Multimodal Biometrics using Iris and Ear Modalities – A Review

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Abstract— The unimodal biometric systems are not much reliable. Most of the existing biometric systems developed were based on single biometric features (fingerprint, ear, face, iris and so on). Each biometric trait has its own strength and weakness. So, multimodal systems has become into limelight. In this paper concept of multimodal systems has been presented and main stress is given on Iris and Ear biometrics. In addition to this various fusion methods and feature extraction methods has been presented in this paper

Keywords - *Iris, Ear, Biometrics, Authentication, Security.*

I. INTRODUCTION

Biometric authentication systems verify a person's claimed identity from behavioral traits (signature, voice) or physiological traits (face, iris, and ear) [1]. Multimodal biometric system overcomes the limitations of unimodal biometric systems such as non-universality, noise in sensed data, spoofing, intra-class variability, inter-class variability [2]. Multimodal biometric system can be constructed using more than one physiological or behavioral characteristic for identification and verification purposes. These types of systems are developed for security purposes in various fields like crime investigation, e-commerce and military purposes. Multimodal biometric system developed using fingerprint, hand geometry, they required the concerned human to make physical contact with a sensing device. Most of the existing biometric systems developed were based on single biometric features (fingerprint, ear, face, iris and so on). Each biometric trait has its own strength and weakness. So multimodal biometric system has become necessity for security requirements in today's era [3].

The organization of the paper is as follows:

Section 2 deals with the multimodal biometrics that eliminates the limits of uni -biometric systems. Section 3describes the architecture of multimodal system following the related work in the section 4. Feature Extraction Algorithms defines in the section 5. Conclusion and future work of the research is defined in section 6.

II. MULTIMODAL BIOMETRICS

Systems that consolidate evidence from multiple sources of biometric information in order to reliably determine the identity of an individual are known as multi modal biometric systems [4]. Multi modal biometric systems can alleviate many of the limitations of uni-biometric systems because the different biometric sources usually compensate for the inherent limitations of the other sources. Use of multiple biometrics indicators for identifying individuals is known as multimodal biometrics [5]. In the multimodal biometric systems firstly individual biometrics systems are run then fusion is made using various algorithms to enhance the performance of the system. There are two parameters named FAR and FRR. There rate can be reduced if the negative results are less than the positive results.

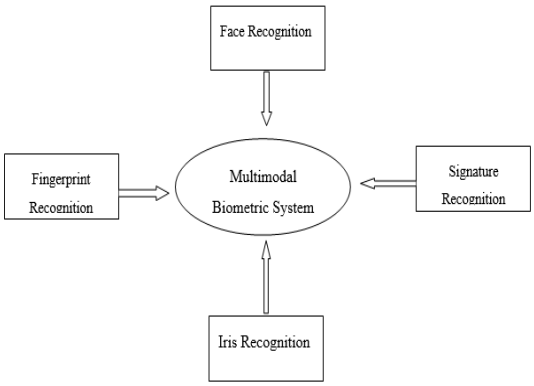

Fig.1: Multimodal biometric system

The fusion of biometric traits leads to the improvement of the performances by reducing the negative results. E.g. fusion of iris and ear is more effective in accordance to the use of only iris or ear modalities. Main benefits of using multimodal systems are reduction in cost and complexity. This is due to the following characteristics:

a) Fusion of modalities must takes place in synchronous manner.
b) Fast processing time fusion strategy must have been adopted.
c) Modalities are self-governing for each new.
d) Different confidence level: like to recognize the crying voice is much easier in video than in audio.
e) The cost may be incurred in units of measure, units of time, money or further [6].

A .Iris and ear Modalities

The iris is an all-around ensured organ that is remotely unmistakable and whose epigenetic examples are exceptionally exceptional and stay stable all through a large portion of an individual's life. Its high uniqueness and soundness makes it a decent biometrics that can be utilized for recognizing people. On the other side, Application of ear recognition in the field of biometrics is a new method. The structure of the ear is robust because it does not change with the facial expressions. The external ear constitutes the most unique design, characteristic features and peculiarities for the

purpose of identification. On no other part of human body do we have flesh lines with such a unique design.

III. ARCHITECTURE OF MULTIMODAL SYSTEM

Structural design of a multi-modal biometric scheme denotes to the sequence in which the multiple cues are acquired and processed [11, 12].

