A Review of Various Feature Extraction Methods On Finger Vein Images

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***Abstract*---Finger vein biometric pattern is an emerging technique for personal identification and authentication for having more security and convenience. Finger vein has gained much attention among researchers to combine accuracy, universality and cost efficiency. This study makes on review over various approaches for finger vein feature extraction. The finger vein basic principle, feature extraction, evaluation procedures are analyzed extensively and systematically. The three part finger vein image acquisition, pre-processing and feature extraction are described specifically in various existing techniques.**

Keywords*-Feature Extraction, Finger veins, Biometric identification, Performance analysis.*

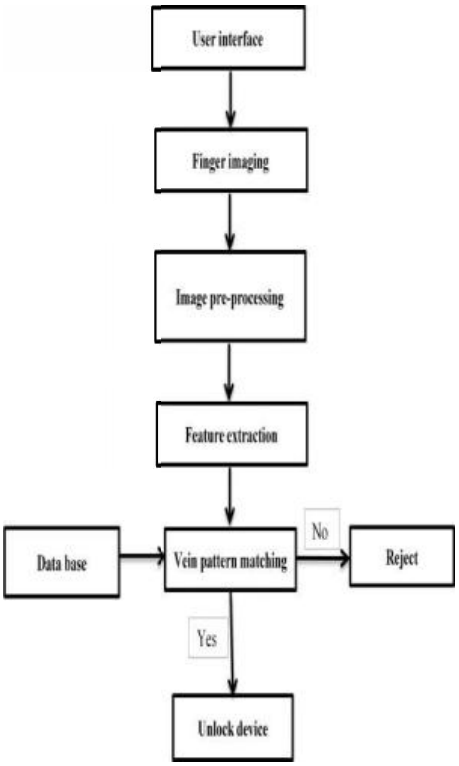
I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like photograph or video frame and output may be image or characteristics associated with that image. Usually image processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. Image Processing basically includes the following three steps:

- Importing the image with optical scanner or by digital photography
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satelllite photographs
- Output is the last stage in which result can be altered image or report that is based on image analysis [5].

Biometrics is defined as the automated recognition of individuals based on their biological or behavioural for the specific application involves a weighting of several factors and they are universlity, uniqueness, measurability, performance, robustness, accuracy and acceptability [2].

Finger vein recognition involves four main steps: Image capture, Pre-processing, Feature extraction and matching. In the image capture step, an infrared LED light of 760-1000 nm is able to pass through the skin of the finger while the haemoglobin in the vein can absorb the infrared light and then the finger vein patterns are captured by an infrared LED and CCD camera. The pre-processing procedure consists of image enhancement, normalization, etc. Enhancement algorithms are utilized to enhance the images for better performance [3].



characteristics. Common forms of biometrics used for logical and physical access control include fingerprint, facial, iris, retina, hand geometry, key-stroke and hand writing recognition. Unique human characteristics are used to identify an individual or to verify an identity. Biometric

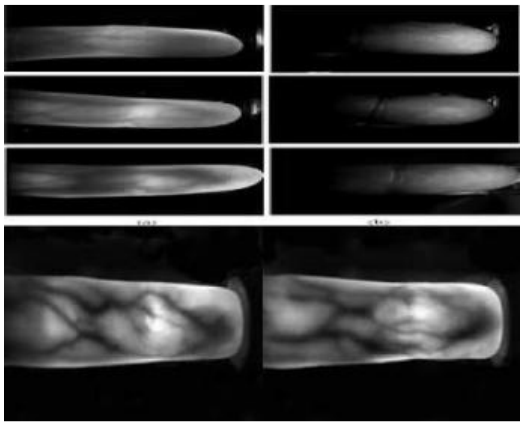


Fig: 2 Extracted Finger Vein Images

Feature Extraction is the critical step in the finger vein recognition process. The feature extracting methods can be classified into two categories based on the rules that determine how the blood vessel network will be segmented. For the first category, the finger vein network is segmented first, and then the geometric shape, topological structure or other information of the segmented blood vessel network are obtained. However, due to low qualities of finger vein images and the limitations of the segmenting algorithms, the segmentation results are often unsatisfying; hence, the feature based on the segmented blood vessel network is less powerful. To solve this problem, another category of feature extracting methods are proposed, where after the pre-processing, the features will be extracted without segmentation. Although promising experiment results are reported in two limitations of these feature extraction methods may exist. One problem is that the effective information contained in these features is not enough to make the feature more powerful and robust [3].

