Vein Biometrics Identification Techniques and Challenges

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Abstract- Numerous biometric traits are in the business when requirement of personalized security is concerned. A biometric is physical or behavioral traits of a person in the visible or hidden form and are used to identify the user uniquely. In this paper, we review the famous biometric traits and try to give overview of trends in their usage. Our goal is to find the burning challenges in this field and to understand the gaps in practical development of hidden biometrics like vein biometrics. Veins hidden in the human body show a unique pattern in every human which is very difficult to forge. Their accurate implementation requires sophisticated hardware which increases the cost of the system out of practical use. So we have come to conclusion that using multimodal biometrics can be a solution for this. We have tried to explore the advantages, methods and shortcomings in this area. We also summarize the instrumentation details.

Keywords – infrared, vein biometric, survey, hand, wrist, palm

I. INTRODUCTION

Biometric system is a pattern recognition system that recognition a person based on feature vectors derived from specific physical or behavioral characteristics. It takes the snapshots of the vein in the source of infrared radiation at a specific wavelength. Hemoglobin in the blood takes oxygen in the lungs and carries oxygen to the tissues of the body through the arteries. After that hemoglobin release oxygen and carry deoxidized blood to the heart through the veins. The deoxidized hemoglobin absorb the light at the wavelength of 760nm in near infrared region [1].

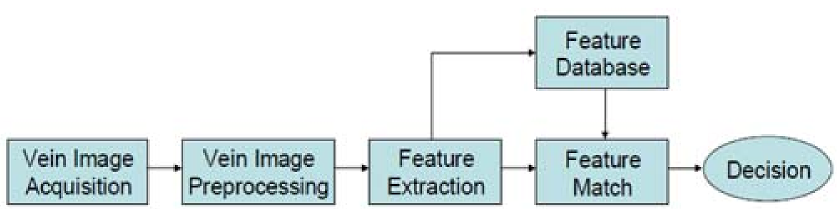


Figure.1 – Diagram of vein recognition system [2]

Vein acquisition device collects vein infrared image, after image pre processing, Author get a clear refinement single pixel vein image. Then, extract the features of the single pixel vein image. In the last, match the features of the vein image with the sample database, and by matching algorithm make the identification come true [2].

The vein recognition system is very effective technology of biometric security system and cannot forge even by surgery [4]. The shape of veins is distinct from each other. Veins are the internal part of the body and cannot be seen with naked eye. Vein patterns are stable and remain unchanged even when human being grows with age [10]. The blood vessels are not growing and branching with its identical patterns, the DNA does not affect on the identical patterns of veins. To research the vein pattern of every healthy person will show the different vein patterns [12]. Patterns of the palm, back hand and finger veins are shows in the following figure.

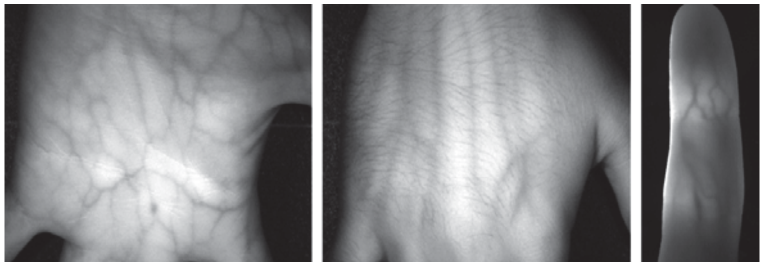


Figure2. Palm, back-hand taken and finger vein images [12]

Vein scanner is work without direct physical contact. The vein recognition system is also use for the disease recognition from the fix patterns. Author describes a feature extraction method for vein patterns based on minutiae points. The position of end and branch points from the skeletal representation of vein pattern is being used [15]. In the biometric system, only single biometric feature has not good accuracy due to variations of the user's health conditions. In the finger vein recognition system the performance is based on the blood flow in the veins. The blood flow is change by physical conditions and temperature, like illness. To overcome this kind of drawbacks, a multimodal biometric recognition of touched finger print and finger vein is proposed. The multimodal system makes the security very strong and cannot forge [6]. Biometric approaches are use for security systems at the place of passwords and tokens. The main drawback of biometric systems is that the fake fingerprint can be use. To overcome this drawback, the biometric feature palm vein can be used. Due to the characteristics of vein patterns, it is more difficult and not possible to forge. The acquisition of vein images is made by a near or far-infrared sensor camera. The application field changes, but the applied methods are the same[5].

