iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** V **Month of publication:** May 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 5 Issue V, May 2017
ISSN: 2321-9653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Palmprint Recognition Based on Fusion of Spatial and Transform Domain Features

Chandrakala V[1], Chetan Tippanna Madiwalar[2], K Suresh Babu[2], K B Raja[2], Venugopal K R[3]
[1]*Dr. Ambedkar Institute of Technology, Bangalore-560056, India.*
[2]*University of Visvesvaraya College of Engineering, Bangalore University, Bangalore-560 001, India.*

Abstract: The authentication of person using palmprint biometric trait is more efficient as more number of features are available. In this paper we propose palmprint recognition based on fusion of spatial and transform domain features. The palmprint images are preprocessed and the spatial domain features are extracted using Linear Binary Pattern (LBP). The LBP features of test palmprint images are compared with LBP features of database images using Euclidean Distance(ED) to compute performance parameters. The Stationary Wavelet Transform (SWT) is applied on LL band of Discrete Wavelet Transform (DWT) matrix of palmprint images to extract transform domain features. The ED is used to compare transform domain features of database and test palmprint images to compute performance parameters. The Optimum Total Success Rates (OTSR) of spatial and transform domain technique are fused to obtain better OTSR compared to individual techniques. It is observed that, the performance parameters are better compared to existing methods.
Keywords— Biometrics, Palmprint images, LBP, DWT, SWT, Fusion.

I. INTRODUCTION

biometric systems are used to authenticate the identity of human beings by measuring the physiological and/or behavioral characteristics of biometric traits. the physiological biometric traits are parts of human body and almost static which includes fingerprint, palmprint, iris, dna etc., the behavioral biometric traits include signature, voice, keystroke, hand gesture etc., which vary based on moods of humans and environment around a person. the biometric traits are characteristics must satisfy. (i) universality: every person must have the characteristics. (ii)distinctiveness: the characteristic of biometric traits must be different for humans.(iii)permanence: the characteristic must be constant over a period. (iv)collectability: the characteristic must be measured quantitatively by collecting biometric trait samples. (v)performance: the recognition efficiency must be high with low error rates.(vi)acceptability: the human beings are willing to accept the use of biometric traits for their recognition. (vii)privacy: the privacy of the person must be protected.the palmprint is used in our research to recognize a person as it has lot of unique and stable information such as (i) geometrical features like dimensions and area of the palmprint. (ii) principle line and its locations. (iii) wrinkle features which are irregular and thin lines and are different from the principle lines. (iv)delta like regions, which are stable and unique (v) minutiae features Organization: This paper is organized as follows: Section 2 describes the overview of Related Work, Section 3 focuses on proposed model, Section 4 describes proposed algorithm, and Section 5 displays the Performance analysis and results using LBP, DWT and Fusion to indicate the effectiveness of proposed approach. Finally Section 6 presents the conclusion and outlines our future work.

II. RELATED WORK

Shashikala and Raja [1] explored palm print identification based on DWT, DCT, and QPCA. The Histogram Equalization is used to increase the contrast. The DWT is applied to generate LL, LH, HL, HH bands. The LL is converted into the DCT co-efficient using DCT and QPCA is applied to generate the features. Hafiz Imtiaz and Shaikh Anowarle Fahan [2] proposed 2D DWT. The entire image is segmented into spatial modules, histogram of each local mode reduces the feature dimensions and also high within class compactness and between class separability of extracted feature. Further the features are reduced by PCA. The recognition accuracy and complexity is reduced. Zhaongxian Qu et al., [3] introduced a novel specific palmprint verification approach. It uses 32×32 user specific blocks. Three methods are adopted for verification rate and speed i) sliding block-extracts every part feature ii) classify method-k nearest neighbor method iii) specific block and dimensions of extracted features. This method achieved higher verification rate compared with the methods without block selection on a database.Wei Li et al., [4] proposed efficient joint 2D and 3D palmprint matching with proper alignment. The 2D and 3D palmprint data is captured simultaneously and the features are fused. The use of ICP method (Iterative Closest Point) estimates the Translation and Rotation. The refinement by Translation (T) and rotation (R) used to align the texture features and all of the principle lines of features and shape features have increased verification accuracy. Runbin Cai and Dewan Hu [5] introduced Image Fusion of Palmprint and Palm Vein. The use of dual-sensor fusion system combines image from a visible light CCD camera with near infrared images. In this fusion of palmprint and palm vein uses pre-processing algorithms for palm authentication systems. The methods used are opponent–processing and Dual-Tree Complex Wavelet algorithm (DTCWT). Opponent –processing based on biological model, while DTCWT is based on mathematical model. The results show that fused images using two methods are more effective for image fusion than Discrete Wavelet Transform (DWT) and Shift Invariant Discrete Wavelet Transform (SIDWT). Ragavendra et al., [6] proposed a three Stage Process for Palmprint Verification. The palmprint verification is based on to locate the Region Of Interest (ROI). The three process of palmprint verification are (i) Locating and segmenting the ROI and locating the corner points between middle finger and ring finger. (ii) Texture feature extraction of palmprint using Log Gabor Transform. (iii) Palmprint classification for using Gaussian Mixture Model (GMM) and Independent Component Analysis (ICA) both together as ICA Mixture Model (ICAMM). By combining the Log Gabor with ICA will perform better than Log Gabor and ICA and outperform individual performance of Log Gabor and ICA. Jane you et al., [7] Presented a technique on hierarchical coding scheme to integrate multiple palmprint features for guided palmprint matching. The combination of four features is Level-1 Global geometry, Level-2 Global texture energy, Level-3 fuzzy interest line, Level-4 local texture feature. The level 1, 2, 3 reduce the number of samples for further processing at the fine level and Level-4 does fast search for the best match. Qichuntian et al., [8] proposed palmprint classification algorithm based on wavelet multi-scale analysis with a new feature extraction and match algorithm. (i) Feature extraction- based on wavelet analysis used for multiscale analysis. (ii) Matching algorithm-layered match algorithm for different scale features. The result shows decrease affects from illumination, imaging distance, shape transform, aging and noise. Lishang et al., [9] introduced Palmprint extraction using weight coding based non-negative sparse coding. By extracting the feature vectors of the palm print locality, orientation and spatial selection with feature extraction. The image reconstruction task is implemented and compared with basic NNSC (Non-Negative Sparse Coding). Palanikumar et al., [10] proposed palmprint enhancement using GA-AIVHE method (Genetic algorithm-Adaptively Increasing the Value of Histogram).HE-AIVHE (Histogram Equalization-AIVHE) is a contrast enhancement method. Enhancement is controlled by two user parameters beta and gamma. It enhances the contrast but the brightness is not preserved. To overcome this genetic algorithm is used. It optimizes the value of beta and gamma based on the entropy value which is a fitness function. Lei Zhang et al., [11] 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.

