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Engineering & Technology in India www.engineeringandtechnologyinindia.com
Vol. 1:1 February 2016
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Human Identification Using FKP, IRIS and FV Images

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Abstract

Biometric Recognition will provide strong link between individual and claimed identity. In modern years, biometrics is largely used for personal recognition. In this paper, a new combined biometric system, namely, Finger-Knuckle-Print (FKP), Finger vein and IRIS, is proposed. We can extract the FKPs features by Linear Discriminate Analysis (LDA), and Finger Vein and IRIS features by the 2D Block based on Gabor method. Finally, performance of all finger knuckle, vein and iris are determined individually and a min rule fusion is applied to develop a combined authentication system. Experimental results show that LDA is the best performance for identifying FKPs, and Gabor is the best performance for IRIS as well as Finger vein and it is able to provide an excellent recognition rate and more security.

Keywords*:* Finger Knuckle Print, IRIS, LDA, Finger Vein, Gabor, Recognition.

I. INTRODUCTION

Biometrics is used to identify a person using one's physiological or characteristics Human physiological and/or behavioural characteristic can be used as a biometric feature when it satisfies the requirements as ubiquity, peculiarity, stability and collectability. Well known Biometric features are fingerprints, hand veins, handwritten signatures, retinal patterns, ear patterns, etc. Hand-based biometrics has been fascinating considerable attention over present years due to its ease in accession.

Presently, it is noticed that the dorsum of hand has the potential to do personal authentication. The texture pattern is captured by bending the finger knuckle of a person, and it is hugely unique and thus can serve as a distinct biometric feature. The user acceptance for the outer finger surface imaging can be very huge as, unlike attractive fingerprints, there is no stigma of criminal examination associated with finger knuckle surface imaging [2]. The peg-free imaging of the finger knuckle surface is hugely convenient to users and offers very huge potential for reliable personal identification and authentication. The appearance based approach examination in for the finger knuckle identification cannot exploit line based features and therefore achieves quality performance. The finger knuckle surface is hugely rich in lines and creases, which are fairly curved but hugely unique for individuals.

Compared to fingerprint, iris are stable and fixed throughout life.

II. RELATED WORK

A survey of identification and authentication using finger knuckle, finger vein and iris surface are described below. The finger knuckle bending is hugely unique biometric identifier. Similarly finger vein patterns are unique, even in identical twins. Finger veins are hidden structure and its difficult to steal without their knowledge. It also offers strong antispoofing and it ensures liveness in the presented fingers during imaging.

Iris recognition is one of the most important biometric technologies due to its accurate and reliable advantages Iris localization means, it calculates the positions of iris boundaries, and extracts the iris region in iris recognition [7]. Our classical iris localization method is shown below.

$$\max_{(r, x_0, y_0)} \left| G_\sigma(r) * \frac{\partial}{\partial r} \oint_{r, x_0, y_0} \frac{I(x, y)}{2\pi r} \, ds \right| \qquad (1)$$

Where * denotes convolution and $G_{\clubsuit}(r)$ is a smoothing function. The method searches on the three dimensional space (r, x_0, y_0), takes a long time to complete the localization. Gabor method presents a robust, real-time algorithm for localizing the iris of an eye image. It localizes the outer boundary of the iris first and then localizes the inner boundary. The method consumes huge computational cost. Finally all biometric recognition methods are integrated to improve the performance.

III. ARCHITECTURE AND MODELING

Having the database of FKP images of all the people consumes more space and complexity. So, here we use user identification number (UID) for each person. The FKP image features as number of peaks in the Gabor Wavelet graph and the successive distances between those peaks are stored in the database corresponding to particular UID. During authentication, the person has to hand over the UID and his FKP image is captured. If the features of new captured image match with the corresponding features in the database would mean then the person will be authenticated [11].

A. *FKP Image Acquisition*

A specially get FKP image acquisition databases are get from PolyU FKP Database[1].

B. *Pre-processing*

Captured image is converted into gray-scale format. Then the region of interest (ROI) is extracted from FKP image. The original FKP image and the corresponding ROI FKP image is shown in Figure 1(a) and 1(b) properly. The edges are detected by local maxima of the gradient of image. Gaussian filter is used to calculate The gradient of an image *f(x, y)* and its defined as

$$\nabla f = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix} \qquad (2)$$

The magnitude ∇f is given as,

$$\nabla f = mag(\nabla f) = \left[G_x^2 + G_y^2\right]^{\frac{1}{2}} \qquad (3)$$