There are different kind of physiological or behaviour characteristic measurements to increase the authentication of biometric system. In PLBP (partition local binary patterns) micro and macro patterns are use as an feature descriptor. Author use the coded and weighted partition local binary patterns (WPLBP) uses as effective feature descriptor for hand dorsa vein recognition [9]. Biometric techniques are used as a hedge against identity theft in this digital age. Only two types of the light sources are use in the biometric technique which are near-infrared (NIR) light and Far-infrared (FIR) light. Author proposed a low cost camera. It becomes more and more important because it is more reliable than traditional methods such as passwords [13].

	FIR Imaging Method	Traditional NIR imagining method	NIR imagining method[13]
Key Devices	Thermal Camera FIR Lights	Professional Camera.Video Capture card and NIR LEDs	Logitech Pro4000 camera and NIR LEDs
Cost	Several Thousand Dollars	More then 300 Dollers	Only about 60 Dollers
Image Quality	High	High	Low

Table1. Comparison of the three imaging way [13]

In the above table 1 the authors compare the FIR, NIR. The authors use the NIR light source LED with low cost Logitech pro4000 camera and made a device to get the vein images of low image quality with low cost then other techniques.

II. IMAGE ACQUISITION

A. Devices

The lower importance of spatial resolution and frame rate make the camera chipper in cost. **N**ear infrared CCD camera and lighting system are used to get the images [1]. The USB camera has a commercial optical fingerprint device to get the fingerprint and the camera adopt the metal oxide semiconductor (CMOS) sensors of 2 mega pixels to capture finger vein [6]. Device includes Logitech pro4000,thermal camera, professional camera, Monochromatic camera of resolution 580 × 600 pixels, , Near Infrared(NIR) and Far Infrared(FAR) light sources , daylight cut-off filters (lights with the wavelength less than 800 nm are cut off), transparent acryl (thickness is 10 mm) [9][1][6][14].

B. The Principie of Imaging the Vein Pattern

Finger-vein patterns can be imaged based on the principles of light reflection or light transmission [14]. The superficial human veins have higher temperature than the surrounding tissues. So, by using a FIR light and a thermal camera, it obtain image in which vein is brighter. For NIR light method, the principle could be explained by photobiology and in biology it known as "medical spectral window". The light in this window could penetrate deeply into tissues. Author use a CCD camera with an attached IR filter to capture images in which vein appears darker. Scattering effect is caused by the different refractive index of different body parts. It could change the light directions and it is much bigger than absorption [13]. Author developed a finger-vein imaging device based on light transmission for more distinct imaging [14].

C. Imaging Techniques

There are two kinds of the infrared wave sources and that are far infrared (FIR) and near infrared (NIR). That wave source emitted the wave on the hand and the haemoglobin absorbs the fixed wave length and then the Webcam camera is use for capture the vein image. This process is show in the following figure. The scattering papers are use as filter for remove noise [11]. The following figure shows this process.

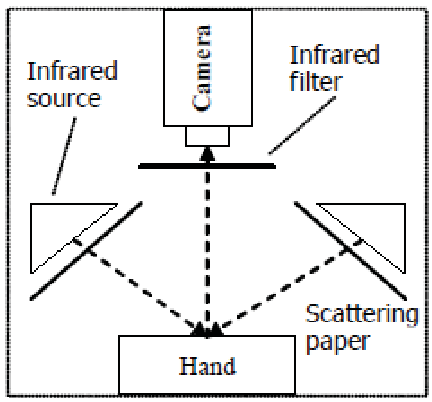


Figure3. Schematic vein image acquisition [9]

The imaging technique is use the absorption capacity of particular substances in the blood running through the veins. This technique is use the near infrared (NIR) light source and put on the body part to capture the image of vein patterns [12].

