On-the-Fly Metacarpus Vein based Biological Recognition based on Image Processing

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Abstract:

The security of Palm vein technology is paramount as it ensures that no one can replicate the technology. The vein pattern of the human palm is employed in this palm system for identity verification. This technique is more secure than other biometric systems as it is a contactless system and each person has a different vein pattern. The main objective is to build a unique, cheap and reliable system to replace the contact-based systems. Images from a near-infrared camera are used as they help in creating the clear veins required for the ideal functioning of the system. To determine the appropriate profile, we must process the image and perform grayscale thresholding before inverting it. Image segmentation is performed on the image to obtain meaningful edges. Morphological operations are employed to describe the pattern of veins after removing noise from images. The resulting grayscale image is divided into 20x20 sub-regions before feature matching.Feature vectors for these sub-region are used to represent mean absolute deviation (MAD) These feature sets form the input to the backpropagation neural network.Therefore, the accuracy rate of classification using the feature matching method can goup to75%.

Keywords: Biometrics, Palm Vein Recognition System.

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1. Introduction

Palm vein authentication is a lightweight yet digital authentication technology.The land-based winning sound is utilized as a biometric marker in this network.Each person has a distinct palm mode that exists below the surface of their own body, such as hand modes, retinas (reflex neurons), iris modes or winners, chop modes. modes. Since security is becoming more and more valuable in various fields, especially in most protocol cases, this is why these biometric systems are considered unique from person to person and provide much less security and reliability than other systems.Two distinct biometric systems are present.The authentication process is dependent on a single source of information, which is the basis for Unimodal methods. But these systems are not efficient and reliable enough.

Multimodal:

It integrates information from multiple modalities to reach a decision.This improves the system's performance and makes it less vulnerable to attacks by impersonators and more sensitive environmental conditions. There are several ways to use human biometrics that meet the criteria of high security, reliability, and performance. One of the earliest systems, known as the "face recognition system," is designed to recognize an individual in a group. Handwriting, fingerprints, voice, and other biometric systems are utilized for authentication purposes. The system using fingerprints for authentication and identification is mainly usedmove, with the increase in ease of use and throughput of the identification system. Deep learning methods, based on both convolutional neural networks (CNN) and recurrent neural networks (RNN), are here exploited to extract discriminative features from the obtained vein patterns and achieve remarkable recognition performance.

1.1 Start with vein Images

Four stages are typically used in a palm vein recognition system, including image capture, preprocessing (including ROI localization), feature extraction, and matching. Palm vein image acquisition is performed using palm vein image capture. To extract features from the palm vein image, the preprocessing process splits a portion of the image.The extraction of useful features from palm veins is achieved by using preprocessed feature extraction. This method is quite simple.

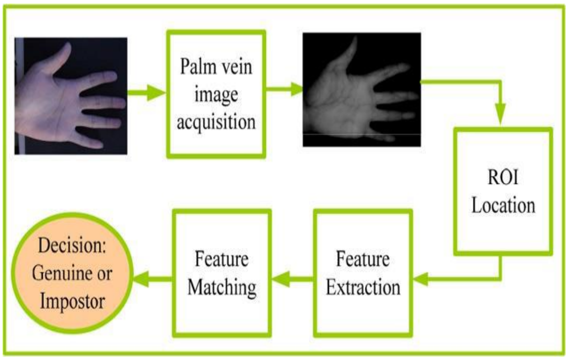

Figure 1: Image Acquisition of the Palm Veins

Using a comparator, two palm vein features are compared and the database is used to record the results.

This study will further investigate how image acquisition has evolved to reduce hygiene problems and psychological persistence. Therefore, the proposed system will be non-contact to solve hygiene issues. In addition, the study can be used as part of an access control device. This access control device controls access to rooms or buildings reserved for restricted personnel

2. Related Works

For palm vein-based recognition systems, researchers Yingbo Zhou and Ajay Kumar [4,7] proposed two novel methods to improve the performance. One method uses subspace learning to generate the overall methods, while the other uses a vessel extraction method to find the line/curve correspondences. The palm vein images are projected onto the subspaces constructed from the training data in subspace learning, which has emerged as a powerful method.

