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Palmprint Recognition Using Transform Domain and Spatial Domain Techniques

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***Abstract*— Palmprint is physiological biometric used for recognition of person. Palmprint containing texture, statistical, line, point, geometry features. In this paper we proposed palmprint recognition using DWT, DCT and PCA techniques (PRUDDP). It is simple and effective methodology for palmprint recognition. The preprocessing used for palmprint image alignment, resize the palmprint image and to enhance contrast of palmprint image by using histogram equalization. DCT and DWT used to generate features and that features are extracted by using PCA. The extracted features from database images and test images are match by using Euclidean Distance.**

***Keywords*— Biometric, DCT, DWT, ED, PCA, and Palmprint**

I. INTRODUCTION

There are two traditional person identification methods are token based and knowledge based. The passport, driving licenses and ID cards are used in token based identification method. The signature and password are used in knowledge based identification method. The passport and ID cards can be lost and password can be forgotten. Biometric identification avoids the limitation of traditional identification. Biometric person identification methods having two characteristics are behavioral and physiological. The behavioral characteristics such as mood and action perform by human like sound, posture, voice, keystroke, signature etc. are depend upon behavior of person. Physiological characteristics depend upon physical body part of person which is unique such as retina, face, iris, fingerprint, and palmprint etc. [1].

There are various types of physiological characteristics for biometric person identification methods but palmprint identification more advantages as compare to other type of biometric system. Palmprint identification is lower cost, high accuracy and high speed features. Palmprint feature having following characteristics:

- Uniqueness
- Reliability
- Security
- Performance
- Collectability

Every person having palmprint line features and that are unique. The palmprint point features require high resolution image. The high resolution image is obtained through scanner. The palmprint geometry features contain palm area, palm length and palm width. The palmprint statistical feature use low resolution image. In this paper we proposed palmprint recognition using DWT, DCT and PCA techniques. The Poly U palmprints are preprocessed by applying transform domain techniques are DWT and DCT. The features are extracted by using spatial domain technique is PCA and extracted features are matching by using ED.

The paper is represented as follow, overview of related work is discusses in section II. The proposed model describe in section III. In section IV discusses algorithm of system. Result and performance analysis in V. The conclusion is in section VI.

II. LITERATURE SURVEY

There has been a demand for high accuracy and robust biometric systems. Numbers of techniques are available for palmprint recognition with their advantages and disadvantages they are as follow:

K P Shashikala et al., [1] proposed palmprint identification system which used poly U database, preprocessing is done by applying DWT and DCT. The features are extracted by using QPCA and matched using Euclidean Distance.

D. Zhang et al., [2] proposed online palmprint identification system which used 2D Gabor phase for feature extraction and features are matched by using Hamming Distance.

Dai et al., [3] proposed robust and efficient ridge based palmprint matching system which used Gabor filter for enhanced the ridges. Principle line feature extracted by using Hough transform is used as fusion method for verification system.

A. Kong et al., [4] proposed competitive coding scheme for palmprint identification system which used competitive coding scheme for extract the palm line information using 2D Gabor filter. This information stored in the competitive code. The angular matched with competitive code.

Huang et al., [5] proposed palmprint verification based on robust line orientation code in which modified finite random transform (MFRAT) used to extract the features of palmprint and that features are matched with test image feature using matching techniques based on pixel to area algorithm.

S. M. Prasad et al., [6] proposed palmprint authentication using fusion of wavelet based representation in which texture features and line features extracted by using wavelet

decomposition of palmprint. The product rule and sum rule are used for score level matching.

Xingpeng Xu et al., [7] proposed multispectral biometrics system. Palmprint images are sampled by using DWT and PCA used for features extraction. Features are matched by using Euclidean Distance.

Cappelli et al., [8] proposed fast and accurate palmprint recognition system based on minutiae. In preprocessing to enhanced the quality of palmprint image then minutiae features are extracted using Gabor filter and that features are matched using minutiae cylinder code.

Zhenhua Gout et al., [9] proposed a hyperspactral palmprint image system which used for correct feature band selection. The 2PCA is used for feature extraction and select the best feature band.

