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RESEARCH ARTICLE

Improved Human Identification using Finger Vein Images

Sameer Sharma[1], Mr. Shashi Bhushan[2], Ms. Jaspreet Kaur[3]

[1]M.Tech (IT), Chandigarh Engineering College, Landran (Mohali), Punjab, India

[2]Head of Department (IT), Chandigarh Engineering College, Landran (Mohali), Punjab, India

[3]Asst Professor (Department of IT), Chandigarh Engineering College, Landran (Mohali), Punjab, India

[1] survivor.sam3789@gmail.com; [3] cecm.infotech.jaspreetaulakh@gmail.com

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Abstract— Finger vein is a unique physiological biometric for identifying individuals based on the physical characteristics and attributes of the vein patterns in the human. The technology is currently in use or development for a wide variety of applications, including credit card authentication, automobile security, employee time and attendance tracking, computer and network authentication, end point security and automated teller machines. The proposed system simultaneously acquires the finger-vein and low-resolution finger image images and combines these two evidences using a novel score-level combination strategy. Examine the previously proposed finger-vein identification approaches and develop a new approach that illustrates it superiority over prior published efforts. In this thesis developed and investigated two new score-level combinations, i.e., Gabor filter, Repeated Line Tracking with Median filter and comparatively evaluate them with more popular score-level fusion approaches to ascertain their effectiveness in the proposed system.

Index Terms— Feature Extraction; Finger Vein Recognition System; Gabor Filter; Repeated Line Tracking; Median Filter

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I. INTRODUCTION

Biometrics is the unique features of a person. Biometric recognition refers to an automatic recognition of individual based on feature vectors derived from their physiological and/or behavioral characteristic. Biometric systems for human identification at a distance have ever been an increasing demand in various significant applications [1].

Vein recognition was first developed by Joseph Rice [2]. Smart recognition of human identity for security and control is a global issue of concern in our world today. Financial losses due to identity theft can be severe, and the integrity of security systems compromised. Hence, automatic authentication systems for control have found application in criminal identification, autonomous vending and automated banking among others. Among the many authentication systems that have been proposed and implemented, finger vein biometrics is emerging as the foolproof method of automated personal identification. Finger vein is a unique physiological biometric for identifying individuals based on the physical characteristics and attributes of the vein patterns in the human finger. It is a fairly recent technological advance in the field of biometrics that is being applied to different fields such as medical, financial, law enforcement facilities and other applications where high levels of security or privacy is

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very important. This technology is impressive because it requires only small, relatively cheap single-chip design, and has a very fast identification process that is contact-less and of higher accuracy when compared with other identification biometrics like fingerprint, iris, facial and others. This higher accuracy rate of finger vein is not unconnected with the fact that finger vein patterns are virtually impossible to forge thus it has become one of the fastest growing new biometric technology that is quickly finding its way from research labs to commercial development.

In 1984 he had his identity stolen, which led to fraudulent use of his bank account. He decided to do something about it, which led to his first vein recognition prototype around1985. Biometric techniques can generally be classified into two main categories: Physiological and Behavioral. Physiological techniques include fingerprint recognition, retinal and iris scanning, facial recognition, hand and finger geometry and DNA analysis. Behavioral techniques include handwriting recognition, voice authentication, gait, and keystroke dynamics just to name a few [3]. Main advantage of Finger vein recognition is that it is not affected by dryness or roughness of skin or by physical injury on surface of the hand but sometimes the temperature and humidity can affect the quality of the captured image. Even though is little bit expensive it is highly adaptable as it is highly secure because blood vessels are hidden within the body. And also in this there is no physical contact between the user and system but it causes apprehension. Finger vein pattern recognition is a convenient and easy to use biometric technology with high security and accuracy level. There are mainly far infrared scanning technology and near infrared scanning technology and there are thermal hand vein pattern verification systems for security evaluation of biometric systems. Today, this technology plays a major role in providing authentication.

Finger vein biometric system can verify a person's identity by recognizing the pattern of blood veins in the Finger. Finger vein authentication [4] uses the vascular patterns of an individual's Finger as personal identification data.

Like fingerprints, the pattern of blood veins in the Finger is unique to every individual, even twins have different patterns and apart from size, this pattern will not vary over the course of a person's lifetime.

