Review on Enhancement of Finger Vein Using Segmentation and Neural Networks

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ABSTRACT

Biometric technologies are computerized methods for establishing someone's identity genetically or behaviourally. In the fields of physical security and information security, biometric characteristics include fingerprint, face, voice pattern, iris, gait, hand vein, signature and these are used for authentication purposes in the fields of physical and information security. Nowadays, Finger Vein Authentication (FVA) is reckoned as a major biometric technology in the matter of security and reliability. This paper demonstrates a novel approach to intensify the performance metrics of FVA systems examined in the previous work. We propose a system that takes finger veins and low resolution images concurrently and combines them using the new score level combination strategy which employs: Repeated Line Tracking, Even Symmetric Gabor Filter, Segmentation and Neural Network. This system enhances the ridge pattern by reducing noise and neural networks verify the person's identity.

Keywords- Enhancement, Finger Vein, Segmentation, Neural Network.

1. INTRODUCTION

Personal Identification technology is used in an array of fields for fundamental functions including but not limited to area access control, law enforcement, credit card authentication and authentication for PCs and e-commerce processes. Biometric identification techniques like identifying fingerprint, iris, face recognition, are gaining popularity because of the risks associated with conventional techniques such as keys, passwords, PIN numbers. Unlike the conventional techniques, biometric identification is practically impossible to be replicated or stolen. Biometric Methods can be broadly classified in two categories - Physiological and Behavioural methods. Physiological methods take into account unique physical characteristics of the individual and include facial contours, fingerprints, hand/palm geometries, DNA and irises. Behavioural methods use calculated behavioural traits of the individual like voice/speech pattern, gait, and typing cadence.

In recent years, Finger Vein recognition has emerged as a precise and fool-proof biometric technique. Pattern Recognition experts assert significance of finger veins as forgery-proof, activated, shielded, contact-less and stable [14] physiological attribute.

Vein patterns are subcutaneous structures and are therefore, better concealed and more secure than any other physiological trait. The biometric technology of vein recognition has some characteristics that make it the most reliable authentication:

- Universality and uniqueness [6]: Every individual has vein pattern and they are unique in every individual. Even twins do not have same vein pattern.
- Subcutaneous: Vein recognition is most secure because of its subcutaneous structure i.e. it resides inside the body.
- The vein feature is practically impossible to replicate.

- These have no negative effect on body health as it lies in the body.

TABLE-1

Type	Characteristic	Defect	Security	Sensor
Voice	Natural/Convenient	Noise	Normal	Non-contact
Face	Remote Controlled	Light	Normal	Non-contact
Fingerprint	Widely Application	Skin	Good	Contact
Iris	High Precision	Glasses	Excellent	Non-contact
Finger Vein	High Security	Few	Excellent	Non-contact

Table-1 shows the characteristic comparison of Biometric [6]

From the above table , we can estimate how much finger vein , biometric technique , is convenient and secure.

2. LITERATURE SURVEY

Jinfeng Yang, Yihua Shi (2013) proposed a novel scheme for venous region enhancement and finger vein network segmentation. Firstly, they aimed at scattering removal, directional filtering and then matting based segmentation approach was introduced.

Ajay Kumar, Yingbo Zhou (2012) worked on a system that simultaneously acquires finger vein and finger texture images and combine these two evidences using a novel score level strategy.

Qin Bin Pan Jian-fei Cao Guang-zhong, Du Ge-guo (2009) proposed two kinds of different algorithms for feature extraction, one for vital sign detection, other for identification and to prevent the identification spoofing and improve the security capability of vein identification system.

David Mulyono, Horng Shi Jinn (2008) introduced a preliminary process to enhance the image quality worsened by light effect and noise produced by camera, then segment the vein pattern by using adaptive threshold method and matched them using improved template matching.

Naoto Miura, Akio Nagasaka, Takafumi Miyatake (2004) proposed the method which extracts the finger vein pattern from the unclear image by using repeated line tracking. Experimental results showed that it achieved robust pattern extraction, and the equal error rate was 0.145% in personal identification.

3. DESCRIPTION OF THE FINGER VEIN AUTHENTICATION SYSTEM

Finger Vein Authentication System involves the following steps as shown in the figure. Different authentication systems use different strategies.

