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Study on Palm Vein Authentication

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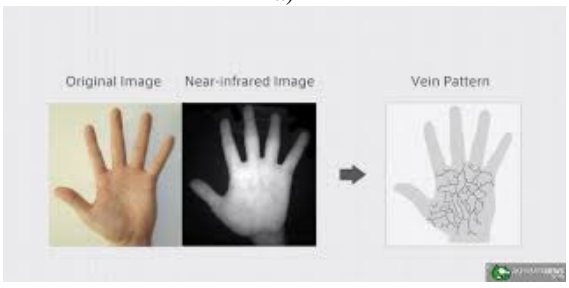
***Abstract*—**Biometrics is a method by which a person's authentication information is generated by digitizing measurements of a physiological or behavioral characteristic. Biometric authentication checks user's claimed identity by comparing an encoded value with a stored value of the concerned biometric characteristic. Various biometric authentications are face recognition, fingerprints, hand geometry etc .Among this, the most recent technology is palm vein authentication. Various techniques have been proposed by researchers in the area of palm vein identification. Most of the methods uses various features of palm vein like geometric, cosine similarity, wavelet features etc but lags with the accuracy of identification and authentication. Authentication using hand geometry does not have the same degree of permanence or individuality as other characteristics. Even authentication using Cosine similarity and wavelet features lags in accuracy. Palm vein authentication is highly accurate and secure since the authentication data exists inside the body and it is difficult to forge. It uses vascular patterns as personal identification data. This paper presents the analysis of various methods and algorithms that identifies the vein patterns in palm for authentication purpose.

***Keywords*—** Feature extraction, matching, Palm print recognition system, ROI

I. INTRODUCTION

Biometrics [1] is the science of establishing the identity of an individual based on the physical, chemical and behavioral attributes of the person. They are used to identify or distinguish individuals based on their unique features. Palm sensor shown in fig1.1**.**

a)



b)

Fig.1.1 a) palm sensor b) palm vein patterns

Currently, passwords, personal identification numbers or identification cards are used for personal identification. In biometric authentication, an account holder's body characteristics or behaviors are registered in a database and then compared with others who may try to access that account. Some methods for authentication are face recognition, fingerprints, voice prints and palm veins. Among this, the contactless palm vein authentication is highly accurate.

A. Face recognition: face recognition uses the visible physical structure of the face and analyses the spatial geometry of distinguishing features in it to identify an individual. This has a disadvantage that the expression on the face affects the recognition process.

B. Fingerprint: fingerprint recognition is the identification by using patterns of friction ridges and valleys on an individual's fingertips which are unique to that individual. This is vulnerable to noise and distortion brought on by dirt and twists.

C. Voiceprint*:* is the identification using the acoustic features of speech that have been found to differ between individuals. The physical conditions of the voice such as those due to sickness affect the voice verification process.

D. Palm vein technology:
In this technology [2], ONE'S PALM is used as the "PASSWORD" for verification. This has high level of authentication accuracy due to the uniqueness and

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complexity of vein patterns of the palm. As shown in fig.1.2 below:

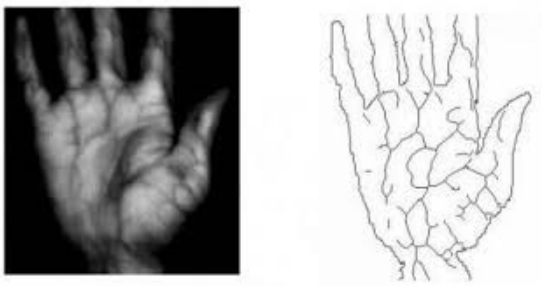

Fig1.2 palm vein patterns

TABLE I
Overview of biometrics

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TECHNOLOGY	ADVANTAGE	DISADVANTAGE
FINGERPRINT	Popular, Cheapest	Less Accurate
VOICE	Non invasive	Least Accurate
IRIS & RETINAL	Very accurate	Invasive, Expensive, Sensitive
PALM VEIN	Non-invasive, Relatively ,Cheap, Accurate	Unfamiliar

a) Its merits:

- It does not require user contact: since vein is the inner feature of body.
- Matching performance is high.
- Most suitable for authentication*:* since it uses vascular pattern of an individual's hand as personal identification data which is unique.
- It is accurate, potential is limitless: finger vein pattern recognition is a convenient and easy to use biometric technology with high security and accuracy level.
- Easy to use or handle*:*
- Unlike fingerprints that change during upbringing, the palm vein pattern is established in the womb and is constant throughout a person's life.
- It can neither be stolen nor reproduced.

b) Demerits:

- Requires specialized devices, so can be expensive.
- Requires highly active deoxidized hemoglobin.

c) Its applications:

Due to its importance in personal identification, it can be used for various applications such as:

1) Management in health care
   - Access control to medication dispensing.
   - Identification of doctors and nurses when accessing protected health records.
   - Patient identification management.
2) Operator authentication
   - Settlement credit card.
   - Obtaining various certificates using the basic resident register card.
3) Owner authentication
   - Retrieval of checked luggage.
   - Driver authentication.
4) Attendance authentication
   - Checking attendance in schools.
   - Clocking in and out of the work place.

