Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 2, Issue 7, October 2018

Biorthognal, Symlet & Discrete Meyer Wavelet Based Palm Print Recognition System

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Abstract: The proposed work investigates the different wavelets at feature level for Palm print based recognition using an indigenously developed peg-free image acquisition platform. The results depict the superiority of different wavelets for the Palm print recognition, using coarse level information. The recognition rate for the proposed model is 97.5% and the value of FRR and FAR is 0.05 and 0.05 respectively. Use other transformer for processing to improve the performance of matching algorithm. Also use best method to perform recognition process.

Keywords: Palm Print; FRR; FAR; Palm Print

I. INTRODUCTION

Palm print based personal verification has become an increasingly active research topic over the years. The Palm-print is rich in information and has been analyzed for discriminating features like where wavelet transform has been used for feature extraction has motivated us to investigate the effectiveness of using combination of multiple wavelets for the textural analysis of palm print.

Personal identification is ubiquitous in our daily lives. For example, we often have to prove our identity for getting access to bank account, entering a protected site, drawing cash from an ATM, logging in to a computer, and so on.

For example, hackers often disrupt computer networks, credit card fraud is estimated at billions dollars per year worldwide. The cost of forgotten passwords is high and accounts for 40%-80% of all the IT help desk calls and resetting the forgotten or compromised passwords costs as much as US$ 340/user/year.

In this paper, a multi biometric system is proposed for human verification i.e. authenticating the identity of an individual.

II. LITERATURE SURVEY

Nowadays, the security systems are beginning to expand into the society because many studies have been focused on improving them. Most of the techniques used to develop these systems are based on ideas from palm-print image analysis. Although these techniques let us to achieve good results, a highly accurate biometrics system can be built through the combination of palm-print texture and hand-geometry features.

G Lu et al [1] has presented a new method for personal recognition using Eigen palms. The proposed method uses similarity measure for the feature matching and has been shown to perform better than Euclidean distance used in for face recognition of objects. Yi-Pu Wu et al., [2] presented a Palm print Recognition based on RB-K means and hierarchical SVM in which palm prints are converted into clusters by successive iterations and the feature matching is done by SVM technology. Adams Wai-Kin Kong and David Zhang [3] proposed a Competitive Coding Scheme for Palmprint Verification. The method uses multiple 2D Gabor filters to extract orientation information from palm lines. The information stored in feature vector called a competitive code and then angular machining is used for comparison.

Lei Zhang et al., [4] proposed Palmprint verification using complex wavelet transform in which complex wavelet structural similarity index is used to compute matching, identify the input palmprint. The algorithm is robust to translation, rotation and scaling. This has a higher acceptance rate and lower false rate than competitive coding method and the drawback is that it requires of big memory management to store the wavelet coefficients. Li Shang et al., [5] proposed that Palm print based personal verification has quickly entered the biometric family due to its ease of acquisition, high user acceptance and reliability. This paper proposes a palm print based identification system using the textural information, employing different wavelet transforms. G. Shobha et al., [6] proposed that Palm Print is one of the relatively new physiological biometrics, attracted the researchers due to its stable and unique characteristics. The rich feature information of palm print offers one of the powerful means in personal recognition. Jessica Lin et al., [7] proposed that parallel explosions of interest in streaming data, and data mining of time series have had surprisingly little intersection. This is in spite of the fact that time series data are typically streaming data. The main reason for this apparent paradox is the fact that the vast majority of work on streaming data explicitly assumes that the data is discrete, whereas the vast majority of time series data is real valued. Tee Connie et al., [8] Palm print is one of the relatively new physiological biometrics due to its stable and unique characteristics. The rich texture information of palm print offers one of the powerful means in personal recognition. Yufei Han et al., [9] said that, Palm print recognition, as a reliable personal identity check method, has been receiving increasing attention during recent years. According to previous work, local texture analysis supplies the most promising framework for palm print image representation. In this paper, we propose a novel palm print recognition method by combining statistical texture descriptions of local image regions and their spatial relations.

Eamonn Keogh et al., [10] introduce the new problem of finding time series discords. Time series discords are subsequence's of a longer time series that are maximally different to all the rest of the time series subsequence. They thus capture the sense of the most unusual subsequence within a time series. Adams Kong et al., [11] propose a feature-level fusion approach for improving the efficiency of palm print identification. Multiple elliptical Gabor filters with different orientations are employed to extract the phase information on a palm print image, which is then merged according to a fusion rule to produce a single feature called the Fusion Code. The similarity of two Fusion Codes is measured by their normalized hamming distance.

