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Analysis Finger Vein Biometric

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Abstract - *Biometric identification for authentication is the study of physiological and behavioral attributes of an individual for better security purpose. Finger vein recognition is a biometric technique used to analyze finger vein patterns of persons for proper authentication. This paper presents a detailed review on different finger vein recognition systems used for security. Includes image acquisition, pre-processing, feature extraction and matching methods to extract and analyze vein patterns. In addition, we have discussed about low-cost and standalone finger-vein capturing devices after highlighting techniques. The comparative studies indicate that the accuracy of finger vein identification for security methods is up to the mark.*

Key Words: **biometrics; finger vein recognition; feature extraction; matching; performance analysis.**

1.INTRODUCTION

Biometrics is a technology used to identify, analyse and measure an individual's physical and behavioural characteristics[1].

Mainly focuses on designing and developing a low-cost and standalone finger-vein capturing device[2]. The main aim of the finger vein biometric system is to capture finger-vein image that is used for biometric security purposes such as authentication, recognition, and identification[3].

Finger vein can be viewed as more secured compared to other hands based biometric traits such as fingerprint and palm print because the characteristics are inside the human body[4][5]. There is a number of existing finger-vein capturing device that is available on the market. However, the devices are extremely expensive.

Finger vein recognition is a method of biometric authentication that uses pattern recognitions techniques based on images of human finger vein patterns beneath the skin surface[6].

Light reflection concept is applied in capturing the finger-vein images Current applications of finger vein recognition includes credit card authentication, automobile security, employee time and attendance tracking , automated teller machine etc[7][8].

2. MOTIVATION

As there are many methods for biometric authentication system like facial, voice, fingerprint, finger vein [7,8]. These methods cannot give complete security, but finger vein is better than other methods[8]. [1] has discussed advantages of finger vein biometric FVR which provides uniqueness for every individual. A vein is not visible externally and is hidden inside the body so it is very difficult to forge or steal[1,7]. A finger pattern is permanent over time and thus re-enrolment of vein pattern is not required once signed up. Besides all these advantages finger vein recognition system can take low resolution images[1,8].

2.1 Image Acquisition

It is found that the use of imaging in the near IR spectrum eliminated many of the unwanted features present on the surface of a human palm like skin marks, finger prints, etc. while improving the contrast between the blood vessels and the surrounding factors. So, the input to the proposed algorithm in[6] is an IR image of a human finger which contains vein information embedded in it[6,7].

In[1] The finger vein scanner consists of the NIR (Near Infra-red) sensors. The finger vein scanner works on the principle of light transmission phenomenon. The finger vein scanner consists of the acryl which serves as the platform for placing the finger. The CCD pre-processors camera is used for capturing the image of finger veins.

Three methods are mainly used for finger vein image acquisition: light transmission method, light reflection method and two-way radiating method [7,8,9]. Among these methods, a high contrast image is captured using the

transmission method, therefore most of finger vein imaging devices employ the light transmission[9].

2.2 Image Pre-processing

Pre-processing method is applied to overcome low contrast, noise and shades which image is captured[9,1].

Three major steps in this method are: 1) Image noise reduction 2)Image enhancement 3)Image Feature Extraction[6]. The noise reduction can be done using median filter as it reduces salt and pepper noise of the image. Region Of Interest (ROI) [6] is extracted using a region-based method where the portion extracted contains the most relevant vein information[1].

The ROI is obtained by thresholding the image. The multidimensional filtering is done for thresholding[9]. [10] states the other extracting methods which are parameter adjustment methods in the pre-processing stages to select the filter in noise reduction and threshold in edge detection, by using Sobel operator. Different imaging devices using the ROI extraction method such as grey level, image size variation and background noise appearances in finger vein images, which affect the performance of the ROI extraction method.

Image enhancement [1] is done using histogram equalisation for the ROI image that is obtained[6] in histogram equalisation which is followed by a gamma correction for better result in the image processing. [9]states different methods used such a Circular Gabor Filter (CGF) approach to improve finger vein images, Gaussian matching technique and contrast-limited adaptive histogram equalization (CLAHE)[10]. Moreover, some enhancement techniques were combined to enhance the finger vein image and reduce the noise[1] by combining Gabor filter and canny edge detector to enhance the finger vein image and remove noise which gives better results compared to other techniques[10,9].

2.3 Feature Extraction

Feature extraction is one of the most crucial and main steps of FVR. During this step, the quantitative property of the basic biometric trait is generated called the template, which is helpful for recognizing the individual. For example, in a fingerprint biometric system, location and direction of minutiae points in a fingerprint image is the key attribute which needs to be distinct from another person. An efficient feature extraction technique is a step which intensifies the precision of finger vein recognition. Numerous feature extraction techniques have been presented, we listed four groups of feature extraction methods, i.e., vein-based method, local binary-based method, dimensionality-based method and minutiae-based method. It can be done with various ways, as different methods are based on different parameters which can be used for feature extraction. Mainly all these methods are divided into several categories they are Vein-Based Method, dimensionality-reduction based Method, local binary based Method and minutiae-based Method.

