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Authentication Based on Texture Analysis And SVM Classification

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Authentication Based on Texture Analysis And SVM Classification

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Abstract— This paper presents for identification and here used a fusion mechanism that amalgamates both, a Canny Edge detection and a Circular Hough Transform to detect the iris boundaries in the eye's digital image. We then applied the Gabor Wavelet filter instead of using 1D Log-Gabor filter in order to exact the deterministic patterns in a person's iris in the form of a feature vector. By comparing the quantized vectors using the Hamming Distance operator, we determine finally and for classification used Support vector Machine.

Keywords—Image Acquisition, Image Manipulation, Canny Edge Detection, Circular Hough Transformation, Gabor Wavelet filter, Segmentation, Hamming Distance, SVM.

I. INTRODUCTION

Biometrics are measurable in physiological and/or behavioral characteristics [1] and can be used to verify the identity of an individual. The term physiological includes the Iris technology, Finger, hand (including knuckle, palm, vascular), Face, Retina, DNA, sweat pore, lips technology, where as the term behavioral includes Signature, voice technology. A biometric system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina, and the one presented in this thesis, the iris. Biometric systems work by first capturing a sample of the feature, such as recording a digital sound signal for voice recognition, or taking a digital colour image for face recognition, iris recognition. The sample is then transformed using some sort of mathematical function into a biometric template. The biometric template will provide a normalized, efficient and highly discriminating representation of the feature, which can then be objectively compared with other templates in order to determine identity. Most biometric systems allow two modes of operation. An enrolment mode for adding templates to a database, and an identification mode, where a template is created for an individual and then a match is searched for in the database of pre-enrolled templates. A good biometric is characterized by use of a feature that is; highly unique – so that the chance of any two people having the same characteristic will be minimal, stable –so that the feature does not change over time, and be easily captured – in order to provide convenience to the user, and prevent misrepresentation of the feature.

II. IMAGE QUALITY ASSESSMENT AND SELECTION

When capturing iris image, one usually obtains a sequence of images rather than a single image. Unfortunately, not all images in the sequence are clear and sharp enough for

recognition. Sometimes we may take some images which are out of focus, so that we will not get proper and clear image. Therefore it is necessary to select a suitable image of high quality from an input sequence before all the operations. Image quality assessment is an important issue of iris recognition as the quality of an image strongly affects recognition accuracy. However, efforts on image quality assessment are still limited. **Daugman** [2] measured total high frequency power in 2D Fourier spectrum of an image to assess the focus of the image .if an image can pass a minimum focus criterion, it will be used for recognition. However, Daugman did not provide detail description of his method. **Zhang and Salganicoff** [3].analyzed the sharpness of the boundary between the pupil and iris to determine whether an image in focus. Both these method aim to measure the focus of an iris image .The former is a common approach to focus of an detection able to be used in various application , where as the latter considers the specific properties of the iris image. Here , an effective scheme to assess image quality by analyzing the frequency distribution of the iris image .Iris image of low quality can be roughly categorized into three classes[6] ,namely out of focused image (also called defocused image),motion blurred image , and image severed occluded by eyelids and eyelashes. When the subject is far from the focus of the camera, a defocused image will form. If the subject moves during imaging a motion blurred image will form. When the subject opens his eye partially, the resulting image contains little useful information. These image often occur in a captured sequence since the eye is in the state of continual motion and noninvasive image acquisition also requires users to adjust their position .Here, the region of interest is the iris, and we thus focus on **only two iris sub regions in the horizontal direction as shown in fig 2.1** for further analysis .That is why I will utilize information of the iris image as much as possible.

Fig2.1: Differences between high quality image and low quality image. (a1) A clear image (a2) An occluded image (b1) contains the right and left rectangle part of annular part of iris in a1. (b2) contains the right and left rectangle part of annular part of iris in a2. (c1) and (c2) are the Fourier spectra corresponding to the b1 and b2 respectively

- From the view point of the frequency analysis, the spectrum of a defocused iris is greatly dominated by low frequency components, and an iris image having the eye partially opened contains significant middle and high frequency components resulted from the heavy eyelashes. As far as motion blurred images are concerned, there are two cases, if the iris sensor works in the interlaced scan mode i.e. a frame is divided into two fields which are captured in an interval of 20ms or less. The resulting image involves obvious interlacing lines called aliasing corresponding to vertical high frequency components in Fourier spectrum is more noticeable in regions close to the pupil and the eyelashes generally stand in high contrast against their surroundings. If the iris sensor works in the progressive scan mode i.e. a complete frame is generated in one time, smearing along the motion direction instead of serious aliasing will occur in the image. Different from the former, the second kind of motion blurred images lacks of middle and high frequency components and has frequency distribution similar to that of defocused image, [4].