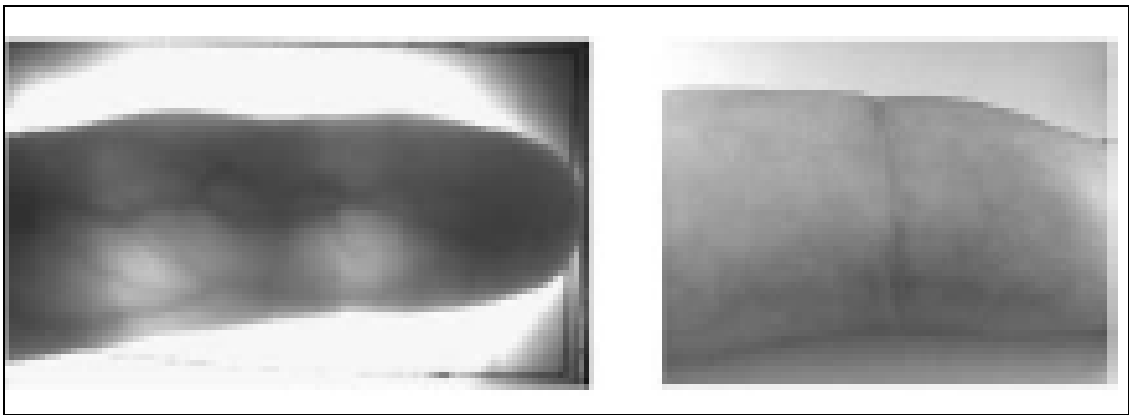

Figure 1. Extracted vein image

The Finger is an ideal part of the body for this technology; it normally does not have hair which can be an obstacle for photographing the blood vessel pattern, and it is less susceptible to a change in skin color, unlike a finger or the back of a hand.[3].

For these disadvantages of other biometric recognition methods, a new biology feature recognition technology – hand vein recognition technology has been studied in this paper. Compared to other biometric authentication techniques, the vein recognition has many advantages as follow.

• The vein is the inner features of body, can't be fabricated.
• The vein recognition is contactless, don't contact with body of human and don't impinge on human body.
• The vein characteristics are lasting.

II. FINGER-VEIN IMAGE PREPROCESSING

The acquired images are noisy with rotational and translational variations resulting from unconstrained imaging[5]. Therefore, the acquired images are first subjected to pre-processing steps that include:

1) Segmentation of ROI,
2) Translation and orientation alignment, and
3) Image enhancement to extract stable/reliable vascular patterns.

The enhanced and normalized ROI images are employed for feature extraction.

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The key objective while segmenting the ROI is to automatically normalize the region in such a way that the image variations, caused by the interaction of the user with the imaging device, can be minimized. In order to make the identification process more effective and efficient, it is necessary to construct a coordinate system that is invariant/robust (or nearly) to such variations. It is judicious to associate the coordinate system with the Finger itself since we are seeking the invariance corresponding to it. Therefore, two webs are utilized as the reference points/line to build up the coordinate system, i.e., the web between the index finger and middle finger together with the web between the ring finger and little finger [Fig. 2]. These web points are easily identified in touch-based imaging (using pegs) but should be automatically generated for contactless imaging[10].

The acquired Finger images are first binarized [see Fig. 2], so that we are able to separate the Finger region from the background region. This is followed by the estimation of the distance from centre position of the binarized Finger to the boundary of Finger.

The block diagram of the proposed system is shown in Fig. 1.

The fingers presented for the identification of subjects are simultaneously exposed to web cam and an infra red camera, as illustrated from the device of our imaging device in Fig. 2.

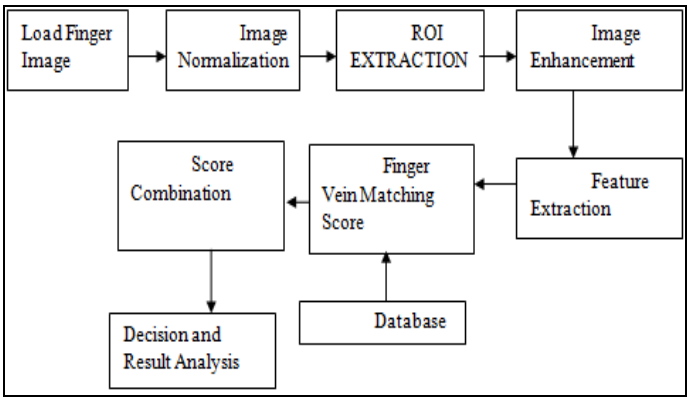

Figure2. Block diagram illustrating key steps employed for the pre-processing of acquired finger-FINGER images.

