International Journal of Electronics Communication and Computer Engineering
Volume 2, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

Multimodal Biometrics Using Palm and Iris

P.Prince Melchi[1,] Dr.D.Manimegali[2],
ppmelchi@yahoo.com[1]

***Abstract*— Biometrics based personal identification is regarded as an effective method for automatically recognizing a person's identity with high confidence. Multimodal biometric systems consolidates the evidence presented by multiple biometric sources and typically give better recognition performance compared to the system based on a single biometric modality. This paper proposes an authentication method for a multimodal biometric system identification using two traits i.e. Iris and palm print. In order to enhance the accuracy of the iris localization, we use the algorithm that combines the merits of wavelet analysis and Hough transform. For Palm print image we use Sequential modified Haar transform that is applied to the resized Palm print image to obtain Modified Haar Energy (MHE) feature. Matching score level fusion is used because matching scores are easily available and contain sufficient information to distinguish between a genuine and an impostor case. Both trait can be matched with the help of Hamming Distance based matching .The receiver operating curve (Roc) is drawn between False Acceptance Rate (FAR) vs False Rejection Rate (FRR).The accuracy can be improved significantly.**

***Keywords*— Biometrics , Multimodal, FAR, FRR, ROC.**

I. INTRODUCTION

The word Biometrics is derived from Greek ' Bio' means Life and 'Metrics' means Measurement. In multimodal biometrics we combine Iris and Palm Print Iris with rich texture is highly unique, and is a very promising. Iris having rich features furrows, ridges, crypts, rings, corona and, freckles, Biometric identification method. The key part of iris identification technology is iris localization. The advantage and disadvantage of iris localization algorithm will directly impact the ultimate recognition rate. Most of the traditional methods make use of the image binarization with Hough transform proposed by Wildes [1,2,3] and circular detection operator proposed by Daugman [4,9] Iris localization includes the inner edge localization and the outer edge localization. The traditional iris localization algorithm is that extracting iris border after edge detection, then realizing Hough transform to the binary marginal image. But too much interference makes the search complicated by a longer time and the localization not precise enough when determining the circle center and radius. However, the speed and accuracy of iris localization measures the system performance. In order to enhance the speed and accuracy of iris localization wavelet analysis is applied to remove the majority of iris image noise. Then, using a median filter the remaining noise in the image and gets noise-free image of pupil. Finally, the Hough transform is used to realize the iris inner edge localization

. The application of iris inner edge localization method can not acquire iris outer edge. So Canny operator is first used to

extract iris image edge, and then remove most of the noise according to the prior knowledge of the iris inner edge parameters detected, thus obtain the iris outer edge image. Because the center of iris inner edge will not deviate from the outer edge center very far, the improved Hough transform based on small-scale search is used to locate the iris outer edge. This method reduces the invalid cumulative computation that directly uses Hough transform. The accuracy and the speed are improved greatly.

II. IRIS ALGORITHM

How to extract effectively the edge is a critical issue in iris localization, which directly affects the quality of localization. Localization algorithm is to calculate the accurate information of iris localization, so as to obtain the integrated iris in the original eye image. The algorithm must take in to account the localization accuracy and its complexity. Meanwhile, the algorithm also considers the various interference factors that impact localization. The method of wavelet analysis and experience value is applied to get rid of the noise in this paper. Then Hough transform and improved Hough transform based on small-scale search are separately used to determine the center and radius of iris inner and outer edge. The proposed algorithm greatly improves the accuracy and speed of localization.

A. IRIS localization Algorithm

As iris has a special ring shape, the average gray value of the sclera, iris and pupil is basically ladder-shaped distribution.So using this feature, the iris inner edge is firstly determined, namely pupil border. The localization method based on wavelet is proposed.

The algorithm is described as follows:

Step1: db4 wavelet function is used to actualize double-deck wavelet decomposition on the iris image.. Because db4 wavelet meets biorthogonal feature and the vanishing moments is higher. The experiment shows that using db4 wavelet for denoising is superior to the other wavelet base. And the image after double-deck wavelet decomposition retains the main component of signal. After the wavelet decomposition, the relatively large amplitude of wavelet coefficients are mainly signal and the relatively small amplitude of wavelet coefficients are noise to a great extent.

