ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 9, September 2014

Fingerprint And Iris Recognition Using Cross Correlation

Uday A.R[1], G.Sreelakshmi[2]

PG Student, M.Tech(ECE), GCET, Cheryala, R.R Disc,Telangana, India[1]

Associate Professor, ECE Department, GCET, Cheryala, R.R Disc,Telangana, India[2]

Abstract: Fingerprint – Iris recognition is done using many ways, we propose to use bifurcations along with ridge patterns to identify the fingerprint image and canny edge features to identify iris image. The ridges along with bifurcations are considered as minutiae of fingerprint. These minutiae along with their position (ie; x and y co-ordinates) and orientations are saved as features. We propose an novel matching scheme to detect the matched minutiae of pairs incrementally. The iris features are effective captured using edge detection algorithm. Following that, the maximum score is computed through cross correlation and used as the recognition parameters. This way of combination has provided efficient recognition results which had overcome the existing drawbacks. The experiments were conducted using FVC 2004 dataset images.

Keywords: Multimodal biometrics, fingerprint recognition, minutiae, iris recognition, Cross Correlation

I. INTRODUCTION

Arithmetic circuits are the ones which perform arithmetic operations like addition, subtraction, multiplication, division, parity calculation. Most of the time, designing these circuits are the same as designing muxers, encoders and decoders. In the electronics, an adder or summer is an digital circuits[7] that performs addition of numbers. In many computers and other kind of processors, adders are other parts of the processor, many computers and other kinds of processors, where they are used to calculate addresses, table and similar. The binary adder [7, 10] is the one type of element in most digital circuit designs including digital signal processors(DSP) and microprocessor data path units. Therefore fast and accurate operation of digital system depends on the performance of adders. Hence improving the performance of adder is the main area of research in VLSI system design[10] .

Each biometric feature has its own strengths and weaknesses and the choice typically depends on the application. The better biometric characteristic has five qualities: robustness, distinctiveness, availability, accessibility and acceptability. Fingerprints are unique and it is most widely used to identify the person. Its matching accuracy was very high [10]. Iris is the ideal part of the eye in human body. It contains many distinctive features such as furrows, ridges and rings etc [11]. Iris technology provides greater unique identification. According to the above features fingerprint and iris are taken to develop the proposed system. A Multibiometric system combines characteristics from different biometric traits.

A reliable and successful multimodal biometric system needs an effective fusion scheme to combine biometric characteristics derived from one or modalities. It also improves the template security by combining the feature sets from different biometric sources using appropriate fusion scheme.

The concept of multimodal biometric system has been proposed by Ross and Jain [1] where apart from fusion strategies various levels of integration are also presented. In [2] fusion of iris and face biometrics has been proposed. The score level fusion in multimodal biometrics system is proposed in [3]. A novel fusion at feature level for face and palmprint has been presented in [4]. The purpose in [4] is to investigate whether the integration of face and palmprint biometrics can achieve higher performance that may not be possible using an single biometric indicator alone. Both Principal Component Analysis (PCA) and Independent Component Analysis (ICA) are considered in this feature vector fusion context. It is found that the performance has improved significantly.

Dass, Nandakumar& Jain (2005) have proposed an approach to score level fusion in multimodal biometrics systems [6]. Experimental results have been presented on face, fingerprint and hand geometry using product rule and coupla method. It is found that both fusion rules show better performance than individual recognizers. Common theoretical framework [7] for combining classifiers using sum rule, median rule, max and min rule are analyzed by Kittler et al. (1998) under the most restrictive assumptions and have observed that sum rule outperforms other classifiers combination schemes.

In this paper we propose a framework for multimodal biometric fusion based on utilization of a single matcher implementation for both modalities. The proposed framework is designed to provide improved performance over the unimodal systems.

The major advantage of the framework is that since both modalities utilized the same matcher module the memory footprint of the system is reduced. The framework is demonstrated through the development of a fingerprint and iris based multimodal biometric identification system with score level fusion.

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

In Fusion at the Matching Score Level, feature vectors are created independently for each sensor and are then compared to the enrollment templates which are stored separately for each biometric trait. Based on the proximity of feature vector and template, each subsystem computes its own matching score. These individual scores are finally combined into a total score which is passed to the decision module.