Murat Ekinci et al., [12] Palm print recognition is a proliferating technique in the ever increasing use of Biometrics for security and identification. Our paper proposes a technique for palm print recognition using the Discrete Cosine Transform, Haar Transform and the DCT Wavelet along with tests related to their fractional coefficients. Ragavendra R, et al., [13] proposed a three Stage Process for Palmprint Verification. The palm print verification is based on to locate the Region of Interest (ROI). Depeng Zhang and Wei Shu [2] presented two characteristics i.e., datum point invariance and line feature matching for palmprint verification. Datum points are the points of registration have the advantage of invariable location. The directional projection algorithm is designed to locate the principle lines and to determine the end points of the palm.

III. PROPOSED MODEL

In this chapter the fundamental definitions and proposed model are discussed. These fundamental definitions are useful in the calculations of FRR, FAR and CRR which in turn measures the performance of the palm recognition technique. And the proposed model contains the main processing of palm images obtained from the PolyU database.

A. *Block Diagram of Proposed Palm Recognition Model:*

The palm is recognized by applying preprocessing and the features are extracted from the palm images by proposed model. It represents the flow of palm processing during the recognition process. Fig 1 shows the flow graph used for both database creation and test images processing to get feature vectors and the obtained features are matched with one another by the help of Weighted Euclidian distance thereby it gives the result whether the test person belongs to the database or not. Preprocessing consists of three steps. They are color to gray conversion, Image Cropping and resizing. After preprocessing, DWT is applied to extract features.

After extracting features from both train and test set, matching is done using Euclidean distance method. Finally recognition is done based on the results obtained from the matching method.

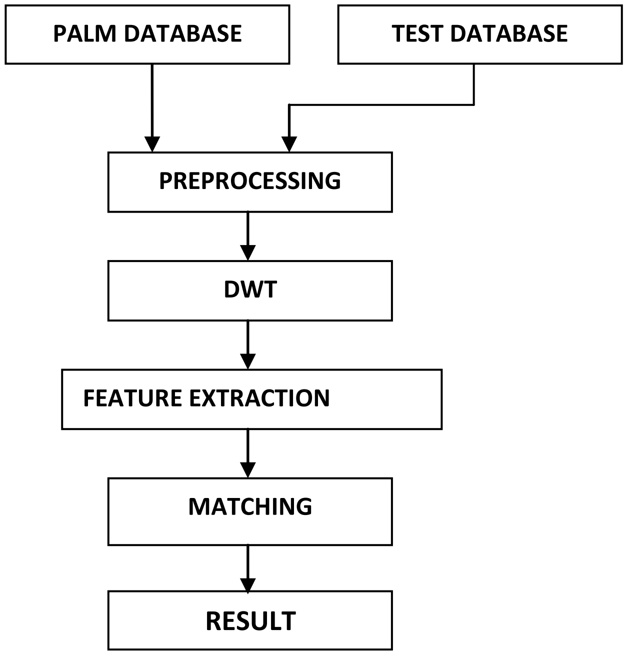


Fig 1. Proposed palm recognition model

B. *Image Acquisition Platform*

The proposed image acquisition setup satisfies the mentioned criteria by proposing a contactless, peg free system. It is an enclosed black box, simple in architecture and employs ring source light for uniform illumination. Two plates are kept inside the image acquisition setup. The upper plate holds the camera and the light source while the bottom plate is used to place individual's hand. The distance between these two plates is kept constant to avoid any mismatch due to scale invariance. The distance between the two plates after empirical testing is kept at 14 inches. The Palm print images have been collected from 80 individuals with 16 images each making a total dataset of 80*16 images. The dataset contains all images of males with age distribution between 22 to 56 years, with a high percentage between 22 to 25 years. A low resolution of 72 dpi has been used employing SONY DSC W-35 CY-BER SHOT for Palm print images acquisition.

C. *Palm print Database*

a) *PolyU palm print Database:*

The average interval between the two sessions was 2 months PolyU Database contains 7752 grayscale palm print images (384 * 284 pixels) corresponding to 386 different palms. As a result, palm prints in the PolyU Palm print Database are believed to have relatively high image qualities. The age distribution is from 20 to 60 years old. We collected samples in two separate sessions. The average time interval between the first and the second sessions was about 9 days.