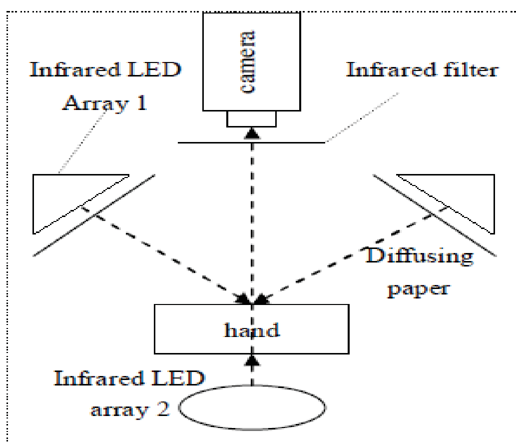


Figure4. Schematic of the images acquisition system [13]

The author design collection system based on the principle of NIR imaging, describe in Figure 4. There are two groups of NIR sources, LED array 1 and 2. There are three ways of imaging. The penetrating way, only use Array 2; the reflecting way, only use Array 1; and the mixing way, use both. Figure 4 shows the images obtain by using the three ways. The first uses penetrating way, the second uses reflecting way and the last uses mixing [13].

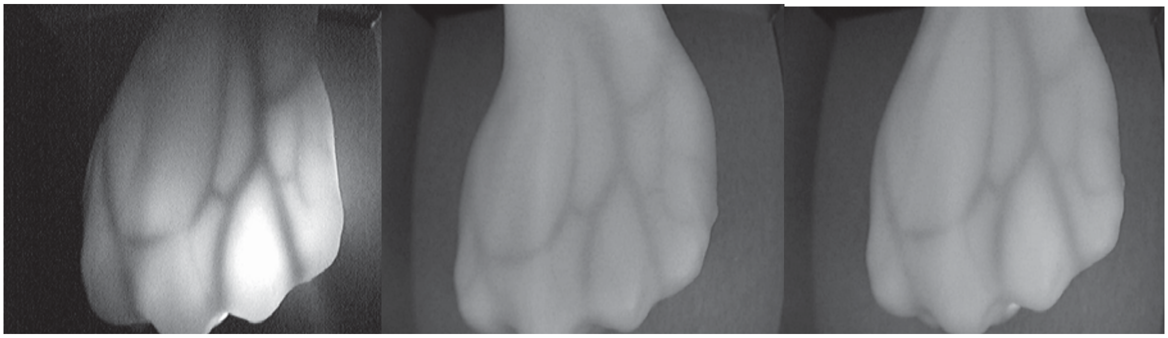


Figure5. Images we obtain using the three ways [13].

In the following, author evaluates the three ways using signal-to-noise ratio (SNR) and contrast. Author use total variation (TV) to evaluate their noises because SNR is not easy to calculate exactly. For a digital image $u(x, y)$, TV value is calculated as follow.

J(u) = $\sum_i \sum_j \left((u(i,j) - u(i-1,j))^2 + (u(i,j) - u(i+1,j))^2 + (u(i,j) - u(i,j-1))^2 + (u(i,j) - u(i,j+1))^2 \right)^{\frac{1}{2}}$

If an image contains noises, the TV value becomes much bigger. The following table shows the result that the mixing both penetrating and reflecting way is better in contrast and low noise is detect.

	Penetrating Way	Reflecting Way	Mixing Way
Contrast	Best	Bad	Better
Noise	High	Low	Low

Table2. Comparison of the three images [13]

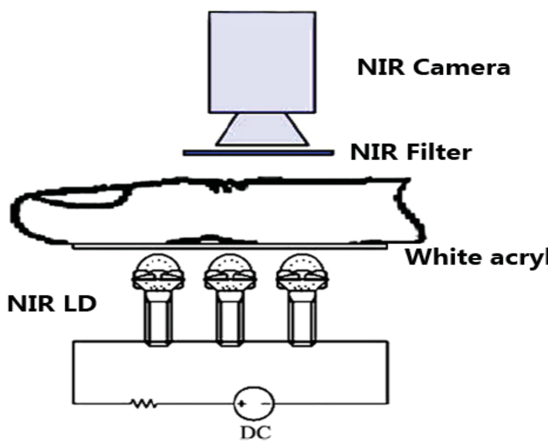


Figure6. Illustration of the imaging device [14].

The structure of this device is illustrated in Fig. 3. The transparent acryl serves as the platform for locating the finger and removing uneven illumination. The NIR light irradiates the backside of the finger. A light-emitting diode (LED) was used as the illumination source for NIR light. The shadow of the finger-vein obviously appears in the captured images in the LED illumination source. To solve this problem, an NIR laser diode (LD) was used in this system. Compared with LED, LD has stronger permeability and higher power. In this device, the wavelength of LD is 808nm [14]. Figure7 shows an example raw finger-vein image captured by using this device.

