

# **Vein Pattern Recognition Using ROI Extraction**

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# Abstract:

This paper presents a new approach to vein pattern recognition system. The various stages involved are Image acquisition, Region Of Interest Extraction. Our main focus is on Dynamic ROI Extraction and thinning. We got a database of hand images which are far infrared images of hand. For that images, we have dynamic ROI extraction. done The advantage of dynamic ROI extraction is that ROI extracted for different hand images varies in size as the size of the hand varies. As the size of ROI varies, we can extract more features from larger hand. We've proposed a new thinning algorithm which involves thinning the ROI to one pixel thick medial axis vein network and also removal of thinning artifacts. We used a sequential

### **1. Introduction**

The prominence and acceptance of biometric technologies like process, identity verification, hand pure mathematics, and iris recognition might leave very little demand for alternative modalities. However, the rising vein-pattern recognition technology, with its own distinctive options and benefits,

thinning algorithm for thinning. We used a flag map in addition to image to decide which pixel to delete during thinning process. An artifact removal algorithm is used to remove any extra artifacts which ends the thinning process. After that key features are extracted which are bifurcations and end points which are stored separately as templates. Finally a matching algorithm is applied for identification. The matching algorithm is a coordinate matching where in we match the coordinate positions of key features of the live image which are stored in live template with the stored templates with certain fixed threshold. Our system is efficient as it got the lowest FAR which is necessary for security.

### Keywords: hand vein, finger web, region of interest, binarisation, bifurcation, endpoint, morphology, template.

has maintained its position against the others. The industrious biometric technologies embody vein, DNA, ear, and body odour recognition. Of these, vein pattern recognition is gaining momentum in concert of the fastest-growing technologies. it's on the right track to become the most recent entrant to thought biometric technologies, moving from the analysis labs



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to industrial readying. A biometric system is basically an automated pattern recognition system that either makes an identification[1].

Various types of biometric systems are being used for real-time applications. Some of the biometric systems generally recognition, used are ocular facial recognition, fingerprints, hand geometry and vein pattern recognition [5]. Hand vein identification has emerged as a promising component of biometrics study. The human vascular structure is individually distinct and appears to be time invariant. Human blood vessels are formed during the embryo stage with a variety of differentiating features, rendering each pattern unique, and their patterns remain relatively constant over one's lifetime. A unique network of veins and arteries exists in every hand and finger of each human being. The subcutaneous vascular network appearing on the back of hand, referred to as the hand vein in this paper, is extremely difficult to forge and, therefore, offers promising biometric which also ensures liveness.VPR technology was developed in the 1990s, and the first commercialized system emerged in 2004.



Fig 1. Vein Pattern Image.

#### 2. Related work

We started the literature survey with the book Vein Pattern Recognition authored by Chuck Wilson [1]. The book provides an objective comparison of the different biometric methods in common use today including fingerprint, eye, face, voice recognition and dynamic signature verification. Primarily the book focuses on the introduction of VPR technology in biometrics, the advantages VPR systems has on other biometric systems, implementation of VPR systems, discusses about various types of vein patterns depending on from where it is collected, like finger vein, palm vein, hand vein etc. Ajay kumar et al [7] presents a new approach to authenticate individuals using triangulation of hand vein images and simultaneous extraction of knuckle shape information. Their method employs palm dorsal hand vein images acquired from the low-cost, near infrared, contactless imaging. Crisan et al [8] takes a new approach where the vein detection process consists of an easy to implement device that takes a snapshot of the subject's veins under a source of infrared radiation at a specific wavelength. By storing the relative angles between segments, the number of terminations and crossing points and the neighbors of each point, the comparison between the template values and the scanned values is faster than in the case of using images and the amount of data stored is kept to a minimum. Here Gaussian



lowpass filter and median filter are used to eliminate the speck noise and the horizontal strip scanning noise respectively. Yuhang Ding et al [17] presents the theoretical foundation and difficulties of hand vein recognition.