Figure 2. shows the block diagram of the proposed method for finger vein recognition. The method consists of four main stages: image acquisition, preprocessing, feature extraction by Surf Feature Extraction and the calculation of matching scores by Hamming distance. The[11] dorsal side of a finger is exposed to the near-infrared frontal surface illuminators, using light-emitting diodes whose illumination peaks are at a wavelength of 850 nm, whereas the frontal surface entirely remains in the contactless position with both of the imaging cameras. Although our imaging system is unconstrained, i.e., it does not use any pegs or finger docking frame, it may not be designated as completely touchless.1 This is because the user often partially or fully touches the finger dorsal surface with the white diffusion background, which holds the infrared illuminators beneath.

The finger-vein and finger texture images are simultaneously acquired using the switching device/ hardware that can switch the infrared illumination at a fast pace[12].

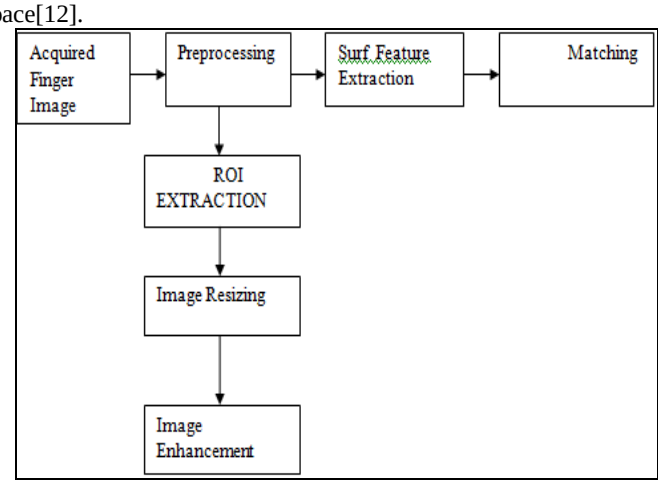

Figure 3: Block diagram illustrating the proposed system employed for the preprocessing of acquired finger-vein images.

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The acquired finger images are noisy with rotational and translational variations resulting from unconstrained imaging. Therefore, the acquired images are first subjected to preprocessing steps (see Fig. 3) that include: 1) segmentation of ROI, 2) translation and orientation alignment, and 3) image enhancement to extract stable/reliable vascular patterns.
Each of the acquired finger-vein images is first subjected to binarization, using a fixed threshold value as 230, to coarsely localize the finger shape in the images. Some portions of background still appear as connected to the bright finger regions, predominantly due to uneven illumination.
The following are the various steps of the proposed system are of the proposed system.

1. Image Normalization.
2. ROI Extraction.
3. Image Enhancement.
4. Repeated Line Tracking.
5. Gabor Filter.
6. Median Filter.

A. Image normalization

In order to achieve high accuracy finger vein image matching, the original image is normalized into smaller size. This step is simple, the original image size of 640x480 pixels is reduced to a smaller resolution, 384x288 pixels, where the scale is 0.6 of the original image size. This is the optimum scaling factor, which is obtained from the experiment of the
vein image database for various scaling factor at fix other parameters. Moreover, processing speed is also reduced with the scaling factor.

$$M = \frac{1}{M \times N} \sum_{i=0}^{M=1} \cdot \sum_{j=0}^{N=1} I(i,j)$$

$$VAR = \frac{1}{M \times N} \sum_{i=0}^{M=1} \cdot \sum_{j=0}^{N=1} (I(i,j) - M(I))^2$$

$$G(i,j) = \begin{cases} M_0 + \sqrt{\frac{VAR_0}{VAR} \times (I(i,j) - M(I))^2}, & I(i,j) \geq M \\ M_0 - \sqrt{\frac{VAR_0}{VAR} \times (I(i,j) - M(I))^2}, & I(i,j) < M \end{cases}$$

Where M and VAR denote the estimated mean and variance of input image and $M_0 = 150$, $VAR_0 = 255$ are desired mean and variance values respectively. After normalization, the output image is ready for next processing step.

