Person Identification Using Hand Geometry and Palmprint Biometrics

Mr. Namdeo D. Kapale[1], Dr. D. N. Kyatanavar[2]
[1]Department of E&Tc Engineering, Sanjivani college of Engineering, Kopargaon-423603, Maharashtra, Savitribai Phule Pune University, Pune.
E-mail: kapalenamdeoetc@sanjivani.org.in,
[2]Principal, Sanjivani College of Engineering, Kopargaon-423603 , Maharashtra, Savitribai Phule Pune University, Pune
E-mail: principalcoe@ sanjivani.org.in

Abstract- **Bimodal identification approach is presented in this paper. Palm geometric and palmprint features are fused at feature level for greater accuracy and flexibility. Subjects are allowed to place their hand in front of camera under uniform lighting condition. Captured palm images are filtered for noise reduction. Palm print features are extracted using 2D discrete cosine transform. Palm geometric features such as finger length, finger width, and palm height and palm width are extracted and added sequentially to improve accuracy. Addition of palm geometric features to palm features yields FAR= 0.015 and FRR=0 by using nearest neighbour matching.**

Index Terms— discrete cosine transform (DCT), feature-level fusion, palm geometry, palmprint verification.

I. INTRODUCTION

Security plays an important role in because of intensive use of internet, net banking and e-commerce. Nowadays, biometric person identification system is being increasingly used in applications such as public security, access control, banks. Uni-modal biometric systems are encounter shortcomings like Noisy data, Non-universality, limitations on identification accuracy and Spoof attacks. To overcome these shortcomings, a multi-modal system fusing more than one modality can be used in which shortcomings encounter by one modality is compensated by other modality and helps to increase identification accuracy.

Biometric traits can be fused at different levels based on the type of information available in a certain module. The various levels of fusion are sensor, feature, match score, rank and decision level. Palm print features possess properties like uniqueness, stability, permanence, user acceptability, more data, while fusing palm geometric features make system robust and difficult to forgery. There is small change in palm geometric features due to ageing. The benefits of multi-modal biometrics are that by using more than one means of identification, system administrator can decide the level of security that is needed. For a very high security, need to use both biometric identifiers and for a lower security, only one biometric is sufficient. Selecting uni-modal biometric or multi-modal identification system is trade-off between time complexity and level of security needed.

We proposed an identification system using feature level fusion of palmprint features and palm geometric features. Explanation of Block diagram of system presented is in section II. The image preprocessing and extracting region of interest (ROI) is elaborated in Sections III. The feature extraction is detailed in section IV. The results from this work are presented in Section V.

II. PROPOSED SYSTEM

The block diagram of the system is as shown in fig. 1. Palm images are filtered to remove noise, converted in to binary by using global thresholding. The portion of palm which content most of important information i.e. Region of Interest is extracted. Following 15 palm geometric features finger length (4), finger width(8) and palm measurement(3) are extracted. Discrete cosine transform (DCT) coefficient are extracted and standard deviation of each block is found out(36).Extracted palm geometry and palm print features are concatenate and stored as database during enrolment phase. During identification palm geometry and palm print features are extracted of test image and compared with database by using different distance measures.