II. PROPOSED BLOCK DIAGRAM

Biometric authentication is an evolving research field in authentication dependent industry. We propose an efficient method to recognize a person using cross correlation. The input images are pre-processed using a denoising filter and contrast equalization methods. The minutiae points, which represent the fingerprint template, are computed through binarization, orientation calculation and segmentation.

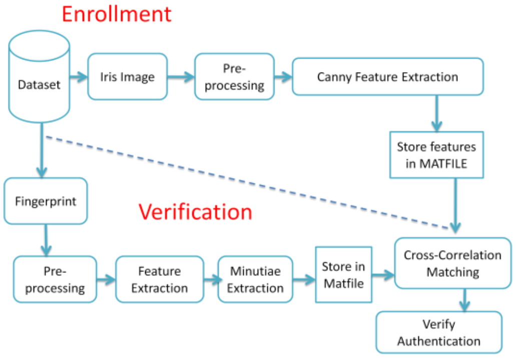


Figure1: Block diagram of fingerprint and iris recognition using cross correlation

Finally we remove the false or spurious minutiae using distance metrics. The Iris image is pre-processed and its edges are detected using canny edge detection algorithm. We calculate cross correlation metrics for respective template images and probe images. Results are produced using, FVC 2004 dataset for fingerprint and CASIA dataset for iris images. The experimental analysis was done using entire dataset and the recognition parameters such as true positive rate, false positive rate and receiving operating characteristics (ROC curves). The selected image is denoise using median filter. The median filter is a non linear digital filtering technique, in which often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing. Median filtering is very widely used in DIP because, under certain conditions, it preserves edges while removing noise.

A. Modules:

1. Fingerprint:

1.1 Pre-Processing

1.1.1 Remove noise

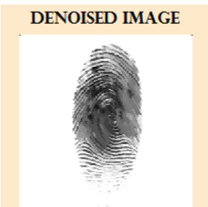


Figure2: Denoised Image (After Noise Removed)

The selected image is denoise using median filter. The median filter is a nonlinear digital filtering technique, often it is used to remove noise. Such noise reduction is a typical pre-processing step is to improve the results of later processing. Median filtering is very widely used in DIP because, under certain conditions, it preserves edges while removing noise.

1.1.2 Histogram Equalization

Histogram equalization is to expand the pixel value distribution of an image so as to increase the perceptional information. The original histogram of a fingerprint image has the bimodal type, the histogram after the histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced.

1.1.3 Fast Fourier Transform

We divide the image into small processing blocks (32x32 pixels) and perform the Fourier Transform according to

$$G(p_1, q_1) = \sum_{p=0}^{M-1}\sum_{q=0}^{N-1} f(p,q) \times \exp\left\{-2i\pi \times \left(\frac{p_1 p}{M} + \frac{q_1 q}{N}\right)\right\}$$

For p_1=1, 2…32 and q_1=1, 2……32.

Thus the image is converted to frequency domain as well as filtered (ie; noises are removed).

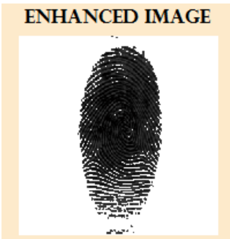


Figure3: Enhanced image

1.2 Feature Extraction

1.2.1 Binarization

Fingerprint Image Binarization is to transform the 8-bit Gray fingerprint image is to 1-bit image with 0-value for ridges and 1-value for the furrows. After the operation, ridges in a fingerprint are highlighted with black color while furrows are white. A locally adaptive binarization method is performed to binarize the fingerprint image. Such a named method comes from the themechanism of transforming a pixel value to 1 if the value is larger than the mean intensity value of the current block is (16x16) to which the pixel belongs to.

Figure4: Binarized image

1.2.2 Direction

The direction information of minutia is to be considered for authentication. Thus the orientation information are obtained by converting ridges and furrows to flow curves

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 9, September 2014

pointing the direction. Here we find the orientation direction for both ridges and bifurcations to detect minutiae.

