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Extraction of Finger-Vein Patterns Using Gabor Filter in Finger vein Image Profiles

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ABSTRACT

Now a days,A biometrics techniques such as fingerprints,palm prints,faces and irises recognition have been widely used in many different applications such as door access control system ,a secure personal authentication for computers,online banking, automatic teller machines for transaction and border-crossing controls system. but The research on finger vein recognition or authentication technology has become a new hot spot due to its superior security features and user acceptance in recent years.As Finger vein recognition uses the unique patterns of finger veins images to identify individuals at a high level of accuracy and security.The major concern in a Biometric Identification System is its accuracy. In spite of the improvements in image acquisition and image processing techniques, the amount of research still being carried out in person verification and identification show that a recognition system which gives 0 percentage FAR (False Acceptance Rate) and FRR (False Rejection Rate) is still not a reality.In this work, we propose to formulate the framework for the finger vein feature extraction using multi-orientation Gabor filters. The morphological operations are further employed to enhance the extracted vein structures. The proposed method extracts the finger-vein pattern from the unclear image by using Gabor filter.Hence This paper will gives a new approach or technique to improve the performance of finger vein identification systems which is presented in the literature.

Keywords:

finger vein, feature extraction,Gabor filter,False Acceptance Rate,False Rejection Rate.

1. INTRODUCTION

Automated human identification using physiological and/or behavioural characteristics, i.e. biometrics, is increasingly mapped to new civilian applications for commercial use.The tremendous growth in the demand for more user friendly and secured biometrics systems [1] has motivated researchers to explore new biometrics features and traits. Biometric Authentication technology is the one that conduct a personal identification by using human physiological characteristics and behavioral characteristics. Vein is free from the impact of external contamination and minor injuries and information characteristic is insensitive to the changes in humidity and temperature. What is more, it is easy to collect, readable and so on. Because of the above unique advantages, the vein recognition is widely used in biometric identification. In recent years, vein recognition has become the most innovative and sophisticated hand biometric identification technology.

In the area of biometric identification, security and convenience of the system are important [1]. In particular, the systems require high accuracy and fast response times. Biometric methods include those based on the pattern of fingerprints [9 11], facial features [18], the iris [14], the voice [15], the hand geometry [13], or the veins on the back of the hand [12]. However, these methods do not necessarily ensure confidentiality because the features used in the methods are exposed outside the human body. These methods can therefore be susceptible to forgery.
Vein recognition technology is divided into two types: one is hand vein recognition [1, 2], and the other is finger vein recognition [3, 4]. Both of them have their own advantages. Compared to the hand vein recognition, the equipment of finger vein recognition needs higher technological requirements, and is smaller. The credibility of the finger vein authentication is higher. Moreover, compared to the hand vein certification, finger certification has more protection. Overall, its advantages [5, 6] include: uniqueness, living body identification, internal characteristics, non-contacting, small sample file, a higher level of security and so on.

In the finger vein image acquisition process, the light intensity has a great impact on the quality of finger vein image. The stronger light can cause the overall image bright and make the vein disappear in the serious. The lower light can cause the overall image dim and make a very few difference between the blood vessels and the background. In order to finish sufficient extraction of the finger vein feature, the image needs preprocessing[7]. The preprocessing is mainly divided into image denoising and image enhancement. The methods of feature extraction mainly include: threshold segmentation methods [8, 9], the maximum principal curvature methods [10], repeated line tracking method proposed by Naoto Miura[11] and so on. However, many algorithms have the problems that the vein characteristics extracted are not ideal and processing speed is lower.

From the technical perspective, vein recognition mainly has following two difficulties: the algorithm of vein image enhancement; the algorithms of vein image feature extraction and matching.
To solve this problem, we proposed a biometric system using

patterns of veins within a finger, that is, patterns inside the human body [2,3]. In this system, an infrared light is transmitted from the backside of the hand. A finger is placed between the infrared light source and camera. As hemoglobin in the blood absorbs the infrared light, the pattern of veins in the palm side of the hand is captured as a pattern of shadows.

The captured images contain not only vein patterns but also irregular shading and noise. The shading is produced by the varying thickness of finger bones and muscles. Therefore, regions in which the veins are and are not sharply visible exist in a single image.
To develop highly accurate personal identification systems, finger-vein patterns should be extracted precisely from the captured images, and the process must be executed speedily in order to satisfy requirements for user convenience. Conventional methods for extracting line-shaped features from images include the matched-filter method [4], mathematical morphology [5], connection of emphasized edge lines [6], and ridge line following for minutiae detection in grayscale fingerprint images [11]. The matched-filter and morphological methods can execute fast feature extraction because all thats required is to filter the image. However, this can also emphasize irregular shading, which presents an obstacle to personal identification since this obscures parts of the pattern of veins. Moreover, dots of noise are also emphasized because continuity is not considered.