ROI Extraction

The original image is captured with the black unwanted background. Including the background reduced the accuracy of image.

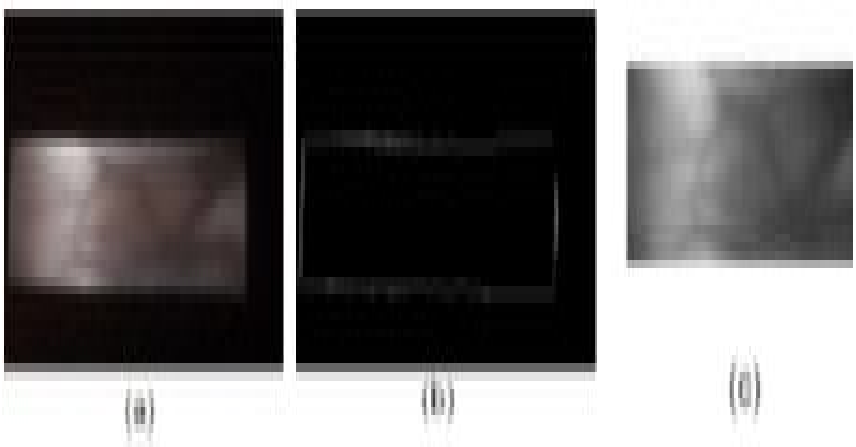

Fig 4(a) Original finger vein image, 2(b) finger edges, and 2 (c) cropped.

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A special algorithm is developed to extract the finger vein image from the background. Three major steps involved in this algorithm. First, edge detection is performed to highlight the finger edge points. There are two major horizontal lines detected representing the finger edges as shown in Figure (b). Second, pairs of edge points are determined from each of the two major horizontal lines by scanning the lines horizontally. The most appropriate cropping points are selected from the pairs of edge points, which must satisfy two conditions: (i) the range of the pair of the edge points is between 35% to 65% of the image height, and (ii) the pair of the edge points is the widest pair among all pairs. Finally, the image is cropped vertically at the cropping points and horizontally at 5% from left border and 15% from right border. For matching purpose, the size of both registered and input images are preserved to be at the same size. The ROI of input image is depending on the ROI of registered image. From the detected cropping points of the input image, the centre of the cropping points is calculated. The input image is cropped at the same height of the registered image origin from the calculated cropping points centre. Figure shows an original finger vein image, finger edges, and the final cropped image.

B. Image enhancement

The process of improving the quality of a digitally damage by manipulating the image with software. It is quite easy, for example, to make an image lighter or darker, or to increase or decrease contrast. Advanced image enhancement software also supports many filters for altering images in various ways. Programs specialized for image enhancements are sometimes called *image editors.*

C. Repeated Line Tracking

The repeated line tracking method gives a promising result in finger-vein identification: The idea is to trace the veins in the image by chosen directions according to predefined probability in the horizontal and vertical orientations, and the starting seed is randomly selected; the whole process is repeatedly done for a certain number of times.

D. Gabor Filter

It is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The Gabor filters are self-similar: all filters can be generated from one mother wavelet by dilation and rotation.

The same as fingerprint recognition, finger vein recognition also contains image pre-processing, feature extraction and matching. Image normalization, finger vein segmentation, thinning are all image pre-processing work. The acquisition time, light intensity of acquisition environment, thickness of each finger, and intensity distribution of finger vein images are all different, hence normalization of image size and gray scale is indispensable in order to feature extraction and classification.

Finger vein contains ridge and valley lines. In addition to show irregular shape in the minutiae and singularity regions, the ridge and valley lines show continuous and smooth change in most regions. In this paper, Gabor filter was used to enhance finger vein images. 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 [10]. 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 the spatial and spatial-frequency domains [11], which have been effectively utilized by researchers to develop a texture and object segmentation paradigm. In this paper, we propose the framework for the finger-vein feature extraction using multi orientation Gabor filters.

Formula:

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma) = \exp\left(\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$$

E. Median Filter

Median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges.

The following are the results of the proposed system.