D. Pre-Processing

The test image and the images in the database are processed before extracting the Features.

a) Preprocessing involves three steps:

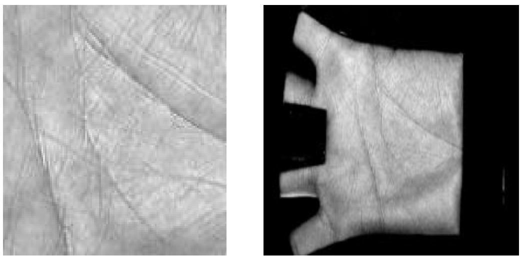
- Colour to gray scale image conversion
- Image cropping
- Image resizing

b) Colour to gray scale image conversion

Images of this sort, also known as black and white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest. Grayscale images are commonly stored with 8 bits per sampled pixel, which allows 256 different intensities.

c) Image cropping.

Palm image contains background and other occlusions that may reduce the accuracy at which the person is identified correctly. Hence, only the palm portion of the image is cropped. The image is converted to binary prior to cropping by comparing the threshold value and pixel value with the help of im2bw function. The threshold for gray scale is calculated with the help of Matlab function gray thresh. The binary image obtained is partitioned into two along the column. For the first portion, image is scanned from left to right until a binary 1 is encountered. When binary 1 is obtained, scanning of that row is stopped by storing the pixel's position. This procedure is repeated for the second half portion scanning the image from right to left. Then the image is cropped based on stored pixel's positions using micro function. Fig 2(a) and Fig 2(b) shows the example of image before cropping and after cropping.



(a) (b)

Fig 2. (a) original image (b) cropped image

E. Feature Extraction

a) Discrete Wavelet Transform

Features extracted from Haar Wavelet transform which Provides better time and frequency information of a signal and can be used to analyze non stationary signal effectively. It Compress the data without losing information by removing redundant data thereby reducing size and computation time. The Haar wavelet is a certain sequence of rescaled square-shaped functions which together form a wavelet family or basis, disadvantage of the Haar wavelet is that it is not continuous, and therefore not differential.

The Haar wavelet's function ψ (t) can be described as

$$\psi(t) = \begin{cases} 1 & 0 \le t < 1/2, \\ -1 & 1/2 \le t < 1, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

Its scaling function φ (t) can be described as

$$\phi(t) = \begin{cases} 1 & 0 \le t < 1, \\ 0 & \text{otherwise.} \end{cases} \quad (3)$$

This process can be repeated until the height and width of the area to be transformed is no longer divisible by 2.

By applying 2D DWT on an image, the image is decomposed into four sub bands LL, LH, HL, HH sub bands, corresponding to approximate, horizontal, vertical, and diagonal features respectively.

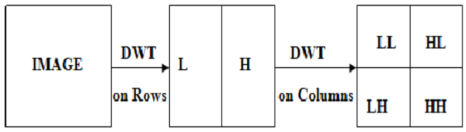


Fig 3. Four bands obtained after DWT

Fig 3 shows the different bands obtained after applying DWT. The sub band HH contains the detail in the high frequency of the image. Two Dimensional Discrete Wavelet Transform for *m* x *n* image is given equation 3,

$$\mathrm{DWT}(j,k) = \frac{1}{\sqrt{2^j}} \int_{-\infty}^{\infty} f(x)\, \psi\left(\left(\frac{x}{2}\right) - k\right) dx \quad (4)$$

Ψ (t) is called mother wavelet. The parameters s and τ, are the scaling and shift parameter, Where j is the power of binary scaling and k is a constant of the filter.

In our project, 1 level DWT is applied on each face image. Haar wavelet is used as the mother wavelet. Approximate band i.e., LL band is considered as the most significant information of the face image. The size of the image obtained after DWT in 50*50.

F. Algorithm

In this section the problem definition, objective and algorithm are described.

The objectives of the proposed model are

- To increase the Correct Recognition Rate (CRR).
- To reduce the False Rejection Rate (FRR).
- To reduce the False Acceptance Rate (FAR).
- To reduce the Equal Error Rate (EER).

The proposed algorithm of palm recognition system is given in the Table 4.1, to authenticate a person based on features of Discrete Wavelet Transform (DWT).

G. Matching Technique

In this we take coefficients of approximate band, these coefficients are reshaped by the help of MATLAB command RESHAPE then applied to find Euclidean distance.

Table 1. Algorithm

Input: Palm Print Image.
Output: Match/Mismatch of a person.

Step1: Read the Palm Image from PolyU database.

Step2: Preprocess the read image.

