Advances in Computer Science and Information Technology (ACSIT)
Print ISSN: 2393-9907; Online ISSN: 2393-9915; Volume 2, Number 2; January-March, 2015 pp. 173-176

http://www.krishisanskriti.org/acsit.html

New Improved Multimodal Biometric Recognition System: Taking Retinal's Optic Disc and Ear as Biometric Trait

Shashank Shekher Tiwari[1], Rajnish Pandey[2] and Praveen Mishra[3]

[1]*SRM University Modinagar UP India*
[2]*Department of Information Technology Dr RMLA University Faizabad UP India*
[3]*Department of Information Technology Dr RMLA University Faizabad UP India*
E-mail: [1]shashankshekhar286@gmail.com, [2]srluvietstp@gmail.com, [3]praveen12march@gmail.com

Abstract—*Biometric is a unique, measurable physiological or behavioral characteristic of a person and finds extensive applications in authentication and authorization. Fingerprint, palm print, iris, voice, are some of the most widely used biometric for personal identification. To reduce the error rates and enhance the usability of biometric system, multimodal biometric systems are used where more than one biometric characteristic are used.*
In this paper it is proposed to use EAR and RETINA as biometric traits. For EAR image processing: Force Field Transformation and Force Field Feature Extraction algorithm is used while in case of Retina: Discrete Cosine Transformation and Feature Extraction algorithm is used. Normalized features which are obtained from both algorithms are then fussed using Feature Level Fusion Technique and stored in the database. For identification, the procedure which is followed for enrollment is used and then matching is done.

Keywords: *biometric trait, force field transformation, discrete cosine transformation, feature vector, features level fusion.*

1. INTRODUCTION

1.1 General Biometric

A biometric system is essentially a pattern recognition system which recognizes a user by determining the authenticity of a specific anatomical or behavioral characteristic possessed by the user. Several important issues must be considered in designing a practical biometric system. First, a user must be enrolled in the system so that his biometric template or reference can be captured. This template is securely stored in a central database or a smart card issued to the user. The template is used for matching when an individual needs to be identified. Depending on the context, a biometric system can operate either in verification (authentication) or identification mode.

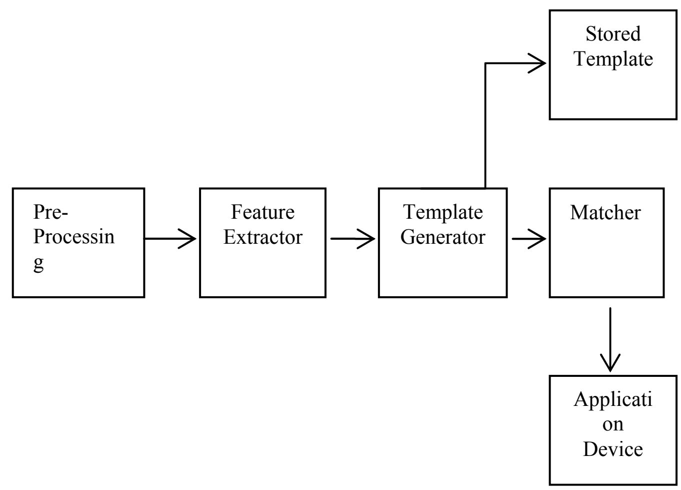

Fig. 1.1: General Biometric

1.2 MULTI MODAL BIOMETRICS

A biometric system that uses more than one biometric modality in a verification / identification system is knows as multimodal biometric system.