2. FUNDAMENTAL PRINCIPLE FOR FINGER-VEIN BIOMETRICS

Traditional Biometric authentication system will be provided by using passwords or Personal Identification Numbers (PINs), which are easy to implement but is vulnerable to the risk of exposure and being forgotten. Biometrics, which uses human physio- logical or behavioral features for personal identification, has attracted more and more attention and is becoming one of the most popular and promising alternatives to the traditional password or PIN based authentication techniques.

As we step ahead into the new millennium, identity thefts and Internet scams are becoming increasingly common. More and more governments and institutions are now using this technology to safeguard their airports, hospitals, prisons and other sensitive areas. In this era, it is imperative that we continuously upgrade our security systems, and the use of biometrics is a step towards the security upgrade that we continuously require.

Again why finger Vein??

Compared with other biometric traits, the finger-vein has the following advantages.

—The vein is hidden inside the body and is mostly invisible to human eyes, so it is difficult to forge or steal.

—The non-invasive and contactless capture of finger-veins ensures the convenience for the user, and is thus more acceptable

—The finger-vein pattern can only be taken from a live body. Therefore, it is a natural and convincing proof that the subject whose finger-vein is successfully captured is alive.

hence we can say that the Finger vein is a promising biometric pattern for personal identification in terms of its security and convenience. However, so residual information, such as shade produced

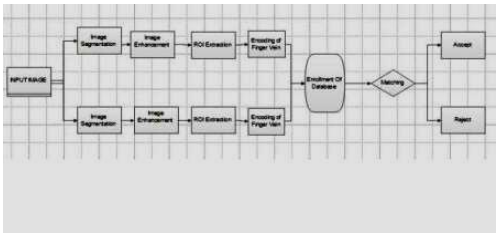

Fig. 1. Block Diagram of Proposed System.

by various thicknesses of the finger muscles, bones, and tissue networks surrounding the vein, are also captured in the infrared images of finger vein. Meanwhile, the pose variation of the finger may also cause failure to recognition.
As a biometric identifier, finger vein has the following properties:

(1) As vein is hidden inside the body and is mostly invisible to the human eye, it is hard to be forged or stolen.
(2) The non-invasive and contactless capture ensures both convenience and cleanliness for the user, and it is more acceptable for the user.
(3) With ten fingers of person, if something unexpected happens in one finger, other fingers can also be authenticated. Finger vein pattern is forecast one of mainstream identification technology in the future.

Hence Personal authentication using finger vein images has received considerable attention and some approaches have been proposed in the literature. The current available approaches for finger vein recognition are all based on texture extraction based on one single infrared image of finger vein.
There are two challenges for finger vein recognition which are..

(1) The quality of the infrared images of finger vein affects the recognition performance significantly, and
(2) The texture information of finger vein is limited and the pose variation of the finger may cause change of finger vein infrared image.

To address these two problems, we proposed the novel framework on finger vein recognition system.The complete system can be illustrated by using the following key components along with it's all details.and Hence the primary challenge is to design a reliable system which can efficiently extract the features from finger vein and also the verification can be done efficiently.There exist several difficulties when implementing such type of Biometric Authentication System such as in an efficient preprocessing of that database during the Enrollment and efficient Matching/verification also.
The great challenge to biometrics is thus to improve recognition performance in terms of both accuracy and efficiency and be maximally resistant to deceptive practices. To this end, many researchers have sought to improve reliability and frustrate spoofers by developing biometrics that are highly individuating; yet at the same time, present a highly complex, hopefully insuperable challenge to those who wish to defeat them.Especially for consumer electronics applications, biometrics authentication systems need to be cost-efficient and easy to implement.The finger-vein is a promising biometric pattern for personal identification in terms of its security and convenience.
This paper gives the idea to develop a Reliable Authentication Biometric system in which we are trying to increase the performance

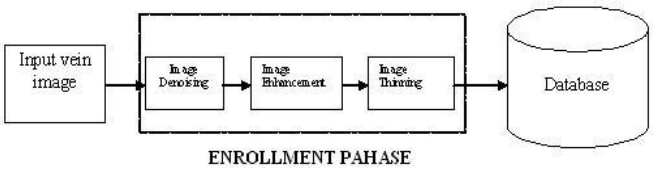

Fig. 2. ENROLLMENT phase.

of a complete system while extracting the features from Finger vein Images during the Enrollment and designing the searching algorithm which can efficiently do the matching with complete database.