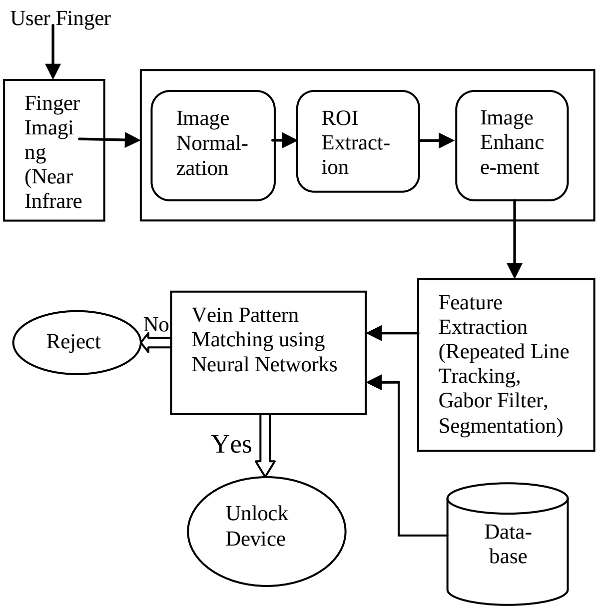

Figure 1 Proposed System for finger vein authentication using segmentation with neural network.

As shown in figure 1, the Near-Infrared rays generated , penetrate the finger and are absorbed by the haemoglobin in the blood. The New Score Level Combination Strategy which we have proposed involves: Repeated Line Tracking, Even Symmetric Gabor Filter, Segmentation and Neural Network. How our proposed system work is described as under:

3.1 Image Acquisition

Image acquisition module is used to gather finger Vein images. Put the finger under the NIR light at the wavelength of 760nm-1000nm, so that the vein pattern is captured as a pattern of shadows by the CCD (Charge Coupled Device) camera under the finger. As haemoglobin in the blood absorbs the infrared light, the patterns of veins in the palm side of the finger are captured as shadows.

As shown in figure 1, after capturing the image of finger vein, further process takes place which involves: normalization, image enhancement, feature extraction and Vein pattern matching with neural network.

3.2 Pre-processing

The acquired Finger vein image contains much noise, so amplification is required. Therefore, enhancement functions such as normalization, ROI extraction and image enhancement is done to reduce noise and dullness.

3.2.1 Normalization:

Normalization is a process that changes the range of pixel intensity values [13]. Normalization is subjected to binarization. Binarization is a method of transforming greyscale image pixels into either black or white pixels by selecting a threshold value 230.

3.2.2 ROI Extractor:

The image attained after normalization contains many unwanted regions which has to be removed by selecting the interested area in the image. This selected area is called ‘Region of Interest’ and unnecessary parts are removed by ROI extractor.

3.2.3 Image Enhancement:

Image enhancement operation improves the quality of the image, its contrast, brightness and reduces its noise content. Median Filters enhances image quality by reducing certain types of noise specially ‘salt and pepper noise’.

3.3 Feature Extraction

Feature Extraction means converting the input data into group of features. Feature extraction employs: Repeated Line Tracking, Even symmetric Gabor filter and Segmentation. These techniques trim down the full size image to extract significant information.

3.3.1 Repeated Line Tracking:

After capturing the image, Repeated Line Tracking method traces the veins in the image according to the chosen directions as per predefined probability in both horizontal and vertical orientations. The starting seed of vein pattern is randomly selected and the whole process is repeatedly done for a certain number of times, as the name suggests.

3.3.2 Even Symmetric Gabor Filter:

Gabor filter is crucial for analysing content of the image. Gabor filter consists of two parts: real and imaginary. The real part, usually called even-symmetric Gabor filter is suitable for ridge detection in an image, while the imaginary part, usually called odd-symmetric Gabor filter, is beneficial to edge detection [4], since veins present dark ridges in finger vein images.

3.3.3 Segmentation:

Image Segmentation is one of the important steps in finger vein authentication system. In this process, the vein pattern is separated from the image background by using Automatic Trimap. Automatic Trimap divides the image into three regions: Definite background, definite foreground and blended region.

3.4 Vein Pattern Matching with Neural Network

Neural Network is interconnected web of biological neurons. Neural Network consists of three layers: the first layer i.e.

Input layer does not modify any data and send the input directly to the hidden layer. The outer layer receives the modified data from inner layers and processes it before passing it to the outer world. Artificial Neural Networks have the ability to match patterns which is the last step in finger vein authentication. We propose Delta Rule and NN Start Tool for matching and authentication purposes. For matching two steps has to be done:

- Extract Features
- Match Features

The features extracted from finger vein images are already stored in the database. If the input image is matched with any one of the extracted veins, the device will be unlocked and if not, then it will show a reject message. This is how finger vein authentication system works and it verifies the whether the person’s identity matches or not.

3.5 Testing

The performance of a biometric system depends upon the different measures such as false rejection rate, false acceptance rate, genuine acceptance rate, PSNR (peak signal to noise ratio). Error rates are measured to determine the accuracy of the biometric system. Brief description of these parameters or measures is:

3.5.1 False Rejection Rate (FRR):

FRR also commonly referred to as type I error, measures the percentage of times an individual who should be positively accepted is rejected- in other words how many times the person cannot gain access [6].

