

# Palm Vein Authentication: A Review

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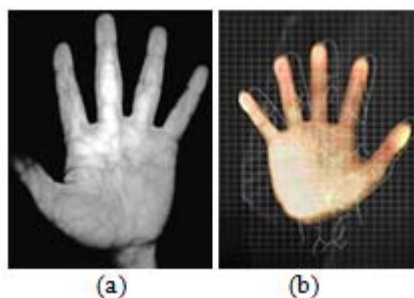
**Abstract:** The palm vein pattern is unique biometric identity of the human beings. The palm vein recognition is a popular biometric technique which is used for authentication purposes in various applications. In this paper a review on new novel palm vein recognition architecture has been described. All of the techniques used to build the palm vein recognition architecture have been discussed in this paper. A palm vein recognition system consists of the following steps: Image acquisition from the database and Pre-Processing, Finding of Region of interest, Extraction of Palm Vein pattern Features and Recognition. The aim of the proposed model is to improve the accuracy and response time of palm vein authentication. The proposed model will use neural networks for the final evaluation of the testing sample and training samples to recognize the person. The proposed model will be robust, flexible and accurate than the existing palm vein authentication schemes.

**Keywords:** Biometrics, Palm Vein, Region of Interest, Feature Extraction, Fuzzy neuro technique.

## 1. Introduction

Biometrics is automated methods of recognizing a person based on physiological or behavioural characteristics [2]. As the frauds are increasing day by day we need more secure methods to increase the security and biometrics are of the best approach. There are various applications such as airports, banking, hospital security and access to restricted areas.[10]. There are number of physiological and behavioural characteristics. Physiological characteristics are like iris, vein technology, face, palm print and behavioural characteristics such as gait recognition, voice, odour etc. These all features are used to control the access in various fields to increase the security [1]. As reliability is the major key for the security and it is low in the face recognition system because of the problems like pose, lighting, orientation and Gesture. Figure print are widely used for authentication purposes but it is also difficult in some situations to acquire the fingerprint features *i.e.* minutiae, for some class of persons such as manual laborers, elderly people, etc[1]. The Palm Vein technology is far away from such kind of problems and it is more reliable biometric system for personal authentication.

Palm Vein Authentication has a greater level of recognition accuracy due to the uniqueness and complexity of vein patterns of the palm[9]. A Palm Vein characteristic has gained more interest in authentication because of its uniqueness even between twins[2]. It is difficult to forge as it is present internal to the body[9]. Furthermore, it will not vary during the person's lifetime and impossible to read or copy since it lies under the skin. The most important advantage of palm vein is that it exists only for live humans.



Some examples of Palm Vein images

Palm vein is the technology which is more secure as it is present internal to the body so it is quite difficult to forge and also it doesn't contain hairs which can create the obstacle in the path of photographing the blood vessel of the palm[6].

## 2. Related Work

The paper published by Jing-Wein Wang, et.al on "Building Palm Vein Capturing System for Extraction" [8]. First phase is pre-processing in which the various steps are carried out to improve the image quality such as image enhancement, a bi-level thresholding, noise removal. Second phase is feature extraction in which the vein features are extracted by "pixel by pixel" scanning. In order to identify connected pixel regions. Third step is post-processing in which thinning is done to remove the unnecessary information the performance of accurate extraction ratio is very good but the error extraction due to bad quality of palm vein pattern images may lead to the fatal errors of the process.

A paper published by Huan Zhang, et.al, on "A Palm Vein Recognition System" [6] In which they proposed a capturing device, a JAI AD-080 CL 1/3" CCD near-infra camera is used. In preprocessing the inscribed circle-based segmentation which extracts the ROI. Image is then smoothed by the Gaussian smooth filter; local contrast enhancement is used to enhance the ROI image. Then the vein patterns are extracted by technique which includes vein length and minutiae for recognition and matching. The

advantage of this paper is Equal Error Rate (EER) is 1.82% but performance is not good.

A paper published by Yi-Bo Zhang, et al. on "Palm Vein Extraction and Matching for Personal Authentication"[15] in which they propose low cost CCD camera to capture the infrared palm images. Then Region of Interest is located to extract the features. Features are extracted by multi-scale filtering. In last matching is done using Template Based Matching. In this the recognition rate is good but the image quality is bad or poor quality.

A paper published by Qing Rao, et al. on "Personal Identification for Single Sample Using Finger Vein Location and Direction coding" [14] in which they propose a finger vein imaging device with near-infrared (NIR) light source. Then they do pre-processing of the image in which they use gradient operator, size and brightness normalization for feature extraction and final matching. Furthermore, finger vein LDC is proposed and performed, which creates a structured feature image for each finger vein. Here the robustness and recognition rate is high but database is small.