3. PROPOSED SYSTEM

The Overall proposed system can be described as follow by using the Block diagram.....
Basically Overall implementation will be divided into 2 Modules.these are

(1) THE ENROLLMENT STAGE.
(2) THE VERIFICATION STAGE.

Now the ENROLLMENT phase can be further elaborated in details by considering the following major key components..
hence the ENROLLMENT phase can be systematically described and implemented in the following three parts which include..

(1) Finger-vein image acquisition module.
(2) Pre-Processing of Image which Include..
    (a) Image Denoising(Noise Removel).
    (b) Enhancement of Image.
    (c) Thinning of Image.
(3) Feature extraction.
(4) Matching / Verification.

3.1 FINGER-VEIN IMAGE ACQUISITION:

The image given will be crop out and enhancement and filtering will be done. The vein will be enhanced until it is easy to visible. Filtering is to reduce the noise and filter out those unwanted object. The database used in this paper is from the Group of Machine Learning and Applications,Shandong University[11]. The database named SDUMLA-HMT is the Homologous Multi-modal Traits Database which includes real multimodal data from individuals. To best of their knowledge, the finger vein database in SDUMLA-HMT is the first open finger vein database[26]. The device used to capture finger vein images is designed by Joint Lab for Intelligent Computing and Intelligent Systems of Wuhan University. In the capturing process, each person was asked to provide images for his/her index finger, middle finger and ring finger of both hands, and a collection for each of the 6 fingers is repeated for 6 times to obtain 36 finger vein images. Therefore, the finger vein database is composed of 3,816 images 320 240 in pixels. The geometrical size of ROI is 96 256. In our experimental setup, each finger is considered as one subject.

The image acquisition system comprises of a light source,a digital camera/scanner. The input image is a colour/gray scale image of the finger-veins.hence we can say that ,This part will contains the collection of database But In this proposed system,had

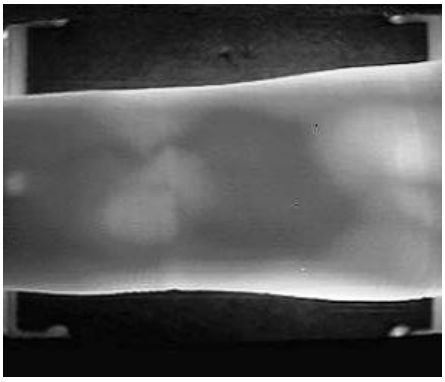

Fig. 3. Acquired Finger Vein Image.

collected all the images of finger vein (i.e. Left and Right) from the site http://rate.pku.edu.cn/vein/. referred website[9].
Fig. 3 is an example of the captured image. This image is gray scale,240 180 pixels in size, with 8 bits per pixel.

3.2 PRE-PROCESSING OF IMAGE:

The next stage is image pre-processing module. Image preprocessing relates to the preparation of an image for later analysis and use. Image may need improvement to reduce noise; other may need to simplified, enhanced, altered,segmented, filtered, etc. The role of the pre-processing module is to prepare the image for feature extraction.
Owing to some kinds of noise or strong reflection resulted from the skins surface and shallow penetration of light under the skin, the original finger vein image contrast is small which makes it not distinct enough for identification[11]. The typical filter-based image enhancement methods are adopted for poor quality finger vein images to improve their contrast[12][13].

3.2.1 Image Denoising:. In signal or image processing, it is often required to perform some kind of noise (unwanted pixels value) reduction on an image or signal.hence here we are using the the median filter which is a nonlinear digital filtering technique,always it is used to remove noise. we can say that Such noise reduction is a typical pre-processing step to improve the results for the image later processing such as, edge detection on an image. Median filtering is widely used in digital image processing field because, under the certain conditions, it will preserves edges while removing noise.

A special type of low-pass filter is the median filter [7]. The median filter takes an area of an image [3x3, 5x5, 7x7, etc.], it looks at all the pixel values in that area, and replaces the center pixel with the median value. The median filter does not require convolution. It does, however, require sorting the values in the image area to find the median value.
There are two imaportant features of the median filter.

(1) It is easy to change the size of the median filter.thus The images later will show the effect of using a different size.and hence Implementing the different size is a simple matter of for loops in the code.
(2) median filters remove noise in images, but change noise-free parts of images minimally.