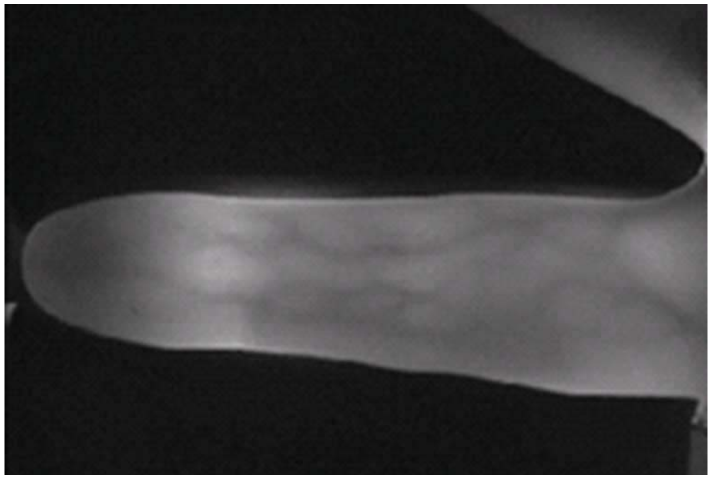


Figure7. An example raw finger-vein image captured by our device [14]

III. IMAGE INHANCEMENT

Pre-processing

The finger vein image is obtained by a biometric device has some faults, such as noise, background light leakage, etc. The image needs to be pre-processed [3].The pre-processing is the image enhancement process [2]. The images are enhanced by using adaptive non-local means, successfully applied to face recognition. At this point the image is inverted; veins now appear as high intensity pixels, while tissue between the veins appears as low intensity. There are many steps to enhance the vein images [15].

(a). Region of interest (ROI)

The first step of vein image is to extract the region of interest (ROI), vein pattern to be recognized [7]. The inscribed circle-based segmentation extracts the ROI from the original palm vein image. To calculate the inscribed circle that meets the boundary of a palm is the basic idea of using an inscribed circle. So it can extract as large an area as possible from the central part of the palm vein image [1]. The region of interest (ROI) containing the vein pattern needs to be extracted. The image centroid was employed as the centre to extract the ROI. Let (x0, y0) is the centroid of vein image, f(x, y) calculated using this formula [9],

$$x_0 = \frac{\sum_{i,j} i \times f(i,j)}{\sum_{i,j} f(i,j)}; \quad y_0 = \frac{\sum_{i,j} j \times f(i,j)}{\sum_{i,j} f(i,j)}$$

(b). Contrast enhancement

The resulted images of dorsal hand veins has low contrast. To watch the vein pattern the contrast will increase [7].

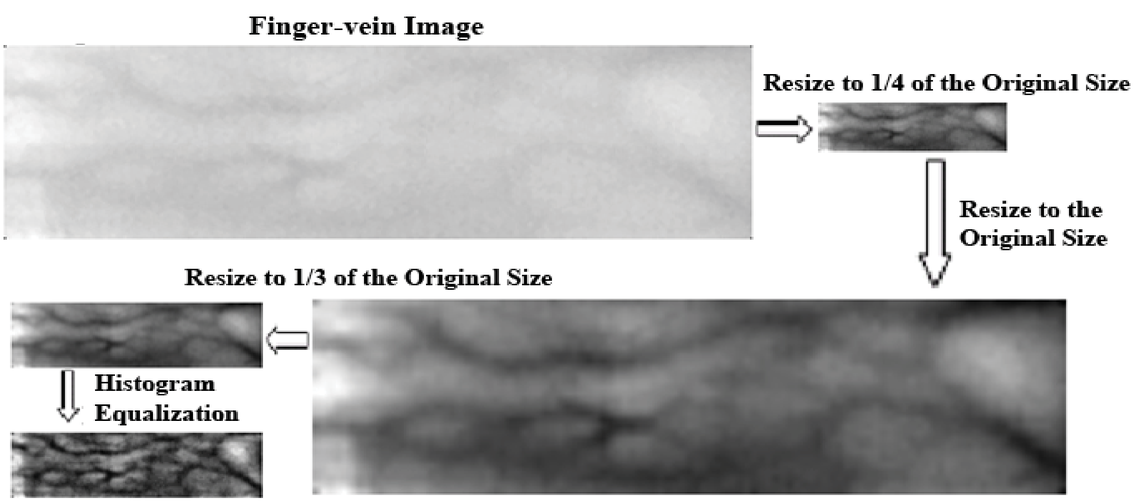


Figure8. The procedure of our method for image enhancement [14].