2.3.1 Vein-Based Method

In vein-based method, at first segmentation of vein pattern is done and then the topological structure or geometric shape of vein pattern is used for matching purpose. Typically six feature extraction methods lie in this category named as, mean curvature, modified repeated line tracking, maximum curvature, Gabor, region growth and repeated line tracking. Using all the methods mentioned above, the vein pattern generated is binary in nature and similar pixel ratio will be general. In matching process best way is match of pixel by pixel for two vein.

2.3.2 Dimensionality reduction Based Method

Dimensionality reduction is a process used for feature reduction which transforms image from high dimension to low dimension. Dimensionality Reduction based method involves in using of various techniques like Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), (2D)2 Principal Component Analysis (2PCA). All these methods use ML methods and neural networks, in which total dataset is divides into training and testing part, so that new data can be estimated with this learning method. In dimensionality reduction-based method, finger vein image is converted into a low dimensional space by dimension reduction, in which the selective information is kept and noises are excreted.

2.3.3 Local Binary Based Method

Local Binary Based method presents the extracted feature in binary format, various techniques used for this are personalized best bit maps (PBB1M), local directional code (LDC), personalized weight maps (PWM) and local binary pattern (LBP). Comparison of grey level of two pixels is done in LBP and LLBP method. In terms of stability PPBM and PWM further explores the stability of binary code. To estimate similarity between two veins, input one and enrolled one hamming distance is used. Among all above mentioned codes LDC are very different which uses local gradient orientation information.

2.3.4 Minutiae Point-Based Method

The point where the ridge lines terminated or fork is explained as a minutiae point. Minutiae points direct to the terminal point and bifurcation point of blood vessels and one kind of important feature of a finger vein image. Minutiae points are used in finger vein recognition and such methods are already used in fingerprint recognition technique[9]. A minutiae-based point feature removal and matching approach which considerably improved the execution of the

identification system. For standard quality fingerprint image may hold around 25 to 80 minutiae depending on the fingerprint scanner resolution and the positioning of finger on the sensor. The extracted minutiae points of finger vein by combining two methods, namely maximum curvature points and fingerprint application method. Using endpoints and bifurcation points to eliminate false minutiae and make the identification more precise.

Minutiae can define as the points where the ridgelines end of fork[11]. Therefore, the minutiae points are the local ridge discontinuities and can be of many types such as Ridge ending, Ridge Bifurcation, Ridge ponds Lake or enclosure[10], Short ridge islands or independent ridge, Ridge Dots, Spur, Crossover or bridge.

Feature extraction from minutiae point method can be do in five following steps: 1) binarization, 2) thinning, 3) minutiae location, 4) removable spurious minutiae, and 5) classification minutiae[11].

- Binarization Technique

  The black and white image (called binary image) are converting into two parts (object and background). The object is usually shown as black and background is usually shown as white.

- Thinning Technique

  Thinning is a technique that used to decrease the ridgeline of fingerprint from compact lines to a single line or pixel. This thinning function executes a thinning object on binary (0, 1) image.

- Define Minutiae Location Technique

  To enumerate each location of minutiae that established on the fingerprint thinned surface with 3*3 pixels window by differentiating to the central pixel with eight locality pixels to regulate location of each type of minutiae.

- Removable Spurious Minutiae Technique

  There is no at least one algorithm is perfect after thinning fingerprint image pre-processing. Noisy or spurious minutiae may generated by subsystem. Spurious minutiae or noisy is the issue for matching minutiae. For any specious or noisy that rises up with ridgeline on object will corrected from the fingerprint surface.

- Classification Minutiae Technique

Two most frequently used in detection minutiae are ridge termination and ridge bifurcation. Classification Minutiae technique will used after the discharge on thinned images. The technique uses a sample window 3 by 3 pixels wide to recognize by key features such as termination and bifurcation.

2.4 MATCHING

The matching technique is a recognition to decide whether an input image is genuine or an imposter for one enrolled image[9], in which a matching score is generated. A matching score measures the likeness between the enrolled template and the input image.

2.5 VERIFICATION

Pre-processed image with extracted features will finally matched with the stored image in data base[9]. So verification is made between input image and template form.

3. CONCLUSIONS

In this paper, a review is considered for the recent evolution of finger vein recognition and gives details for methods so used along with their error rates. In particular, we conferred the various steps used in image acquisition and then how feature extraction is achieved. Along with certain short coming of dispersive system, yet the system is most authentic and secure in comparison to other biometric methods.

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