E. Biometric based palm print verification process.

The palm print recognition system [3] includes preprocessing followed by ROI extraction. After ROI extraction, features are extracted using the feature extraction algorithms. The palm print is then accepted or rejected on the basis of matching the extracted features shown in fig 1.3.

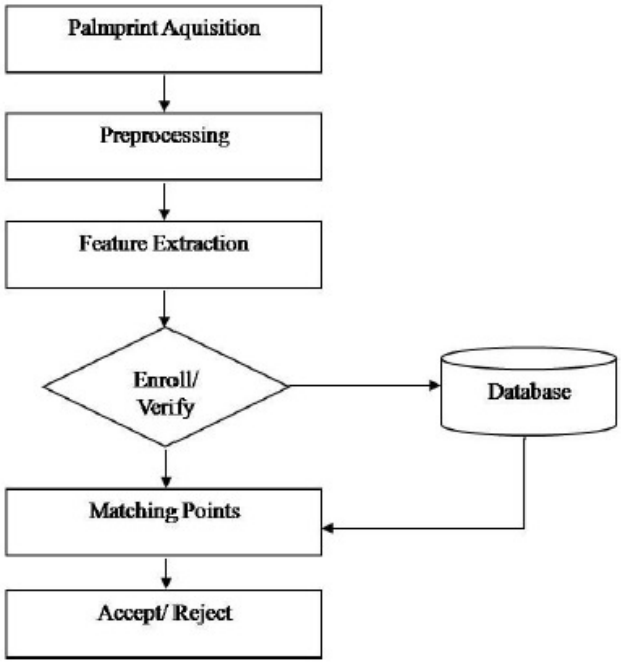

Fig.1.3 flowchart of palm vein extraction

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II. METHODS

Vein recognition methods [10] can be classified into two categories. One is based on low-level image processing called as type I and the other is based on high-level image processing termed as type II method.

A. Type I methods

In the type I methods, traditional image processing methods, such as image enhancement, Li *et al*, 2007a, b; 2009; Li and Pan, 2007,2008) segmentation and edge detection. Some transforms use supplementary tools, such as Discrete Fourier Transform (DFT), discrete cosine transform (DCT), Discrete Wavelet Transform (DWT) (Wang *et al*., 2008a), Radon transform (Wu and Ye, 2009), etc. As high correlation exists among neighboring image pixels, most of these transforms shows high efficiency in energy compaction of highly correlated data and thus can concentrate the vein image content in a few coefficients in transform domain. Nevertheless, some transforms are hardy against affine transforms (e.g., rotation). This is useful for pose variation occurs during vein acquisition.

B. Type II methods

In, Type II methods, personal authentication or identification is considered as a problem of pattern classification and are under investigation. The common characteristics is artificial intelligence and author Ye (2009) proposed a driver identification system using finger-vein technology proposed in which radial basis function (RBF) network and Probabilistic Neural Network (PNN) are employed as the classifiers. Investigational results show the average identification rate of PNN network is no less than 99.2%.

III. PREVIOUS WORKS

A. Palm based recognition system

G.S Badrinath and Phalguni [4] Gupta have proposed the use of stock well transform for palm print recognition. The method proposed is based on instant phase differentiation obtained by using stock well transform of overlapping circular strips. A procedure is proposed to differentiate the left palm from the right. The proposed system is tested on a large database from recognition rate is 100%.

Tee Connie, Andrew Teoh [5] et al have proposed use of palm print recognition using the several linear sub space projection techniques. Specially, PCA(Principal Component Analysis),FDA(Fischer discriminant analysis)and IDA(Independent Discriminant Analysis).In order to analyse the images in multiresolution multi frequency representation a wavelet transform is adopted. The experimental results show that for FDA, the FAR and FRR are as low as 1.356% and 1.492% respectively.

G.Seshokala, Dr.Umakanth Kulkarni [6] et al have proposed palm print recognition by using multiscale wavelet edge detection. Conventional edge detection techniques like Canny suffer from limitations like sensitivity to noise, discriminating between edges etc. These shortcomings are overcome by using wavelet based detection where sharpness of an edge can be described with Lipchitz exponent. Efficiency of correct person recognition is almost 100%.The experiments were carried out on the PolyU standard database.