The segmented finger-vein image is enhanced to improve its contrast as mention in Fig8. The image is resized to 1/4 of the original size, and enlarged back to its original size. The image is resized to 1/3 of the original size for recognition in the next. Bicubic interpolation is used in this resizing procedure. In the last, histogram equalization is used for enhancing the gray level contrast of the image [14].

(*c). Thresholding*

The purpose of thresholding is to separate objects in the foreground from the background [17]. Local thresholding is a way for conversion of black and white picture to a binarized show. The white pixel is 255 and black pixel is 0. This method is used on dorsal hand images to extract veins pattern. Easy and efficient usage of this method with dynamic local threshold has been approved [11]. Histeq function is used to retain the vein pattern, the image is thresholded [17].

(d). Filter

The image is smoothed by the Gaussian smooth filter, the standard deviation of this Gaussian kernel used is σ= 0.625 [1]. Use combination filter to remove salt-and pepper noise and gauss noise [3]. A mask of 5X5 median filter, low pass Gaussian filter with a standard deviation of 0.8, Wiener filter of mask 5X5 are used [17].

(e). Normalization

(1) Gray Level Normalization

The light intensity may vary at different times, so the gray levels of vein images are distributed over different ranges. To reduce the difference and to provide a more uniform vein pattern representation among different vein images, gray level normalization based on the following equation [9],

$y = ((x - \min) \times 255) / (\max - \min)$

where x denote original and y denote normalized images of the gray level values ; min and max denote the minimum and maximum gray level values of the original image, respectively [9].

(2) The vein image size and gray Normalization

Normalization of the vein image size can use nearest neighbour, bilinear interpretation and cubic spline interpolation analysis method. Normalization of the vein image gray can use the following equation [2]

$$N(i,j) = \begin{cases} M_0 + \sqrt{\dfrac{V_0 (I(i,j) - M)^2}{V}}, & I(i,j) > M \\ M_0 - \sqrt{\dfrac{V_0 (I(i,j) - M)^2}{V}}, & I(i,j) \le M \end{cases}$$

Extract the image of finger vein image by finger outline mark and normalize the image to be image of 80×200 pixels [3]. With conversion of colour image to gray scale image, the image size could be decreased from 24 bits in each pixel to 8 bits in each black and white pixel [9].

(f)Segmentation

(1) The Sauvola method is adopted to segment the images. Using the local mean, m(x, y), and standard deviation, s(x, y), in a window of r×r pixels, the threshold at pixel position (x, y) is given by

$$T(x, y) = m(x, y) + k \times s(x, y) \qquad (1)$$

Where, k is a constant. It used to control the amount of the vein boundary taken as a part of the vein pattern. With k set to 0.03 and window size set to 15×15 pixels [7].

(2) Niblack method is a simple and effective local dynamic threshold algorithm. The principle of the algorithm is as follow. For every pixel $f(x, y)$, calculate its mean $m(x, y)$ and variance $s(x, y)$ in each r*r neighbourhood [2].

$$m(x,y) = \frac{1}{r^2}\sum_{i=x-\frac{r}{2}}^{x+\frac{r}{2}}\sum_{j=y-\frac{r}{2}}^{y+\frac{r}{2}} f(i,j) \qquad (2)$$

$$m(x,y) = \sqrt{\frac{1}{r^2}\sum_{i=x-\frac{r}{2}}^{x+\frac{r}{2}}\sum_{j=y-\frac{r}{2}}^{y-\frac{r}{2}} f^2(i,j)} \qquad (3)$$

Then, get its local dynamic threshold $T(x, y)$ of each pixel by the method **(1)[7]** and it's formula. Finally, get the binary image by the following formula:

$$f(x,y) = 255 \qquad f(x,y) > T(x,y)$$

$$f(x,y) = 0 \qquad f(x,y) \leq T(x,y) \qquad (4)$$

(3) The local dynamic threshold segment method

Use the algorithm of local dynamic threshold to divide image, and make the image into binary method [3]. **[P - 13]** Vein image has low contrast and imaging way brings a disadvantage that the illumination distribution is not uniform. Due to these characters, the local dynamic threshold segment method is used. The main idea of the method do segment using the method **(1) [7]** and it's formula . If a pixel value is lower than the threshold, we consider it as vein domain. m(x, y) and s(x, y) are calculated as in the method (2)[2] formula (2),(3). In this algorithm, we make a little improvement to calculate s(x, y) [13].