A paper published by Debnath Bhattacharyya, et al; "Vascular Pattern Analysis towards Pervasive Palm Vein Authentication"[2] in which they proposed three algorithms for preprocessing [2] area. Vascular Pattern Marker Algorithm (VPMA); in which the two pass masking is used such as horizontal and vertical kernels to smoothen the image b. Vascular Pattern Extractor Algorithm (VPEA); in which Thresholding is done for converting a grey scale or color image to a binary image based upon a threshold value. If a pixel in the image has an intensity value less than the threshold value, the corresponding pixel in the resultant image is set to black. Otherwise, if the pixel intensity value is greater than or equal to the threshold intensity, the resulting pixel is set to white. Thus creating a binaries image, or an image with only 2 colors, black (0) and white (255). Vascular Pattern Thinning Algorithm (VPTA) in which thinning is done for capturing the Vascular Pattern of hand Palm of an individual. The resultant Images will be stored in a Database, as the vascular patterns are unique to each individual, so future authentication can be done by comparing the pattern of veins in the palm of a person being authenticated with a pattern stored in a database. Here the threshold value is assumed which is not always the criteria.

A paper published by Sahar Bayoumi, et.al, on "PCA-based Palm Vein Authentication System"[13] In which they proposed a system for authentication using Palm Vein based on using principle component analysis (PCA) for feature extraction. Palm vein images of dorsa captured using infrared camera. PCA is applied to generate vector of features that represent the highest detailed variant information. A matching process is then applied to find the best match from the data base to recognize and authenticate the person. Experiments show that there system is able to recognize human with accuracy 85% in real-time based on supervised recognition.

A paper published by Gin-Der Wu, et.al, on "An enhanced discriminability recurrent fuzzy neural network for temporal classification problems"[4] in which they proposes an

enhanced discriminability recurrent fuzzy neural network for temporal classification problems. To consider classification problems, the most important consideration is the "discriminability". To enhance the "discriminability", the feedback topology of the proposed fuzzy neural network Analysis results indicate that the proposed fuzzy neural network exhibits excellent classification performance.

A paper published by Du Ge-guo, et.al on "The Anti-spoofing Study of Vein Identification System"[12] in which they presents a kind of liveliness detection method based on an optical measurement for sequence infrared images. The vein images are related with vital signs such as oxygen saturation in human blood and heart rate. The two different algorithm are used for feature extraction, one algorithm is used for vital signs detection, the other algorithm is used for identification. It improves the security capability but its cost is very high.

A paper published by Mona A. Ahmed, et.al on "Analysis of Palm Vein Pattern Recognition Algorithms and Systems"[11] in which they presents an analysis of palm vein pattern recognition algorithms, techniques, methodologies and systems. It discusses the technical aspects of recent approaches for the following processes; detection of region of interest (ROI), segment of palm vein pattern, feature extraction, and matching.

A paper published by Daniel Hartung, et.al; on "Spectral Minutiae for Vein Pattern Recognition" [6] in which they proposed a solution based on vein minutiae using SML approach is coded and then evaluated against their comparison strategies on three different dataset of wrist and palm vein samples . The system is able to extract the features of reasonable quality.

A paper published by Andrew Teoh Beng Jin, et.al; on "Design and Implementation of a Contactless Palm Print and Palm Vein Sensor"[5] in which the proposed a approach Local Ridge Enhancement for image enhancement which remove the illumination error and one more approach known as Directional Coding to encode the palm print and palm vein features in bit representation.

A paper published by Jind Liu, et.al; on "Palm Dorsa Vein Recognition based on Independent Principal Component Analysis"[9] in which they proposed two different architecture of ICA i.e. Independent principal Component which is highly accurate and reliable and also remove the high order correlation between data.

### **3. Problem Statement**

After conducting the literature survey on palm vein recognition techniques, I came to know about the overall description of Palm Vein Authentication and its corresponding method. A lot of work has already been done on the Palm Vein recognition but there is still a scope of further improvement. The accuracy and response time of the existing system is slow which can be improved. Error extractions due to bad quality of the palm vein pattern images may lead to the fatal errors of the process. The

quality of images are low. Recognition rate of the existing system is not good enough to be a real system.