The aim of multimodal biometric system is to reduce one or more of the following:

- False acceptance rate (FAR)
- False reject rate (FRR)
- Failure to enroll rate (FTE)

The accuracy of multimodal biometric system is usually measured in terms of matching errors and image acquisition error. Matching error consists of false match rate (FMR) where an imposter is accepted and false non-match rate (FNMR) where a genuine user is denied access. Image acquisition comprise of failure-to-enroll (FTE) and failure-to-acquire (FTA)

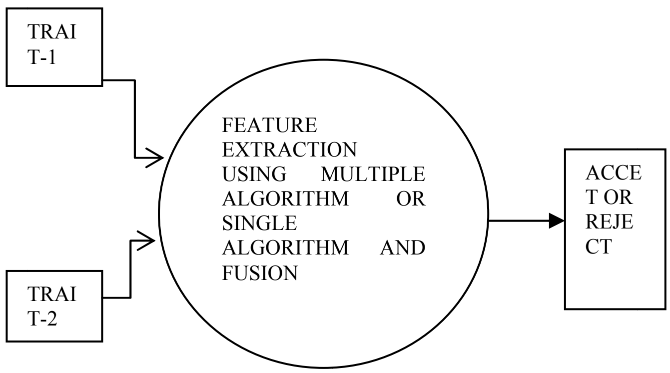

Fig. 1.2: Multimodal Biometrics

2. PROPOSED SYSTEM

Here it is proposed to use a security system which will make use of more than one biometric trait of human body for providing more secure, reliable and fast system. More than one biometric trait will be sensed and preprocessing will be done on those traits. After that different features will be extracted using algorithms such as FFT (Force Field Transformation) and DCT (Discrete Cosine Transformation). After that Feature level fusion will be performed and matching will be done on the basis of those features. Based on this, system will stored data and perform either acceptance or rejection operation.

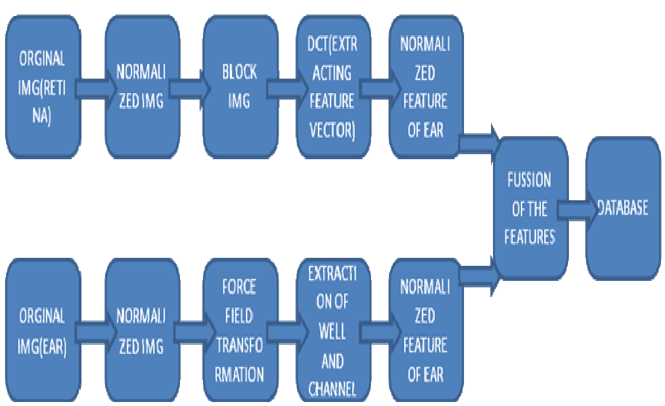

Fig. 2: Proposed Architechure

2.1 Force Field Transformation

The force field can also be defined directly with its own set of equations. The defining equations are more complicated than those of the energy field but the concept is more intuitive. The image is transformed by treating the pixels as an array of N mutually attracting particles that act as the source of a Gaussian force field. In a similar way to Newton's Law of Universal Gravitation, the pixels are considered to attract each other according to the product of their intensities and inversely to the square of the distances between them. Each Pixel is assumed to generate a spherically symmetrical force field so that the force Fi(rj) exerted on a pixel of unit intensity at the pixel location with position vector rj by a remote pixel with position vector ri and pixel intensity P(ri) is given by Fig. 2.1

