Dorsal Hand Vein Authentication Using SIFT Features

A. Jeyakalyani [1], Dr. N. Suguna [2]

[1]Computer and Information Science, Annamalai University, Chidambaram, India

[2] Computer Science and Engineering , Annamalai University Chidambaram, India

Abstract - Using Infrared radiations (IR), research by all means reveals that the biometric application is a concept which is very interesting, though it is very new and it did neither exist previously. In the coming days, a guaranteed and promising as well result will be provided in the filed of biomedical security. A recent approach says that using the vein mesh below the person's skin and with the help of vein patterns, a person can be easily identified. Every individual has a unique vein pattern by birth itself. Therefore, it is never possible to copy the veins as their presence is under the skin. In order to identify a person, with good biometric feature the uniqueness and stability of vein patterns can be used. A method is proposed in this study, in order to detect the veins using an infrared illuminator. Then to identify the person, different techniques are used to enhance the vein images. The proposed effort is related to implement of infrared vein detection and the system matching for person identification. The Captured vein image is used in an infrared illuminator and SIFT feature algorithm is used to extract the feature of hand vein and SIFT feature matching algorithm is used. This is the system implemented using MATLAB.

***Key Words**:- Infrared (IR), Near Infrared (NIR), Far Infrared (FIR), Region of Interest (ROI), Adaptive Histogram Equalization (AHE), SIFT, Hand vein recognition*

I. INTRODUTION

For the purpose of forensic, vein identification is useful as veins have unique identity. The very new and interesting concept using vein patterns for biometric identification is that uses the network of blood vessels underneath a person's skin. The patterns of veins of the hands are unique for every individual and no change takes place till the end of life except size. The veins present under the skin, having a wealth of differentiating features, its difficult to copy one's identity. Greater amount of security for identification of a person is offered by the vein patterns as the property is unique and strong immunity to the imitation of the vein patterns. The vascular pattern which is subcutaneous or network on the back of the hand is referred as hand vein. Figure 1, details the broad vascular map which is found on the dorsum of the hand having two types, such as cephalic and basilica veins. In this, basilica veins are nothing but the group of veins attached to the back surface of the hand, in figure 1. it consists the upper limp of the back of the hand, and Cephalic veins are attached to the elbow of the hand and marked . Because the palm vein patterns function internally, this can not be forged as it is a difficult system.

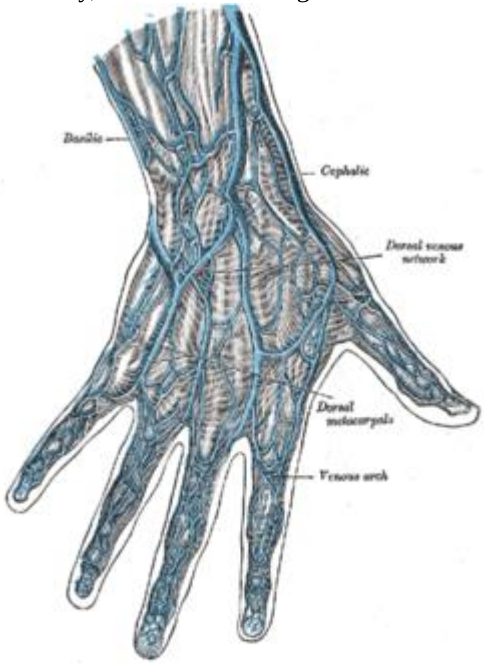

Fig.1. Palm Dorsal Surface

However, Nowadays an infrared imaging is widely used in the medical field as, it, being on-invasive. There are two types of infrared (IR) imaging, Near Infrared (NIR) imaging and Far Infrared (FIR) imaging. There is a medical spectral window from about 700 to 900 nm where light penetrates deeply into tissues. Because of this, with a wavelength around 850 nm, the infrared light beam coming out from a light source is selected to be within the near Infrared region. NIR, later avoids undesirable interference from the IR radiation (3um- 14um) emitted by the human body and the environment using this wavelength. NIR radiation is used because the Near Infrared light is absorbed more strongly by human blood than the surrounding tissue, and therefore veins look darker than as it is supposed to be.