III.PROPOSED MODEL

In this section, the palmprint recognition based on spatial domain technique using Linear Binary Pattern (LBP), transform domain technique using Discrete Wavelet Transform (DWT) and Stationary Wavelet Transform (SWT) are discussed. The proposed technique using fusion of spatial and transform domain techniques is discussed.

A. Palmprint recognition using Spatial Domain Technique:

The palmprint images are resized in pre-processing unit and and features are extracted using LBP technique. The block diagram of spatial domain technique using LBP is shown in figure 1.

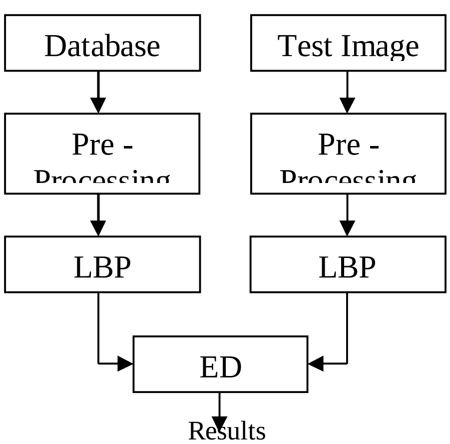

Fig 1: The palmprint recognition using LBP

1) The Palmprint Database: The polyUpalmprint database [28] is considered to test the proposed algorithm. The total number of persons in the database is 386 with twenty images per person. The total number of palmprint images available in the database is 7720. Each palmprint image is of size 384×284 with BMP format. The palmprint image samples of a person are shown in figure 2.

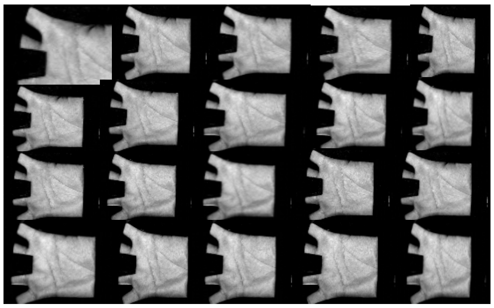

Fig 2 Samples of palmprint images

2) Preprocessing: The palmprint images are resized from 384×284 to 128×128 to reduce dimensions of each image. The original palmprint image and its resized images are shown in figure3.

(a) Original image (384×284) (b) Resized image (128×128)

Fig 3 Preprocessed operation

3) Linear Binary Pattern (LBP): The technique is applaid on 128×128 preprocessed palmprint image to convert original palmprint image into LBP equivalent feature matrix. The LBP technique is applied on each 3×3 matrix of palmprint image. Each pixel Co-efficient of 128×128 image is converted into LBP equivalent. The zeroes are padded around the border of 128×128 image palmprint image to convert border pixel values into LBP co-efficient values.

Illustration of sign LBP:

Consider 3×3 matrix of an imageas shown in matrix 1

$$I = \begin{pmatrix} 28 & 200 & 176 \\ 78 & 156 & 220 \\ 90 & 198 & 256 \end{pmatrix} \quad \text{..............(1)}$$

The centre pixel value is Pc=156 and is compared with neighbouring pixels P_n to convert grey values into binary values based on equation 2.

$$Pn = \begin{cases} 1, & Pn \geq Pc \\ 0, & Pn < Pc \end{cases} \quad \text{.......................(2)}$$

Where n=1 to 8

The LBP matrix is obtained and is given in equation 3.

$$\begin{pmatrix} 0 & 1 & 1 \end{pmatrix}$$

LBP = 0 1 1 ………………….(3)
Matrix 0 1 1

The centre pixel of original value is converted into LBP value based on neighboring binary values, which are converted into decimal value based on weighted by power of two as given in equation 4.