III. METHODOLOGY

The correct person recognized by using Palmprint recognition with DWT, DCT and PCA techniques as shown in Fig. 1.

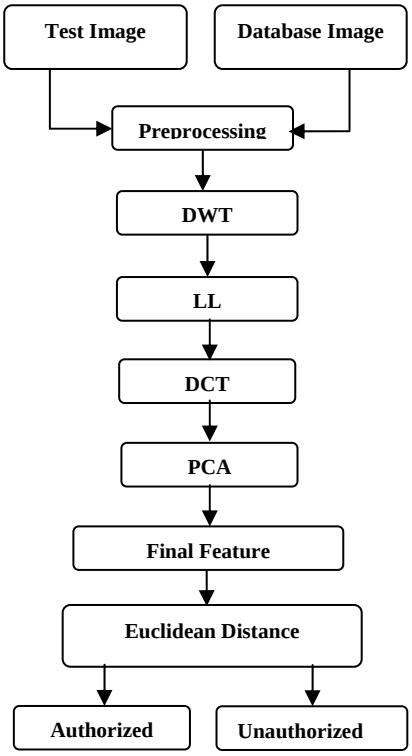

Fig. 1: Palmprint recognition system's flowchart

A. Palmprint Database

The algorithm tested by using POLY-U palmprint database. There are 500 palm images used for system. There are ten images of each person. Seven images are used to create database and remaining three images are used for testing.

B. Preprocessing

The proposed system used preprocessing module, it contain following RGB to gray conversion and filtering.

1) *RGB to Gray conversion:* RGB to gray conversion is to convert colour image into gray scale. Gray scale image in which the value of each pixel is single sample, it carries only intensity information. Gray scale digital images are result of compute the intensity of light at each pixel in single band of the electromagnetic spectrum [14].

2) *Filtering:* The database images and test image are preprocessed. The median filtering is used to remove the noise from the images. The median filtering is used in proposed system to preserving the edges and removes the 'salt and pepper' noise. Filtering improve the clarity of the palmprint image which is important for feature extraction processing.

C. Discrete Wavelet Transform

The Haar Discrete Wavelet Transform is applied on filtered images. There are one approximation band that is LL band and three detailed bands that is LH, HL and HH bands obtaining by passing DWT signal. The approximation band having low frequency and detailed band having high frequency. The significant information present in approximation band that is LL band as compare to detailed band. The DWT sampled the image in four sub bands are as shown in Fig. 2.

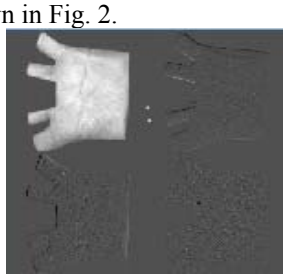

Fig. 2: DWT of palmprint sample

D. Discrete Cosine Transform

A Discrete Cosine Transform (DCT) is used in image processing and signal for lossy data compress. The DCT has strong energy compaction property. The DCT applied on approximation band that LL band to compute the DCT coefficient as shown in Fig. 3.

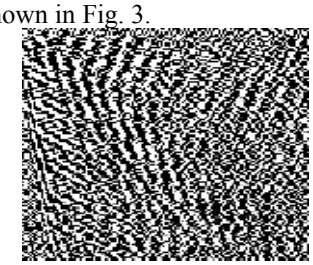

Fig. 3: DCT of palmprint sample

E. Principal Component Analysis

Principal Component Analysis (PCA) is used obtaining the Eigen vectors and Eigen values of image. The palmprint is of size 256x256 pixels. The palmprint image pixels are arranged in column wise to derive a matrix T. To calculate the mean of each row of T to obtain mean matrix m of size. Mean matrix zero z of T is obtained by subtracting each element of T from the corresponding mean. Compute the covariance c of matrix z and Eigen vectors using equation 1.

$$c*V=V*\lambda \quad (1)$$

Where λ is the Eigen value and V is the Eigen vector. Coefficients of PCA are calculated by multiplying z and V [1].

F. Euclidean Distance

Euclidean Distance is used to compare the feature vectors. Euclidean Distance is calculated by summation of squared difference between two feature vectors. The equation 2 for Euclidean Distance is

$$ED = \sqrt{\sum_{j=1}^{k} (r_j - s_j)^2} \qquad (2)$$

Where ED is Euclidean Distance, k is length of feature vector. r_j is the j^{th} component of database feature vector. s_j is the j^{th} component of test feature vector.