In our experiments, motion blurred image belong to the former since our iris sensor only works in the interlaced scan mode. In comparison with these images of low quality a clear and properly focused iris image has relatively uniform frequency distribution. This can be observed from the fig2.7 to fig 2.12. we thus define the quality descriptor as follows.

$$D = [(F1+F2+F3) ; (F2 / (F1+F3))] \quad (2.0)$$

Where F1=power of low frequency components
F3=power of High power frequency components
And
F1+F2+F3=first feature
F2 / (F1+F3) =Second feature

$$F_i = \iint_{\Omega=\{(u,v)|f_1^i < \sqrt{u^2+v^2} \leq f_2^i\}} |F(u,v)| du dv \quad i=1,2,3 \quad (2.1)$$

Where F (u, v) is the 2D Fourier spectrum of an iris region
F2=Power of middle power frequency components

The first feature is the total spectrum power of an iris region which can effectively discriminate clear iris image from severely occluded iris image. The second feature is the ratio of the middle frequency power to the other frequency power. It should be larger for the clear image than for defocused and motion blurred image since the former has much more middle frequency information. After completion up to this I took two iris regions and computed their quality descriptors respectively by implementing the above process. Then the mean of the resulting two quality descriptors is regarded as an appropriate quality measure of an iris image. For a given quality descriptor, the support vector machine (SVM) method is used to distinguish whether the corresponding iris is clear. Here because defocused image, blurred images, and occluded images do not form a compact cluster in the feature space defined by the quality descriptor, I use SVM method to characterize the distribution boundary of the quality descriptor, between low quality images and clear images. A complete diagram of the proposed algorithm for quality assessment is plotted in fig

Fig 2.6: The detail step of the proposed method for image quality assessment

Using the above algorithm, one can accurately assess the quality of an image. Because the input data is an image sequence in our experiments, we adopt a simple selection scheme as follows:

- Compute the quality descriptor of each image in the input sequence.
- Generate a candidate image set where each image should successful pass the above quality assessment
- Select the image whose quality descriptor is the farthest to the decision boundary in all quality description op the candidate images.

The combination of the quality assessment algorithm and the image selection scheme makes sure that an iris image of high quality is identified from the input iris representation and matching based on a single image

After follow the above process we will get the Fourier spectrum starting from step1 to step

Step1

Fig2.7: Reading Original image by MATLAB

Step2

Fig2.8: Blurred image of fig2.4

Step3

Fig2.9: Horizontal Square (left and right side of Iris) of blurred image

Step4

Step5

Fig2.10: fft of fig24.

Fig2.11: fft -shift of fig24

Step6

Fig2.12: logarithmic transformation after fft-shift of fig2.4

III. SEGMENTATION

Segmentation is a process to get the actual and required biometric template remove the noise like eyelashes ,eyelids specular reflection. If we will not do the proper segmentations, then it will generate the false data and that is falsely represented as iris pattern data, will corrupt the biometric templates, resulting in poor recognition rates. The segmentation follows the following steps.

A. Circular Hough Transform

Used to determine the parameters of simple geometric objects, such as lines and circles present in an image. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions. In this, first edge map is generated by calculating the first

derivatives of intensity values in an eye image and then thresholding the result

B. Canny Edge Detection

[Edge degree]= canny (image, sigma)

Where

Edge=edge strength of image

Image=input image (processed image)

Sigma=standard deviation of Gaussian filter (1)

And the result will come out as follows as we did in MATLAB by taking an input image

Fig3.1 Iris edge detection of an Input eye image

[Circle_iris circle_pupil image]= Segment_iris(input image)

The above will give us three result

- Circle_iris presents centre co-ordinate and radius of iris
- Circle_pupil presents centre co-ordinates and radius of pupil
- Image gives the noise image

Fig3.2. Result of image after segmaentation

I. NORMALIZATION

Normalization is a process which produces iris regions and these region have the constant dimensions, so that the two photographs of the same iris under different conditions will have characteristics features at the same spatial location. Another point of note is that the pupil region is not concentric within the iris region.

Fig4.1:Concentric/Non-concnric circle

Normaliris(Extracted image from segmentation ,x-iris, y-iris, r-iris, x-pupil , y-pupil , r-pupil,

image filename , radial resolution , angular resolution)

Fig4.2:Normalised Iiris

II. FEATURE ENCODING AND MATCHING

In order to provide accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. Only the significant features of the iris must be encoded so that comparisons between templates can be made. For matching we used Hamming distance.

A. Selection of Gabor Parameters

Gabor function has five parameters [5], they are interdependent and interactional. The choice of parameters is important when construct the Gabor filter, which will affect indirectly the result of recognition.

Positional Parameters θ_0 . To get the enough texture information to express the original image, the positional parameters should be dense. But excessive parameters will affect the calculation speed. So it is critical to choose the appropriate positional parameters. After a considerable of experiments and considering other parameters' influence, there are 240 centers of location were selected. Dividing the iris image into two blocks, every block has 120 sub-blocks. The center of every sub-block is a couple of positional parameter. Because the circle is 360° , the angle between the contiguous two sub-blocks in x axes is 3° The localization of r_0, θ_0 is shown in Fig.5.1.

Fig.5.1: Localization of Gabor parameters r_0, θ_0

2) *Frequency Parameter* ω . y in 2 octaves, $2^2 \leq 2^5$ is enough for our system. The range of frequency is divided into two bands, the range of low band is $2^2 \leq 2^3$, high band is $2^2 \leq 2^5$.