II. RELATED WORK

Having gained more importance in the current scenario, through the association of many scientists and academics, Image processing was first developed in 1960. There are three major benefits of digital image processing namely consistent high quality of an image, low cost of processing and the ability to manipulate all features of a process.

In the field of digital image processing, Image enhancement is one of the most interesting and important concepts. In Image enhancement, the details that are hidden in an image are brought out and also the contrast in a low contrast image is increased. Image enhancement produces an output image that ultimately looks better than the original image. It changes the pixel's intensity of the input image, also enlarging the intensity differences among objects and background. Biometrics is used differently for many various purposes, at the same time they play vital role in either verification system or an identification system. The difference between these two types of systems is how quickly the system operates and how accurate it becomes, as the size of biometric database keeps increasing.

Ajay.Kumar et al.,[2] proposed Personal Authentication Using Hand Vein Triangulation and knuckle shape. The proposed method has been fully automated and employs dorsal hand vein images obtained from the low-cost, near IR contactless imaging camera. The knuckle tips are used as key points for the image normalization and to extract the region of interest. The experiment has been performed on 100 users and equal error rate of 1.14% has been achieved.

Zhi Liu and Shangling Song et al.,[3] presented An Embedded Real-Time Finger-Vein Recognition System for Mobile Devices. They proposed simple, convenient and high-security authentication system to protect private information stored in mobile devices. The proposed system takes only about 0.8 seconds to verify one input finger vein sample and achieved an equal error rate (EER) of 0.07% on a database of 100 subjects. Ajay Kumar et al.,[4] proposed human identification system using palm vein images. In proposed approach, two different databases have been used with contactless and touch-based imaging setup. The Hessian-phase-based and Radon transform is used to extract the feature from palm vein images. This approach achieved zero percent EER for both databases.

Aycan Yuksel, Lale Akarun, Bulent Sankur.,[5] proposed Hand vein biometry based on geometry and appearance methods.. The BOSPHORUS hand vein database has been used. It is collected under realistic conditions where subjects had to undergo the procedures of holding a bag, pressing an elastic ball and cooling with ice such exercises that force changes in the vein patterns. The applied recognition techniques are the collaboration of geometric and appearance-based techniques and good identification performances have been obtained from the database.

Erdem Yoruk, Bulent Sankur, [6] proposed Shape-based hand recognition. In a pre-processing stage of the algorithm, the silhouettes of hand images are registered to a fixed pose, which involves both rotation and translation of the hand and, separately, of the individual fingers.

III. PROPOSED IDENTIFICATION SYSTEM

Figure 2 shows a block diagram of proposed system . The image of dorsal palm vein is captured using a monochrome NIR CCD Camera . The Captured images show in the RGB format. Then using algorithm to change grayscale image. Extraction of ROI is then followed by Contrast enhancement Method . Then edges are detected for vein detection purpose. Extraction and matching of features are used for identification of person.

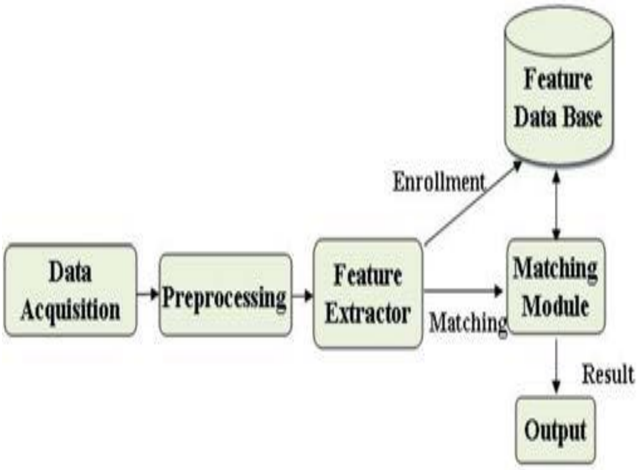

Fig.2. Proposed System for Identification of Person

A. Formation of Database

Many papers are reported good Recognition result, their result are not reproducible as none of them allow open access to their database. "BOSPHOROUS" database is used in our research paper . It contains suitable standard dorsal hand vein database available on the internet. The database is presently open access at http://bosphorus.ee.boun.edu.tr/.