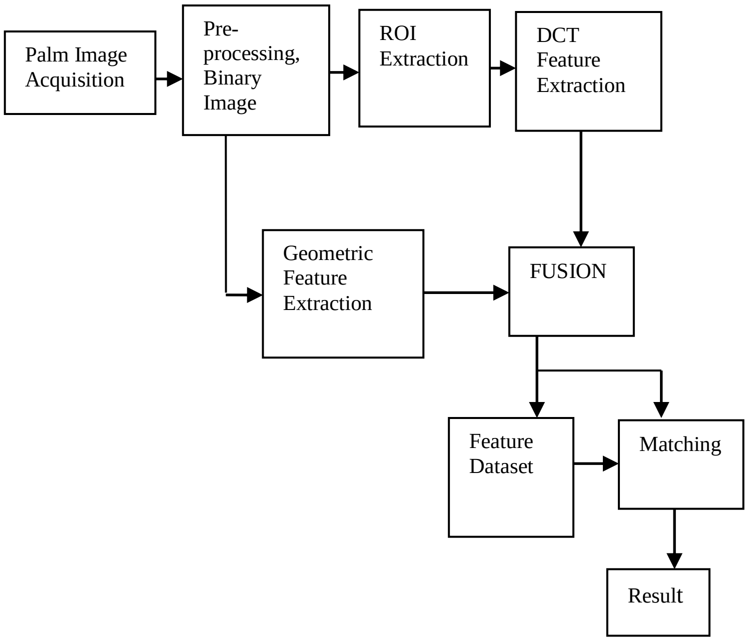


Figure. 1 Proposed System Block Diagram

III. PRE-PROCESSING AND ROI DETECTION

Palm image is converted to gray scale. Image is filtered using Gaussian filter in order to remove any noise which may cause problems while thresholding the image. The proposed method uses Gaussian filter G(x, y) on the original image, I(x, y) to obtain a blur version of the image M(x, y).

M(x,y)=G(x,y)*I(x,y)-- (1)

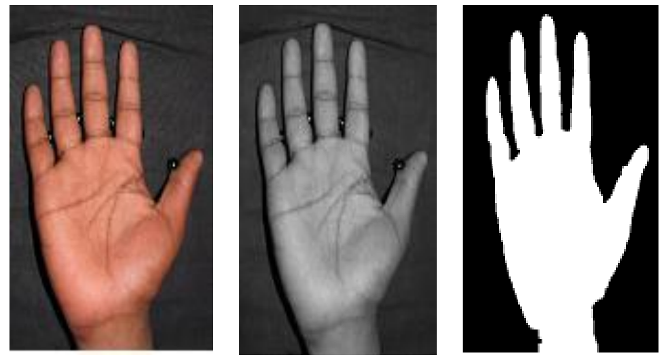
This filtered image is converted to binary image using a global threshold T. Since the binarized result might generate some notch edges on the contour of the palm, the "erosion" and "dilation" operations of morphology is used to reduce this effect.

Algorithm for ROI extraction and palm geometry feature extraction.

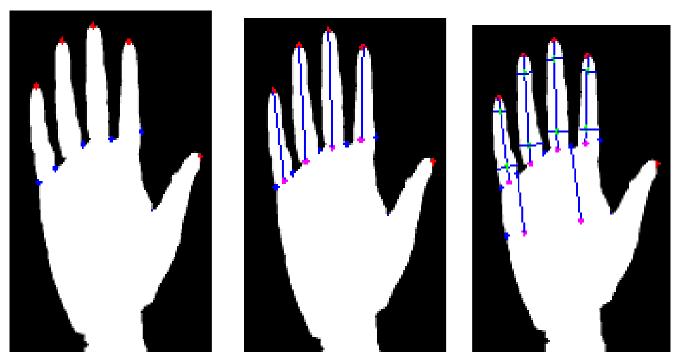
1. Find the tip of thumb by scanning binarized image right to left and top to bottom.
2. Find the tip of all fingers in the binarized Image
3. Find the valley points of fingers.
4. Now to extract the main ROI, the valley points between index and middle finger and little and ring finger are joined. The midpoint of this line is found.
5. Find the Euclidian distance between tips and midpoint of corresponding fingers. (Finger height 4)
6. Find the distance between left & right points at two positions for four fingers (finger width 8).
7. Horizontal line is drawn from thumb valley point to the point on left contour (Palm width).
8. A perpendicular bisector is drawn on the line joining the two valley points to horizontal line (Palm heights).
7. Then mid-point of the line joining these two points is found out. This point is taken as reference to locate the ROI (Region of Interest) of size 128*128.