II. LITERATURE REVIEW

A. NEW FINGER BIOMETRIC METHOD USING NEAR INFRARED IMAGING

In this paper, a new finger vein biometric method by using near infrared imaging was proposed. Here, finger vein images were captured by infrared and then feature extraction was performed based on the modified Gaussian high-pass filter. Mainly this paper focusing the binary feature extraction which is a part of biometric method. The extracted binary codes of the same finger region achieved through binarization can be changed owing to local shadows on the finger area. To overcome these difficulty three types of feature extraction was evolved viz, simple binarization, LBP (Local Binary Pattern) and LDP (Local Derivative Pattern). In simple binarization, the robust threshold value is an important factor. It clearly separates the foreground and background values of an image. An LBP can be defined as an ordered set of binary values determined by comparing the gray values of a centre pixel and the eight neighbouring pixels around the centre. The LDP represents a high-order derivative pattern occurred in a specific direction which was reported to extract more intricate and discriminative features than those by the LBP. The binary codes are extracted from a filtered image using a second-order LDP, considering the 0°, 45°, 90°, and 135° directions logically, an extracted binary pattern includes multimodal biometric features of finger veins and finger geometries. All the three types of feature extraction were compared on the basis of processing time and recognition accuracy. In terms of processing time, the simple binarization gave the best result of 30.6 ms. Considering an accuracy in recognition of an image, LDP results to a minimum error rate of 0.13% by combining the finger geometry and finger vein.

B. A NOVEL DESIGN OF FINGER VEIN RECOGNITION FOR PERSONAL AUTHENTICATION AND VEHICLE SECURITY

In this paper, the proposed methodology was a real time embedded finger vein recognition system for personal identification and vehicle security. Each person has different finger vein patterns which are hidden underneath the skin's surface. In the security system the finger vein pattern recognition set has greater adoption ability than the available technologies. Implementation is done in MATLAB platform along with a novel finger vein recognition algorithm.

The author mainly focuses on the four different modules such as image acquisition module, finger vein matching module, embedded main board module, communication module. In image acquisition module, the finger vein is recognized by the use of CCD and USB web camera. In Finger vein matching module the recognized image is segmented, enhanced and feature extracted. The feature extraction is made by the HAAR classifier. The localized feature of signals can be analysed by HAAR transform. Due to the orthogonal property of the Haar function, the frequency components of input signal can be analyzed. With matching results, there occurs two types of errors, FRR(False Rejection Rate) and FAR(False Acceptance Rate).In biometric system both FRR and FAR are treated equally for overall performance. Then the newly extracted image is verified with the image in the database. If the verification yields score greater than 0.2500, then the authorization is success else it is failed.

In embedded main board module, a microcontroller specifically AT89C51 is used to programme in embedded C. In communication module, GSM is used. When there is an unauthorized access, then the user is altered with an message. This system takes minimized time duration of 0.5sec to verify one input finger vein sample with expected error rate of 0.06. The proposed system has an advantage of less computational complexity and requires low power which made the system as a suitable method in security applications like vehicle, home, banks and industries etc.

C. FINGER VEIN RECOGNITION WITH PERSONALIZED FEATURE SELECTION

In this paper finger vein feature extraction is done by the method called Pyramid Histograms of Gray, Texture and Orientation Gradients (PHGTOG). The technique includes the combination of more effective information such as gray, texture and shape. To develop the recognition performance and to minimize the computational complexity, the author selects a specific set of features from PHGTOG, which was trained by using LASSO and it is called as PHF-PHGTOG. Extensive experiments have been demonstrated by this personalized feature selection which can improve the performance in comparison with PHGTOG.

The PHGTOG is designed as the concatenation of the Pyramid Histogram of gray (PHG), Pyramid Histogram of Texture (PHT) and Pyramid Histogram of Orientation Gradients (PHOG). At first each image was partitioned as finger spatial grids, by repeating the divisions in each axis. Secondly calculate the gray histogram of grid cells in PHG, LBP for the pixels in PHT and Histograms of Orientation Gradients in PHOG. Finally, all these features are combined to obtain the PHGTOG.

The performance is improved with sufficient training samples, but in some application areas, it is very difficult and expensive to obtain sufficient instances for training. So, finding a more powerful feature selection method to make full use of fewer samples will be the focus of future work.

D. COMMON SPATIAL PATTERN FOR HUMAN IDENTIFICATION BASED ON FINGER VEIN IMAGES IN RADON SPACE

In this paper a method of finger vein recognition was proposed for identifying individuals. Using entropy based thresholding the finger vein images are extracted with some short and long lines. The short lines are the actual veins and the long lines are the noise present. The radon transformation was applied to segmented images. This is not sensitive to noise, for extracting dominant features from finger vein images, Common spatial patterns (CSP) was applied to the blocks of radon transformation. The data was classified using nearest neighbour (1-NN) and multilayer perceptron (MLP) neural network. The research was performed on the peking University finger vein dataset.