$LBP(Pc)=0\times2^7+1\times2^6+1\times2^5+1\times2^4=0\times2^3+0\times2^2+1\times2^1+1\times2^0$

$= 2^6+2^5+2^4+2^1$

$=114$ ………………..(4)

Similarly every pixel value of palmprint image is converted into LBP values. The original palprint image and its LBP image is as shown in figure 4.

(a) Original image (b) LBP image

Fig. 4 LBP Feature image

4) *Euclidean Distance*: The similarity measurement between two images i.e., two matrices is computed using ED. The threshold values are fixed and are compared with computed ED values to check similarities. The computed ED values are greater than the threshold values then the images are different else similar images. The ED is computed using equation (5)

$$E\,D = \sqrt{\sum_{i=1}^{M}(Pi - qi)^2} \quad \text{……………………………….. (5)}$$

Where, M = No of coefficients in a vector.

Pi= Coefficients values of vectors in database.

qi = Coefficient value of vectors in test image

B. Palmprint Recognition based on Transform Domain:

The human being is recognized using palmprints based on transform domain techniques. The polyu palmprint database is considered in the algorithm. The DWT is applied on palmprint images to generate high and low frequency bands. The SWT is applied on low frequency band of DWT to derive features of palmprint. The palmprint recognition based on transform domain technique is as shown in figure 5

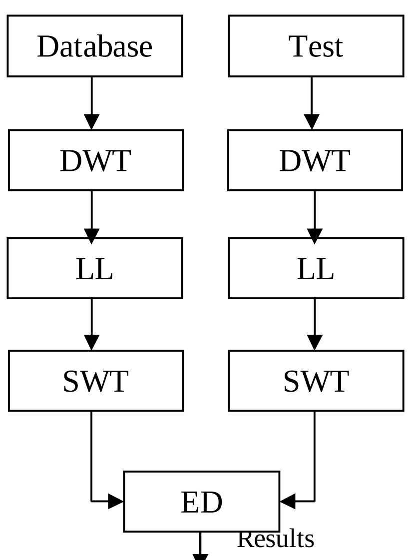

Fig. 5 The palmprint recognition using DWT and SWT

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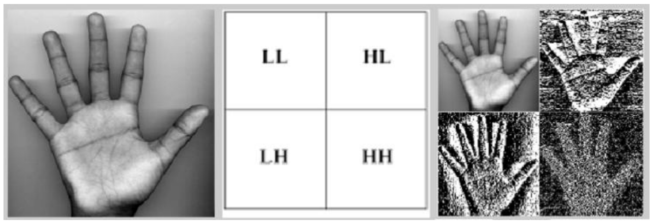
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

1) *Discrete Wavelet transform (DWT):* The 2D spatial domain signal is converted to transform domain signal using DWT. The 2D signal is decomposed simultaneously using low and high pass filters to obtain corresponding frequency components. The spatial domain signal is converted into detailed bands such as LH, HL, HL and HH using high pass filters. The horizontal, vertical and diagonal edge informations are available in detailed bands. The low pass filter converts spatial domain signal into approximation band (LL) of DWT, which has significant information of the signal. The one level decomposition of spatial domain palmprint image of DWT is as shown in figure 6.



a)Palmprint b) DWT decomposition c) Palmprint decomposition.

/Fig. 6 DWT Decomposition of palmprint image

DWT provide information about both time location and frequency compared to Fourier Transform, which provide information about only frequency.

The palmprint image is converted into DWT matrix by considering 2×2 matrix from palmprint image matrix is given in equation 6.

$$x = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad \text{……………….(6)}$$

Where a, b, c and d are pixel intensity values of palmprint image.

The DWT bands such as LL, LH, HL and HH are obtained using equations 7, 8, 9 and 10

$$LL= \frac{a+b+c+d}{2} \quad \text{…………………(7)}$$

$$LH= \frac{a+b-c-d}{2} \quad \text{…………………(8)}$$

$$HL= \frac{a-b+c-d}{2} \quad \text{…………………(9)}$$

$$HH= \frac{a-b-c+d}{2} \quad \text{………………...(10)}$$

Similarly, the procedure is repeated for all 2×2 matrix of palmprint image to convert whole image into DWT matrix.

2) *Stationary Wavelet Transform (SWT):* The DWT has a drawback of translation invariance, which is taken care in SWT. The undecimated version of DWT is SWT and is also known as Redundant Wavelet Transform (RWT).The SWT has shift invariance property, which is achieved by removing the down samples in DWT. The number of samples of SWT are same as number of samples of original spatial domain image. The number of samples in spatial domain and SWT are maintained equally by inserting Zeroes in the boundaries of spatial domain image.

IV. PROPOSED FUSION TECHNIQUE MODEL

The Spatial domain technique based on LBP and transfer domain Technique based on DWT and SWT are fused using normalization technique to obtain better results. The proposed model is as shown in figure 7. Problem Definition: The palm print recognition based on LBP, DWT, SWT and Fusion technique is proposed to authenticate human beings effectively. The algorithm is given in Table 1.

A. Objectives

The algorithm must identify humans efficiently with the following

1) The success rate of identification is high.

2) The error rates such as FRR, FAR and EER must be low.