In above algorithm steps number 1,2,3,4,5,6,7,8 are used for palm geometry feature extraction simultaneously.

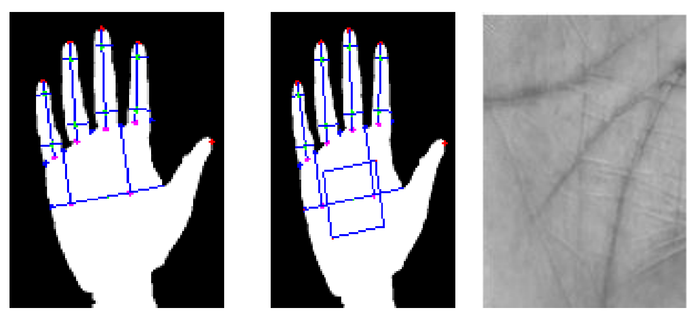
The figure below shows the different pre-processing stage and geometric feature extraction



a. Original palmprint b. Grey & filtered image c.Binary image



e. Tips & Vally points of fingers,thumb f. Fingers height g. fingers width



h. Palm width & height i. ROI detected j. ROI from Original Palm

figure 2: Pre processing & ROI Detection

IV. FEATURE EXTRACTION

DCT is an orthogonal transformation that is very widely used in image compression. Selection of block-sizes in DCT is an important consideration. The images should be so subdivided that the level of redundancies between the adjacent sub images are reduced to an acceptable level and the dimension of the sub-images should be an integer powers of 2. Increasing the block size reduces adjacent block redundancies and reduces mean square reconstruction error using truncated and quantized coefficients, but involves more computations. The two dimensional DCT of an M x N image f(x, y) is defined as

$$C(u,v) = \propto_u \propto_v \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\cos\left(\frac{(2x+1)\pi u}{2N}\right)\cos\left(\frac{(2y+1)\pi v}{2N}\right)$$

Where, $0 \le u \le M-1,\ 0 \le v \le N-1$

$$\propto_u,\ \propto_v = \begin{cases} \sqrt{\frac{1}{N}} & \text{for } u, v = 0 \\ \sqrt{\frac{2}{N}} & \text{for } u, v \neq 0 \end{cases}$$

It is obvious from the above equation that for $u = v = 0$,

$$C(u,v) = \frac{1}{N}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)$$

The first transform coefficient is the average value of the sample sequence. This value is referred to as the DC Coefficient. All other transform coefficients are called the AC Coefficients. The DCT is real, orthogonal, fast and separable transform. It has excellent energy compaction for highly correlated data.

The ROI is divided into four parts. Each of the four sub-images is transformed using discrete cosine transform (DCT).Each DCT matrix is sub-divided into 9 blocks. The standard deviation is calculated for every block, and is used as a feature. Thus there are total of 36 features (9×4)

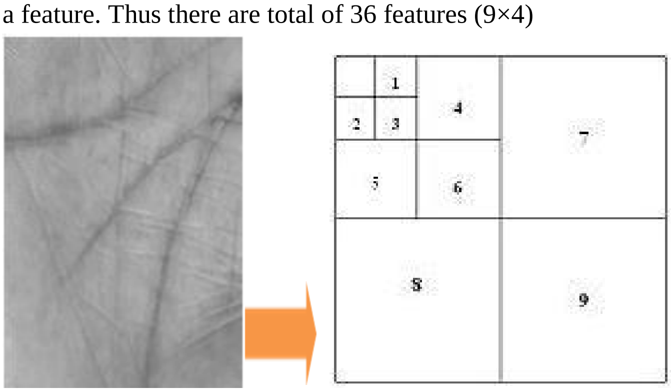


figure 3: DCT feature extraction

Performance measure:

The degree of similarity between two biometric feature sets is indicated by a similarity score. A similarity match score is known as a genuine or authentic score if it is a result of matching two samples of the same biometric trait of a user. It is known as an impostor score if it involves comparing two biometric samples originating from different users. An impostor score that exceeds the threshold η results in a false accept, while a genuine score that falls below the threshold η results in a false reject.