The reason for the high level of interest in obtaining curve or line features from palm vein images is.The return on investment extraction method was proposed by W. Kang and Q. Wu [1] used the OTSU method and the radial distance function (RDF). First, the image is smoothed using Gaussian Blur. With this initial threshold Th, we can start hand shape segmentation using the OTSU method. This new threshold Th* is obtained by multiplying the initial Th with the correction factor C.The concept of maximum connected domain is introduced to enhance the performance of binary images.The image's wrist region is subject to a new method that reduces noise.As a convolution technique with ROI and ROI to enhance the underlying texture, the authors Amioy Kumar; Mr. Hanmandlu; H.M. Gupta [2] proposed the two-dimensional Gabor filter.The 2D Gabor filter and ROI are used to split the image into real and fictitious portions. Only the real part is used for further processing such as feature extraction using Gabor waves.Many authors have summarized that the branching point and box method is used to describe the pattern of the ridges, such as Amioy Kumar; M Hanmandlu; Vamsi K. Madasu; Brian C. Requirement [3]. A vein sample point is considered as a branch point in the branch point method if there are more than two vein sample paths arising from it.To identify all branching locations, the thin image of the vein sample is employed.The hand geometry factors were proposed by Irfan Ahmad, Zahoor Jan, Inayat Ali Shah and Jamil Ahmad [16].Hand measurements include length and width, as well as finger length & width. Verification using key lines was developed by De-Shuang Huang et al. [18].

A. Image Acquisition

Infrared light and the structure of the human body combine to create an image that can accurately depict veins in a palm.The visible part of the electromagnetic spectrum is separated from the microwave part by means infrared light. The average wavelength of infrared light is75 µm to 1000 µm. Based on ISO 20473, the infrared region is divided into three sub-regions, far infrared with a range of 50 to 1000 µm, mid-infrared from 3 µm to 50 µm, and near infrared from 0.78 µm to 3 µm. There are two types of infrared imaging technologies for palm vein authentication, far infrared thermography and near infrared imaging, which have been analyzed in [3].

B. Preprocessing

In [4], researchers proposed and used histogram equalization to enhance the vein image. This method is useful if the researcher uses FIR imaging techniques, because this method redistributes the intensity of the pixels, thus changing the sharpness and contrast of the image.The region of interest is extracted in [2013], and a 5x5 filter is applied to it to reduce noise.A Gaussian low-pass filter of 51x51 was applied to the region of interest measured at low frequency, and it was subtracted from the original region. This method extracted the brightness from this image.Due to the inadequate contrast in the image, they employed normalization.6.

C. Feature Extraction

Two extraction methods, namely the holistic and structural approaches, are used for palm vein identification.Feature points and palm vein lines are the components of these significant approaches.Features were extracted through Gabor filter and Fisher discriminant analysis (FDA), as described inThe Gabor filter was applied to extract and enhance areas of concern.Fisher discriminant analysis was used to make the feature table smaller.Anartificial neural network was used to cluster the data and features were extracted using hybrid principal component analysis (PCA) for palm veinrecognitionin PCA-ANN experiments were considered twice when the ANN input was not scaled.

D. Feature Selection

For matching two images, researchers used the cross-correlation algorithm, which is now widely recognized. The correlation operation is linear and shift invariant.To determine the similarity between the sample image and the test image, one needs to measure the absolute difference between its values.In the study of [7], researchers used artificial neural networks, namely Self-Organizing Feature Maps (SOFM), to group the tasks.Similarity-based clustering is intended to reduce the amount of data by separating or grouping similar data together. SOFM consists of two layers of units: the input layer and the concurrency layer (2013).

.E. False Acceptance Rate – False Rejected RateTesting

the system's overall success rate involves utilizing both false acceptance rate and false rejection rate.The number of successful impersonations against a person is calculated as the FAR divided by the total number (or attempted impostors)When attempts at spoofing are unsuccessful, the

GUI will display a "rejected/succed" notification.The FRR is the proportion of failed authentication attempts to a real person. What is this? == Total authentication attempted (FRR)The display of the "rejected/failed" message on the GUI indicates that the verification attempt was unsuccessful.