#### 4. Methodology

Palm vein is an unique and popular biometric identity. It is in use at various real life application like restricted entry points, lockers, etc. To obtain palm vein, a palm vein biometric device is required, on what human place his/her hand, and the device results the image of palm vein. Here, the palm vein recognition algorithm reads the palm vein image obtained by palm vein scanning device to accomplish the image acquisition task. Palm vein image may carry some kind of noise caused by camera, weather, or other external stimuli eg Salt and pepper noise. Hence, palm vein image is required to pre-processed to remove the noise to produce reliable results. At this step, after the palm vein is obtained, the noise removal would be performed using median filter. The median filter is applied to remove the noise, hence will improve the palm vein image quality. The median filter is a non-linear digital filtering technique, often used to remove the noise. The median filter runs through part by part of an image and replaces each entry with the median of neighbouring values.

After removing the noise, the next step will consist of extracting the Region of Interest (ROI) because the image obtained by palm vein imaging/scanning device obtains the sample of whole human hand. The palm vein matching algorithm has to work with palm area of the hand only, so there is need to extract the region of interest from the sampled image. Then the ROI would be extracted using a unique algorithm, which detects the boundaries of the image, mark the internal objects, obtain the x and y co-ordinates, and the extract the desired region of interest from the target image. ROI algorithm will use a binarized image to perform the boundary detection. After finishing with finding the boundaries of the hand object, it will make logical difference between fingers and palm shapes. Then compute x and y coordinates for of the palm region, then re-adjust the (x1,y1) and (x2,y2) coordinates accordingly. Finally, it will result the sub-image of hand carrying the palm vein region for the further processing.

Afterwards, the image enhancement techniques would be used to create a prominent palm vein for the fault tolerance and, reliable and accurate results. Firstly, the region growing technique will be used to enhance the image. Region growing utilizes Euclidean distance method to extract the features by enhancing the palm vein sub image. In maths, the Euclidean distance is the normal distance between the two points that can be measured with a ruler and is given by the Pythagorean formula. Using this formula, Euclidean space becomes the Euclidean matrix. The horizontal and vertical distance between the points is measured. With this small addition we get a right-angled geometric shape with its legs or coordinates. Then, using the Pythagorean Theorem, the square of the hypotenuse is performed, which results the length of the hypotenuse. This result is same as the distance between the two points according to the distance formula. Region growing is a popular image segmentation method. Region growing segment the image on the basis of the region. It is also called a pixel-based image segmentation

method because it uses the selection of the seed points. The major goal of region growing segmentation is to partition the image into regions based on the pixel properties. Region growing algorithm will produce the better results and separate the regions with same properties as per the defined ones. Then the light effect would be neutralized to clear the palm vein object more prominent for the feature matching process. Also contrast enhancement would be applied to the image for the additional clarity of the palm vein features.

Then it comes to the feature matching using fuzzy-neuro hybrid method, which combines fuzzy logic and neural networks for the feature matching. Fuzzy logic is used to compute a threshold value based on the image quality, which will reflect a different action for various image quality classes. Image quality would be computed with a novel image quality measuring method. The quality algorithm will return a threshold value. On the basis of the image quality value, the fuzzy logic will be applied. The fuzzy logic will process the image with the different sensitivity matrix on the basis of the quality threshold value, while executing the neural network.

Neural network is the method used for feature matching with the training database. The trained database contains the feature sets of the particular users which were obtained on the time of registration. Neural network will return a percentage value after matching the test image with the training database. This percentage value is called sensitivity. The result will be returned after applying the hybrid decision logic, which contains fuzzy logic and neural network duo to finalize the result.

A detailed literature survey on all of the above mentioned techniques or methods would be studied to understand them at the core. Then the proposed algorithm flow would be reviewed and improved in case any changes are required. The experiment results would be thoroughly analyzed and compared with the existing algorithm results. This is also very important to get the information about the other parameters used for palm vein matching and analysis. A thorough performance and feature testing approach would be designed and applied to evaluate the performance of the simulated palm vein recognition algorithm to detect the errors and to recover them. Afterwards, the experiment results would be thoroughly analyzed and compared with the existing palm vein recognition techniques to examine the performance of the new palm vein recognition algorithm.

#### 5. Conclusion and Future Work

After studying the research papers I came to know about the overall description of Palm Vein Authentication and its corresponding method. Further in literature, each technique is summarized with the advantages and shortcomings. Besides a number of palm vein recognition techniques are already been developed, there is still a scope of further improvements. So I have chosen this topic for my research. In the future the implementation of the system would be done by the authors of this paper. The future authors taking this paper as inspiration can proposed enhancements or improvements in the proposed model. Also they can

proposed a new technique based on proposed model with higher accuracy and robustness.

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