Step2: Carry on nonlinear threshold processing to wavelet coefficients. The second layer of detail coefficients are used to estimate the standard deviation of noise and select

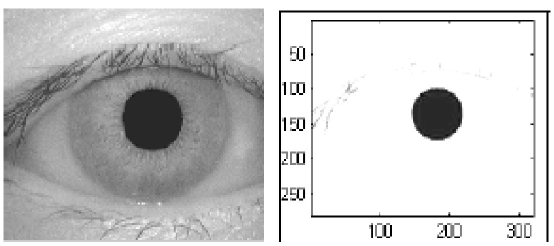
International Journal of Electronics Communication and Computer Engineering
Volume 2, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

the global threshold of noise in the image. The soft threshold approach is
applied to denoise the image.

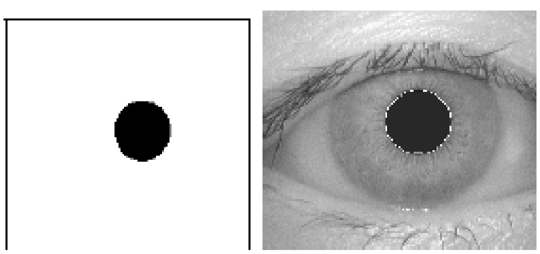
Step3: The scale 13×13 of median filter is used to remove the surplus weak noise in the above denoised iris image. And then quantify its codes to improve the quality of image. The image is turned into gray-scale image, thus the pupil image without noise is obtained.

Step4: Sobel operator [6] is applied to extract the edge of pupil. Using the circle Hough transform [6,7] computes the center and radius of pupil, which is the center and radius of iris inner edge.

The iris image is firstly denoised in this paper so as to obtain the pupil image without noise and then extract the pupil edge, namely the iris inner edge. Do we like this, not only reduce the noise interference on the edge but also reduces the search scope of Hough transform and thus enhance the speed and accuracy of the iris inner edge localization.



(a) The original Iris image (b) The image after using soft threshold to denoise



(c) The pupil image after median filtering (d) Iris inner edge localization image

Fig. 1 Iris inner edge localization

III. PALM ALGORITHM

The contour consisted of the enough level is good to reduce the computation complexity and to represent the global geometry information, so we use the following algorithm.

1) start point=max(image)
2) ridgepoint1=find_furthest(startpoint,contour)
3) ridgepoint2=the_other_furthest(startpoint,ridgepoint1,contour)
4) ridgepoint3=local_furthest(startpoint,nextcontour)
5) Continue (4)

In this work, only the detail coefficient C, of the sequential modified Haar wavelet is used to find the energy feature. This is because the approximation coefficient contains the mean component of the Palm print image.

For every image of the detail coefficient, the image is further divided into 4 x 4 blocks. The Modified Haar Energy (MHE) for each of the block is calculated using (3.1)

$$MHE_{i,j,k} = \sum_{p=1}^{P}\sum_{q=1}^{Q}(C_{p,q})^2 \quad (1)$$

The MHE energy feature for every detail coefficient is arranged as (3.2).

$$MHE_{i,j} = [MHE_{i.j,1}, MHE_{i,j,2} .... MHE_{i,j,n}] \quad (2)$$

Let Detail HVD,i represent the combination of horizontal, vertical and diagonal detail coefficient in i decomposition level, as in (3.3).

$$Detail_{HVD,i} = [MHE_i(h), MHE_i(v), MHE_i(D)] \quad (3)$$

The Detail HVD in different decomposition levels are normalized using (3.4).

$$D_i = Detail_{HVD,i} / sum(Dedail_{HVD,i}) \quad (4)$$

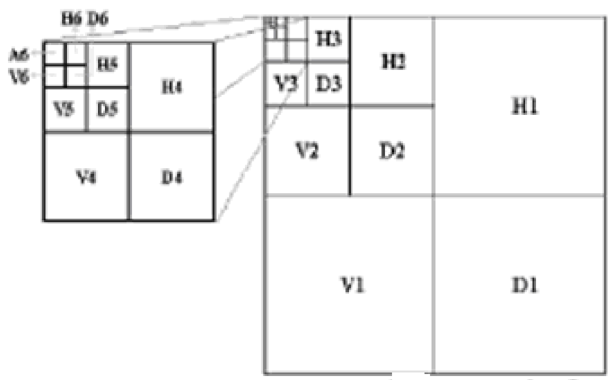


Fig2. Location of details in every Decomposition level

IV.MATCHING SCORE LEVEL FUSION

The matching score is calculated through the HD calculation between two final fused templates. The template obtained in the encoding process will need a corresponding matching metric that provides a measure of the similarity degree between the two templates. The result of the measure is then compared with an experimental threshold to decide whether or not the two representations belong to the same user The metric used in this paper is also used by Daugman [9] in his recognition system..