False Acceptance Rate (FAR): It is defined as the fraction of impostor scores exceeding the threshold η. FAR is given by

$$(\%)FAR = \frac{FA}{N} x100$$

Where, FA=Number of incidents of false acceptance.

Distance Metric	FRR	FAR
Euclidean Distance	0.023	0.0245
City Block Distance	0	0.015
Canberra Distance	0.023	0.345

N= Total number of samples

False Rejection Rate (FRR): defined as the fraction of genuine scores falling below the threshold η. FRR is given by

$$(\%)FRR = \frac{FR}{N} x100$$

Where, FA=Number of incidents of false rejections.

N= Total number of samples

The Genuine Accept Rate (GAR) is the fraction of genuine scores exceeding the threshold η.

GAR=1-FAR

V. EXPERIMENTAL RESULTS

System uses a COEP Palm Print database of 168 individuals available from College of Engineering, Pune-411005, website. Out of 8 images of individual, Six images of each individual were used for training.

The extracted features are then compared with those stored in the database using three types of distances:

1.Euclidean Distance 2.City Block Distance 3. Canberra Distance. Out of three distances city block distance is better because FRR is better as per the table 1 .

Thresholds are defined for the verification of test data with training data. Only if the distances is below threshold, then a match is found. The threshold is selected so that the verification error is minimum.

Table 1. The results for the student database using the three distances

Testing: From same Database 8th image of all individuals is used for testing.

Initially the system was implemented as a solely palmprint based verification system. However, the accuracy of this system was not very high. Hand geometry features are then added sequentially in order to improve the identification accuracy of the system. The table showing the values of the system FRR and FAR with the addition of specific features is given below.