A. Serial Architecture: In this architecture, processing takes place in the sequential manner. E.g. ATM processing.

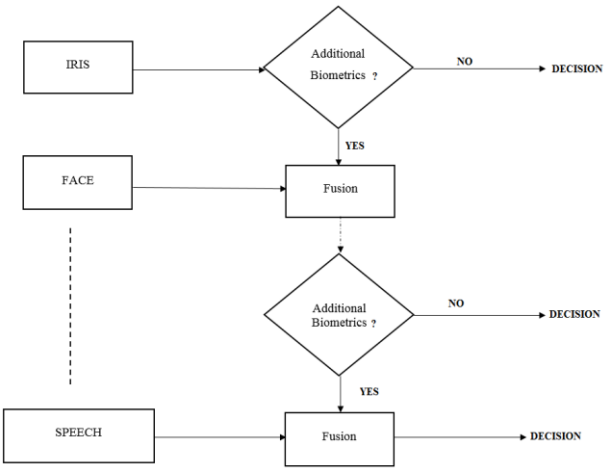

Fig.2: Serial Architecture

B. Parallel Architecture: In parallel architecture, processing takes place in the non-sequential manner. E.g. military.

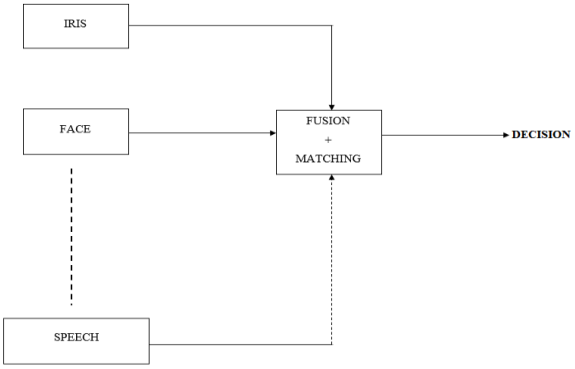

Fig.3: Parallel Architecture

IV. RELATED WORK

Li Yuan, Zhi chun Mu, 2012 [7] proposed the Neighborhood Preserving Embedding Algorithm. This paper offers a 2D ear recognition method which is particularly established on local data fusion on the way to deal with ear recognition in partial occlusion. The advantage is that it acquires higher recognition rate with the disadvantage of that it acquires only 2-d Ear image recognition. A. Kumar, C. Wu, 2012 [8] used Morphological and Descriptors Algorithm. They demonstrate an entirely automatic method meant for the robust subdivision of the curved area of interest utilizing morphological operators as well as Fourier descriptors. The Recognition accuracy of 96.27% but only Small Dataset is used. Lenina Birgale and M. Kokare, 2010 [9] has described 2-DGabor Filter technique. Results show that the system is quite effective and provides encouraging performance. It improve the security. Shashi Kumar D R, K B Raja, R. K Chhootaray, Sabyasachi Pattnaik, 2011 [10] defined PCA based DWT technique. The picture is improved utilizing Histogram Equalization to get great contrast. The suggested procedure has a way enhanced performance parameters compared to existing algorithms.

V. FEATURE EXTRACTION TECNIQUES

A. Independent Component Analysis (ICA)

Independent Component Analysis (ICA) [13] is a computational method to get hidden values of random variables. ICA basically designed for multivariate data. ICA is somewhat related tp Principal Component Analysis (PCA). But it is capable when PCA fails. The data used for analyzing using ICA can be originated from many fields like economics, digital images, document databases etc.

ICA Algorithm Steps

1. Make data to mean zero
2. Choose the number of components.
3. Whiten the data.
4. Choose random matrix.
5. Orthogonalised the matrix.
6. Do converged.
7. Repeat again.
8. Stop.

ICA Model

- Use statistical "latent variables" system
- Random variable s_k instead of time signal

$$x_j = a_{j1}s_1 + a_{j2}s_2 + .. + a_{jn}s_n, \text{ for all } j$$

$$\mathbf{x} = \mathbf{As}$$

- IC's **s** are latent variables & are unknown AND Mixing matrix **A** is also unknown
- Task: estimate **A** and **s** using only the observeable random vector **x**
- Lets assume that no. of IC's = no of observable mixtures and **A** is square and invertible

So after estimating A, we can compute $W=A^{-1}$ and hence

$$s = Wx = A^{-1}x$$

B. Scale Invariant Feature Transform (SIFT)

Scale Invariant Feature Transform (SIFT) was proposed by David Lowe [14] that has the capacity to distinguish and depict neighborhood picture elements positively. The necessary SIFT appraisal comprises of five noteworthy stages:

- *Scale-space local extreme detection*

The first step of key point detection involves identification of locations.

- *Key-point localization*

To detect the importance points, DOG pictures are utilized also local maxima as well as local minima are computed

across different scales. Each pixel of a DOG image is compared to 8 neighbors in the same scale and 9 neighbors in the neighboring scales.

- *Orientation assignment*

To attain invariance to picture rotations, an orientation is allocated towards each and every one of the key-point localities.

- *Key-point descriptor*

In this stage, a particular descriptor is registered at every key-point. The picture gradient magnitudes and introductions, with respect to the significant introduction of the key point, are inspected inside a 16X16 locale around every key-point.

- *Trimming of false matches*

The key-point matching procedure described may generate some erroneous coordinating focuses. We have evacuated spurious coordinating focuses using geometric limitations.

C. Genetic Algorithm (GA)

Genetic Algorithms are adaptive heuristic search algorithm based on the evolutionary ideas of normal range and inheritance. As such they signify an intelligent operation of a arbitrary search used to solve optimization problems. Even if randomized, GAs are by no means random, as a substitute they develop past in sequence to direct the search into the region of better act within the search space [15].

In the main the subsequent technique is utilized for producing simple form of the genetic algorithms is summarized as follows:

Produce random population of n chromosomes (suitable solutions for the problem)

$w0i, i = (w1, w2)\ i = 1...N_m$

Where N_m: size of populace

Strength f(x) of each genetic material x in the population is used for evaluation.

VI. CONCLUSION AND FUTURE SCOPE

The concept of the multimodal systems makes it possible to use the biometric technology in real time applications. These systems have made the improvement in the performance of the multimodal systems. They solve the problems like susceptibility, representation, high error rate, non-universality etc. So, this paper discusses the various iris and ear multimodal biometric system in addition with features extraction techniques commonly used in Multimodal security systems.

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