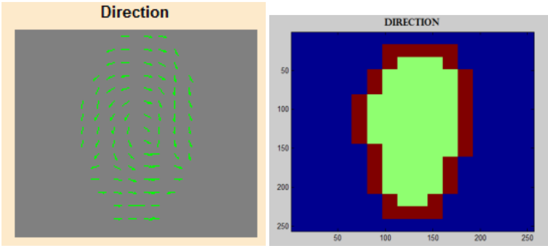


Figure5: Modified Direction showing for both ridges and bifurcations to detect minutiae

1.2.3 Region of Interest:

Two Morphological operations called ‘OPEN’ and ‘CLOSE’ are adopted. The ‘OPEN’ operation can expand images and remove peaks introduced by background noise. The ‘CLOSE’ operation can shrink images and eliminate small cavities. The bound is the subtraction of the closed area from the opened area. Then the algorithm throws away those leftmost, rightmost, uppermost and bottommost blocks out of the bound so as to get the tightly bounded region just containing the bound and inner area.

1.1.1 Thinning

The thinning (skeletonization) of fingerprint is done for making the terminations and bifurcations to be clearly visible. The thinned fingerprint is then subjected for minutiae extraction algorithm.

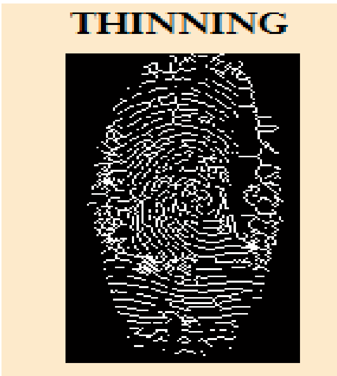


Figure6: Thinned fingerprint

1.3 Minutiae Extraction

1.3.1 Crossing Number Algorithm

The Crossing Number (CN) method is used to perform minutiae extraction. This method extracts an ridge of endings and bifurcations from the skeleton image by examining the local neighborhood of each ridge pixel using a 3*3 window. The CN for a ridge pixel P is given, After the CN for a ridge pixel has been computed, a pixel can then be classified according to the property of its CN value. As shown Figure, a ridge pixel with a CN of one corresponds to a ridge ending, and a CN of three corresponds to a bifurcation.

$$CN = 0.5\sum_{i=1}^{8}|P_i - P_{i+1}|, \qquad P_9 = P_1$$

P_4	P_3	P_2
P_5	P	P_1
P_6	P_7	P_8

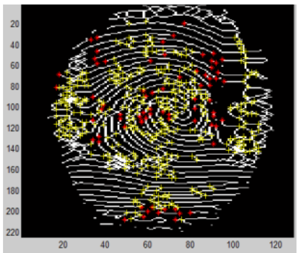


Figure7: Modified minute extraction

1.3.2 Real Minutiae

False minutiae removal are implemented as follows,
The first step in this algorithm is to find the distance between termination and bifurcation. We have used Euclidian method for finding the distance. After finding the distance use the following rules to remove false minutiae.

- If Distance is too small then Minutiae is false
- If Distance is medium then Minutiae is true
- If Distance is large then Minutiae is true

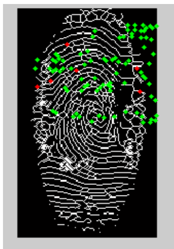


Figure8: Modified False minute removed

1.3.3 Compute cross correlation:

- Calculate cross-correlation in the spatial or the frequency domain, depending on size of images.
- Calculate local sums by pre-computing running sums.
- Use local sums to normalize the cross-correlation to get correlation coefficients.
- Thus the template image features are cross-correlated with the probe image features in-order to verify the probe image.

2. Iris:

2.1 Pre-Processing

2.1.1 Remove noise

The selected image is de noising using median filter. The median filter is a nonlinear digital filtering technique, which often used to remove noise. Such noise reduction is typical pre-processing step to improve the results of later processing. Median filtering is very widely used in DIP because, under certain conditions, it preserves edges while removing noise.

