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Review paper on applications of principal component analysis in multimodal biometrics system

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Abstract

Unimodal biometric systems are susceptible to a variety of problems such as noisy data, intra-class variations, limited degrees of freedom, non-universality, spoof attacks and unacceptable error rates. Some of these limitations can be addressed by deploy multimodal biometric systems that integrates the evidence presented by multiple sources of information The proposed system provides effective fusion scheme that combines information presented by the multiple domain experts based on the Rank level fusion integration method, thereby increasing the efficiency of the system which is not possible by the unimodal biometric system. The proposed multimodal biometric system has a number of unique qualities, including principal component analysis and fisher's linear discriminate methods for individual matchers authentication. The novel rank level fusion method is used in order to consolidate the results obtained from different biometric matchers.

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Keywords: Multimodal biometrics; PCA; Fingerprint *Recognition; Iris Recognition; Minutiae Extraction.*

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1. Introduction

Biometrics has drawn wide acceptability during the last 35 years. It is used for building and store access control, image identification, observation and computer interfacing. The key issue of these applications is the identification of individuals by their physiological or behavioral characteristics (e.g., face, fingerprint, iris, signature, or gait)[1][2]. Each biometric characteristic has its own strengths and weaknesses: but, none is free from any one or more issues such as noisy data, non universality, spoof attacks, and unacceptable error rates. In the past few years, researchers have more and more focused on the possibility of including multiple sources of information.

A simple biometric system consists of four basic components: A simple biometric system consists of four basic components:

1) Sensor module which acquires the biometric data;
2) Feature extraction module where the acquired data is processed to extract feature vectors;
3) Matching module where feature vectors are compared against those in the template;
4) Decision-making module in which the user's identity is established or a claimed identity is accepted or rejected.

Any human physiological or behavioural trait can serve as a biometric characteristic as long as it satisfies the following requirements:[1][2][8]
1) *Universality*. Everyone should have it, barring a few exceptions, like physical deformities;
2) *Distinctiveness*. No two individuals should have the same characteristics;
3) *Permanence*. It should be invariant over a given period of time;
4) *Collectability*. The feature should be sensed the given system.

2. Literature survey

Multimodal techniques are not new to the medical world. In routine medical checkups also, it is often preferred have a primary and a confirmatory examination. The inclusion of evidences from more than one sources would enhance the overall Accuracy of the system.

Table 1. Literature Survey.

Author	Biometric Modalities	Level of fusion	Accuracy reported
Vincenzo Conti *et al*. [3]	Fingerprint and iris	Feature level fusion	96%
Abhishek Nagar *et al.* [4]	Iris, fingerprint and face	Feature level fusion	97%
Robert Snelick *et al.* [5]	fingerprint, face	Simple-Sum fusion	95.5%
A. Muthukumar *et al.* [6]	Iris and fingerprint	Score fusion	95.5%
Sumit Shekhar, *et al.* [7]	Iris, fingerprint and face	Sparse matrices	97.5%

3. Biometric system errors

The Biometrics signal acquisition is not free from errors. When errors are significant, two samples of the same biometric characteristic from the same subject (e.g., two impressions of a user's right index finger) may not exactly be the same due to imperfect imaging conditions (e.g., sensor noise and dry fingers), changes in the user's physiological or behavioural characteristics (e.g., cuts and bruises on the finger), ambient conditions (e.g., temperature and humidity), and user's interaction with the sensor (e.g.finger placement). Therefore, the response of a biometric matching system is the matching score (typically a single number) that quantifies the similarity between the input() and the template() representations. The higher the score, the more certain is the system that the two biometric measurements come from the same person. The system decisions regulated by the threshold: pairs of biometric samples generating scores higher than or equal to are