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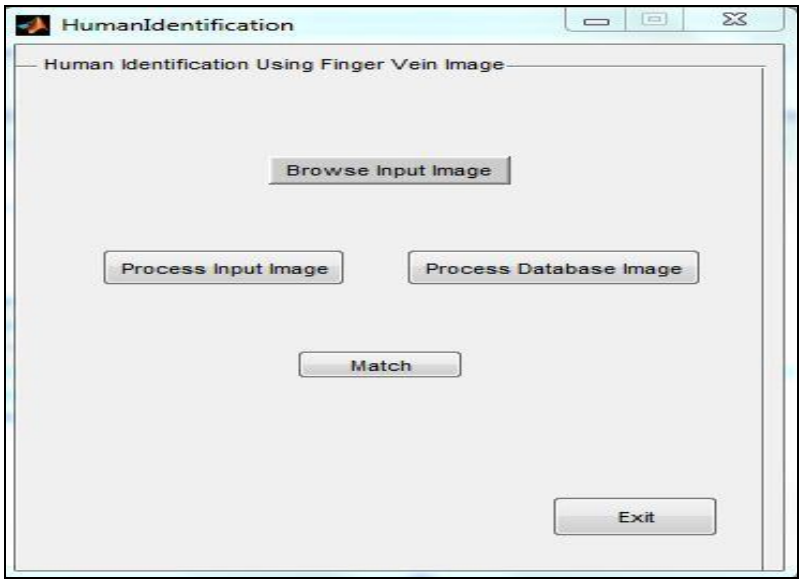

Figure 5. Basic layout of the proposed system

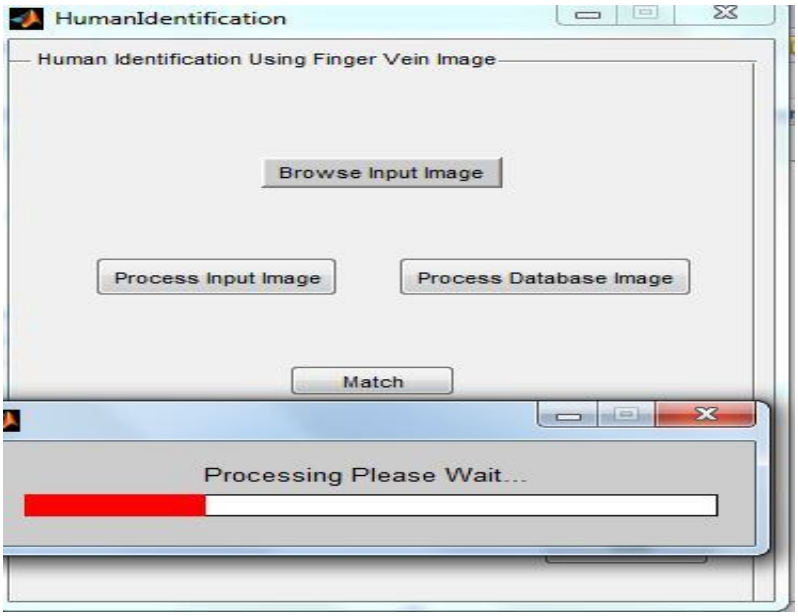

Figure 6 Processing of the proposed system & Figure 7 The acquired vein image.

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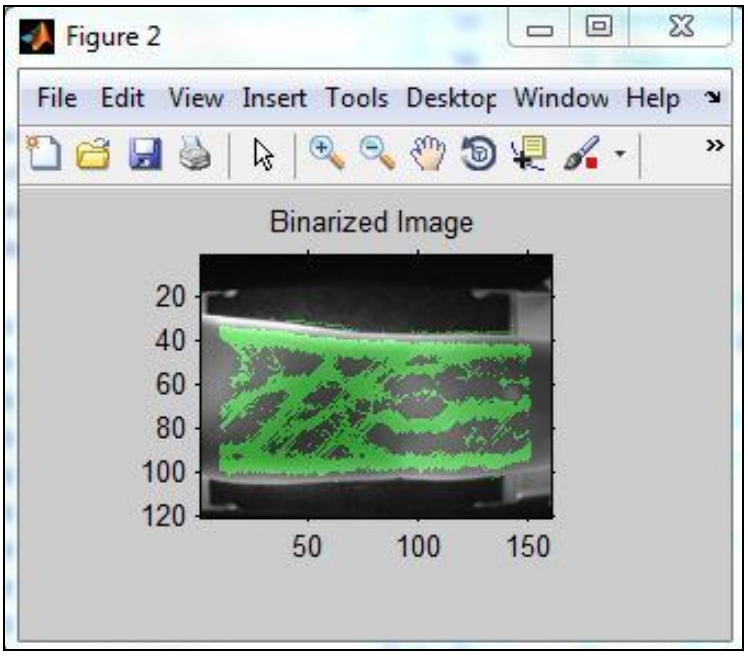

Figure 8. The Binarized Image.