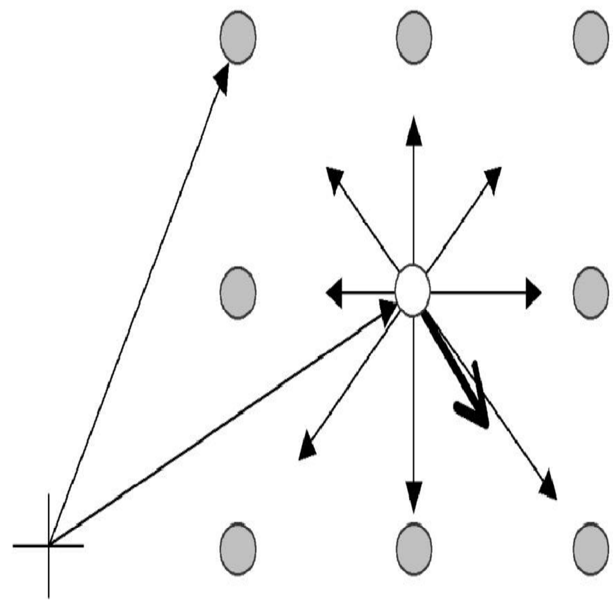

Fig. 2.1: Force field calculations at the centre of a 3x3 pixel image

2.2 Discrete Cosine Transformation

Transform coding constitutes an integral component of contemporary image application. Transform coding relies on the premise that pixel in an image exhibit a certain level of correlation with their neighbouring pixel. Like other transforms, the Discrete Cosine Transform (DCT) [2], [3] attempt to de-correlate the image data. After de-correlation each transform coefficient can be encoded independently without losing compression efficiency.

The most common DCT definition of an 1-D image of size N*N is given in the equations (2.1), (2.2), (2.3) and (2.4)

$$C(u) = \alpha(u) \sum_{x=0}^{N-1} f(x) \cos\left[\frac{\prod(2x+1)u}{2N}\right] \qquad (2.1)$$

For u = 0, 1, 2,.......N-1. Similarly, the inverse transformation is defined as

$$f(x) = \sum \alpha(u) C(u) \cos\left[\frac{\prod(2x+1)u}{2N}\right] \qquad (2.2)$$

For x = 0, 1, 2,......,N-1. In both equations (2.1) and (2.2) α(u) is defined as

$$\alpha(u) = \sqrt{\frac{1}{N}} \tag{2.3}$$

For u = 0 and

$$\alpha(u) = \sqrt{\frac{2}{N}} \tag{2.4}$$

For u ≠ 0

Thus, the first transform coefficient is the average value of the sample sequence. In literature, this value is referred to as the *DC coefficient*. All other transform coefficients are called the *AC coefficients*.

2.3 Fusion of the Extracted Features

In multimodal biometrics we use more than one biometric modality; we have more than one decision channels. We need to design a mechanism that combines the classification results from each biometric channels; this is called as biometric fusion. It is of following four types.

2.3.1 Sensor Level Fusion: In this we combine the biometric traits coming from sensors like Thumbprint scanner, video camera, Iris scanner etc, to form a composite biometric traits and process. Although fusion at such a level is expected to enhance the biometric recognition accuracy.

2.3.2 Feature Level Fusion: In feature level fusion signal coming from different biometric channels are first preprocessed, and feature vectors are extracted separately, using specific fusion algorithm we combine these feature vectors to form a composite feature vector. This composite feature vector is then used for classification process. Concatenating the feature vectors extracted from face and fingerprint modalities is an example of a multimodal system.

2.3.3 Matching Score Level: Here rather than combining the feature vector, we process them separately and individual matching score is found, then depending on the accuracy of each biometric channel we can fuse the matching level to find composite matching score which is then sent to the decision module. Currently, this appears to be the most useful fusion level because of its good performance and simplicity.

2.3.4 Decision Level Fusion: Each modality is first pre-classified independently. The final classification is based on the fusion of the output of the different modalities. In this approach, a separate is taken for each biometric type at a very late stage. This technique is least powerful

In this paper we have used Feature Level Fusion.

3. EXPERIMENTAL RESULTS

In this section following set of experiments were carried out.

1. Image Registration
2. Matching
   1. Image Registration

The first set of experiment was carried out for image registration. This section stores the fused features of human retina i.e. optic disc and ear cauncha obtained from the template Locator. It is shown in Fig. 3.1 and Fig. 3.2