3) The optimum total success rate must be high.

Table 1: Proposed Algorithm

Input: Palm print Images Output: Performance Parameters 1. The Palmprint images are considered from poly U database to test the proposed algorithm. 2. The Palmprint images are resized to 128×128 in pre-processing section to apply LBP technique. 3. The spatial domain features are extracted from plamprint images using LBP technique. 4. The LBP features of database images are compared with test images using ED to compute performance parameters. 6.The DWT is applied on Palmprint images and only LL sub-band is considered. 7. The transform domain features are extracted using SWT on LL band. 8.The ED is used to compare SWT features of database images and test images to compute performance parameters. 9.The performance parameters obtained from spatial domain and transform domain techniques are fused based on normalization technique to obtain better performance parameters.

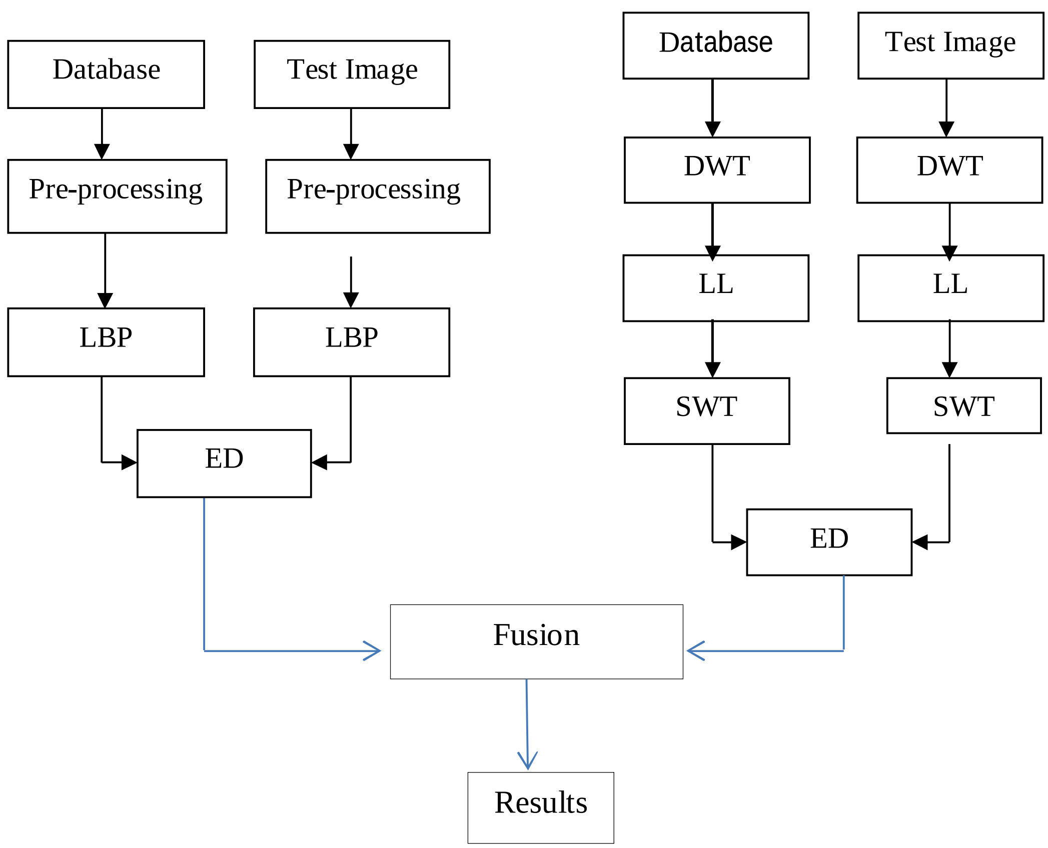


Fig. 7 Fusion of Spatial and Transform domain

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ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

V. PERFORMANCE ANALYSIS

In this section, the definitions of performance parameters, the performance results using LBP and transform domain techniques, the performance results based on fusion techniques and comparison of proposed method with existing methods are discussed.

A. Definitions of performance parameters

The performance parameters such as FRR, FAR, EER, TSR and OTSR are used to test the performance of the proposed algorithm.

1) *False Rejection Rate (FRR):* The probability of genuine persons being rejected as an imposter. It is the ratio of number of genuine persons rejected to the total number of persons inside the database and is computed in equation 11

$$FRR = \frac{\text{number of genuine persons rejected}}{\text{total number of persons inside the database}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

2) *False Acceptance Rate (FAR):*The probability of imposter being accepted as genuine persons. It is ratio of imposters accepted as genuine persons from outside the database to the total number of persons in the outside database and is computed in equation 12

$$FAR = \frac{\text{number of imposter accepted as genuine persons}}{\text{total number of persons outside the database}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

3) *Equal Error Rate (EER):* Is defined as error trade of between FRR and FAR i.e., FAR = FRR for a particular threshold value. A lower EER value indicates better performance of biometric systems.

