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Secure and Reliable Human Identification Based on Finger-Vein Patterns

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***Abstract*— Personal authentication has attracted great attention due to its large potential of security application, finger vein recognition technique has become the most preferred and novelist biometric method due to its low device constraint and high anti counterfeit. In this paper a study of advancement in finger vein recognition is given. Generally it focuses on three aspects, i.e., general introduction of finger vein recognition, presented research work on image acquisition and feature extraction methods. Finger vein has an outstanding promise in different application. The performance framework for vein parameter such as EER is calculated by means of different algorithms.**

Keywords — Image Acquisition Device, Finger-vein recognition, Preprocessing, Biometrics, Feature Extraction,

I. INTRODUCTION

With the growing demand for more user friendly and rigorous safety, automatic personal identification has become one of the most significant and demanding tasks. Thus, some researchers are provoked to discover new biometric features and characters. Biometrics, which uses human physical and behavioral characteristics, has concerned more and more attention and becomes one of the most accepted and capable alternatives to the traditional password or PIN based authentication techniques [1] furthermore, some multimedia content in consumer electronic appliances can be secured by biometrics [2]. As compared to traditional identification techniques such as personal Identification Numbers (PINs), passwords, the biometric techniques based on human physiological qualities can ensure higher security and more convenience for the consumer, hence the biometrics-based automated human recognition are now attractive more and become more popular in a huge range of inhabitant applications. Now days, a number of biometric characteristics have been employed to achieve the identification task and can be broadly categorized in two categories: (1) extrinsic biometric features, such *as* faces, fingerprints, iris, hand shapes ,gait and signature, and voice[3]; (2) intrinsic biometric features such as palm-veins, hand-veins and finger-veins. Extrinsic biometric features are easy to use because their fake versions can be effectively working to imitate the identification. Also has the advantages of simple convenience of these biometric traits cause some concerns on privacy and security. On the disparity, the intrinsic biometric features do not remain on the capturing device when the user interacts with the device, which ensure high security in various applications. The grand challenge to biometrics is thus to improve recognition performance for both accuracy and efficiency and be maximally resistant to deceptive practices. To this end, many researchers have required to recover consistency and aggravate spoofers by developing biometrics that are highly individuating; however at the same time, present a greatly complex, hopefully unbeatable challenge to those who desire to defeat them [4]. Especially for consumer electronics applications, biometrics recognition systems require to be cost-efficient and easy to apply [5].

As compared with other biometric, the finger-vein is a promising biometric pattern for personal identification in terms of its security and convenience [6]. The finger-vein biometric has the following advantages [7]:

(1) The vein is difficult to forge or steal as it is hidden inside the body.
(2) The contactless capture of finger-veins ensures both convenience and hygiene for the user, and is for this reason more adequate.
(3) The sample of finger-vein can only be taken from a survive body.
(4) It is a natural and convincing proof that the subject whose finger-vein is successfully captured is alive.
(5) Vein patterns are distinctive between twins and even between a person's left and right hand.

II. LITERATURE SURVEY

Conventional methods used for extracting line-shaped features
from images consist of matched-filter method [12], mathematical morphology [13], emphasized edge lines connection[14], and ridge line following for minutiae detection in grayscale fingerprint images [11]. The matched-filter and morphological methods can perform fast feature extraction since all that's required is to filter the image. On the other hand, this can also emphasize irregular shading, which presents an obstacle to personal identification since this obscures parts of the pattern of veins. Besides, dots of noise are also emphasized because continuity is not measured.

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A. *Feature extraction of finger vein using repeted line tracking*

Another method of Feature Extraction of Finger-Vein Patterns is introduced by Naoto Miura which is Based on Repeated Line Tracking and its Application to Personal Identification [8] . In which an image of a finger vein has been captured using infrared light contains not just the vein pattern but also irregular shading produced by the various thicknesses of the finger bones and muscles. In this paper author have proposed a method that extracts the finger-vein pattern from the unclear image by using line tracking that starts from various positions.

Experimental results show that it achieve robust pattern extraction, and the equal error rate of 0.145% and the response time of 460 ms. From the resulting output it has been concluded that the proposed technique is successful for personal identification.

B. *Local line binary pattern for finger vein recognition*

In this paper, a new technique has been proposed for personal recognition based on finger vein image. Local Line Binary Pattern (LLBP) technique for feature extraction has been used. The LLBP technique has a benefit of having straight line neighborhood shapes. In Local Binary Pattern (LBP) technique which has been introduced earlier, the neighbourhood shape is a square one. While comparing the result of proposed method with LBP technique authors have shown that LLBP gives better performance. For the experiment Images for 204 fingers have been considered where the images were captured by their own device. Time requiring for feature extraction in LLBP technique is less than the LBP technique.

C. *Finger-Vein Patterns Extraction Using Maximum Curvature Points in Image Profiles*

In this technique to extract the accurate details of the depicted
veins, a method of calculating local maximum curvatures in cross-sectional profiles of a vein image has been developed. This method is used to extract the centerlines of the veins consistently without being affected by the fluctuations in vein
width and brightness, such that its pattern matching is highly precise. Experimental results show that this method extracted
patterns strongly when vein width and intensity fluctuated, For personal identification the equal error rate was greatly better than that of conventional methods.