Step3: Region of interest from Preprocessed Image.

Step4: Feature extraction using discrete Haar Wavelet

Step5: Feature Template is compared with Test Template

Step6: Matching is Performed using Euclidian distance.

Test image is taken from the database and Euclidean distance is calculated by comparing the feature vector of one test image and feature vectors of all images in the database. Euclidean distance value and position of the image in the database for which Euclidean distance is minimum, is noted. Person number is calculated. Euclidean distance value is compared with the threshold value.

Now the test image is taken out of the database and above procedure is repeated to calculate the Euclidean distance value. If p_i and q_i are 2 points in a 2 dimensional plane where i =1,2 ,then the Euclidean distance is given below by Equation

$$d(p,q)= \sqrt{((p_1-q_1)^2 + (p_2-q_2)^2)}$$

IV. PERFORMANCE ANALYSES

We obtained ten images of each individual of which five were used for training and the rest of them were used for validation. The obtained registered palm print image has been analyzed for its texture using different symmetrical wavelet families namely bi orthogonal 3.9, symmelt 8 and demeyer 5. The palm print region 256x256 has been decomposed into three scales for each wavelet type. The Performance analysis of a biometric system is measured using Parameters False Acceptance Ratio, False Rejection Ratio and Equal Error Rate.

- False Acceptance Rate (FAR): Number of false acceptance/number of persons out of database.
- False Rejection Rate (FRR): Number of false rejections / number of persons in the database.
- Equal Error Rate (EER) = FAR-FRR

A. Receiver Operating Characteristics (ROC)

The ROC plot is a visual characterization of the trade-off between the FAR and the FRR.

The FAR and FRR values for different threshold are tabulated below. It is observed from Table 2, and graph Figure 4 that FRR value decreases with respect to threshold. And the FAR values increases with respect to threshold. The both values of FAR and FRR are plotted in one graph then the point at which FRR and FAR curve intersects, the corresponding point of intersection in threshold axis is accepted as threshold value. Similarly the corresponding point of intersection in FRR and FAR axis is known as Equal Error Rate (EER).

Threshold	ID-OD	FAR	FRR	TSR	EER
0.2	20-20	0.05	0.05	95.00	0.05
0.4	20-60	0.05	0.05	95.00	0.05
0.6	40-40	0.15	0.02	97.50	0.08
0.8	30-70	0.10	0.03	96.67	0.07

Table 4.1: Output values for different thresholds

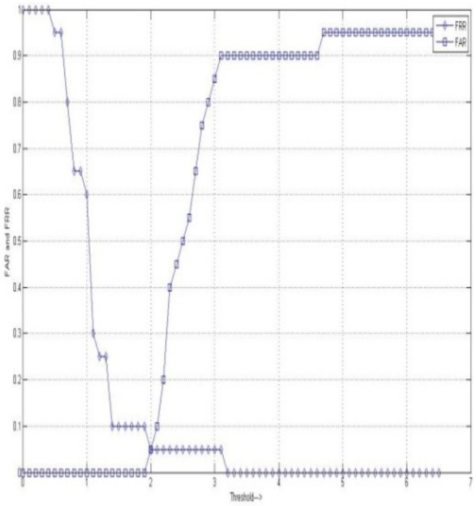


Fig 4. FRR and FAR v/s Threshold.

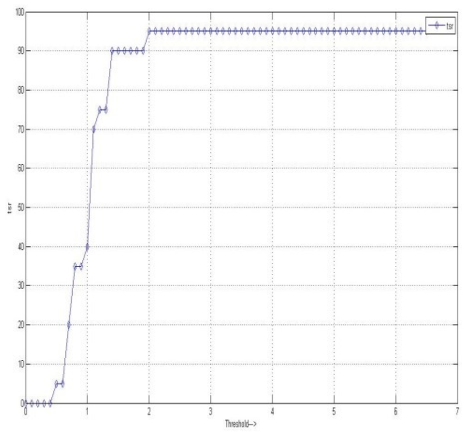


Fig 5. TSR v/s Threshold

V. Conclusion

This proposed work investigates the different wavelets at feature level for Palm print based recognition using an indigenously developed peg-free image acquisition platform. The results depict the superiority of different wavelets for the Palm print recognition, using coarse level information. The recognition rate for the proposed model is 97.5% and the value of FRR and FAR is 0.05 and 0.05 respectively. The future work will be to increase the speed of execution. Use other transformer for processing to improve the performance of matching algorithm. Also use best method to perform recognition process.

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