4) *Total Success Rate (TSR):* Is the measure of accuracy of biometric systems. It is the ratio of the total number of genuine persons identified correctly in the database to the total number of persons inside the database and is computed in equation 13.

$$TSR = \frac{\text{genuine persons identified correctly}}{\text{total number of persons in inside the database}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

5) *Optimum Total Success Rate (OTSR):* The value of TSR corresponding to the EER for specified threshold. The optimum TSR values are computed using equation 14

$$NormalizationFusion = \left[\frac{\text{Actual value of Opt. TSR of DWT}}{\text{Actual value of Opt. TSR of LBS}}\right] \times [\text{Max of TSR of LBP}] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

6) *Maximum Total Success Rate (MTSR):* The value of maximum TSR for specified threshold value irrespective of error value.

B. Performance Results using LBP

The LBP techniques are used to extract texture features of Palmprint images in the spatial domain to test the performance of the biometric system. The performance parameters such as combinations of Person inside Database (PID) and Person Outside the Database (POD) are tabulated and plotted. The variations of performance parameters with threshold value for PID and POD combinations of 10:10, 20:10, 20:30, 50:50 and 100:50 are tabulated in table 2 to 7 and plotted in figure 8 to 13. The value of FRR decreases with increase in threshold values. The values of FAR and TSR increases with increase in threshold value for all combinations of PID and POD's. The EER values for PID and POD combinations of 10:10, 20:10, 20:30, 50:50 and 100:50 are 10, 9, 9, 13 and 6 respectively. The percentage OTSR values for PID and POD combinations of 10:10, 20:10, 20:30, 50:50 and 100:50 are 90, 91, 91, 87 and 94 respectively. The percentage maximum TSR values for PID and POD combinations of 10:10, 20:10, 20:30, 50:50 and 100:50 are 100, 95, 95, 98 and 99 respectively. The average EER, OTSR and maximum TSR values are 94, 90.6 and 97.4 respectively.

Table 2: Performance parameter variations for PID and POD of 10 and 10.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.7	100	0	0
0.8	80	0	20

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0.9	30	0	70
1.0	10	0	90
1.02	10	10	90
1.20	0	100	100
2.20	0	100	100

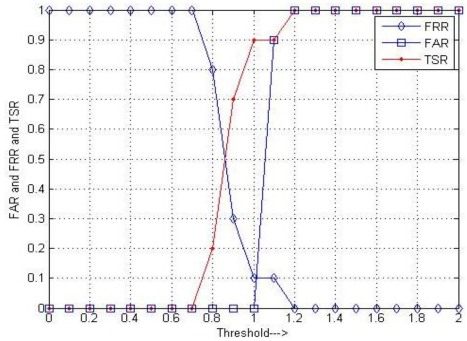

Fig. 8 Variations of performance parameters for PID and POD of 10 and 10.

Table 3: Performance parameter variations for PID and POD of 20 and 10.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.6	100	0	0
0.7	95	0	5
0.8	75	0	25
1.0	10	0	90
1.02	9	9	91
1.10	0	90	95
2.00	0	100	95

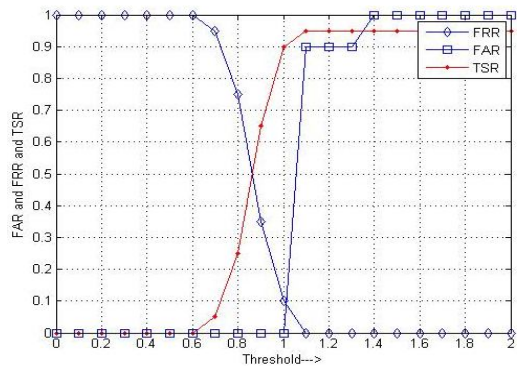

Fig. 9 Variations of performance parameters for PID and POD of 20 and 10.

Table 4: Performance parameter variations for PID and PD of 20 and 30.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.6	100	0	0
0.7	95	0	5
0.8	75	0	25
1.0	10	0	90
1.01	9	9	91
1.10	0	97	95
2.00	0	100	95

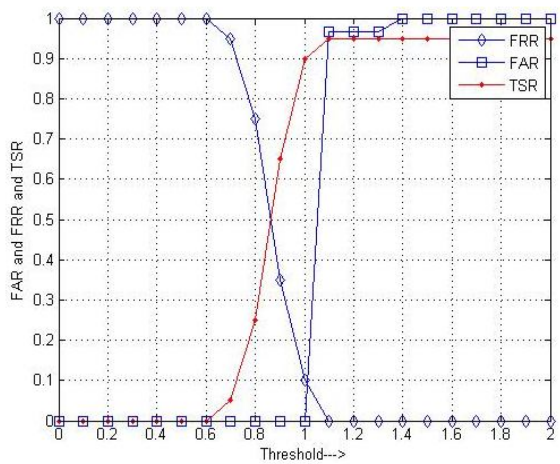

Fig. 10 Variations of performance parameters for PID and POD of 20 and 30.

Table 5: Performance parameter variations for PIDand POD of 30 and 20.