If two patterns *X* and *Y* have to be compared, the HD is sum of discordant bits in homologous position (XOR operation between *X* and *Y* bits).

$$HD = \frac{1}{N}\sum_{J=1}^{N} XOR\left(Xj, Y_j\right) \qquad (5)$$

where N is the total number of bits. If two patterns are completely independent, the HD between them should be equal to 0.5, since independence implies that the two strings of bits are completely random so that 0.5 is the ability to set every bit to 1 and patterns of the same biometric descriptor are processed, then, their distance should be zero.

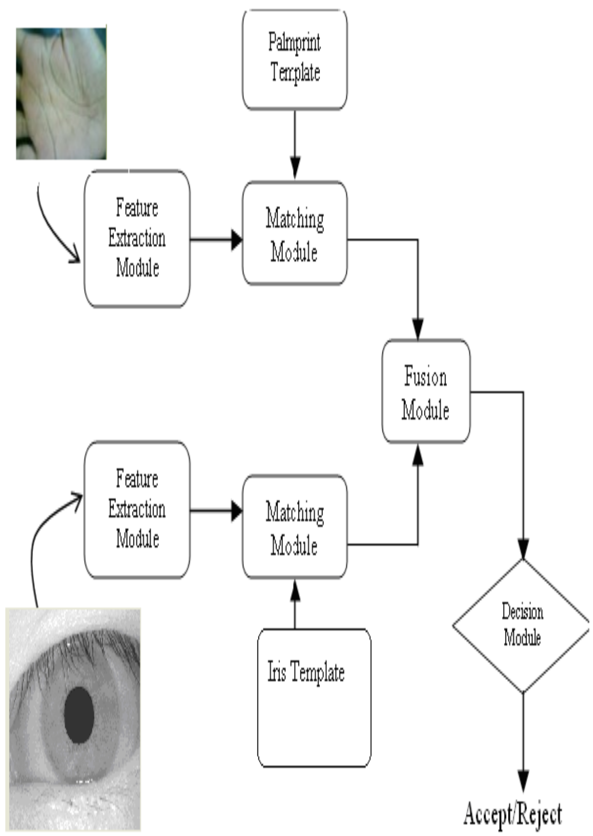


Fig3:Block diagram of Palmprint and Iris Multimodal biometric system

V. Experimental Results

We evaluated the proposed multimodal system on a data set including 720 pairs of images from 120 subjects. The Training database contains an Iris & Palm print image for each individual for each subject.

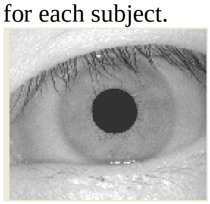


Fig 4.Input image

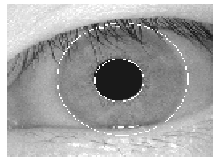


Fig 5 Iris localization

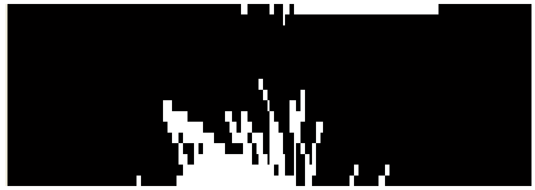


Fig. 6Infusion

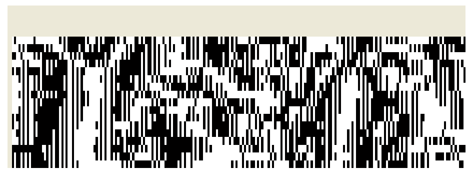


Fig. 7 Feature Extraction

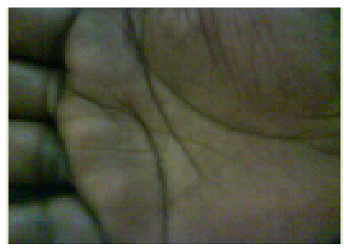


Fig. 8 Palm input image

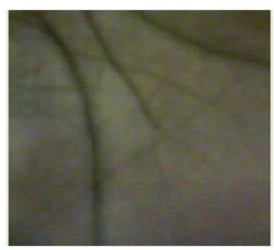


Fig.9 Cropped Image

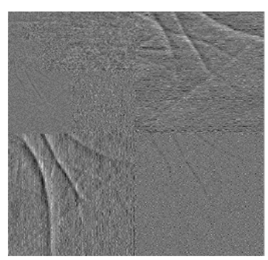


Fig 10 Feature Extraction

A. Performance Analysis

The multimodal system has been designed at multi classifier & multimodal level. At multi-classifier level, multiple algorithms are combined and better results have been obtained. At first experimental level the individual systems were developed and tested for FAR, FRR &