3) *Scale Parameter* α, β : α, β influence the shape of Gabor in two dimensions. They will be selected inverse proportion . That means the wider is the width of space field, the narrower is the width of the frequency field. This embodies the characteristic of “math microscope” of wavelet. It is very useful to capture the texture of the detail. Considering the image is rectangle, the parameters are selected as follows:

Low frequency band:

$$\beta = 2 \times \pi / \omega^{\alpha=0.5 \times \beta} \quad 5.1$$

High frequency band:

$$\beta = 2 \times \pi / \omega^{\alpha=\beta} \quad 5.2$$

The scale parameters of Gabor take an important part in constructing the filter; they also are influenced by the size of the image. .

Above five parameters interact to compose a set of self similar wavelet family; every wavelet has its own location appointed by the local parameters r_0, θ_0 . So it can extract the texture information of the corresponding block of iris. The formula is given as follows:

$$h_{\{Re, Im\}} = \text{sgn}_{\{Re, Im\}} \int_r \int_{\theta} I(r, \theta) e^{-i\omega(r-\theta_0)} e^{-(r-r_0)^2/\alpha^2} e^{-(\theta-\theta_0)^2/\beta^2} r dr d\theta \quad (5.3)$$

$I(r, \theta)$ is the block of iris. The result of $h_{\{Re, Im\}}$ is 1 or 0, which depended on the sign of the 2D integral. So every wavelet will get two bits. Because the sum of wavelets is invariable, the codes of every iris have the same length.

IV. EXPERIMENTAL RESULTS

We got some peak values of centre Wavelength and range of peak values lie in between 11 to 14. And in our we took the angular resolution and radial resolution twice as the pair values {10,20} ,{20,60}. We used the peak value of centre wavelength as 13 and maintained the experiment . Whereas I took 11.5, 12.5 and 14 as the three peak value of centre wave length and recorded the result . Comparing the Matching result it is sure that with the value 13 ,the % of matching is high. But using the different parameters (11.5 ,12.5 and 14), overall I got the matching percentages are less. So I conclude that centre wavelength ‘13’ is best for matching.

Image 1	Image 2	HD	%Of Matching
1im11	1im12	0.2794	72%
1im11	1im13	0.3082	70%
1im12	1im13	0.4031	60%
1im11	1im11	0	100%
1im21	1im22	0.2535	75%
1im21	1im23	0.2109	79%
1im21	1im21	0	100%
3im11	3im12	0.2007	80%
3im11	3im13	0.1913	81%
3im12	3im13	0.1533	85%
3im11	3im11	0	100%
3im21	3im22	0.2452	76%
3im21	3im23	0.2950	71%
3im22	3im23	0.2426	76%
3im21	3im21	0	100%

Table6.1: Matching Result

Here we have taken the left and right eyes of one person with different position e.g.1im11, 1im12 and 1im13 are representing the left eye of the same person with position1, position2, position3 respectively .Similarly 1im21,1im22 and 1im23 are representing the right eye of same position with position1,position2 and position3 respectively.

From the above experiment and its tabulated result in Table6.1 and Table6.2 we I conclude that the % of matching lies in between the 60% to 100% and number of occurrence in between 71% to 75% are highest except 100%. So if the matching result is 71-75 % then two iris are same else are different

Img1	Img2	C.W	H.D	matching
1im11	1im12	13	0.2931	71%
1im11	1im12	11.5	0.3086	70%
1im11	1im12	14	0.2961	71%
1im11	1im12	12.5	0.3972	61%
2im11	2im12	11.5	0.3771	63%
2im11	2im12	12.5	0.3665	64%
2im11	2im12	14	0.3697	64%

3im11	3im12	11.5	0.3024	70%
3im11	3im12	12.5	0.2831	72%
3im11	3im12	14	0.2720	73%
4im11	4im12	11.5	0.2792	73%
4im11	4im12	12.5	0.2695	74%
4im11	4im12	14	0.2638	74%
5im11	5im12	11.5	0.3208	68%
5im11	5im12	12.5	0.3090	70%
5im11	5im12	14	0.2884	72%
6im11	6im12	11.5	0.3290	68%
6im11	6im12	12.5	0.3235	68%
6im11	6im12	14	0.3239	68%

Table6.2::Matching table with angular resolution 20 and Horizontal resolution 60

In above Table the abbreviation C.W is the Centre Wavelength
H.D is the Hamming Distance

VII. CONCLUSION AND FUTURE WORK

In this experiment if we are getting 71% to 75% match then the two irises are same with the radial resolution 10 and angular resolution 40. Since the system is implemented in MATLAB speed benefits could be made by implementing computationally intensive parts in C / C++/JAVA. Speed was not one of the objectives for developing this system, but this would have to be considered if using the system for real-time recognition. Another extension to the system would be to interface it to an iris acquisition camera having infrared light .Due to the accretion of the body or injure the basic template may change. So if it would be resolved, a nice work may come to picture.

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