IV. ALGORITHM

The algorithm of palm identification system is given in the TABLE I, to authentication of person using DWT, DCT and PCA.

TABLE I
ALGORITHM of PRUDDP

Input: Palm Image
Output: Authorized/Unauthorized of person

1. Read palm image from POLY-U database.
2. Apply preprocessing technique.
3. Apply Haar DWT.
4. Apply DCT on approximation band image.
5. Final feature vector is extracted by applying PCA on DCT coefficient.
6. The Euclidian distance is used to compare test features and database features for matching.

V. RESULTS AND PERFORMANCE ANALYSIS

The Poly-U palmprint database is used to test the performance of the system. Total 550 verifications are done. Poly-U palmprint database contains ten sample images of each person. The first seven palm images of each person used for the database creation. The last three palm images of each person considered for testing.

A. False Rejection Rate (FRR)

It is stated as the ratio of the number of falsely rejected person to the total number of database person, is given in equation 3. The system falsely rejected the test palm image of person whose palm image is in database.

$$FRR = \frac{\text{Number of false rejected person}}{\text{Total number of database person}} \qquad (3)$$

TABLE II shows the different Euclidean distance and FRR, Fig. 4 shows the FRR against different Euclidean distance plotted using the data in table.

TABLE II
EUCLIDEAN DISTANCE and FRR

Euclidean Distance	FRR
0.00	0.1
0.02	0.095
0.04	0.062
0.06	0.05
0.08	0.016
0.1	0.00
0.12	0.00

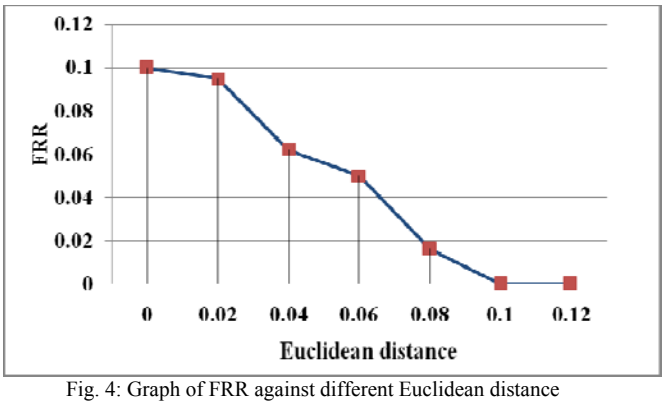

Fig. 4: Graph of FRR against different Euclidean distance

B. False Acceptance Rate (FAR)

It is stated as the ratio of the number of falsely accepted person to the total number of database person, is specified in equation 4. The system falsely accepted the test palm image of person whose palm image is not in database.

$$FAR = \frac{\text{Number of false accepted person}}{\text{Total number of database person}} \qquad (4)$$

TABLE III shows the different Euclidean distance and FAR and a graph is plotted for FAR is as shown in Fig 5.

TABLE III
Euclidean distance and FAR

Euclidean Distance	FAR
0.00	0.00
0.02	0.00
0.04	0.00
0.06	0.04
0.08	0.05
0.1	0.071
0.12	0.083

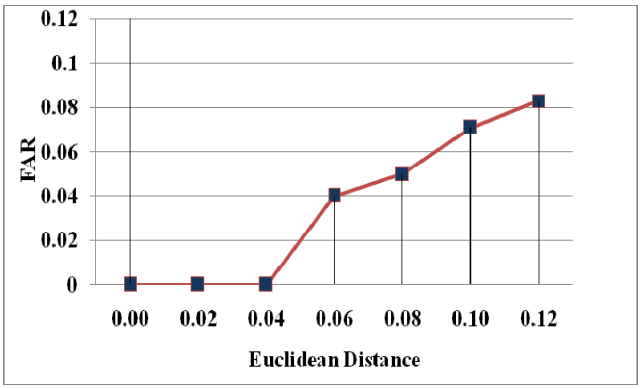

Fig. 5: Graph of FAR against different Euclidean distance

C. *Equal Error Rate (EER)*

It is stated as the ratio of both accept and reject errors are equal. The EER value obtained from the FRR and FAR values with threshold graph. The lower EER value is better for system performance. Fig. 6 shows the EER of this system. The EER of the system is 0.045 and the Euclidean distance taken for identification is 0.05.