B. ROI Extraction

The next step is to crop the vein images. The region which contains the information of vein patterns is the region of interest. Then from the grayscale image , the region of interest (ROI) is extracted. The ROI is cropped manually by dragging the square of size 120 X 120 on particular interested vein region and then by double click on that square it shows only cropped portion of an image. Figure 2 shows the extracted ROI of a testing image.

Fig. 2 ROI of testing Image

C. Adaptive Histogram Equalization

Adaptive Histogram Equalization is a contrast enhancement method. Ordinary histogram Equalization operates on an entire image but AHE operates on small regions in the image called 'tiles'. Each tile's contrast is enhanced and then the neighbouring tiles are combined to eliminate artificially included boundaries.

D. Edge Detection

Edge detection is one of the most important phenomenon in image processing. It also shows the abrupt change in the intensity of the gray level. " Edges can be defined as a set of connected pixels that lies in the boundary between two regions." In this paper using Canny Edge dedection technique is used for extracting structural information and reduce the amount of data to be processed. Canny Edge detection is a reliable detection of veins.

IV. HAND VEIN FEATURE EXTRACTION

In order to avoid the interference of rotation, scaling, and translation of the hand vein image, In this Paper shift algorithm is used for extracting hand vein feature.
SIFT algorithm was proposed by Lowe[6] can be used to do stable local feature detection and representation. It contains two stages: Keypoint Localization , Key point descriptor.

A. *Key Point Localization.*
The image is scanned over the location and scale for identifying potential interest points. The Gaussain scale-space L(x, y, σ) of an image is defined as follows.

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y)$$

$$G(x, y, \sigma) = \frac{1}{2\prod \sigma^2} e^{-(x^2+y^2)/2\sigma^2}$$

Where $I(x, y, ,\sigma)$ is an input image, $G(x, y, ,\sigma)$ is a variable-scale function, σ is the scale smoothness of the scale transformed image, $L(x, y,\sigma)$ is the convolution of $G(x, y,\sigma)$ and $I(x, y)$. To detect the key point in the in the scale space efficiently , DOG(Difference of Gaussian is defined as the difference of two nearby scales separated by a constant multiplicative factor k:

$$D(x,y,\sigma)=(G(x,y,k\sigma)-G(x,y,\sigma))*I(x,y)=L(x,y,k\sigma)-L(x,y,\sigma)$$

B. Key Point descriptor

The key point descriptor is done by computing the gradient magnitude and orientation of each
image sample point in the neighbourhood region of the key point. The gradient magnitude $m(x, y)$ and orientation θ (x, y) are defined as follows

$$m(x,y)=\sqrt{L(x+1,y)-L(x-1,y))2+L(x,y+1)-L(x,y-1))^{\;2}}$$

$$\theta(x,y)=\sigma\tan 2\left(\frac{L(x,y+1)-L(x,y-1))}{L(x+1,y)-L(x-1,y))}\right)$$

To get the main orientation of one key point, an orientation histogram should be drawn with 36 orientations, and the sample points are within a region around the key point, we select 16×16 pixels. The peak orientation represents the **main orientation**. To achieve rotation invariance, axis should be rotated to the orientation of the key point. Then describe the key point with the 4×4 seeds around, computed the gradient orientations histogram of each seeds with eight orientations, and format the 4×4×8=128 element feature vector for each key point.