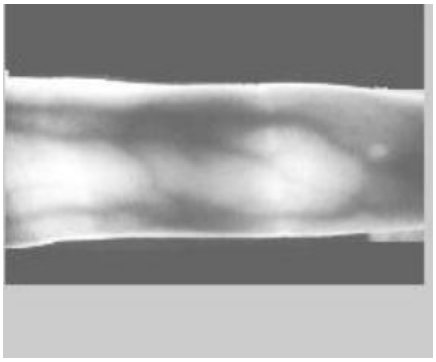

Fig. 4. Finger Vein Image after Denoising.

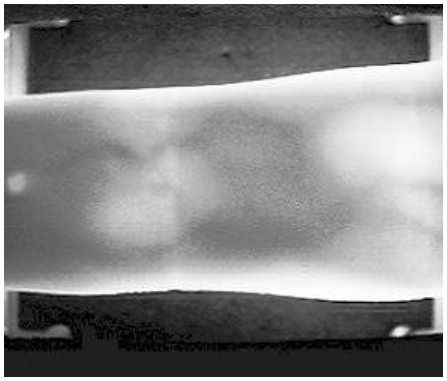

Fig. 5. Finger Vein Image after enhancement.

3.2.2 Image Enhancement:. The image given will be crop out and enhancement and filtering will be done. The vein will be enhanced until it is easy to visible. Filtering is to reduce the noise and filter out those unwanted object.For many applications it makes sense to improve the quality of the image before starting further computations. One common method is to calculate a histogram and modify the image such that the pixels make use of the full range of gray-values 0 . . . 255.

For image enhancement, every image must convert to grey scale for further processing. Grey scale is a measurement of intensity. The range for the intensity of grey scale is from 0 to 255. 0 represent the darkest pixel while 255 is the brightest pixel. Enhancement can be done by reading the grey scale histogram of the image and intensity can be adjusted according to the user.From grey scale, binary form is one of the outcomes. Binary basically have only two grey scale, which is 0 and 1. 0 represent black while 1 represent white.Depending on the used method we will receive higher contrast and an appropriate illumination.

3.2.3 Thinning:. Thinning is one of the morphological functions that used to remove selected foreground pixels from a binary image. This function normally used to join up the output of edge detector by shrink all lines to a single pixel thickness. Thinning function is related to the hit-and-miss transform.
The vein will undergo the thinning process which all veins will shrink it size to 1 pixel size. This function will have better result

Fig. 6. Finger Vein Image after thinning.

compare to skeletonization. This is to increase the accuracy for the matching process.

4. FEATURE EXTRACTION:

During this process, morphological is used with the structuring element Small object from the image will be removed and morphological operation or other equivalent method will be applied for further process of matching.
In this paper, we systematically develop a new approach for the finger vein feature extraction using Gabor filters. In addition, we also investigate a new feature extraction approach using matched filters as the matched filters have been successfully utilized for the enhancement of retinal features in [8]. The details of the employed feature extraction methods are provided in the following section.

Gabor filter is very useful in pattern recognition applications such as iris recognition[14],fingerprint recognition[13] and hand vein recognition[13], which is powerful in capturing some specific texture characteristics in images. As even-symmetric Gabor filter is suitable for ridge detection for an image, a filter bank consisting of even-symmetric Gabor filters with one scale and 8 rotations is defined as follow:

4.1 Gabor Filters for Feature Extraction

The Gabor filters are inspired by the multichannel processing of visual information in the biological model of human visual system and are known to achieve the maximum possible joint resolution in spatial and spatial-frequency domain [11] have been effectively utilized by researchers to develop texture and object segmentation paradigm [12]. In this work, we propose to formulate the framework for the finger vein feature extraction using multi-orientation Gabor filters. The morphological operations are further employed to enhance the extracted vein structures.
The analytical form of 2D even Gabor filters in spatial domain [12].

5. MATCHING /VERIFICATION :

After the Enrollment stage the Verification or Matching will be there.For the last process, this stage dose comparison between the obtained data after process and the image from the database.
Matching is the last step of an image processing. The matching matched between an image being process and a template image.[7] This matching process basically applied correlation which is quite simple in principle. An image f(x, y) is correlated with a template

image w(x, y) to find all the possible match location by the different methods.

6. CONCLUSION AND FUTURE SCOPE:

In this Paper , we had implemented the pre-processing of an finger Vein Image for the proposed an end-to-end finger-vein recognition system based on the blanket dimension and lacunarity .The proposed system includes a method for ROI segmentation, the enhancement. so as to implement this proposed system we need the images from some specified number of fingers in the dataset were taken from the specified web site.Now we are planning for extraction of ROI and encoding of finger vein pattern that will leads to Enrollment of databse.and Finally we will implement the verification stage.

FUTURE SCOPE:
This system can be enhanced for application in mobile devices because of its relatively low computational complexity and low power consumption.

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