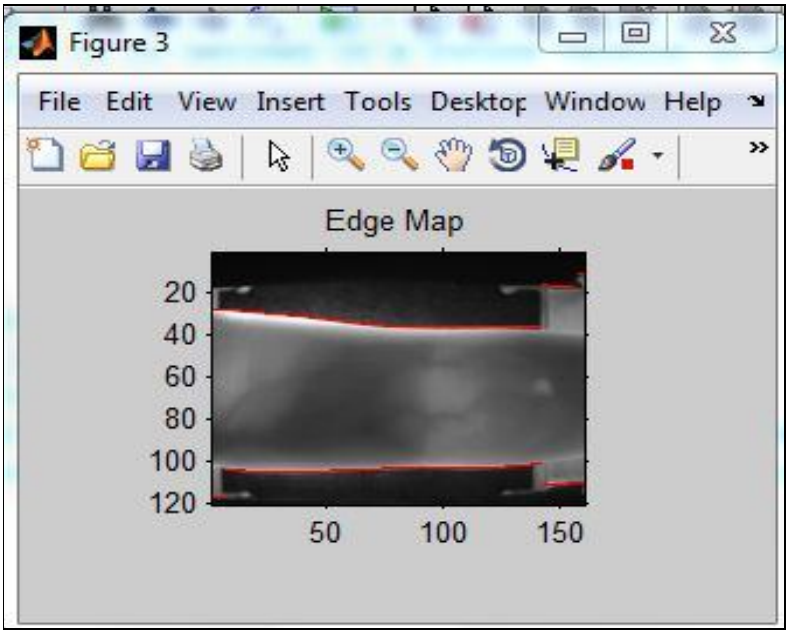

Figure 9. The image acquired after the edge mapping. & Figure 10. The region of interest is acquired.

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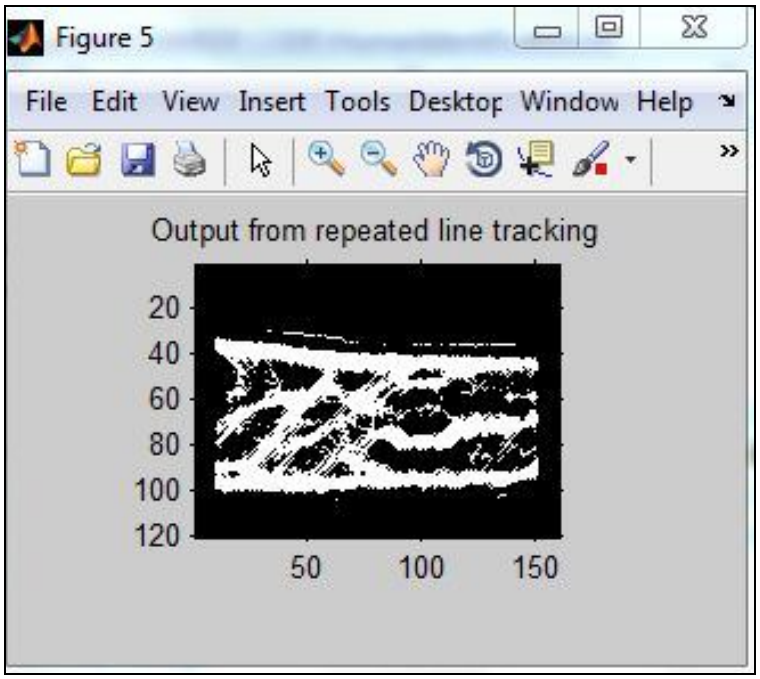

Figure 11. The image is acquired after applying the repeated line technique.