B. Palm vein based recognition system

Wei YU-Han [7] et al have proposed the adaptive Gabor filter method for palm vein recognition. The overall aim of this work is optimization algorithm that determines the best parameter values of a single Gabor filter for palm vein recognition. The trial results show that the proposed approach is feasible and effective in palm vein recognition. The EER for this approach is 0.6%.

Kuang Shyr-wu [8] et al,Jen chun Lee et al have proposed a method of directional filter bank and minimum directional code for palm vein detection. Directional filter bank involving different orientations is designed to extract vein pattern and minimum directional code is employed to encode the line based vein features in binary code. The EER for the proposed method was 0.518%.The method was applied to a large database of 7200 image for training and testing.

C. Palm Vein Recognition System Using Hybrid Principal Component

This research work focuses on palm vein recognition system [9] using Hybrid Principal Component Analysis (PCA) and Self Organizing Map (SOM). The PCA-ANN experiments were considered twice when inputs to ANN were unscaled (raw scale between 0 and 255) and scaled (scale between 0 and 0.9). The operation of the system was evaluated based on different image resolutions, different training datasets, recognition time and recognition precision. The unscaled PCA-ANN and scaled PCA-ANN gave an optimal recognition accuracies of between (55% and 98%) and (56%-99%) respectively at a resolution of between 30*30 and 60*60 pixels level of cropping. Also further trials were performed in determining the error rates so that the scalability of the algorithms to the task of controlling access will be investigated. The FAR and FRR were between (2.5%-12.5% for unscaled and 2.5-15% for scaled) and (2%-82% for Unscaled and 1%-81% for scaled) at 0.0001 threshold respectively. EER was 9.839% for

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unscaled PCA-ANN at 49.53 pixels resolution and 12.53% for the scaled PCA-AN at 46.37 pixels resolution. This displayed that EER was achieved at lower pixels resolution (46.37) for scaled PCA-ANN than the unscaled PCA-ANN (49.53) which revealed that overall system accuracy would optimally be attained by scaled PCA-ANN than the unscaled PCA-ANN.

D. Analysis of Palm Vein Pattern Recognition Algorithms and Systems

The analysis of palm vein pattern recognition algorithms [11], techniques, methodologies and systems are presented in this paper. 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. The result demonstrates that, there is no benchmark database exists for palm vein recognition. For all processes, there are many machine learning techniques with very high accuracy.

The contactless palm vein authentication technology consists of image sensing and software technology. Palm vein recognition system consists of four key steps: Infrared palm images capture Detection of Region of Interest (ROI) and pre-processing and Palm vein pattern extraction, feature extraction and feature matching. Table2 shows the Analysis of Palm Vein Pattern Recognition Algorithms and Systems where various pattern extraction, feature extraction and matching are discussed.

TABLE II
Analysis of Palm Vein Pattern Recognition Algorithms and Systems [11]

Ladoux et al. [12]	home database	192 images (24 individuals)	

Table 2: Palm vein recognition algorithms and systems.

Authors	pattern extraction	Feature extraction	Matching
Hassan et al. [7]		SITF	Linear Vector Quantization (LVQ)
Zhou and Kumar [9]	Histogram equalization	Hessian phase	Neighborhood matching Random Transform
Zhang et al. [10]	Gaussian-shaped filter		template matching (exclusive or operation)
Li et.al [11]	Histogram equalization	curvelet transform and PCA	nearest-neighbor (NN) classifie
Ladoux et al. [12]	Gaussian low-pass 51x51 filter	SIFT	Euclidean distance between SIFT descriptors
Malki et al. [16]			Cellular Neural Network
Deepamala et al. [17]		Gabor filter, hand shape features, and thinning and pruning algorithms	K-NN with Euclidean distance and ART1 neural network
Zhou and Kumar [19]	Histogram equalization	Hessian phase & localized Radon transform (LRT)	Cosine similarity& Hamming distance
Zhang et al. [20]	Gaussian-shaped filters		Measure distance between two palm vein feature maps by using AND and OR operators
Mirmohamsdadeghi and Drygajlo [21]	Local Binary Patterns (LBP) and Local Derivative Patterns (LDP)	LBPs & high order LDPs	Histogram intersection

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ABLE III

Analysis of Palm Vein Techniques

Methods	Results	Limitation
1.Using multiscale wavelet edge detection	Efficiency is 100%.	Sensitive to noise, discriminating between edges.
2.Using adaptive Gabor filter	EER is 0.6%,High accuracy and speed	Better using directional filter bank method.
3.Using Hybrid Principal Component	EER was 9.839% for unscaled PCA-ANN	EER has lower pixels resolution (46.37) for scaled PCA-ANN.

IV. CONCLUSIONS

This paper presents the various techniques for palm vein recognition. In this conventional edge detection techniques suffer from limitation like sensitivity to noise, discriminating between edges etc. We conclude that palm vein recognition using neural network is quite efficient and accurate.

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