

# Improved Human Identification using Finger Vein Images: A Review

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## Abstract

*Vein pattern is the network of blood vessels beneath a person's skin. This vein pattern can be used to authenticate the identity of an individual. In the ubiquitous network society, where individuals can easily access their information anytime and anywhere, people are also faced with the risk that others can easily access the same information anytime and anywhere. Because of this risk, personal identification technology, which can distinguish between registered legitimate users and imposters, is now generating interest. Currently, passwords, Personal Identification cards are used for personal identification. However, cards can be stolen, and passwords and numbers can be guessed or forgotten. To solve these problems, biometric authentication technology, which identifies people by their unique biological information, is attracting attention. 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. We will be using MATLAB software for our proposed work.*

## Keywords

*Feature Extraction, Finger Vein Recognition System, Gabor Filter, Median Filter*

## 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 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 around 1985. 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]. 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. 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.

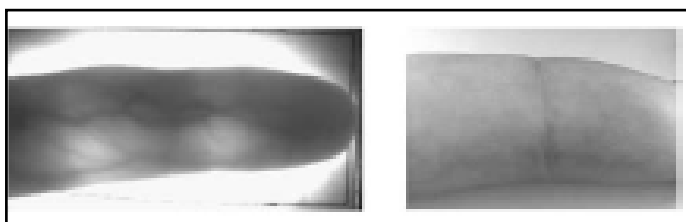


Fig. 1: Extracted Vein Image

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-Finger 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.

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.

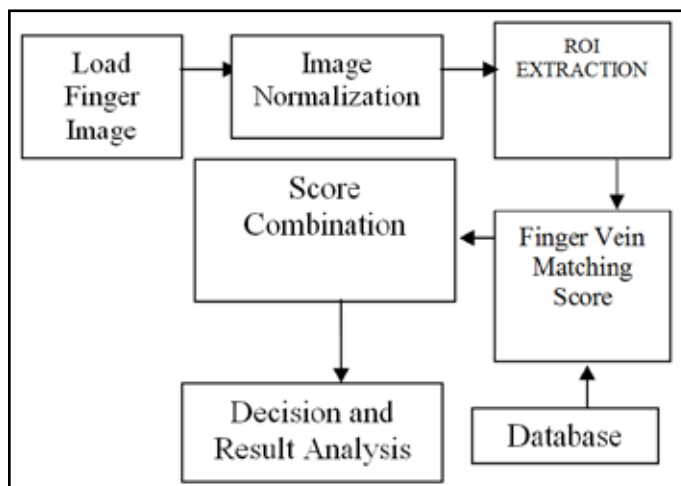


Fig. 2: Block Diagram Illustrating Key Steps Employed for the processing of acquired finger-FINGER images.

The block diagram of the proposed system is shown in Fig. 2.

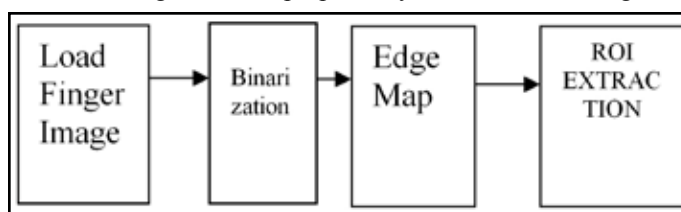


Fig. 3: Block Diagram Illustrating Key Steps Employed for the Preprocessing of Acquired Finger-Vein Images.

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. 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. 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.

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.

## III. Recognition

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. 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.

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.

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 object segmentation paradigm. In this paper, we propose the framework for the finger-vein feature extraction using multi orientation Gabor filters. We will be using GABOR Filter, Median Filter and Repeated Line Tracking method for recognition.

#### IV. 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. 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.

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