### 3. Proposed System

In this paper we develop a hand vein authentication system by extracting the key features of the hand which, for us is bifurcation and end points. In order to extract the key features, we have to go through several phases and they are dynamic ROI extraction [4,12]. The dynamic ROI extraction where we extract a region of interest based upon the size of the hand is explained in section 3.1.

# **3.1. Dynamic ROI Extraction**

A database containing a total of 178 images which are far infrared images of the hand are obtained. Depending on the size of the hand, if the size of region of interest changes, we will get a larger ROI for larger hand. So, it is possible that we can extract more features from the larger hand which otherwise is not possible with fixed region of interest extraction. The process of dynamic ROI extraction from hand images is explained below. In order to extract the ROI, the first step is to make the image rotation invariant. For this we need to locate finger webs [18], which are key control points. Once the key control points are located, the image orientation is ascertained to extract reliable region of interest. The finger webs are located as follows.

First, the image is binarised using a global thresholding algorithm. Thresholding creates binary images from grey-level ones by turning all pixels below some threshold to zero and all pixels above that threshold to one [2].

If g (x, y) is a thresholded version of f (x, y) at some global threshold T ,

$$g(x,y) = \begin{cases} 1 & \text{if } f(x,y) \ge T \\ 0 & \text{otherwise} \end{cases}$$

A global thresholding involves only one threshold value for the entire image in contrast to local thresholding which is also called adaptive thresholding for which the thresholding value changes in different regions of image. A global thresholding method called Otsu thresholding [13] is used to binarise the image.



Fig 2. (a) Actual Image (b) Image after Otsu thresholding

After binarisation process, boundary extraction is done using morphological operations [2] on the binary image. The boundary of a set A, denoted as  $\beta(A)$ , can be obtained by first eroding A by B and then performing the set difference between A and its erosion as follows.

$$\beta(A) = A - (A \ominus B)$$

where B is a suitable structuring element.

The structuring element used is a  $3 \times 3$  matrix of ones as shown below.

1	1	1
1	1	1
1	1	1

Fig 3. Structuring element used in boundary extraction

After applying morphological operations, boundary is extracted as follows.



Fig 4. Extracted boundary of the image.



Now the boundary is traced [3] and the boundary pixel coordinates are stored in a matrix(Boundary Pixel Vector) starting from the lower left pixel and tracing towards right.After boundary tracing, the coordinates of the finger webs which are key control points are to be located. For this, euclidean distance is found between first pixel(P) coordinate in BPV(Boundary pixel vector and entire coordinates in the vector and the distances are stored in the distance vector(DE).

$$D_{E}(i) = \sqrt{\left(X_{p} - X_{b}(i)\right)^{2} - \left(Y_{p} - Y_{b}(i)\right)^{2}}$$

A Distance distribution diagram[11] is constructed using the vector DE. The constructed diagram pattern is similar to geometric shape of the palm. In the diagram four local minima can be seen and five local maxima, which resemble the five finger tips (local maxima) and four finger webs (local minima) i.e., valley between fingers.



#### Fig 5. Distance Distribution Diagram

The local minimas which correspond to finger webs are located and the correspondind xaxis value is located which corresponds to the index to that pixel coordinates in BPV[27].



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Fig 6. Finger webs of an image

After obtaining finger webs the image is aligned to horizontal axis. The line joining fw1 and fw3 is made parallel to horizontal axis, thus making the image rotation invariant.



Fig 7. Image after rotation

After alignment of the image, the finger webs are found again using the sameprocess discussed above. After finding finger webs, the ROI is extracted from the image. The ROI is the rectangle whose dimensions are as follows

Xdim=Distance between fw1 and fw3+(4\*A)

Ydim= Xdim+10-A;

Where A=half the distance between fw2 and the line connecting fw1 and fw3.

The selected ROI from the image is shown below.



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# **5.** Conclusion

Image process is done by some operations like image improvement, filtering and segmentation that are performed to make the image with higher quality and to extract the region of interest for feature extraction. This paper proposes a new dynamic ROI extraction method. Our dynamic ROI extraction made it possible to grab more features from the hand and our thinning algorithm gave a perfect one pixel thick medial axis which was very helpful in feature extraction. We got a FAR which is very low which is perfect for security applications.

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