International Journal of Electronics Communication and Computer Engineering
Volume 2, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

Accuracy. Table1 shows FAR, FRR & Accuracy of the systems

In the second level both the traits are combined at matching score level using sum of score technique. The results are found to be very encouraging and giving scope for the research in this field.

Accuracy can be calculated by the following formula.

$$\text{Accuracy} = \frac{\text{Genuine Matching}}{\text{Total Number of Matching}} \times 100\% \quad (6)$$

TABLE I

THE ACCURAY OF IRIS AND PALMPRINT

Trait	FAR	FRR	Accuracy
IRIS	0.8 %	1 %	98.2%
PALM PRINT	1 %	1.5 %	97.5%
IRIS+PALM PRINT	0.2 %	0.3 %	99.5%

Receiver operating curve is drawn between False acceptance Rate (FAR) vs False Rejection Rate(FRR)

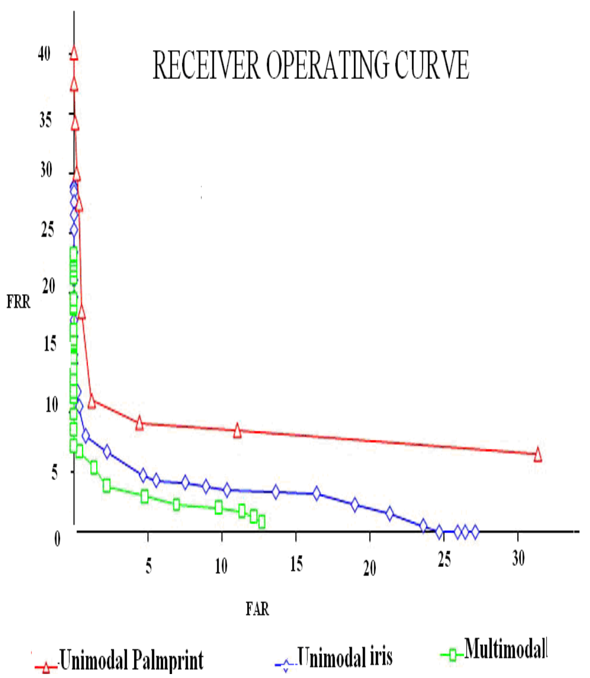


Fig.11 RECEIVER OPERATING CURVE

VI. CONCLUSION

Biometric systems are widely used to overcome the traditional methods of authentication. But the unimodal biometric system fails in case of biometric data for particular trait. Thus the individual score of two traits (Iris & palm print) are combined at classifier level and trait level to develop a multimodal biometric system. From the experimental observation it is found that accuracy is increased significantly.