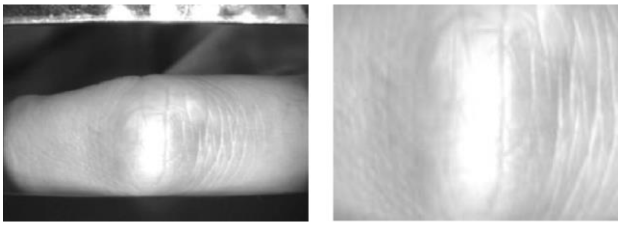
To detect strong and weak edges we can use two thresholds. Fig. 2 shows the image after edge detection. The algorithm for edge detection is given in Table I. Algorithm uses Median filter, which is given as –

$$\hat{f}(x, y) = median_{(s, t) \in S_{xy}} \{g(s, t)\} \quad (4)$$

Here, S_{xy} represents the set of coordinates

C. Feature Extraction

The features are extracted using Gabor Wavelet transform. It has two components real and imaginary and can be convolved with an image to estimate the magnitude of wavelength and orientation in the image[2].



(a) Original FKP Image (b) Extracted ROI

Fig. 1 Test Image 1

Fig. 2 Phase Congruency and LDA for Test Image1

√

TABLE I

1. The input image is smoothed using a Gaussian filter (specified standard deviation σ), to reduce noise. 2. Determine The local gradient, $g(x, y) = (G_x^2 + G_y^2)^{1/2}$, and edge point $\frac{G_x}{G_y}$ 3. Consider two thresholds T1 and T2.Pixels with values greater than T2 are said to be strong edge pixels. Other Pixels are said to be weak edge pixels.

By applying Gabor wavelet, we will get resultant image as shown in Figure 3.

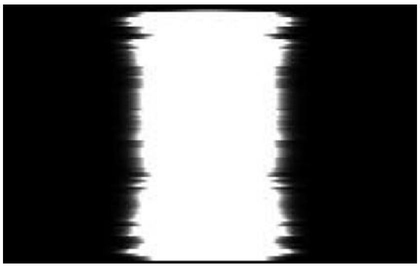


Fig. 3 Gabor Image obtained for Test Image1

D. *Feature Matching*

Now we have two sets of values containing peak-points – a set, *A* image is from the database for a particular person, and set *B* is of input FKP image of a person waiting to get authenticated. Now, compute the consecutive distance between the points in *A* as –

$$d_{Ai} = \sqrt{(x_{Ai} - x_{A(i+1)})^2 + (y_{Ai} - y_{A(i+1)})^2} \quad (5)$$

Here, $i = 1 \ldots M - 1$. Similarly, the successive distances between the points in *B* are –

$$d_{Bj} = \sqrt{(x_{Bj} - x_{B(j+1)})^2 + (y_{Bj} - y_{B(j+1)})^2} \quad (6)$$

Based on the above result we get a sequence of successes and failures. Probability of success as –

$$P = \frac{\text{the number of success observed}}{S_{count}} \quad (7)$$

total number of comparisons made $\overline{\quad n \quad}$

The probability always ranges from 0 to 1 indicating no chance to 100% chance. If the computed value of P is greater than 0.60 (a threshold value), then we can decide the person is authenticated or not.

E. Iris Recognition

Iris Recognition consists of three modules: image pre-processing, feature extraction, and authentication modules. Since the system is tested on the UBIRIS iris image database [8].

1. Pre-processing Module

Input image has useless data derived from the surrounding eye region. Image must be pre-processed like localize, segment and enhance the region of interest. Image pre-processing module has three units: iris localization, iris segmentation with coordinate transform, and enhancement units, as shown in Fig. 4.

2) Iris Localization Unit

The iris is an annular region between the pupil and the sclera. Iris localization unit performs an operation of enhancing principal edges and blurring useless edges on the copied and down sample image instead of the original one. Following that, the system estimates the centre coordinates of the iris first.