3. Methodology

3.1. Requirements

Hardware :

The proposed system requires the following hardware:

Operating Systems : Windows 10

Processors : Any Intel or Amd x86-64

RAM : 4GB

Software :

MATLAB

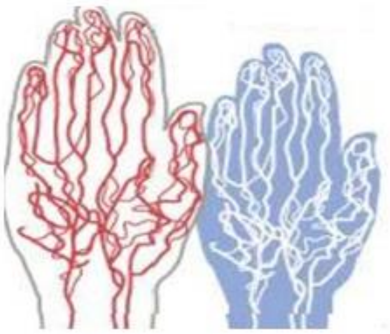

Figure 3: Images of registered Palm

3.2 Proposed Model

Currently, the system relies on image processing techniques that involve acquiring and storing data in the database while also comparing images with the databases. This is known as live image acquisition. The user's activation must begin with the creation of images, which are extracted together through profile extraction, ROI extractiontainment, and feature extraction. The image is captured by an NIR camera after the user scans their hand. Following that, the image is converted to grayscale and then processed as binarized using Otsu's thresholding method. The extraction of the region of interest (ROI) from an image using the edge detection method is the final joint profile. After performing the necessary cropping of the ROI, Adaptive Histogram Equalization (AHE) is performed to obtain a contrast stretched image. The noise reduction techniques used are median filtering or LOG filtering. The image is then morphologically thinned to obtain vein patterns, which show the necessary branching and termination points. These are the small points from which Delaunay triangulation is performed. After Delaun tirangulation, an existing database of user data is matched with the image, and a decision is made about whether to permit the user or not based on matrix matching.The proposed method is a combination as well as an addition of new and recent toolkits and commands available in the latest software versions. This system, being new, has several advantages over the existing legacy systems.Based on the triangulation method, the method is generally described and a block diagram is provided to illustrate its implementation. The procedure can be followed in detail. It can be seen that the two most basic and important steps that govern the operation of the method used for this system or any image processing based system are: 1) Database acquisition2) Database storage3) Direct image acquisition and comparison with the database or comparison of existing images in the database with images in the database.

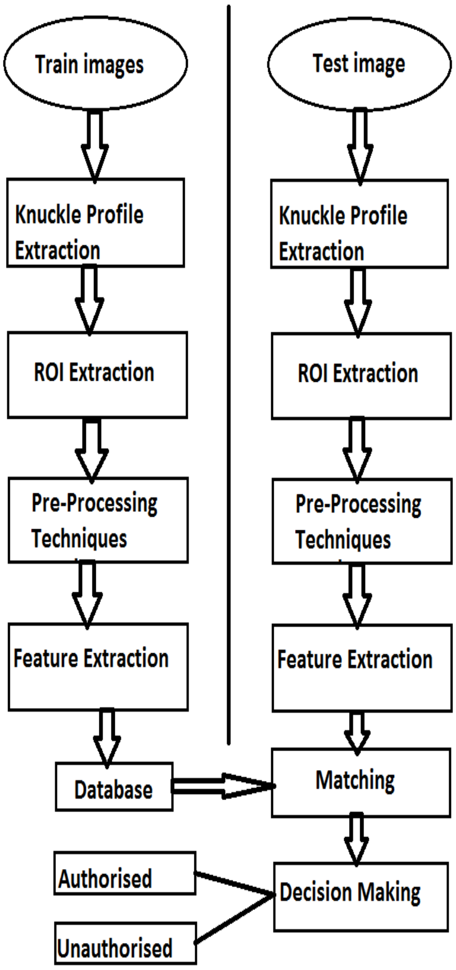

Fig. 1 Block Diagram of the System

The Proposed 2d-Dwtpp Model

Palm vein recognition is proposed to be based on three stages: palm vein image preprocessing, feature extraction, reduction and classification.

[An explanation of this may be found here] Figure 1 illustrates the details of the proposed model.

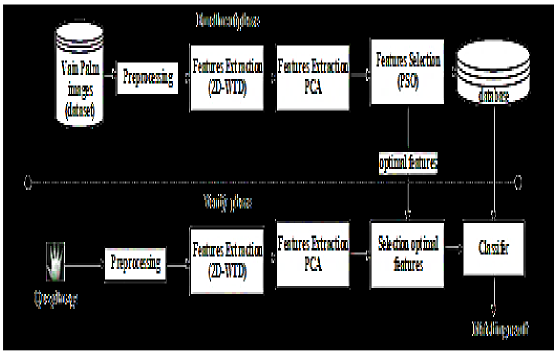

Figure 1.Proposed model structure.

4. Experiments And Result Analysis

The standard PUT Vein Database dataset was used to evaluate the effectiveness of palm vein image classification. Then used 2D HAAR Wavelet 2 level to extract features for the whole image. The experimental results based on raw features and PCA-reduced features are compared and explained in the following sections.

A. PUT Vein Dataset

The palm vein image dataset that we used in our experiment is the PUT Vein Database[3].The researcher gathered data from 50 individuals for both hands and included 1200 images of human vein patterns on the left and right hands. The images were taken in three sessions, four images each, with at least one week between each session. The images in the database have a resolution of 1280x960 and are stored as 24- bitmaps.