3.5.2 False Acceptance Rate (FAR):

FAR also commonly referred to as type II error, measures the percentage of times an individual who should be rejected is positively matched by the biometric system- how many times the person beat the system [6].

3.5.3 Genuine Acceptance Rate (GAR):

GAR is an accuracy measurement of a biometric system. It is calculated by the formula:

$$GAR = 1- FRR$$

GAR is considered as the chief measurement of precision. Higher the GAR rate, more accurate is the system.

3.5.4 Peak Signal to Noise Ratio (PSNR) :

To calculate PSNR, firstly, we have to calculate MSE (Mean Squared Error):

$$MSE= \sum (I_1-I_2)^2 /N^2$$

I_1 I_2 are the source image and reconstructed image respectively. And from MSE, we compute RMSE (Root Mean Squared Error) which is the square root of MSE. After computing RMSE, we calculate PSNR (in decibels (db)) by using the following equation:

$$PSNR= 10 \log_{10} (255/RMSE)$$

In case of ideal condition, if noise is zero, then MSE=0 and PSNR=∞.

3. CONCLUSION

In this paper, we proposed a new score level combination strategy which not only enhances the image quality, but by combining the techniques such as Repeated Line Tracking, Gabor Filter, Segmentation and Neural Network provides better results for identification of a person. The proposed system improves the computational speed, which results in perfect finger vein network extraction.

REFERENCES

[1] Naoto Miura, Akio Nagasaka, Takafumi Miyatake, “Feature extraction of finger vein patterns based on repeated line tracking and its application to personal identification”, Springer-Verlag, 2004.

[2] Naoto Miura, Akio Nagasaka, Takafumi Miyatake, “Extraction of Finger-Vein Patterns Using Maximum Curvature Points in Image Profiles”, Conference on Machine VIsion Applications , May 2005.

[3] David Mulyono, Horng Shi Jinn, “A Study of Finger Vein Biometric for Personal Identification”, IEEE, 2008.

[4] Jinfeng Yang, Jinli Yang, Yihua Shi, “Finger-Vein Segmentation Based on Multi-channel Even-Symmetric Gabor Filters”, IEEE, 2009.

[5] Qin Bin Pan Jian-fei Cao Guag-zhong, Du Ge-guo, “The Anti-spoofing Study of Vein Identification System”, IEEE, 2009.

[6] Azadeh Noori Hoshyar, Riza Sulaiman, “Review on Finger Vein Authentication System by Applying Neural Network”, IEEE, 2010.

[7] Prof G.Ramaswamy, Vuda Sreenivasarao, Dr.P.Ramesh, D.Ravi Kiran, “A Novel Approach for Human Identification through Fingerprints”, International Journal of Computer Applications (IJCA), Volume 4 - No.3, July 2010.

[8] Jingfeng Yang, Xu Li, “Efficient Finger Vein Localization and Recognition”, IEEE, 2010.

[9] Dipali K.Bhole, A.V.Vidhate, Shrikant Velankar, “Offline signature using Cross validation and Graph matching approach”, International Journal of Technology And Engineering System (IJTES),Vol.2,No.1,2011.

[10] Jinfeng Yang, Junjie Wang, “Finger-vein Image Restoration Considering Skin Layer Structure”, IEEE, 2011.

[11] Ajay Kumar, Yingbo Zhou, “Human Identification Using Finger Images”, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL.21, NO.4, April 2012.

[12] Alima DAMAK MASMOUDI, Randa BOUKHRIS TRABELIS, Dorra SELLAMI MASMOUDI, "A new biometric human identification based on fusion fingerprints and finger veins using MonoLBP descriptor", CEM Research laboratory, Vol.78, 2013.

[13] Dipantu Bhowmik, "Finger Vein & Texture Recognization Using Score Level Fusion And 2-D Gabor Filter For Human Identification", International Journal of Engineering Research and Applications, Vol.3, Issue 2, pp.170-177, ISSN: 2248-9622, 2013.

[14] Jinfeng Yang, Yihua Shi,"Finger-vein network enhancement and segmentation", Springer, 24 March 2013.

[15] M.Bhavani, Mrs.Shoba Rani, "Human Identification Using Finger and Iris Images", International Journal of Computer Trends and Technology (IJCTT), volume 4, Issue 3, ISSN: 2231- 2803, 2013.

[16] Megha P.Arakeri, G. Ram Mohana Reddy, "An intelligent content-based image retrieval system for clinical decision support in brain tumor diagnosis", Springer, 2013.