Table 2. Effect of hand geometry features added in palm print features

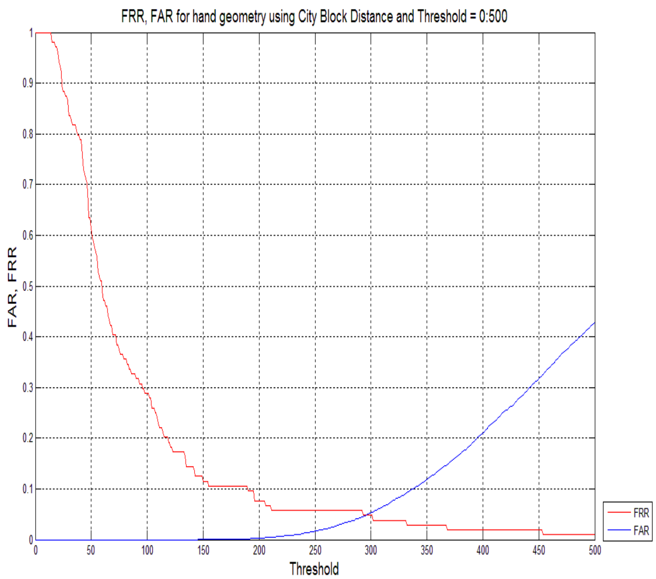


FIGURE 3. PLOT OF FAR & FRR AGAINST THRESHOLD FOR PALM GEOMETRY FEATURES

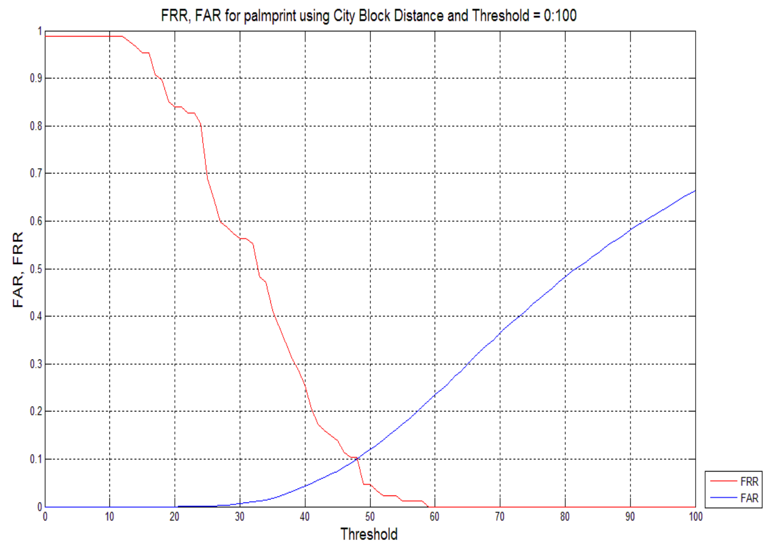


FIGURE 4. PLOT OF FAR & FRR AGAINST THRESHOLD FOR PALM PRINT FEATURES

Feature added (in addition to palmprint features)	FRR	FAR
Finger Lengths	0.0721	0.0588
Palm width and upper palm heights at two locations	0.0294	0.0561
Top finger widths	0	0.0339
Bottom finger widths	0	0.015

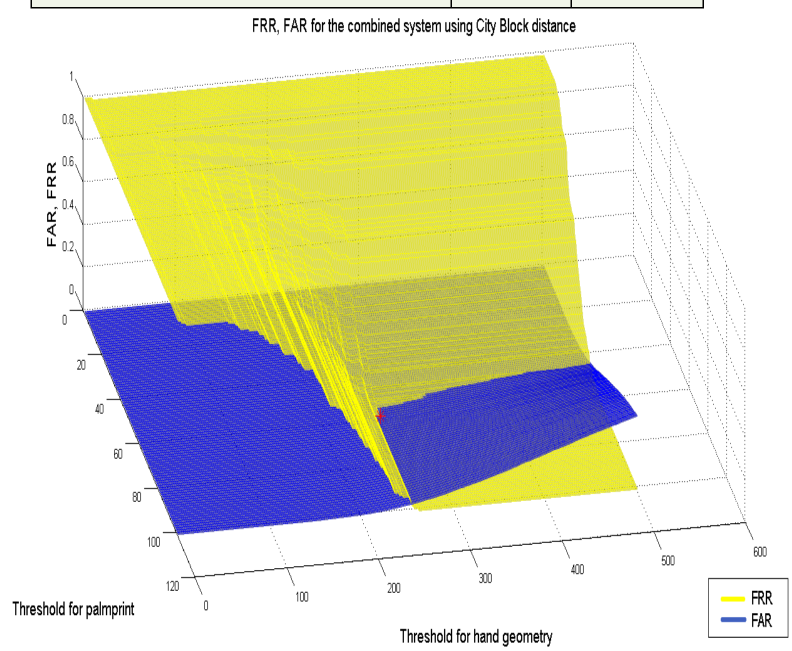


FIGURE 5. PLOT OF FAR & FRR AGAINST THRESHOLD FOR COMBINED FEATURES

VII. CONCLUSIONS

The proposed feature level fusion framework gives FAR= 0.015 & FRR=0. Sequentially addition of geometric features to palm print features leads to significant reduction in values of FRR and FAR .Results from experiments shows that the proposed multi-modal system gives better results compared to the corresponding uni-modal systems. The system uses feature level fusion of palm print and palm geometry. The proposed system uses only 51 features it has low computational complexity still maintains high accuracy. Useful in a lesser complex environment.

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REFERENCES

[1] Bilal Attallah ,Amina Serir , Youssef Chahir and Abdelwahhab Boudjelal "Application of BSIF, Log-Gabor and mRMR Transforms for Iris and Palmprint based Bi-modal Identification System" 3rd International Conference on Advanced Technologies for Signal and Image Processing - ATSIP'2017 .