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Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.5	100	0	0
0.6	93.3	0	7
0.8	70	0	30
1.0	14	6	87
1.01	11	11	89
1.1	0	100	97
2.0	0	100	97

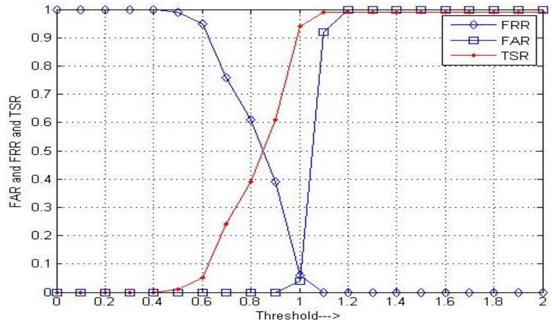

Fig. 11 Variations of performance parameters for PID and POD of 30 and 2

Table 6: Performance parameter variations for PIDand POD of 50 and 50.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.5	100	0	0
0.6	95	0	6.7
0.8	60	0	40
0.95	13	13	87
1.00	10	15	90
2.00	0	100	98

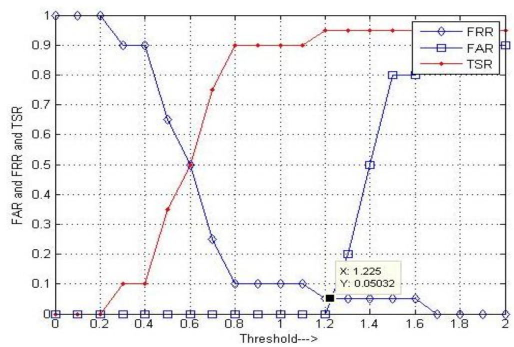

Fig. 12 Variations of performance parameters for PID and POD of 50 and 50.

Table 7: Performance parameter variations for PIDand POD of 100 and 50.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.4	100	0	0
0.5	99	0	2
0.6	95	0	5
0.8	62	0	40
1.0	6	6	94
1.1	0	92	99
2.0	0	100	99

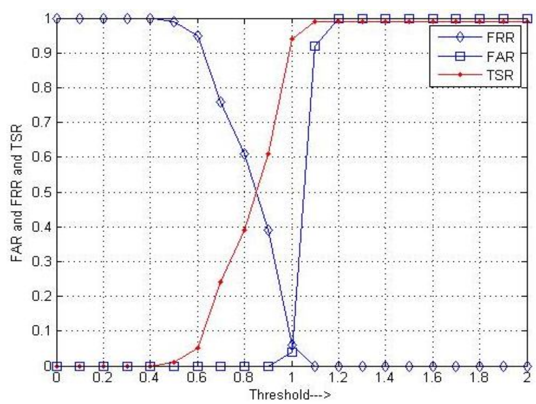

Fig. 13 Variations of performance parameters for PID and POD of 100 and 50.

C. Performance Results using Transfer Domain

The palmprint images are converted into LL band matrix of DWT and SWT are applied on LL band matrix to derive transform domain features. The performance parameters such as percentage FRR, FAR, EER, OTSR and MTSR are computed to test the performance of the biometric system. The performance parameters are computed by considering the different combinations of PID and POD's. The variations of percentage FRR, FAR and TSR with threshold for various PID and POD combinations of 10:10, 20:10, 20:30, 30:20, and 50:50 and 100:50 are tabulated in tables 8 to 12 respectively. It is observed that the values of FAR and TSR increases with threshold values. The variations of performance parameters with threshold values are plotted in figures 14 to 19. For PID and POD combinations of 10:10, 20:10, 20:30, 30:20, 50:50 and100:50 It is observed that the percentage EER values are 90, 95, 95, 95, 98 and 98 and the percentage OTSR values are 90, 95, 92, 93.5, 95 and 93 for PID and POD combinations of 10:10, 20:10, 20:30, 30:20, 50:50 and100:50.

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Table 8: Performance parameter variations for PIDand POD of 10 of 10

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.2	100	0	0
0.4	90	0	10
0.6	50	0	50
1.0	20	0	80
1.2	10	10	90
2.0	0	100	90

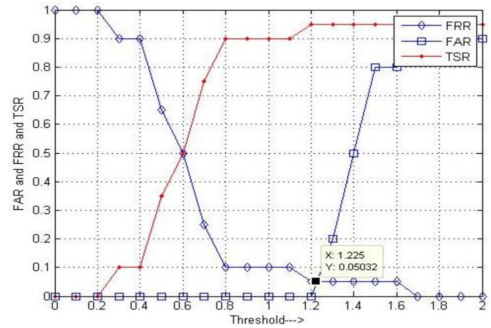


Fig. 14 Variations of performance parameters for PID and POD of 10 and 10.

Table 9: Performance parameter variations for PID and POD of 20 and 10.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.2	100	0	0
0.4	90	0	10
0.6	50	0	50
1.0	10	0	90
1.22	5	5	95
2.0	0	90	95

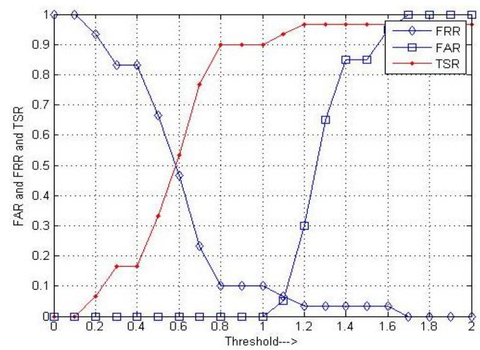


Fig. 14Variations of performance parameters for PID and POD of 20 and 10

Table 10: Performance parameter variations for PID and POD of 20 and 30.