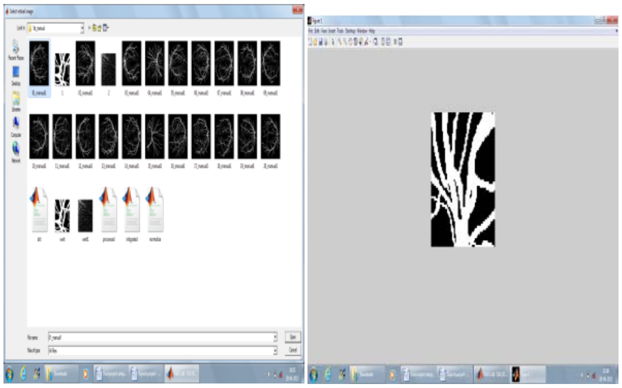

Fig. 3.1: Optic disk corresponding to the retinal image

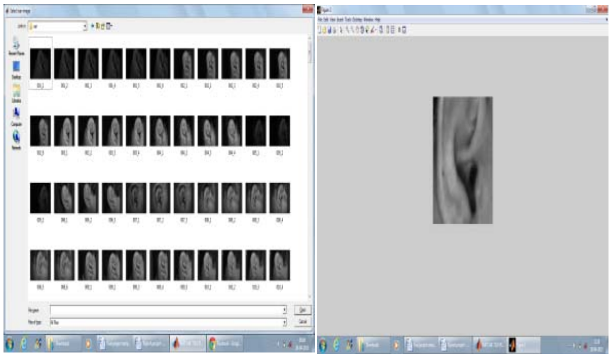

Fig. 3.2: Ear ROI corresponding to the ear image

2. Matching

The test image traits are processed till previous steps. Let the generated fused variable is 'test'. To check whether this subject is registered with the database or not call the compare function, if this function generates positive result then the given subject is registered otherwise the subject is fake or not registered with the database.

Fig. 3.3: Result of test subject

4. CONCLUSIONS

This work is focused on fusion between retinal optic disk and ROI of ear image. Here two subjects have been taken with six ear images corresponding to a subject and one retinal image of each subject. Obtained features have been used to fuse. The operation gives an efficient result in matching and detecting correct subject. This experiment gives results with 100% accuracy. In this work some consideration has been done which can be improved later on. The considerations are:

- The ear image database which is used here contains ear images of very small it is 300 x 400 pixels. To perform all the operations on the new ear images it must be resized to the above size and this resize operation is based on manipulation of pixel values.
- For ear each pixel is treated as point mass and distance between two nearest pixel is unity.
- The fusion process done here with the ear images and retinal images are without occlusions.

5. ACKNOWLEDGEMENT

The authors wish to thank to Image Sciences Institute for providing DRIVE database and to Dr C. Malathy of SRM University Chennai for ear database.

REFERENCES

[1] J. J. Staal, M. D. Abramoff, M .Niemeijer, M. A. Viergever, B. van Ginneken, “Ridge based vessel segmentation in color images of retina”, *IEEE Transactions on Medical Imaging*, 2004, vol. 23,pp.501-509.

[2] Jain, A.K. *Fundamentals of Digital Image Processing,* Englewood Cliffs, NJ: Prentice-Hall, 1989.

[3] Pennebaker, W.B., and J.L. Mitchell. *JPEG Still Image Data Compression Standard,* New York, NY: Van Nostrand Reinhold, 1993. Chapter 4.

[4] H. Farzin, H. Abrisham Moghaddam, and M. Sh. Moin, " A new method for blood vessels segmentation in retinal images,"in Proceedings of the 13th Iranian Conference on Biomedical Engineering (ICBME '07), Tehran, Iran, February 2007.

[5] C. Simon and I. Goldstein, "A New Scientific Method of Identification", New York State Journal of Medicine, Vol. 35, pp. 901-906, 1935.

[6] M. Ortega, C. Marino, M.G. Penedo, M. Blanco, F. Gonzalez, "Biometric authentication using digital retinal images", WSEAS International Conference on Applied Computer Science, (2006), pp. 422-427.

[7] H. Farzin, H. Abrishami-Moghaddam, M. Moin, "A Novel Retinal Identification System", EURASIP Journal on Advances in Signal Processing Vol. 2008, Article Id. 280635, 2008.

[8] H. Oinonen, H. Forsvik, P. Ruusuvuori, O. Yli-Harja, V. Voipio, H Huttunen, "Identity verification based on vessel matching from fundus images", 17th IEEE International Conference on Image Processing (ICIP), Sep. 2010, pp. 4089-4092.