D. *Finger vein identificaation using phase only correlation*

In this paper, Authors have proposed algorithm finger vein recognition with low complexity in the image pre-processing part, where finger vein extraction is not included. In the proposed algorithm authors have implemented phase-only correlation (POC) function at the matching stage with a simple pre-processing technique. Authors have done the experiment using a set of finger vein images captured by a low cost device [6] have resulting an efficient recognition performance where the equal error rate (EER) was 0.9803% with a response time of 0.6362*s*.

E. *Finger-vein recognition system based on fractal dimentions*

In this paper a real time finger vein authentication device propose a real-time embedded finger-vein recognition system for authentication on mobile devices [9]. The system equipped with a novel finger-vein recognition algorithm based on the concept of fractal model and lacunarity. The proposed system takes only about 0.8 seconds to verify one input finger vein sample and achieves an equal error rate (EER) of 0.07% on a database of 100 subjects. The experimental results show that the proposed finger-vein recognition system is qualified for authentication on mobile devices.

F. *Human identification by using finger images*

This paper presents a new approach to improve the performance of finger-vein identification systems. The proposed system simultaneously acquires the finger-vein and low-resolution fingerprint images and combines these two evidences using a novel score-level combination strategy [11]. Authors have examined the previously proposed finger-vein identification approaches and develop a new approach that illustrates it superiority over prior methods. The utility of low-resolution fingerprint images acquired from a webcam is examined to establish the matching performance from such images. Two new score-level combinations, i.e., holistic and nonlinear fusion have developed and examine, and relatively evaluate them with more popular score-level fusion approach to find out their effectiveness in the proposed system. The experimental results presented on the database of 626 images from 156 subjects demonstrate significant enhancement in the performance.

III. OVERVIEW OF THE SYSTEM

Finger Vein Identification system consist of following Steps: image acquisition, Image Pre-processing, Feature extraction, matching and verification.

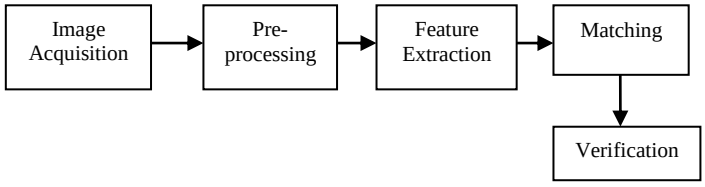

Fig.1 A typical finger vein identification system

1. Finger Vein Image Acquisition

A special imaging device is used to obtain the high quality near infrared (NIR) images of the finger.

There are two ways of finger vein image acquisition, i.e., light reflection method and light transmission method [7], as shown in Fig.2. The difference between two methods is the position of near-infrared light. In light reflection method, near-infrared light is placed in finger palmar side, and finger vein pattern is captured by the reflected light from finger palmar surface. While in light transmission

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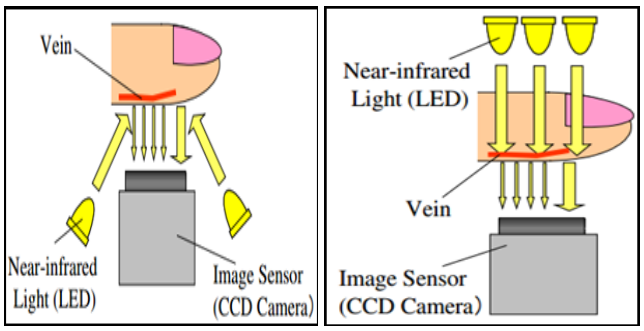
method near-infrared light is placed in finger dorsal side, and the light will penetrate finger. Compared with light reflection method, In light transmission method high-contrast image can capture, so most of image acquisition devices utilize light transmission method.



a. b.

Fig.2 Finger vein image acquisition:- a. Light reflection; b. Light transmission.

2. Pre-Processing

Finger-vein image pre-processing, in which detection of the region of interest (ROI), image segmentation, alignment, Image enhancement is included. In pre-processing ROI of the finger vein is segmented. The image enhancement is an necessary step for advanced image quality to get improved matching performance. In this purpose of enhancement is to process an image so that the result is more. Finally, histogram equalization is used for enhancing the gray level contrast of the image.

3. Feature Extraction

Feature extraction is one key process in finger vein recognition. These feature extraction methods can be classified into three groups, i.e., vein pattern-based methods, dimensionality reduction-based methods and local binary-based methods, equivalent method will be applied for further process of matching.

4. Matching

Verification stage occurs after the Feature extraction, obtained image will be given to verification stage. In this step the input image and vein template image should be compared. Afterward the matching original image is to be identified.

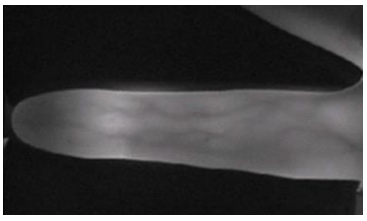


Fig 3. Finger-vein Image

IV. CONCLUSION

Extraction of robust features from finger vein images is an significant concern in a finger vein based biometric system. This present system deals with the study which related to different techniques of finger vein feature extraction for biometric authentication and identification. Existing work in

Literatures and commercial utilization deals with the study and implementation of experiences in different finger vein, features extraction. These techniques offer different levels of performance in finger vein robustness, security and precision.

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