$$s(x,y) = \sqrt{\frac{1}{r^2}\sum_{i=x-\frac{r}{2}}^{x+\frac{r}{2}}\sum_{j=y-\frac{r}{2}}^{y+\frac{r}{2}}(f(i,j)-m(x,y))^2}$$

To certify this method choose a hand whose vein is hard to discern and following Figure shows the results. The middle one use Kejun Wang's segment algorithm and the right one uses proposed local dynamic threshold segment method. The results show that ' s(x, y) ' of the proposed has better connectivity [13].

Figure9.Segment results[13]

***(4)** Multi-scale filter method*

It is designed for simultaneous noise and background suppression in medical imaging of vessels. The method searches for tubular structures in the image by analyzing the second order information. The second order derivative of a Gaussian kernel generates a probe kernel that can measure contrast inside a defined range in the direction of the derivative. An eigen-value analysis of the Hessian gives the direction of smallest curvature and therefore the direction of the vessel, the eigen-values can be used to classify pixels as vessel [15].

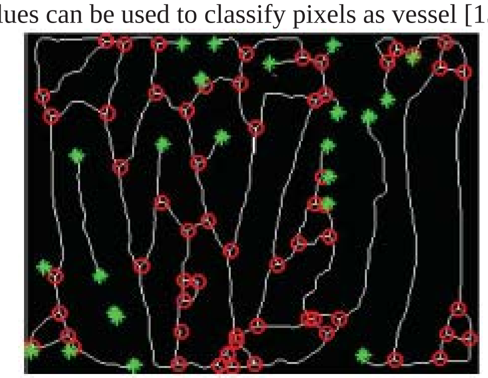


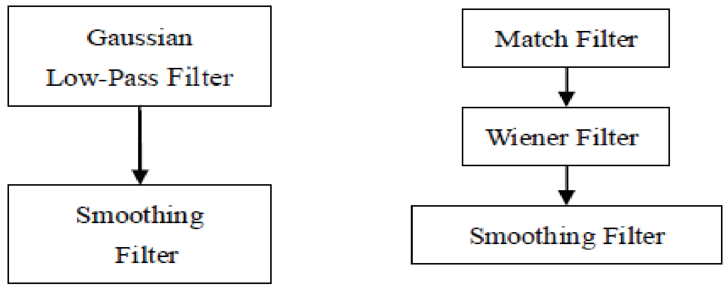
Figure10. Extracted minutiae points and skeleton [15]

Fig.10 overlay of extracted minutiae points and skeleton. Green stars: endpoints, red circles: branch points or background. Figure shows the effect of the method applied to the optimized image. The Contrast limited adaptive histogram equalization (CLAHE) is used by dividing the image into small segments where each region's contrast is improved [17].

(g)De-noising

To remove the noise of image mathematical morphology and median filtering method can be used [2]. Remove noise by the elimination method of area [3].

Restrain the Noise



Traditional algorithm Proposed algorithm

Fig11. The flow charts of noise reduction [13].

The proposed process contains big noise. Traditional de-noising method is not valid. The figure shows the traditional method and author's proposed method (the right one). Proposed algorithm contains three steps. The first step is the most important a match filter. Author use this new method to make the SNR to its maximal at the first step [13]. Author want to extract actual signal x(t) from observed signal y(t) and make SNR to maximal, we could use a match filter $H_{opt}(\omega)$ expressed as

y(t) = x(t) + n(t)

$$H_{opt}(w) = \frac{X(-w)}{P_n(w)} e^{-jwT_0}$$

Where n(t) is the noise, X (ω) is the spectrum of the x(t) . $P_n(\omega)$ is the power spectrum of n(t). $H_{opt}(\omega)$ is difficult to estimate. The noise in the processed images could be considered as Gaussian white noise. In this case, we could obtain $H_{opt}(\omega)$ a simple form. Its time domain $h_{opt}(t)$ could be expressed in the following equation.

$$H_{opt}(w) = X(-w) e^{-jwT_0}$$

$$h_{opt}(t) = x(T_0 - t)$$

It is a mirror signal of the actual signal; author could design match filter much easier. The second step of algorithm is a wiener filter. Wiener filter is calculated as the equation.