[2] R.Parkavi, K.R. Chandeesh Babu, J.Ajeeth Kumar "Multimodal Biometrics for User Authentication" 2017 11 th International Conference on Intelligent Systems and Control (ISCO) 978-1-5090-2717-0/171$31 .00 ©2017 IEEE

[3] Ahilandeswari,Prabu U, Priyadharshini G, Saranya M, "Efficient Personal Identification using Multimodal Biometrics" 2015 International Conference on Circuit, Power and Computing Technologies [ICCPCT]978-1-4799-7075-9/15/$31.00 ©2015 IEEE

[4]Sudeep D.Thepade , Rupali K.Bhondave "Multimodal Identification Technique using Iris & Palmprint traits with Matching Score Level In Various Color Spaces with BTC of Bit Plane Slices" 2015 International Conference on Industrial Instrumentation and Control(ICIC) College of Engineering Pune, India. May 28-30,2015, 978-1-4799-7165-7/15/$31.00 ©2015 IEEE

[5] Gayathri.r.Nayar, Anusree Bhaskar, Leshmi Satheesh "Personal Authentication using Partial Palmprint and Palmvein Images with Image Quality Measures" 2015 Intl. Conference on Computing and Network Communications (CoCoNet'15), Dec. 16-19, 2015, 978-1-4673-7309-8/15/$31.00 ©2015 IEEE

[6] Qing Zhang, Yilo ng Yin, De-Chuan Zhan, and Jingling Peng "A Novel Serial Multimodal Biometrics Framework Based on Semi supervised Learning Techniques" IEEE transactions on information forensics and security, vol. 9, no. 10, october 2014

[7]Miguel A. Ferrer, Aythami Morales, Carlos M. Travieso, Jesws B. Alonso"Low Cost Multimodal Biometric identification System Based on Hand Geometry, Palm and Finger Print Texture" 1-4244-1129-7/07/$25.00 ©2014 IEEE

[8] Dhanashree Vaidya, Sheetal Pawar, Madhuri A Joshi, S. Kar, A.M. Sapkal, 'Feature-level Fusion of Palm Print and Palm Vein for Person Authentication Based on Entropy Technique', IJECT Vol. 5, Issue spl-1, Jan - March 2014, pp. 53- 57.

[9] Abdullah Meraoumia, Salim Chitroub and Ahmed Bouridane "Multimodal Biometric systems by Fusion of Palmprint and Finger- Knuckle-Print Using Hidden Markov Model"978-1-4799-2452- 3/13/$31.00 ©2013 IEEE

[10] Yijian Pei, Jiang Yu, Huayu Zhou, Guangzhou Cai, "The Improved Wavelet Transform Based Image Fusion Algorithm and The Quality Assessment", 2010 3rd International Congress on Image and Signal Processing(CISP2010),978-1-4244-6516-/10/$26.00©2010 IEEE.

Author's Biography

Mr. N.D.Kapale is pursuing his ph. D in image processing(image fusion).He has completed his M.E.(Electronics) from Walchand College of Engineering, Sangli. He is presently working as a Assistant Professor in Sanjivani college of Engineering,Kopargaon. He has about 18 years of Teaching Experience. He has about 6 papers published in National/International Journals and conferences.He is a member of ISTE, IETE and IE(I)

Dr. **D N Kyatanavar**, received his BE degree in Electronics and Communication Engineering from Karnataka University Dharwar in 1984,ME in Electronics Engg from Walchand College of Engineering Sangli, affiliated to Shivaji University Kollhapur in 1991 and Ph D in Electronics from Shivaji University Kolhapur in 2009. He is presently working as Principal, SRES' Sanjivani College of Engineering Kopargaon, and Maharashtra. His total experience in teaching is 35 years. His areas of interest are instrumentation and control, mobile computing, microcontrollers, computer networks and power electronics. He is a Fellow member of Institution of Engineers (India) and life member of ISTE New Delhi. He had presented/published 68 papers in national/international conferences and journals. He is the recipient of best paper award from Institution of Engineers India.