The brain patterns are successfully indentified by a powerful technique called common spatial pattern (CSP). CSP was a useful method for feature extraction of EEG signals. For the purpose of recording EEG signals from the brain, several electrodes are placed on the head of the people and final signal was obtained by combining all signals .The EEG signals and the obtained vein images have three similar components R, G, and B. Because of this reason the author uses common spatial patterns for extracting features. The images are first divided into equal sized window and the CSP feature extraction was applied to get separate feature vectors from each window. Experimental results show that the CSP 1-NN has good performance in recognizing individuals based on the finger vein images and achieves a success rate of 99.6753%.

E. HUMAN IDENTIFICATION WITH FINGER VEINS USING REPEATED LINE TRACKING, EVEN GABOR AND AUTOMATIC TRIMAP GENERATION ALGORITHMS

In this paper various techniques were discussed and analysed namely repeated line tracking, gabor filter and automatic trimap generation. At present identification of individuals through finger vein plays a vital role in many applications such as credit card authentication, security in automobile, computer and network authentication, etc. The existing works functionally have three parts that is finger vein acquired image, pre-processing and feature extraction.

In repeater line tracking the veins in the image is traced out by a predefined probability and it gives a promising result in finger vein identification. Gabor filters acquires optimal localization properties in frequency and spatial domain, hence suited for texture segmentation problems. The applications such as texture segmentation, edge detection, retina identification widely uses Gabor filter. The automatic trimap generation achieves higher performance in segmentation of low quality images of finger vein. Combining the repeated line tracking and Gabor filter with automatic trimap generation uplifts the accuracy of the results has compared to the individual results of these methods.

F. AUTOMATIC FEATURE EXTRACTION FROM NON-UNIFORM FINGER VEIN IMAGE AND ITS APPLICATION TO PERSONAL IDENTIFICATION

The proposed paper has a new method to extract vein patterns from an unclear finger image. Finger vein pattern can be used for personal identification technology. The robustness and the tolerance to the uneven luminance and noise in pattern extraction algorithm were required. Thus the author uses a special algorithm called special line tracking that enhances the robustness of finger vein extraction.

The shades and noises result from the different thickness between the finger bones and muscles. And the contrast of the image fluctuates due to light intensity fluctuations. To extract finger vein patterns from the unclear image, special line tracking were repeatedly carried out with changing its starting point. As the location and length of the number of veins are unknown, the vein tracking is done at random positions. In conventional method the matched filter emphasizes the depth of veins' cross sectional view thereby the noise was also emphasized. The evaluation of special line tracking approach emphasizes only on the line patterns extracted by the number of tracking irrespective of the noise. The author's experimental result shows that EER was 0.145% which means the personal identification by using finger vein pattern was very effective. The performance is 0.145% equal error rate in the evaluation.

III. PERFORMANCE ANALYSIS

Reference	Author	Method	Performance
[1]	Eui chul lee, Hyunwoo jung, Daeyeoul kim	Local Derivative Pattern method	Error Rate=0.13%
[2]	V.Ramya, P.Vijayakumar, B.Palaniappan	Finger vein recognition algorithm and HAAR Classifier	Processing Time=0.5 sec Expected Error Rate=0.06
[3]	Xiaoming Xi,gongping Yang, Yilong Yin,Xianjing meng	i).PHGTOG Feature Extraction and ii).PFS-PHGTOG Feature Extraction	i).PHGTOG: EER=0.0353 Recognition Rate=0.9765 ii).PFS-PHGTOG: EER:0.0110 FAR at-Zero-FRR=0.3680 FRR at-Zero-FAR=0.0801
[4]	Akram Gholami, Hamid Hassanpour	Common Spatial Patterns and Radon Transformation (1-Nearest Neighbour)	Detecting Rate=100% (for 50,100 classes) Detecting Rate=99.6753% (for 154 classes) Processing Time:162.67491 seconds,
[5]	Prabjot kaur, Prince Verma	Repeated Line Tracking and Gabor filter with Trimap generation	Average Accuracy=98% MSE=58.1635 PSNR=49.4486
[6]	Naoto Miura,Akio Nagasaka,Takafumi Miyatake	Special Line Tracking	Equal Error Rate=0.145%

IV. CONCLUSION

Finger vein biometric technology finds its application in many areas such as door access control system, the personal identification, online banking, etc. When compared to various biometric identifications finger vein is more securable. Existing technologies have various finger vein feature extraction techniques. This study reviews various approaches for feature extraction and offers different level of performance, security and accuracy.

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