B. Experimental Results and Discussion

The proposed model is compared with a convolutional neural network using AlexNet as a pre-trained CNN [33]. AlexNet mainly contains eight weighted layers, the first five are convolutional layers and the remaining three are fully connected layers. This layer is fed by a 1000-dimensional softmax, which generates a distribution over 1000 class labels. Relu is applied after a highly convolutional and fully connected layer [2]. Table II shows the accuracy of palm vein image classification based on AlexNet.

TABLE II. ACCURACY OF PALM VEIN BASED ON ALEXNET

Algorithm	Accuracy	Dataset
Alex	63.50%	Left hand

AlexNet	62.50%	Right hand

The proposed system compares two studies on palm vein recognition. Table IV presents a summary of the comparison of different techniques on the same dataset in terms of accuracy.

TABLE IV. COMPARISON

Algorithm	Accuracy	Dataset
Proposed model	98.65	vein images
Lefkovits	84	vein images
MHAbed [2]	94	PUT vein images

5. Conclusion And Feature Work

A verification model for the Palm Vein was proposed in this paper, which uses 2D discrete Haar wavelet transform for feature extraction and PCA for reducing features with particle swarm optimization (PSO) for selecting new features.Two-level decomposition of wavelets was also employed. The accuracy results were compared with different feature extraction algorithms. According to the experiments, PCA and PSO significantly improved the classification performance. The features extracted by 2D discrete wavelet transform have high redundancy. In the future, we will attempt to utilize the global search feature. The dorsal vein pattern provides high security and reliability for identification, thus making it more advantageous than other biometric systems. This precise system is also contactless and requires very little maintenance. Long-term database is obtained as well as the system is suitable for use in everyday applications. By applying hybrid processing algorithms, we achieve better results and accuracy than existing methods. Therefore, multimodal biometric systems can provide better performance and higher security than single-modal systems. Perhaps the future of biometrics may be multimodal biometric systems instead of single-modal systems, as they overcome some of the problems encountered in single-modal biometric systems.

References

1. Ajay kumar, K. VenkataPrathyusha, "Personal Authentication using Hand Vein Triangulation and Knuckle Shape", IEEE Transactions on Image Processing, vol.38, pp. 2127-2136, September 2009

2. C. Nandini, Ashwini C, MedhaAparna, NiveditaRamani, PragnyaKini, Sheeba K, ,"Biometric Authentication by Dorsal Hand Vein Pattern", International Journal of Engineering and Technology, ISSN : 2049-3444, Volume 2, Issue No.5, May, 2012.
3. Li Xueyan and GuoShuxu"The Fourth Biometric - Vein Recognition", Pattern Recognition Techniques, Technology and Applications, Peng – YengYin(Ed.), ISBN: 978-953-7619-24-4, In Tech., 2008
4. V Evelyn Brindha, "Biometric Template Security using Dorsal Hand Vein Fuzzy Vault", J Biomet Biosat(JBMBS), ISSN:2155-6180, Volume 3, Issue 4, doi : 10.4172/2155-6180.1000145,2012
5. DiptiVerma, Dr.SipiDubey, "A Survey on Biometric Authentication techniques using Palm Vein feature", Journal of Global Research in Computer Science, Volume 5, No. 8, pg no. 5-8, August 2014.
6. V. H. Yadav, "Dorsal hand vein Biometry by Independent component analysis." International Journal on Computer Science and Engineering (IJCSE). ISSN: 0975-3397, Vol.4, Issue No.07, Pg No: 1338-1344, July 2012
7. Abiramsundari, S.Sasidevi, " Hand Dorsal Vein Recognition based on discrete Wavelet transforms", International Journal of Engineering Research- Online , ISSN: 2321-7758, Vol.3, pg.no.72-77, 2015.
8. C. Colbert, "Knuckle profile identity Verification System ," US Patent no.5862246, Jan-1999
9. Chih -Lung Lin and Kuo-Chin Fan, "Biometric Verification Using Thermal Images of Palm-Dorsa Vein Patterns",IEEE,Vol.14, pp.199-213,Feb-2004
10. Chih-Bin Hsu ;Shu-Sheng Hao ; Jen-Chun Lee, "Personal authentication through dorsal hand vein *patterns", Opt. Eng. 50(8), 087201 doi:10.1117/1.3607413, July 28, 2011.s*