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Review On: Multimodal Biometric Fusion

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Abstract: *Biometric Fusion combined multiple data from multiple sources so that accuracy, efficiency and robustness of a biometric system can be improved. Multimodal biometric systems perform better than uni-modal biometric systems as it removes the limitations of single biometric system. In this review paper, different feature extraction algorithms (PCA, ICA) are discussed along with GA (Genetic Algorithm).*

Keywords: *GA (Genetic algorithm), DWT (Discrete wavelet transform), PCA (Principal Component Analysis), ICA (Independent component analysis), GA (Genetic Algorithm).*

1. Introduction

Biometric fusion constitutes multiple types of biometric data for improving the performance of biometric systems. A perfect biometric should be unique, universal, and permanent over time that is easy to measure, also cheap in costs, and have high user acceptance. No single biometric can fulfills all these requirements simultaneously. For instance, fingerprints and retina are known to be highly unique, but they require dedicated sensors and are not user friendly. On the other hand, voice and facial geometry are not as unique, but they require only a cheap microphone or a camera as a sensor, and they are unobtrusive. Therefore combination of several complementary biometrics can provide higher recognition accuracy than any individual biometric alone [1].Some of the problem with fingerprint recognition system is fingerprint images have been observed to have poor ridge details. Multimodal systems available are face and ear, face and fingerprint, palm print and face, etc.

2. MULTIMODAL FUSION

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.
Use of multiple biometrics indicators for identifying individuals is known as multimodal biometrics. Evidence obtained from different modalities can be combined by using an effective fusion technique for improving the overall accuracy of the biometrics system ,as multimodal biometric system can reduce the FAR/FRR rates [2] and provide more resistance . Multimodal biometric system is more dependable than any other single biometric system. The different Levels of Fusion are [3]

- Data-sensor level
- Feature-extraction level
- Matching-score level
- Decision level

The multimodal biometric system can implemented on these fusion schemes to improve the Performance of the system.

Usually a classification of the biometric features is made: physiological that consist of fingerprint, face shape, iris, retina etc. and behavioural i.e. voice, gait, writing style etc. In practice, all biometric verifiers may be considered combinations of physiological and behavioural characteristics due to the interaction mode between the user and the system, which puts its mark over the characteristic.

IRIS: The idea of using iris patterns for identification of persons was first proposed in1936 by the ophthalmologist Frank Burch. John G.Daugman, then professor of Harvard University so that he developed the algorithms necessary to perform the biometric recognition through the iris pattern [4]. These algorithms, patented by Daugman [5],are the basis of all iris recognition systems that exist today. There are various work undertaken for iris recognition, as the work performed by Ahmad M. Sarhan [6], which uses

neural networks and Discrete Cosine Transform for the identification based on iris.

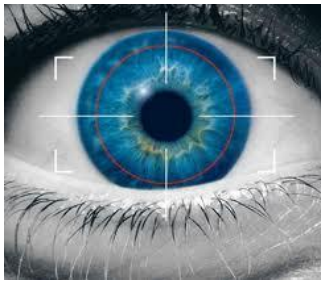

Fig.1 Pattern of iris [6]

Ear: The human recognition based on ear is of particular interest because is not affected by environmental factors such as mood, health, and clothing, as well as not affected by aging, making it more suitable for long-term identification compared with other measures, such as the face.

Fig.2. Patterns of ear [19]

One of the best known works is that of Carreira Perpiñán [7], where it uses artificial neural networks (ANN) for feature extraction [8]. Other work is of Ali, Javed and Basit, where they proposed a new ear recognition method using Wavelets [9].

3. FEATURE EXTRACTION ALGORITHMS

A. *Principal component analysis (PCA)*:

Principal Component Analysis method is used to extract the features from two traits thatprint separately. The feature matrix is formed by normalizing feature concatenation scheme that is followed by a dimensionality reduction.

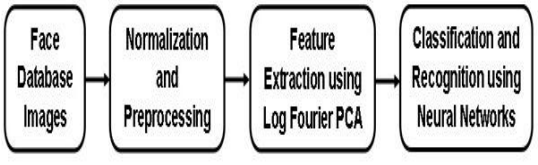

Figure.3. PCA model

B. *Independent Component analysis* (ICA):

ICA is related to principal component analysis and factor analysis.ICA is a powerful technique that is capable of finding the underlying factors or sources when classic methods (PCA)fail completely. The data analyzed by ICA could originate from many different kinds of application fields that include digital images, document from databases, economic indicators and psychometric measurements.

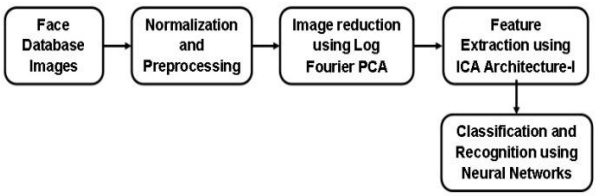

Figure.4 ICA model.

When the independence assumption is correct then blind ICA separation from a mixed signal gives very good results. It is also used for signals that are not supposed to be generated by a mixing for analysis purposes.