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 9, September 2014

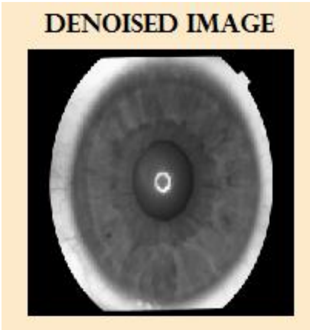


Figure9: Denoised Image (After Noise Removed)

2.1.2 Histogram Equalization
Histogram equalization is to expand the pixel value distribution of an image so as to increase the perceptional information. The original histogram of a fingerprint image has the bimodal type, the histogram after the histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced.

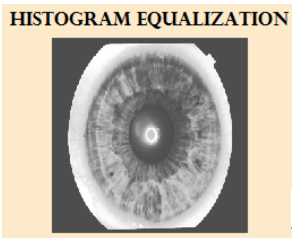


Figure10: pixel value distribution of an image

2.2 Feature Extraction
2.2.1 Canny Edge Features
- Edge detection takes a grayscale or a binary image I as its input, and returns a binary image BW of the same size as I, with 1's where the function finds the edges in I and 0's elsewhere.

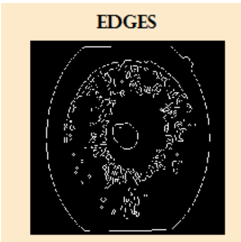
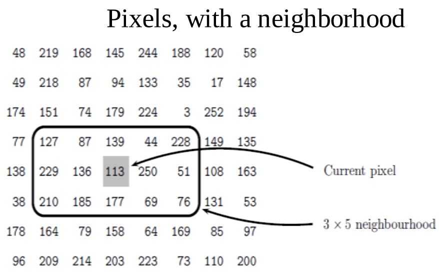


Figure11: grayscale or a binary image

- We propose to use canny edge detection method to extract features from iris image.
- The Canny method finds the edges by looking for local maxima of the gradient of I. The gradient is calculated using the derivative of a Gaussian filter. The method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.

2.3 Compute Cross correlation
- Calculate cross-correlation in the spatial or the frequency domain, depending on size of images.
- Calculate local sums by pre-computing running sums.
- Use local sums to normalize the cross-correlation to get correlation coefficients.
- Thus the template image features are cross-correlated with the probe image features in-order to verify the probe image.



2.3.1 Some applications
Image processing has an enormous range of applications, almost every area of the science and technology can make use of image processing methods. Here is a short list just to give some indication of the range of image processing applications.

1. Medicine
- Inspection and interpretation of images obtained from X-rays, MRI or CAT scans,
- Analysis of the cell images, of chromosome karyotypes.

2. Agriculture
- Satellite/aerial views of land, for example to determine how much land is being used for different purposes, or to investigate the suitability of different regions for different crops,
- Inspection of fruit and vegetables distinguishing good and fresh produce from old.

3. Industry
- Automatic inspection of items on a production line, Inspection of paper samples.

4. Law enforcement
- Fingerprint analysis,
- Sharpening or de-blurring of the speed-camera images.

III. EXPERIMENTAL RESULTS
The results are tested on iris and fingerprint images given to us by our guide. The database consists of four iris images (50×4) and four fingerprint images (50×4) per person with total of 50 persons. For the purpose allowing comparisons two levels of experiments are performed. At first level iris and fingerprints algorithms are tested individually. At this level the individual results are computed and an accuracy curve is plotted as shown in Figure 12. At this level the individual accuracy for iris and fingerprint is found to be 95.16% and 91.94% respectively as shown in Table 1.

However in order to increase the accuracy of the biometric system as a whole individual results are combined at matching score level. At second level of the experiment the matching scores from the individual traits are combined and final accuracy graph is plotted as shown in Figure 12. Table 1 shows the accuracy and error rates obtained from the individual and combined system. The overall performance of the system has increased showing an accuracy of 94.07% with FAR of 1.46% and FRR of 6.87% respectively. Receiver Operating Characteristic Histograms for genuine and imposter data are shown in Figure 9 below. The distribution of genuine and imposter data shows that at threshold of 0.5 the system would give minimum FAR and FRR rates with maximum accuracy of 96.04%.