Threshold	%FRR	%FAR	%TSR
0.2	100	0	0
0.4	90	0	10
0.6	560	0	50
0.8	10	0	90
1.15	8	8	92
2.00	0	97	95

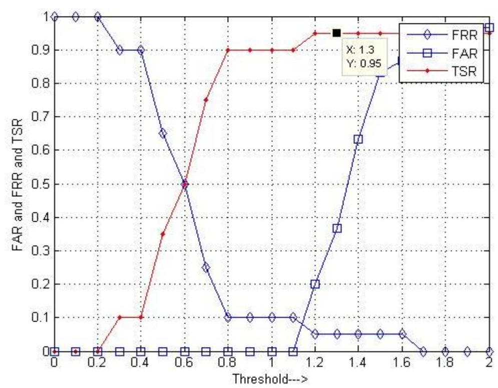
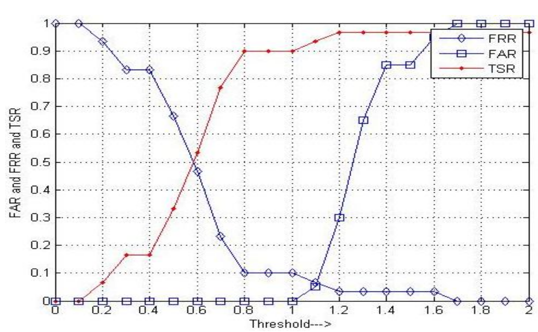


Fig. 15 Variations of performance parameters for PID and POD of 20 and 30.

Table 11: Performance parameter variations for PID and POD of 30 and 20.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.2	95	0	7
0.6	47	0	53
1.0	10	0	90
1.1	5	5	93.5
2.0	0	100	97



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ISSN: 2321-9653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig. 16 Variations of performance parameters for PID and POD of 30 and 20

Table 11: Performance parameter variations for PID and POD of 50 and 50.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.2	98	0	4
0.4	74	0	27
0.8	8	0	92.5
1.02	2	53	98
2.0	0	95	98

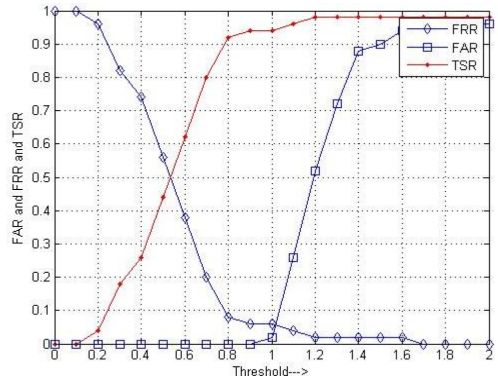

Fig. 17 Variations of performance parameters for PID and POD of 50 and 50.

Table 12: Performance parameter variations for PIDand POD of 100 and 50.

Threshold	%FRR	%FAR	%TSR
0.1	100	0	0
0.2	97	0	4
0.6	33	0	68
0.8	8.3	0	91
0.95	7.3	7.3	93
1.2	2	64	98
2.0	0	100	98

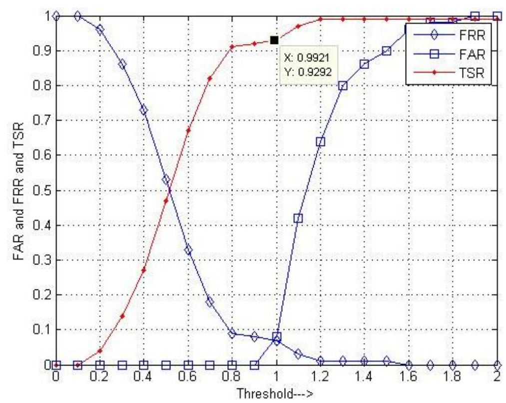

Fig. 19 Variations of performance parameters for PIDand POD of 100 and 50.

1) *Performance of proposed Fusion Technique:* The percentage of OTSR values of proposed fusion technique are obtained by fusing percentage OTSR values of spatial and transform domain techniques using normalization technique. The variations of OTSR for different combinations of PID and POD are given in Table 13. It is observed that, the OTSR values are better compared to individual techniques.

table13: variations of OTSR for various combinations of PID and POD's.

PID	POD	% OTSR
10	10	94.0
20	10	98.1
20	30	95.0
30	20	98.7
50	50	99.2
100	50	93.0

D. Performance comparison of proposed method with existing methods

The percentage MTSR and EER of proposed method are compared with existing methods. The existing methods presented by Sang et al., [13], Sumangala Biradar et al. [14], Raouia Mokni and Monji Kherallah [15] and Shivakanth Koushik and Rajendra Singh[16] are compared with our proposed method in table14. It is observed that, the MTSR value is better in the case of proposed

method compared to existing methods. The percentage EER values of proposed methods are compared with existing methods.
The percentage EER values of proposed method are compared with existing methods presented by Yong Xu et al. [17] and Lavanya and Sumathi [18]. It is observed that the error rate is less in the case of proposed method compared to existing methods in table 15.

Table14. Comparison of MTSR values of proposed method of with existing methods.

