Multimodal Biometric System Fusion using Fingerprint and Iris

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Abstract— Single biometric systems have a too much of problems like noisy data, non-universality, spoof attacks and higher acceptance and rejection rate. These limitations can be solved by using multimodal biometric systems. Multimodal Biometric systems fuse two or more physical traits to provide optimal False Acceptance Rate (FAR) and False Rejection Rate (FRR), thus improving system accuracy. This paper surveys that multimodal biometric systems using fusion of fingerprint and iris recognition gives better FAR and FRR. Different Fusion level techniques are mentioned with their advantage and disadvantages.

Key words: Fusion, Fingerprint, False Acceptance Rate

I. INTRODUCTION

The term Biometric comes from the Greek word bios which mean life and metrikos which means measure. Biometric systems uses physical part of the body to identify the authenticated human these features make biometrics a promising solution to the society. The access to the secured area can be made by the use of ID numbers or password which can be stolen or can be spoofed. Till now lots of algorithms are implemented and applied for biometrics system but in the case of single or unimodal biometric system where only one physical or behavioral actions is used this leads to high spoofing rate, high error rate, non-universality and noise.[2] As In face recognition, it is affected by sadness, happiness, position of the face and the amount of ambient light. The another problem faced in unimodal system is that when for any biometric system based on single part of body if person is missing that part then it is useless for that person so in these cases unimodal systems are meaningless. [5] This paper contains section 2 literature survey, section 3 contains overview of multimodal systems and section 4 contains conclusion.

II. LITERATURE SURVEY

F. Besbes, H. Trichili, and B. Solaiman, proposed multimodal biometric system using Fingerprint and Iris features. They use a hybrid approach based on: 1) Fingerprint minutiae extraction and 2) Iris template encoding through a mathematical representation of the extracted Iris region. Here in which every part has its own decision. The final decision was taken by considering the Unimodal. No Result has been shown[1], Hong and Jain [6] proposed an identification system based on face and fingerprint but as far as face recognition was concerned it was having higher FAR. [6] Anzar S .M. Sathidevi used Leave-One-Out Cross Validation technique (LOOCV) and Gaussian mixture model for score level fusion to implement system using fingerprint and voice The performance of the system was calculated under different noise condition. Drawback is in the case of extreme noise conditions it gives attenuating fusion. Y. Zhu, T. Tan, and Y. Wang proposed a system for biometric system based on iris patterns. The algorithm of feature extraction iris based on texture analysis using multichannel Gabor filtering and wavelet transform [4]. Julian fierrez Auguilar adapted basically different schemes for fusion were experimented for an individual biometric technique. And basically it was also experimented and compared. Score Level matching was found best overall in fusion level techniques but it requires lots of time to computation and time and time increases when data base increases, maintaining threshold value is also an issue. This research investigates the necessity of multiple sensors, multiple recognition algorithms and multiple levels of fusion and their efficiency for a Person Authentication system (PAS) with face, fingerprint and iris biometrics. In this paper highly secured paper was introduced but there are more than two biometric systems were used it was giving less FAR but FRR was increased as average score was considered. In this paper [9] Mohamad Abdolahi, Majid Mohamadi, Mehdi Jafari proposed fusion of multilmodal biometric using decision level fusion which increased accuracy but FRR was near to 5.5%.

III. BIOMETRIC SYSTEM

Biometric systems developed till now are finger print recognition,

A. Finger Print Recognition

Finger Print Recognition system is basically used to identify a unique curvature on the finger. Fingerprint composed of ridges and furrows having same width and both are parallel to each other. The system identify the unique finger by its minutia which is feature available on ridges.

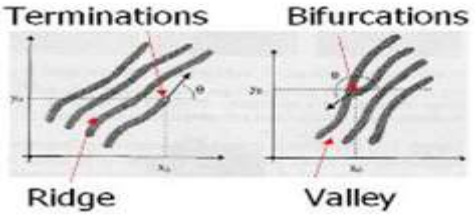

Fig. 1: Minutia on Fingers [8]

Valley is also called as Furrow, Termination is also called as Ending, and Bifurcation is also called Branch.

B. Iris Recognition

Iris is unique par to each individual person and it remains constant over the life since the birth. The eyeball has a circular black disk in the center called pupil, it dilates when exposed to light and it contracts in dark. Thus the size of pupil varies with respect to light it is exposed on it. And The iris is the annular ring between the sclera and pupil boundary and contains the flowery pattern unique to each individual person. This texture information is completely unique to each and every image is extracted from rest of the eye image and is transformed into strip to apply pattern matching algorithm between the database and query images

of iris. The Important steps in iris recognition are pupil detection, Iris detection Feature Extraction Matching.

Trait	FAR	FRR	Accuracy
Fingerprint	%3.5	%4	%96
Iris	%5	%5	%97.5
Fingerprint & Iris	%2	%2	%98.3

Fig. 2: Comparison of unimodal and multimodal systems

IV. MULTIMODAL BIOMETRIC SYSTEM

In which multiple categories of data recollected and used for various purposes, including but not limited to fusion multi biometrics system is having following operations.