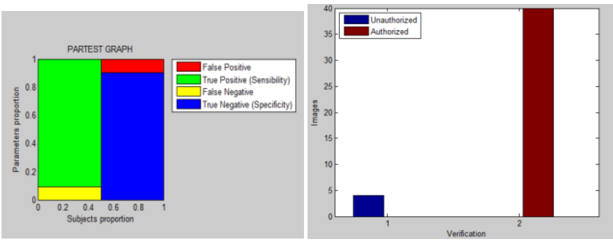


Figure12: Showing authorized and unauthorized using bar chart representation and partest graph.

Table1: Comparison Table by showing individual and combined accuracy

	Correct Match	False Match	False Reject	Accuracy
Existing				
Finger print	60	15	15	50-60%
Iris	65	13	13	
Proposed				
Finger print	40	0	4	100%
Iris	40	0	4	

IV. CONCLUSION

Along with ridge features we propose to extract bifurcations and its orientations. This kind of multiple feature authentication using cross correlation provides an incomparable fingerprint & iris matching. The false acceptance minimization is the most advantageous achievement of this proposal. Fingerprint and Iris matching system is used in many applications such as, Attendance maintenance system Car driver monitoring system ,Employers authentication system, Enrollment and verification in Banking, etc. In future we can add more traits along with finger print and iris.

ACKNOWLEDGEMENT

Uday A R would like to thank Miss G.Sreelakshmi, Associate Professor, ECE Department who had been guiding throughout the project and supporting me in giving technical ideas about the paper and motivating me to complete the work efficiently and successfully.

REFERENCES

[1] Ross, S. Dass, and A. K. Jain, "A deformable model for fingerprint matching," Pattern Recognit., vol. 38, no. 1, pp. 95–103, 2005.
[2] X. Chen, J. Tian, X. Yang, and Y. Zhang, "An algorithm for distorted the fingerprint matching based on local triangle feature set," IEEE Trans. Inf. Forensics Security, vol. 1, no. 2, pp. 169–177, Jun. 2006.
[3] Z. M. Kovacs-Vajna, "A fingerprint verification system based on triangular matching and dynamic time warping," IEEE Trans. Pattern Anal. Mach. Intell., vol. 22, no. 11, pp. 1266–1276, Nov. 2000.
[4] L. Hong, Y. Wan, and A. K. Jain, "Fingerprint image enhancement: Algorithm and performance evaluation," IEEE Trans. Pattern Anal. Mach. Intell., vol. 20, no. 8, pp. 777–789, Aug. 1998.
[5] S. Lee, H. Choi, and J. Kim, "Fingerprint quality index using gradient components," IEEE Trans. Inf. Forensics Security, vol. 3, no. 4, pp. 792–800, Dec. 2008.
[6] Bhanu and X. Tan, "Fingerprint indexing based on novel features of the minutiae triplets," IEEE Trans. Pattern Anal. Mach. Intell., vol. 25, no. 5, pp. 616–622, May 2003.
[7] Qing Tao, Dejun Chu, and Jue Wang, —Recursive support vector machines for diamensionality reduction" IEEE Trans. Neural
[8] Netw., vol. 19, no.1, Jan.2008, pp.189-193.
[9] A.K. Jain, S. Prabhakar, and L. Hong, —A multichannel approach to fingerprint classification", IEEE Trans. Pattern Anal. Machine Intel., vol. 21, no. 4, Apr. 1999, pp. 348-359.
[10] J. Lee, and S. D. Wang, —Fingerprint feature extraction using gabor filter‖, Electron. Lett., vol. 35, no. 4, Feb. 1999, pp. 288-290.
[11] Xiang, X. A. Fan, and T. H. Lee, —Face recognition using Recursive Fisher of Linear Discriminant‖, IEEE Trans. Image Process., vol. 15, no. 8, Aug. 2006, pp. 2097-2105.
[12] Jing Luo, Shuzhong Lin, Ming Lei, Jianyun Ni, —Application of dimensionality reduction analysis to fingerprint recognition‖, ISCID 2008, pp. 102-105.

Web Resources:

1. http://bias.csr.unibo.it/fvc2002
2. http://bias.csr.unibo.it/fvc2004