REFERENCES

[1] R.WILDES, J.ASMUTH, et al, "A machine-vision system for iris recognition", Machine Vision and Applications, Vol.9: pp.1-8, 1996.
[2] WILDES R P, "Iris recognition: An emerging biometric technology", Proceeding of the IEEE, 1997, 85(9):1348-1363.
[3] WILDES R P, "Automated Non-invasive iris recognition system and method", US, Patent 5572596, 1996.
[4] John Daugman, "How iris recognition works", IEEE Trans. on Circuit and Systems for Video Technology, 2004, 14(1):21-30.
[5] Yan-Kui Sun, Wavelet analysis and application, China Machine Press, Beijing, 2005.190 ~ 191,233 -235.
[6] Bi-Cheng Li, Tian-Qiang Peng, and Bo Peng, Intelligent image processing technology, Publishing House of Electronics Industry, Beijing, 2004.153 -154.
[7] Qi-Chuan Tian, etc, "The application of Hough transform in the iris regional segmentation", Computer application research, 2005, 1:249 - 254
[8] CANNY J.A, "Computational approach to edge detection", IEEE Trans. on Pattern Analysis and Machine Intelligence, 1986, 8(6): 679
[9] DAUGMAN J G, "Biometrical Personal Identification System Based on Iris Analysis", US: Patent 52911560, 1994.
[10] Gonzalez, Digital image processing, Publishing House of Electronics Industry, Beijing, 2003 .
[11] Institute of Automation, Chinese Academy of Sciences, CASIA iris iage database [EB / OL]
[12] S. Prabhakar, m S. Pankanti, A. K. Jain, "Biometric Recognition: Security and Privacy Concerns", IEEE Security & Privacy, March/April 2003, pp. 33-42
[13] A. K. Jain, A. Ross, S. Prabhakar, "An Introduction to Biometric Recognition", IEEE Trans. on Circuits and Systems for Video Technology, Vol. 14, No. 1, pp 4-19, January 2004
[14] D. Maio, D. Maltoni, R. Cappelli, J. L. Wayman, A. K. Jain, "FVC2002: Fingerprint verification competition" in Proc. Int. Conf. Pattern Recognition (ICPR), Quebec City, QC, Canada, August 2002, pp. 744-747
[15] A. Ross, A. K. Jain, "Information fusion in biometrics", Pattern Recognition Letters 24 (2003) 2115-2125, available at http://www.computerscienceweb.com/
[16] P. J. Philips, P. Grother, R. J. Micheals, D. M. Blackburn, E. Tabassi, J. M. Bone, "FRVT2002: Overview and Summary," available at: http://www.frvt.org/FRVT2002/documents.htm
[17] M. Golfarelli, D. Maio, D. Maltoni, "On the error-reject tradeoff in biometric verification systems," IEEE Trans. Pattern Anal. Machine Intell., Vol. 19, pp. 786-796, July 1997
[18 J. Daugman, "How Iris Recognition Works", IEEE Trans. on Circuits and Systems for Video Technology, Vol. 14, No. 1, pp. 21-30, January 2004
[19] L. O'Gorman, "Seven issues with human authentication technologies," in Proc. Workshop Automatic Identification Advanced Technologies (AutoID), Tarrytown, NY, Mar. 2002, pp. 185-186
[20] L. Hong, A. K. Jain, S. Pankanti, "Can multibiometrics improve performance?," in Proc. AutoID'99, Summit, NJ, October 1999, pp. 59-64
[21] L. I. Kuncheva, C. J. Whitaker, C. A. Shipp, R. P. W. Duin, "Is independence good for combining classifiers?," in Proc. Int. Conf. Pattern Recognition (ICPR), Vol. 2, Barcelona, Spain, 2001, pp. 168-171
[22] L. Hong, A. K. Jain, "Integrating faces and fingerprints for personal identification," IEEE Trans. Pattern Analysis Machine Intell., Vol. 20, pp. 1295-1307, December 1998

International Journal of Electronics Communication and Computer Engineering
Volume 2, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

[23] A. K. Jain, A. Ross, "Multibiometric Systems", Appeared in Communication of the ACM, Special Issue on Multimodal Interfaces, Vol. 47, No.1, pp. 34-40, January 2004
[24] Handbook of Multibiometrics
By Arun A, Ross Lane Department of Computer Science and Electrical Engineering West Virginia University, USA,Karthik Nandakumar Department of Computer Science and Engineering Michigan State University, USA

AUTHOR'S PROFILE

Prof. P. Prince Melchi completed his B.E - ECE from National Engineering College, Kovilpatti Tamilnadu, India. He finished his M.Tech in MS University, Tirunelveli, Tamilnadu, India.

Now he is doing Ph.D (Information and Communication engineering) in Anna University, Tirunelveli, Tamilnadu, India. His research interests are Image Processing, Biometrics, Pattern recognition ,and Fuzzy logic. He has published a modest number of papers in National and International Conferences.

Currently he is working as the Head of the Department of Electronics and Communication and Engineering, Dr.G.U.Pope College of Engineering, Sawyerpuram, Tamilnadu, India.

Prof. Dr. D. Manimegalai had her BE and ME from the Government College of Technology, Coimbatore and PhD from the Manonmanium Sundaranar University, Tirunelveli. She worked in PSNA College of Engineering, Dindigal from 1985 – 1987. Since 1987, she has been working in the National Engineering College in various positions. She has modest number of research publications including journals such as AMSE and Pattern Recognition letter and in National and International Conferences

She is also recognized supervisor for guiding Ph.D students by various universities. Currently 9 scholars are pursuing research under her supervision