- Selection, in which the best or most useful dat a is retained for use, while the other data is di scarded
- Validation, in which some of the data is used to che ck the integrity of the other data.
- Fusion, in which data is combined at different levels

A. *Levels of Fusion*

- Fusion at data-sensor level: Data coming from different sensors can be combined, so that the resulting information is in some sense better than single data. These sources of data were individually used for identification.
- Fusion at feature-extraction level: The information Extracted from sensors of different modalities is stored in vectors form on the basis of their classification. These feature vectors are then combined to create a joint feature vector, which is use for the matching and recognition process. One of the actually problems in this strategy is that, in some cases, very high dimensional feature vector results from the fusion process are obtained..
- Fusion at decision level: In this kind of fusion level each biometric subsystem completes the processing individually and then fusion takes place it give less information compared to all other fusion level techniques.
- Fusion at template level: It is very difficult to obtain, since biometric features have different structures and distinctiveness. In this paper use two level fusion template level fusions and matching score level fusion. To generate a unified homogeneous template for fingerprint and iris features.

As shown in the flowchart the basic approach in multimodal system is to compute the result for an individual biometric system and then after the results is combined to match them with a specific database of templates available in the system.

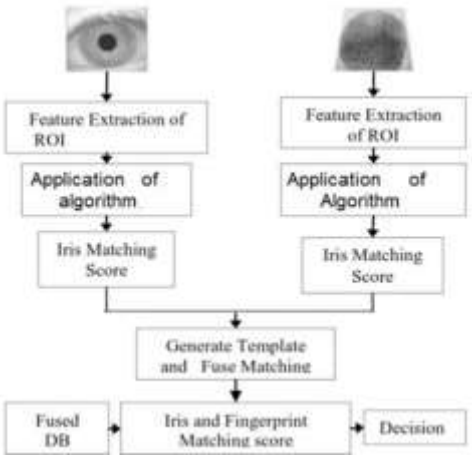

Fig. 3: Multimodal System

V. METHODOLOGY

The proposed system will contain basically and individual input of iris and fingerprint, then after image enhancement and noise removal will take place, Extracted image will be compared to the database by matching module and individual score will be counted and decision level fusion will be done as per [3] and iris recognition done as per [6]. And Hamming distance will be calculated of output that will be matched with the database.

Flow of Decision level fusion is shown fig demonstrates the decision level fusion. It"ll assign a specific appreciation to each decision according to the best threshold minimizing both FRR and FAR. The fuzzy if-then rules will produce decisions according to the matching distance calculated for each modality for that,

- Two fuzzy variables for the input need to be defined: "Iris" for the iris trait and "Finger" for the fingerprint trait,
- The output fuzzy variable: "fusion,"
- Each variable is represented by a trapezoidal fuzzy set
- For the inputs, we define three fuzzy sets according to the matching distance: bad, medium, and good,
- The output is fuzzy: either very bad or bad or medium or good or very good, or excellent.

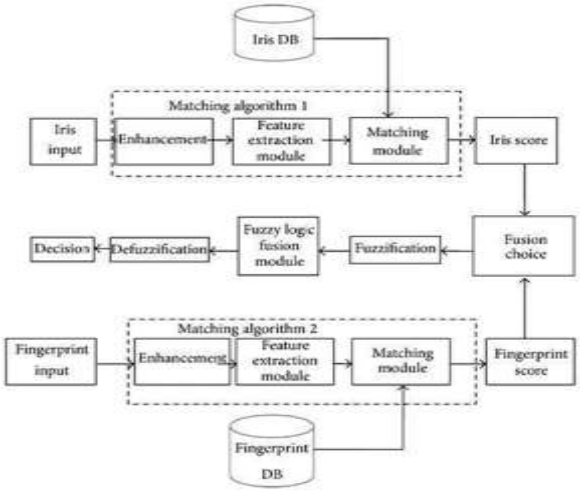

Fig 4: Decision level fusion using Iris and Fingerprint

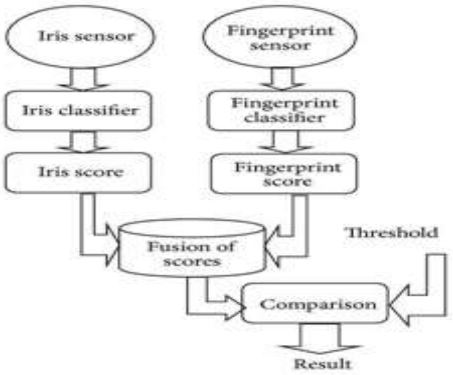

Fig 5: Proposed system block diagram

VI. EXPERIMENTS

A. Selection of Input Image & Preprocessing

Input: Image of Finger Print & Iris of person.