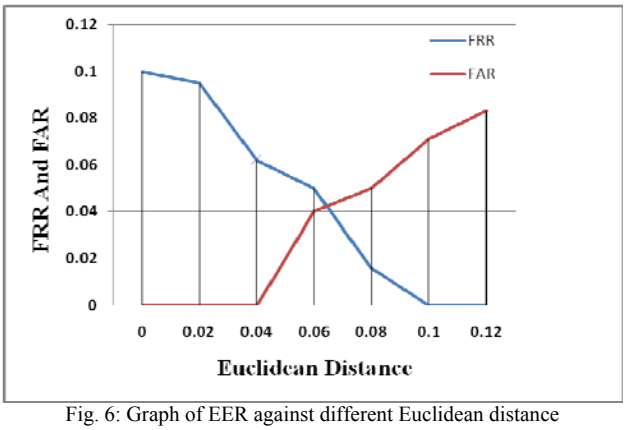

Fig. 6: Graph of EER against different Euclidean distance

D. *Correct Recognition Rate (CRR)*

It is stated as the ratio of the number of correctly matched person in the database to the total number of database person, is given in equation 5.

$$CRR = \frac{\text{Number of correctly matched person}}{\text{Total number of database person}} \quad (5)$$

There are total 550 images counts. The system responds with number times count correct and incorrect identifications. There are 3 identifications are false accepted while 8 identifications are false rejected. And 539 identifications correct. The system accuracy calculated by taking percentage of correct identification over total images count. Therefore accuracy of the system is 98%. TABLE IV summarizes the result and Fig. 7 shows summery of result.

TABLE IV
SUMMARY of RESULTS

Falsely accepted images	3
Falsely rejected images	8
Correct recognition	539
Total images count	550

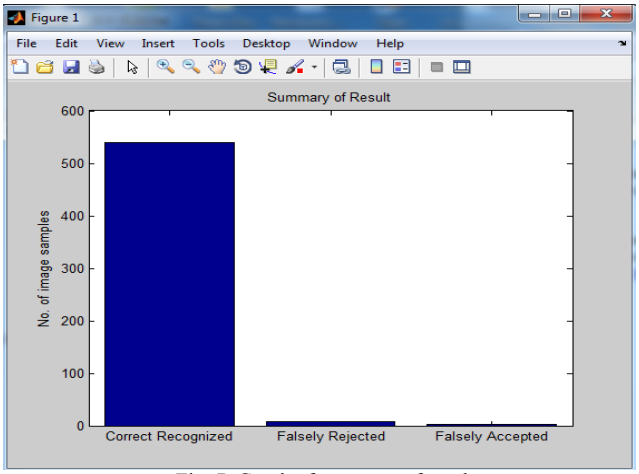

Fig. 7: Graph of summary of result

In TABLE V, compare accuracy of the existing Palmprint Recognition Using Image Processing palmprint verification system (PRUIP) [10] and proposed PRUDDP model. It is observed that the accuracy is better in the case of proposed algorithm compared to the existing algorithm.

TABLE V
COMPARISN of EXISTING and PROPOSED TECHNIQUE

Model	**Accuracy (%)**
Existing PRUIP (DCT)Model[10]	92.86
Proposed PRUDDP Model	98

VI. Conclusion

This paper presents the palmprint recognition using DWT, DCT and PCA techniques. The Poly U palmprint database is used to test the performance analysis. Median filtering used to remove the noise from palmprint images. The haar wavelet is used on filtered image to generate approximation band is LL and detailed bands are LH, HL and HH. The DCT is applied on approximation band to obtain DCT coefficients. The features are extracted by applying PCA on DCT coefficient. The ED is used to compare test features and database features. It is observed that the recognition rate is 98%. The EER of the system also low, which is about 0.045. This is acceptable and performance of the system is better than existing system.

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