$$b(i, j) = \mu + \frac{\sigma^2 - v^2}{\sigma^2}(a(i, j) - \mu)$$

Where a(i, j) and b(i, j) are the original and estimated values of each pixel, μ and σ^2 are the estimated local mean and variance around each pixel, assigning the area to 5×5 pixels. v^2 is the noise variance, but it is estimated as the average of all the local estimated variances in the algorithm. Wiener filter could remove the noise. In the last step, to applying a 12×12 pixels averaging filter to make the images smooth. Table.3 shows the comparison of traditional method and proposed method. The result shows that the Wiener filter method is much more effective and can reduce the noise effectively and keep the contrast [13].

	Original	After Gaussian Low-Pass Filter		After Smoothing Filter
TV	3.0580e +004	2.1272e +004		2.1812e +003
	Original	After Match Filter	After Wiener Filter	After Smoothing Filter
TV	3.0580e +004	5.3155e +003	2.4529e +003	1.9138e +003

Table3. The TV values of the two de-noising algorithm[13]

(h)Thinning

The common thinning methods include Hilditch method, Rosenfeld method, etc. After de-noising and thinning, the vein image becomes the single pixel vein image [2]. An image thinning associates to a connected region. Though, reaching a pixel width is often difficult [11]. A parallel thinning algorithm developed by Zhang and Suen is employed to retain a thinned vein pattern to be used [17].

(i)Morphological processing

In morphological processing small or extra particles on an image could be taken out in a way that no damage threats larger particles or the pictured shape. Morphology will be changes in binary geometrical structure with evaluation of structural elements [11].

IV. Feature Selection

(A).Finger Web & Key-Point Detection

To identify the finger web key-points, the relevant areas are the position between pinky and ring finger, between ring and middle finger, between middle and index finger and between index and thumb. The key-points are relevant in order to identify the ROI and make an exact matching possible [5].

Extraction of key-points using SIFT [7]

The scale-invariant feature transform (SIFT) was proposed by Lowe, and it is widely used to match images of an object. The following four steps are used to extract a set of key points from the binarized images. The first step is to detect extrema in all scales and all image positions [7]. A given image denoted by I(x, y), and the scale space of it denoted by L(x, y, σ) is produced by convolution with a Gaussian function denoted G(x, y, σ), that is368

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

and the difference-of-Gaussian (DOG) space is given by

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

Where, k is a constant factor in the scale space and k=21/s, s denotes the intervals in each octave in the scale space. The second step is to remove unreliable key points. In the third step, identify the dominant orientation of each key-point based on the local image characteristics. For each pixel in a region of 32×32 pixels around each key-point, the gradient magnitude, m(x, y), and orientation, θ(x, y), are computed using

$m(x, y) = (L(x+1, y) - L(x-1, y))2 + (L(x, y+1) - L(x, y-1))2$

$\theta(x, y) = \tan-1((L(x, y+1) - L(x, y-1)) (L(x+1, y) - L(x-1, y)))$

The fourth step is to construct a local image descriptor for each key-point [7].

(B).Histogram Sequence

The images are divided into sub-images and histograms of these sub-images are calculated. The reason for dividing the image into multiple non-overlapping regions with the same size is not to lose the spatial information of the phase maps. Template matching is done by Histogram Intersection to get the similarity of two templates. In the Histogram Intersection the identical gray values of two histograms of the original image and the authenticated image are compared to determine their intersection. The intersection of two gray values is the minimum density value. The intersection values of all histograms of all images are summed up and this value is further compared to an already defined threshold value. If the value exceeds the threshold, the person is accepted else rejected [5].

(C).Clustering method

Clustering is an unsupervised important classification technique. In the clustering a range of patterns in clusters are clustered based on criteria of similarity measurement [11].

(D).End points and cross points

For the pattern recognition some researchers proposed using endpoints and cross points. Compute distances between them and get distance, which could be used to match the vein image. In the other local patterns consider every vascular as a short straight vector, which has position and angle. In the next step, use modified LBP (Local Binary Patterns) method as a important local pattern. First time author will use global patterns, Gabor wavelet transform [13].

(E).Branch point

For the matching the branch points are use in the biometric system like artifacts, which are introduced by segmentation errors or noise and can be removed by applying a threshold. All skeleton points where the difference between their indices falls below the threshold are deleted. All other points are kept. The threshold depending remote branches are cut off. The difference between indices at fine-grained branches at the edge of the image skeleton is small and large in the center part [15].