There are some problems for SIFT key point descriptor algorithm to describe key points in hand vein image , Firstly , there are a large number of key points in one hand vein image, So we use 128 dimensional feature vector to describe one key point require larger storage space and increase the complexity of matching, Secondly the texture of hand vein image is relatively simple , so the local feature of different feature points may be similar sometimes. Because of these problem the standard key point descriptor algorithm must be modified SIFT feature points and its gradient modulus.

C. Correlation Coefficient

The correlation coefficient of two key points is defined as follows.

$$r = \frac{\sum_{n=0}^{N-1} [A(n)` - \bar{A}][B(n) - \bar{B}]}{\sqrt{\sum_{n=0}^{N-1} [A(n) - \bar{A}]2 \sum_{n=0}^{N-1} [B(n) - \bar{B}]2}}$$

Where A and B are the feature vector of feature point with N=48 . A and B respectively the mean of the elements of A and B. If r>tp, Two key points are matching successful. Statistics show that tp > 0.65. The match coefficient of two hand vein images is defined as follows.

$$S=Num_m/MIN(Num_A,Num_B)$$

Num_m is the number of the matching key point of the image. Num_A and Num_B are the key point numbers of the two images. If $S > t_s$, We think the two hand vein images are of the same category , otherwise , on the contrary.

D. Experimental Result

The Proposed algorithm is implemented using MATLAB . All the images are taken from BOSPHORUS Database. A Hand vein database (30 hands ,20 hand vein images for each one with size 120 X 120 are taken from the database) to evaluate the performance of the proposed algorithm Taken three images of each people , got the shift feature vector of each key point (□=1.6) and stored in the so called matching database. In the remaining hand vein images match coefficient s between these samples and the sample that is the same kind in the matching database . The FRR(False Rejection Rate) is shown in Table.1. Then selected ten samples from the remaining hand vein images randomly, and computed the match coefficient s between these samples and the sample that is not the same kind in the matching database. The FAR(False Acceptance Rate) is shown in Table.1

Set t_p =0.7, t_s =0.25 to 0.75. The experiment results are show in Table 1, We can see that the if setting t_s =0.55. Correct rate is 98.6%.

Table 1. Experimental result

t_s	FAR	FRR	TOTAL
0.25	0.082	0.002	0.084
0.35	0.030	0	0.030
0.45	0.012	0.003	0.015
0.55	0	0.014	0.014
0.65	0	0.028	0.028
0.75	0	0.102	0.102

V. CONCLUSION

Using the systematic proposed methodology, infrared vein detection for identification of a person is done. It's been shown that hand vein pattern biometry is a promising technique. The proposed work is rationed to NIR images. The program is written in MATLAB. The BOSPHORUS database is presently publicly available for the sake of reproducible results at http://bosphorus.ee.boun.edu.tr/. In future, person verification can be done.

VI. REFERENCES

[1] Jae Hee Song et al , :"Vein Visualization using the smart phone with Multispectral Wiener Estimation for Point-care-Application." IEEE journal of Biomedical and Health Informatics . pp.1-7.2014.

[2] Ajay Kumar , et al , " Personal Authentication Using Hand vein Triangulation and Knuckle Shape ." IEEE Transaction on Image processing , vol.18, no.9, pp 2127-2136. September n2009.

[3] Zi Liu and Shangling Song et al , " An embedded real time finger vein recognition system for mobile device ", IEEE Transaction on consumer consumer electronics , vol .58, no.2. pp.522-527, May 2012.

[4] Ajay kumar et al, " Human Identification using palm vein images ," IEEE Transaction on Information and Security vol.6 . no.4 , pp.1259-1274 , Dec 2011.

[5] Jie Cao et al , " My Palm vein based Low –cost Mobile Identification system For Wide Age Range", 17th international Conference on E- health Networking Applications & Services 2015.

[6]. N.Mura, A. Nagasaka, T. Miyatake, " Feature extraction of finger vein pattern based on repeated line tracking and its application to person identification ", Machine vision and Application , vol.15. no.4. pp. 194-203. 2004.