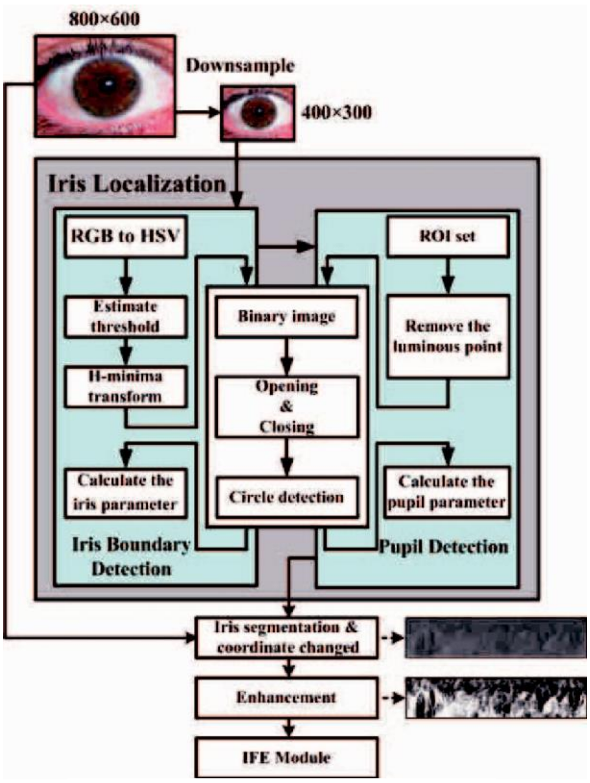


Fig. 4 Pre-processing module

3) *Iris Segmentation and Coordinate Transform Unit*

The localized iris image is transformed into polar coordinate system. When acquiring the human eye image,eyelids and eyelashes generally obscure the upper limbus of an iris, so we have to remove it. Finally it generates a rectangular iris image of a fixed size by linear interpolation. The image size of iris is 512□128[5].

4) Enhancement Unit

The normalized iris has low contrast. The final step is to perform image enhancement in order to obtain a good-quality image. It uses histogram equalization for the normalized iris image.

F. Finger Vein Recognition

Finger-vein matching is more stable, as compared with that of the texture.

1. Finger-Vein Image Pre-processing

The acquired finger images are noisy. Therefore, the acquired images are first subjected to pre-processing step that include: 1) Segmentation of ROI, 2) Translation and orientation alignment, and 3) Image enhancement to excerpt stable/reliable vascular patterns [12]. Finger-vein images are binarized, using a fixed threshold value as 230. The isolated and loosely connected regions in the binarized images are eliminated in two steps: First, the Sobel edge detector is used to eliminate number of connected white pixels being less than a threshold. Finally we got ROI image. Fig. 5 shows image samples from preprocessing steps that automatically ensures reliable segmentation of ROI.

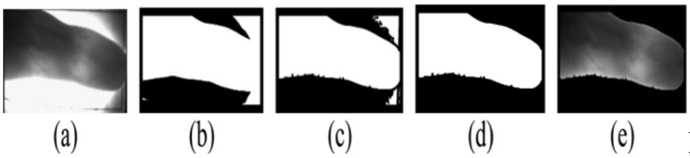


Fig. 5. Extraction of ROI from finger vein images. (a) Acquired image sample.(b) Binarized image. (c) Edge map subtracted from (b). (d) ROI mask from the image in (c) and the ROI finger vein image.(e) ROI image.

2. Finger-Vein Feature Extraction

In this paper, we propose finger-vein feature extraction using Gabor filters. It's also to enhance the extracted vein structures.

Gabor Filters for Feature Extraction: The analytical form of 2-D Gabor filters can be expressed as

$$h(\boldsymbol{p})_\theta = \frac{1}{2\pi|C|^{\frac{1}{2}}} \cos \boldsymbol{\omega}_m^T(\boldsymbol{p}_n - \boldsymbol{p}_0) \times \exp\left[-\frac{1}{2}(\boldsymbol{p}_n - \boldsymbol{p}_0)^T C^{-1}(\boldsymbol{p}_n - \boldsymbol{p}_0)\right]^T \quad (8)$$

3. Generating Finger-Vein Matching Scores

The matching scores between two finger-vein features are generated as follows:

$$s_v(R,T) = \min_{\forall i \in [0,2w], \forall j \in [0,2h]} \times \left(\frac{\sum_{x=1}^{m} \sum_{y=1}^{n} \odot \left(\hat{\boldsymbol{R}}(x+i, y+j), \boldsymbol{T}(x,y) \right)}{\sum_{x=1}^{m} \sum_{y=1}^{n} \left(\hat{\boldsymbol{R}}(x+i, y+j) \oplus -1 \right)} \right) \quad (9)$$

By using this equation, we can decide whether the person is genuine or not.

V. CONCLUSION

In this paper, we propose an efficient way for human authentication using FKP, FV and Iris images. In the proposed technique, we have applied LDA pre-processed FKP image. In IRIS proposed technique, we have enforced is Gabor Wavelet transform on the pre-processed IRIS image. In Finger vein the repeated line tracking method gives a correct result in finger-vein identification: It repeatedly traces the vein in horizontal and vertical orientations and the starting seed is randomly selected; the whole process is repeatedly done for a particular amount of times. The acceptance rate is then computed. If the acceptance rate is greater than 80%, the person can be accepted. Otherwise, they will be rejected [11].

The Euclidean distance is used for the information fusion of different biometrics at feature level is able to increase the recognition rates to a higher value. In this case, the recognition rate obtained by fusion of multiple biometrics at feature level is 97.96%. We believe that the recognition rate can be improved.

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