(F).Minutiae points

Rotations is a problem in vein recognition, depending on the capture device used for the acquirement. The fast rotation shift search algorithm makes a costly normalization of the minutiae points. Appling the polar-logarithmic transform to the Fourier spectra, the rotation becomes the circular shift in the horizontal direction in minutiae spectra [15].

(G).The end and the branch points

After extracting the skeletal representation from a vein image, the specific feature points have to be extracted. It is based on convoluting the binary image with a filter consisting of unique power of two values to get unique filter responses for every pattern in the mask size. The end and the branch points of the vascular skeleton can be found by searching for their pre-computed filter response values in the filter response of the image [15].

V. MATCHING

Matching

Hand vein recognition method based on the results of matching key points. The Key-points of extracted image are match from the match points of the pre-enrolled, pre-extracted image [7].The blanket dimension distance Hausdorff (HD) between two finger vein patterns and the lacunarity distance H^ are defined as

$$HD = \sum_{s=1}^{4} \sum_{i,j} \left| D_{1s}(i,j) - D_{2s}(i,j) \right|$$

$$H\wedge = \sum_{s=1}^{4} \sum_{i,j} \left| \wedge_{1s}(i,j) - \wedge_{2s}(i,j) \right|$$

In this method, the dimension and lacunarity features are combined for finger-vein recognition: if HD < th1 and H^< th2 (th1 and th2 are thresholds), then the two finger vein patterns are from the same finger; if HD > th1 or H^ > th2, they are from different fingers [14]. Let R(m, n) and T(m, n) be the two sampled minutiae spectra in the polar-logarithmic domain. Both R(m, n) and T(m, n) are normalized to have zero mean and unit energy. As a similarity score, the normalized cross-correlation with zero lag of two minutiae spectra was chosen, which is a common similarity measure in image processing [15]. Therefore, the SML correlation (SMLC) as similarity score Rand T is defined as:

$$S_{DM}^{(R,T)} = \frac{1}{MN} \sum_{m,n} R(m,n) T(m,n)$$

There are many feature extraction and matching algorithms for pattern recognition. They are K-L transformation method, structure feature of geometry method, immovability moment feature method [14], the pixel-by-pixel method [16], Fractal model using blanket method [18], Fractal model using Differential Box Counting method (DBC) [18].

VI. MULTIMODEL TECHNIQUES

Multimodal biometric is a combination of different biometric modalities which provide higher accuracy and more security. Single biometric feature method has many disadvantages, to reduce this disadvantages multimodal biometric is use. Disadvantages, in the uni-biometric are 1) Noise- is possible due to the biometric feature or from the biometric sensors. 2) Intra class variation – The adjustment of the sensors and the user has create more problems for the image capture image. 3) Inter class similarities- In the large scale biometric system, there are many kind of similarities detect and can't differentiate them. 4) Spoof attack- In uni-biometric method, it is easy to make a fake identification proof to forge the system. Example-voice can be recorded and use for voice verification [22].

A multimodal biometric system with the combination of the hand shape, finger-print and palm-print biometric features and tested at the small size database [24]. The combination of palm-print and hand geometric biometric features are use to make a multimodal biometric system [25]. The combination of finger-print, palm-print and hand shape biometric features are use to make a multimodal biometric system [26]. Author proposed a multimodal biometric system to secure the data. Author use the finger-print, Near Infra-red (NIR) dorsal hand vein pattern and left or right (L/R) NIR dorsal hand geometry shape. This system is very secure and it is not possible to forge the sensors. Vein patterns and hand geometry only work for the live person [22].

VII. CONCLUSION AND FUTURE TRENDS

As per the knowledge gathered while reviewing the work, the biometrics alone are not much secure and have accuracy upper threshold. So to increase the accuracy multimodal techniques need to be used where the total accuracy can be increased by more than one biometric traits usage. Both can work against different security threats. The methods for vein biometric security have been reviewed in the paper which is considered to most secure and reliable hidden biometric technique. One of the biometric should be hidden so that it can encounter spoof attacks against biometrics. Another biometric in multimodal algorithm can be fingerprint, finger shape, hand shape, or even another hidden biometric as finger veins, so both can together encounter the attacks.

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