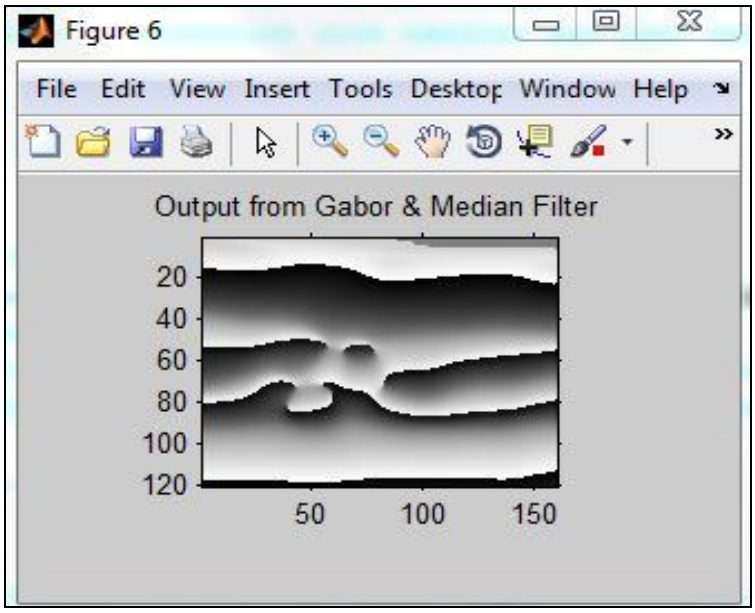

Figure 12. The final image is acquired after applying the gabor filter and the median filter. & Figure 13. The resulted image and the database image is been matched.

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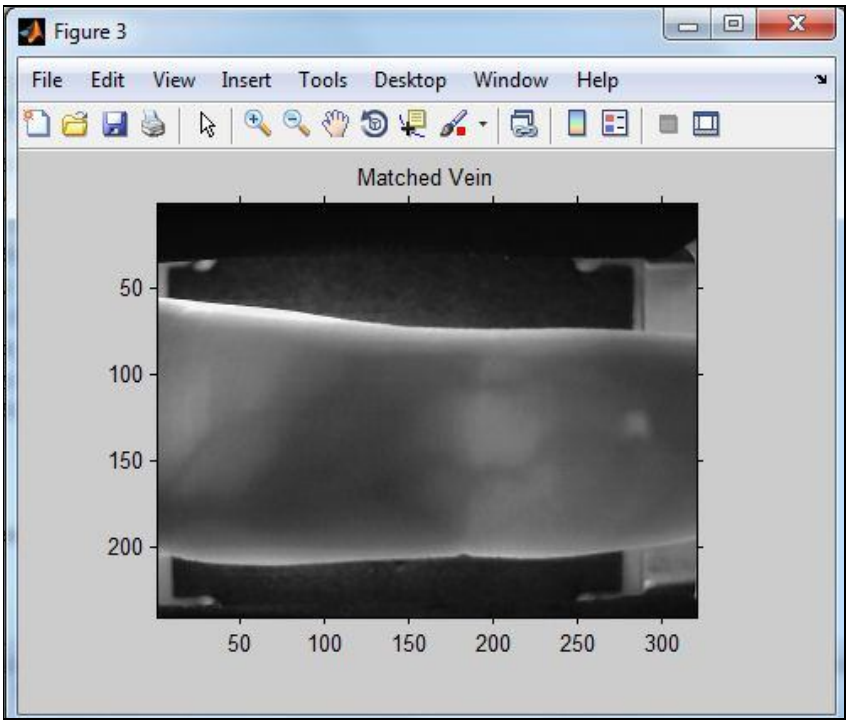

Figure 14. The matched image.