1) Input image of finger print.
2) Input image of Iris.
3) Preprocessing on both Images (Noise Reduction)

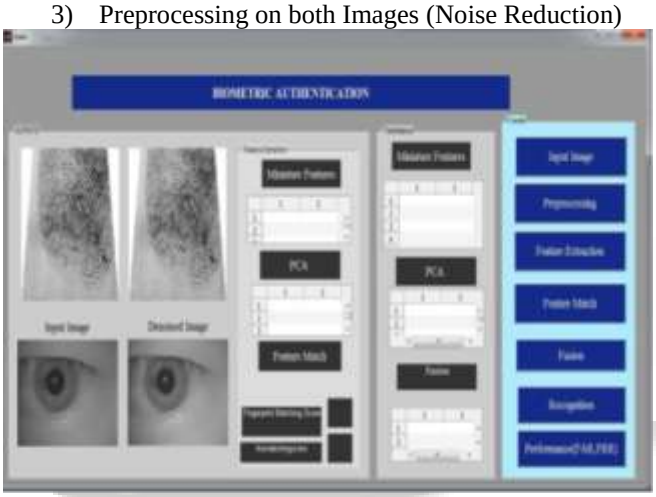

Fig. 6: Biometric Authentication

B. Feature Extraction from Finger Print and Iris.

1) Input: Preprocessed images of input
2) Output: Feature Extraction from input images.

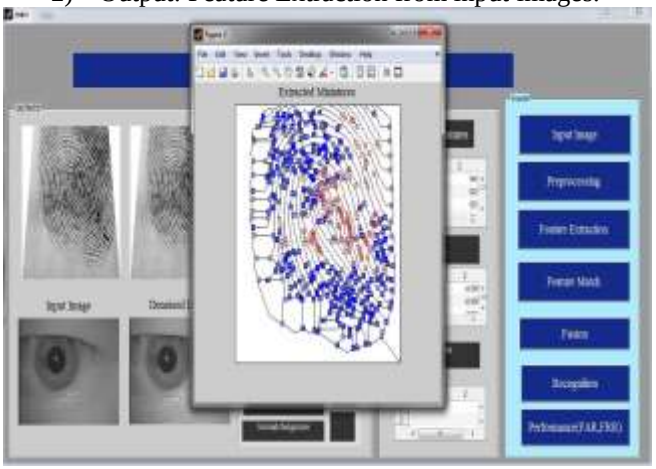

Fig. 7: Feature Extraction from Finger Print and Iris

C. PCA (Process Component Analysis)

1) Input: Extracted Features of finger print and iris
2) Output: PCA for extracted Features.

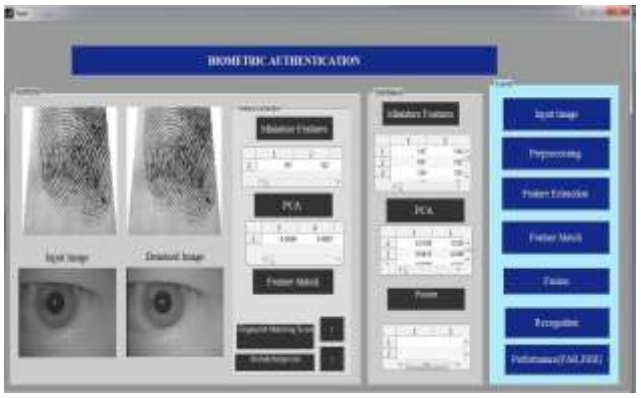

Fig. 8: PCA (Process Component Analysis)

D. Fusion of Fingerprint & Iris Features

1) Input: Extracted Features of finger print and iris.
2) Output: Fusion matrix of Iris and Fingerprint and authentication.

Fig. 9: Fusion of Fingerprint & Iris Features

E. Far & FRR graph

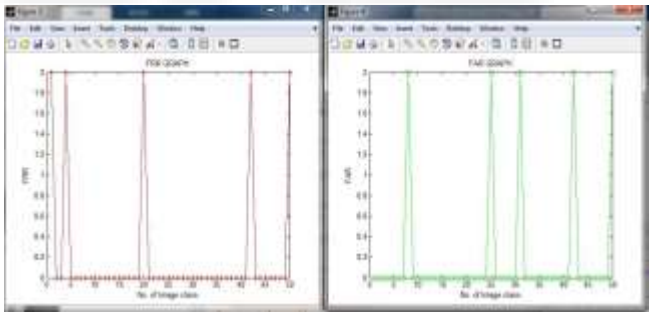

Fig. 10: Far & FRR graph

VII. CONCLUSION

Now a days use of biometric systems for authentication purpose is increasing and unimodal systems are facing lots of problems like noisy inputs, non-universality, lack of individuality, lesser accuracy as compared to multimodal systems. So to overcome this multimodal system needs to be developed and as far as combining two systems are concerned fingerprint and iris are most suitable biometrics as both are independent of genetic nature of humans as well as it remains the same throughout the life. Score level fusion is accurate but FRR is increased and requires lots of computations which slows the output. In this case using decision level fusion and finger print recognition extraction will be taken using linear filter and in the case

of iris recognition combination of high pass and low pass filter can improve efficiency. And overall FAR and FRR can be increased.

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