Author	Method	Accuracy
Sang et al. [13]	2DPCA, Cosine Distance	99.14%
Sumangala Biradar et al. [14]	Canny edge detection algorith	85%
Raouia Mokni and Monji Kherallah [15]	BC Cumlnt, Mass Radius+ Random Forest	95.98%
Shivakanth Koushik and Rajendra Singh [16]	LDA, PCA, 2DLDA and Wavelet	98%
Proposed Work	LBP, DWT and SWT	100%

Table15. Comparison of EER values of proposed method with existing methods.

Author	Method	Error Rate
Yong Xu et al. [17]	Novel framework, Palmcode	2.90%
V.Lavanya and S. Sumathi [18]	SIFT and OLOF	0.58%
Proposed Work	LBP, DWT and SWT	0.02%

VI. CONCLUSION

The physiological palmprint biometric trait is used to identify a person effectively. In this paper, palmprint recognition is based on fusion spatial and transform domain features is proposed. The spatial domain features are extracted from resized palmprint images using LBP. The DWT is applied on palmprint images and LL band is considered for further processing. The SWT is used to extract transform domain features from LL band of DWT. The performance parameters are computed using spatial and transform domain techniques. The OTSR of spatial and transform domain techniques. The OTSR of spatial and transform domain techniques are fused using normalization technique to obtain better results. It is observed that the performance of the proposed method is better than the existing methods.

In future the palmprint images are compressed using appropriate technique to reduce number of features to increase the speed of computation.

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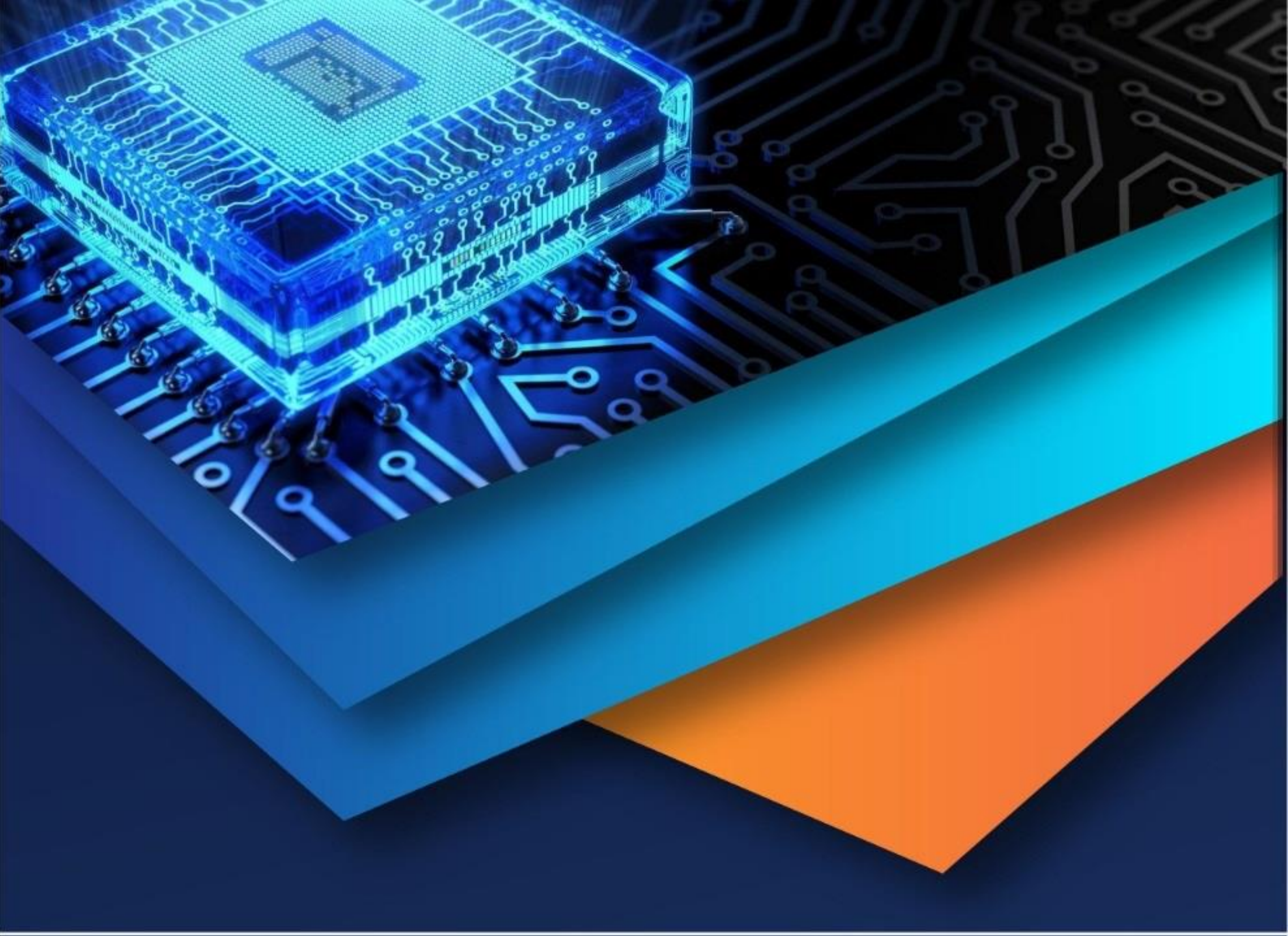

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