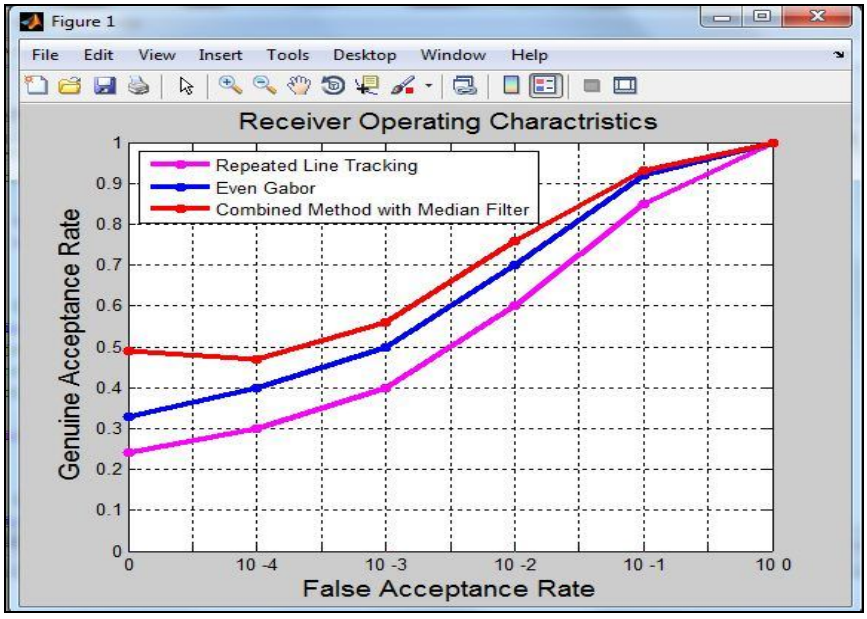

Figure 15. The graphical representation of the acquired result.

III. CONCLUSION

This paper will present a complete and fully automated Finger image matching framework by simultaneously utilizing the Finger surface and Finger subsurface features, i.e., from Finger-vein images.

Security is becoming essential in all kind of application. This project is implemented in a way to improve the security level. As the finger-vein is a promising biometric pattern for personal identification in terms of its security and convenience. Also the

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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 both convenience and hygiene for the user, and is thus more acceptable. So this system is more hopeful in improving the security level.

This will present a new algorithm for the Finger-vein identification, which can more reliably extract the Finger-vein shape features and achieve much higher accuracy than previously proposed Finger-vein identification approaches. Our Finger -vein matching scheme will work more effectively in more realistic scenarios and leads to a more accurate performance, as will be demonstrated from the experimental results. We will examine a complete and fully automated approach for the identification of low resolution Finger-surface for the performance improvement.

REFERENCES

[1]http://www.darpa.mil/iao/HID.htm or http://www.humanid. org/index.html, 2000.

[2] S. Stevenage, M. Nixon, and K. Vince, "Visual Analysis of Gait as a Cue to Identity," Applied Cognitive Psychology, vol. 13, pp. 513- 526, 1999.

[3] S. Niyogi and E. Adelson, "Analyzing and Recognizing Walking Figures in XYT," Proc. IEEE CS Conf. Computer Vision and Pattern Recognition, pp. 469-474, 1994.

[4] D. Cunado, M. Nixon, and J. Carter, "Using Gait as a Biometric, via Phase-Weighted Magnitude Spectra," Proc. Int'l Conf. Audio and Video-Based Biometric Person Authentication, pp. 95-102, 1997.

[5] J. Little and J. Boyd, "Recognizing People by Their Gait: The Shape of Motion," Videre: J. Computer Vision Research, vol. 1, no. 2, pp. 2- 32, 1998.

[6] H. Murase and R. Sakai, "Moving Object Recognition in Eigen space Representation: Gait Analysis and Lip Reading," Pattern Recognition Letters, vol. 17, pp. 155-162, 1996.

[7] P. Huang, C. Harris, and M. Nixon, "Human Gait Recognition in Canonical Space Using Temporal Templates," IEE Proc. Vision Image and Signal Processing Conf., vol. 146, no. 2, pp. 93-100, 1999.

[8] A. Johnson and A. Bobick, "A Multi view Method for Gait Recognition Using Static Body Parameters," Proc. Int'l Conf. Audio and Video-Based Biometric Person Authentication, pp. 301-311, 2001.

[9] Y. Yang and M. Levine, "The Background Primal Sketch: An Approach for Tracking Moving Objects," Machine Vision and Applications, vol. 5, pp. 17-34, 1992.

[10] S. Chaudhuri, S. Chatterjee, N. Katz, M. Nelson, and M. Goldbaum, "Detection of blood vessels in retinal images using two-dimensional matched filters," IEEE Trans. Med. Imag., vol. 8, no. 3, pp. 263–269, Sep. 1989.

[11] J. G. Daugman, "High confidence visual recognition of persons by a test of statistical independence," IEEE Trans. Pattern Anal. Mach. Intell., vol. 15, no. 11, pp. 1148–1161, Nov. 1993.

[12] Y. Kuno, T. Watanabe, Y. Shimosakoda, and S. Nakagawa, "Automated Detection of Human for Visual Surveillance System," Proc. Int'l Conf. Pattern Recognition, pp. 865-869, 1996.

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