 2-D wavelet size parameters, spanning an 8-fold range from 0.15 mm to 1.2 mm on the iris;

ω is wavelet frequency, spanning 3 octaves in inverse proportion to β;

$(r_0 - \theta_0)$ represents the polar coordinates of each region of iris for which the phasor coordinates h(Re,I m), like figure 4.

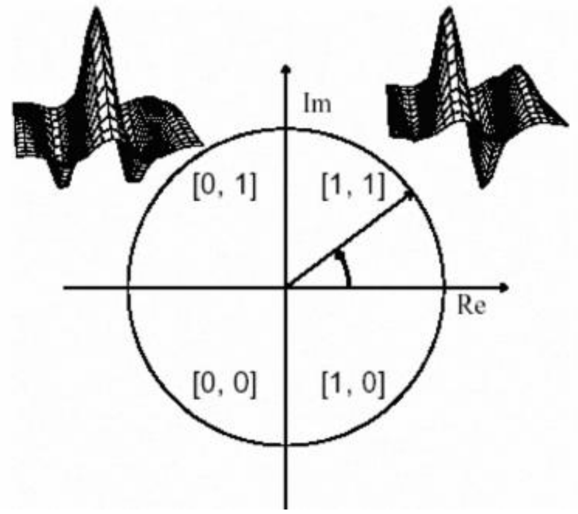

Figure 4. Phase-Quadrant Demodulation Code

Equation (1) generates complex-valued projection coefficients whose real and imaginary parts specify the coordinates of a phasor in the complex plane. The angle of each phasor is quantized to one of the four quadrants, setting two bits of phase information. This process is repeated all across the iris with many wavelet sizes, frequencies, and orientations to extract 2,048 bits, i.e. 256 bytes. Such a phase quadrant coding sequence is illustrated for one iris by the bit stream shown graphically in Figure 4.

After feature extraction of figure 1, get figure 6 & 7.

Figure 5. Normalized Unwrapped Iris

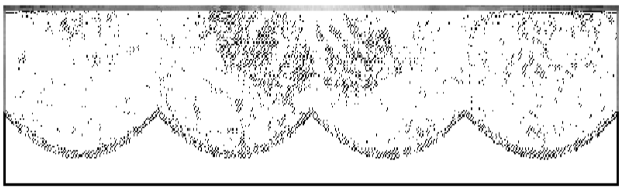

Figure 6. Real Component

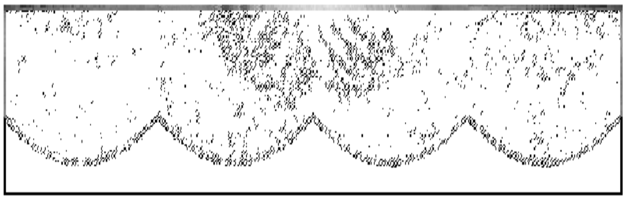

Figure 7. Imaginary Component

5. Experimental Results

We use images of eyes from 10 persons, and every person has six images of eyes. The top three images are used as test images and the next three images are used for training purpose. We use the Daugman's methods to iris regions segmentation and use Gabor wavelet for feature extraction. At last, in the identification stage we calculate Hamming distance between a test image & a training image. The smallest distance among them is expressed, that test image belongs to this class.

The recognition rate is showed in table 1.

Table 1. Experimental Result

Gabor Wavelet	96.5%

6. Conclusion

Iris recognition in Biometrics is an emerging field of interest and many new inventions had inspired to develop many accurate methods for feature extraction. It is a classic biometric application.Iris recognition is the need in many areas. 2D gabor wavelets have the highest recognition rate. Because iris is rotator, and 2D gabor wavelets have rotation invariance, it has the highest recognition rate. But 2D gabor wavelets have high computational complexity, and need more time.

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References

[1] J. G. Daugman, "*High Confidence Visual Recognition of Persons by a Test of Statistical Independence*", IEEE Trans. Pattern Analysis and

Machine Intelligence, vol. 15, pp. 1148-1161, Nov. 1993.

[2] W. Boles, B. Boashash. A human identification technique using images of the iris and wavelet transform. IEEE Transaction on Signal Processing, 1998, 46(4), pp.1185–1188

[3] Lye Wil Liam, Ali Chekima, Liau Chung Fan, *"Iris recognition using self-organizing neural network"*, IEEE 2002.

[4] Daugman G. , *"How Iris Recognition Works"* , IEEE Transaction on Circuits and System for Video Technology , vol . 14, no. I, pp . 21-30,2004.

[5] U.M. Chaskar, M.S. Suataone, *"A Novel Approach for Iris Recognition",* IEEE 2010

[6] Lin Zhonghua, Lu Bibo, *"Iris Recognition Method Based on the Coefficients of Morlet Wavelet Transform"*, IEEE 2010

[7] Jie Wang, Xie Mei, *"Iris Feature extraction based on wavelet packet analysis"*, IEEE 2006.

[8] Tze Weng Ng, Thien Lang Tay, Siak Wang Khor, *"Iris Recognition using Rapid Haar Wavelet Decomposition"*, IEEE 2010.

[9] Zhonghua Lin, Bibo Lu, *"Iris Recognition Method Based on the Optimized Gabor Filters"*, IEEE 2010.

[10] L.Masek.(2003). *"Recognition of human iris patterns for biometricidentification*" [Online].Available:http://www.csse.uwa.edu.au/~pk/studentprojects/libor/LiborMasekThesis.pdf

[11] R. P. Wildes, *"Iris recognition: an emerging biometric technology,"* Proc IEEE, vol. 85, pp. 1348- 1363, 1997.

[12] Pearson, K. (1901). *"On Lines and Planes of Closest Fit to Systems of Points in Space"* (PDF). Philosophical Magazine 2 (6): 559-572. http://stat.smmu.edu.cnihistory/pearsonI90 l.pdf.

[13] Institute of Automation Chinese Academy of Sciences. Database of CASIA iris image [EB/OL]