C. *Genetic Algorithm (G.A.):*

Genetic Algorithms are adaptive heuristic search algorithm based on the evolutionary ideas of normal range and inheritance. GAs simulates the continued existence of the fittest in the middle of persons over successive generation for solving a problem. Each creation consists of a populace of quality strings that are related to the genetic material that we see in our DNA. Each being represents a point in a search space and a possible explanation. Those in the population are then completed to go through a process of growth. Generally the following procedure is used for generating simple form of the genetic algorithms is summarized as follows:

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

w0i, i = (w1, w2) i = 1...N

Where N: size of population

- fitness f(x) of each chromosome x in the population is used for evaluation
- These following steps repeat for creation of new population until the new population is complete

4. LITERATURE REVIEW

Nagesh kumar.M(et,al) [9] Biometric systems are widely used to overcome problems of the traditional methods of authentication. An authentication method is proposed for multimode biometric system identification using two different traits for face and palm print by combining them. he performance table shows that multimodal system performs better as compared to unimodal biometrics with accuracy of more than 98%**.**

Yunhong Wang [10] The fusion of two biometrics has several other advantages i.e. Face and iris identification. Two different strategies used for fusing iris and face classifiers.The first strategy is used for computing weighted or unweighted sum and to compare the result to a threshold. The second strategy is used for to treating the matching distances of face and iris classifiers as a two-dimensional feature vector. The results of the combined classifier are compared with the results of the individual face and iris classifiers **.**

Dapinder Kaur [11] Different techniques for the fusion are discussed at different levels of fusion for improving the performance. Multimodal biometric system used to combines the different biometric traits thus provides better recognition performance as compared to the single systems that is based on single biometric trait or modality**.**Multi-modal biometric system overcomes the disadvantages of single biometric system using fuzzy logic. Two single modal biometrics i.e., iris and fingerprint are combined as multi-biometrics show high accuracy results achieves an additional improvement of 1.7% with fuzzy logic.

Mohamad Abdolahi,(et.al),[12] Multimodal biometric systems used the evidence presented by multiple biometric sources (e.g., face and fingerprint, multiple fingers of a user, multiple impressions of a single finger, etc.) For verify the identity of an individual. Information can be consolidated by extracting features, match score level; and match score level. Preliminary results indicate that the proposed technique can lead to substantial improvement in multimodal matching performance**.**

Ricardo N. Rodrigues [14], the application of a Modular Neural Network (MNN) for iris, ear and voice recognition for a database of 77 persons are presented. The proposed MNN architecture consists of three modules; iris, ear and voice. Each module is divided in other three sub modules. Each sub module contains different information, which, the first 26 individuals are considered in module 1, the following 26 individuals in module 2 and the last 25 in module 3. Integration of each biometric measure is considered separately with a fuzzy integrator. Also, optimization of the modular neural networks is done by fuzzy integrators using genetic algorithms. A comparison is done on optimized results with non optimization results.

Shashi Kumar (et.al)[16] In this paper PCA based iris recognition using DWT (PIRDWT) is proposed. The image is enhanced using Histogram Equalization to get high contrast. DWT is applied on histogram equalized so as to get DWT coefficients. The features are extracted from the approximation band of the DWT coefficients using PCA. Multiple classifiers such as KNN, RF and SVM are used for matching. The proposed algorithm has better performance parameters compared to existing algorithm.

M. Ramya(et.al) [17] shows that the fingerprint and Iris are the most unique features that does n not change as compare to other biometrics. Proposed approach consist of 5 steps i.e. i) Feature extraction of fingerprint and iris ii) Fusion of extracted features iii) Key is generated from the fused feature which is of greater than 128 bit which is enough for AES encryption iv) AES encryption v) Hash Encoding vi) AES decryption. In the verification phase, decryption is to be done. Message is obtained when the encrypted value from the enrolment phase and verification phase are same. Fingerprint is obtained from publicly available sources and Iris is obtained from CASIA Iris database. From this system performance of False acceptance rate and false rejection rate are highly reduced.

Ali, (et.al)[8] Various methods have been employed for ear recognition to improve the performance by comparing the results with other existing methods. New ear recognition method is proposed. Ear images are cropped manually from the side head images. After that wavelet transform is used for feature extraction and matching is carried out using Euclidean distance.

Lenina Birgale[20] process used traditionally in iris recognition systems. The technique proposed here used different masks to filter out iris image from an eye. Comparative study of different masks was done and optimized mask is proposed. The experiment was carried on CASIA database consisting of 756 iris images of 108 persons. Each person contributes seven images of eye (108×7 = 756) images in the database.

5. CONCULSION AND FUTURE SCOPE

Biometrics usually refers for measuring and analyzing human body characteristics such as fingerprints, eye retinas and irises, voice patterns, facial patterns, and hand measurements. Multimodal biometric systems perform better than uni-modal biometric systems as it removes the limitations of single biometric system. Future scope lies in the use of better feature extraction method like ICA with high accuracy providing matching methods like hamming distance.

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