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Fusion Time Reduction of a Feature Level Based Multimodal Biometric Authentication System

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ABSTRACT

In the present study, a multimodal biometric authentication method is presented to confirm the identity of a person based on his face and iris features. This method depends on multiple biometric techniques that combine face and iris (left and right) features to recognize. The authors have designed and applied a system to identify people. It depends on extracting the features of the face using Rectangle Histogram of Oriented Gradient (R-HOG). The study applies a feature-level fusion using a novel fusion method which employs both the canonical correlation process and the proposed serial concatenation. A deep belief network was used for the recognition process. The performance of the proposed systems was validated and evaluated through a set of experiments on SDUMLA-HMT database. The results were compared with others, and have shown that the fusion time has been reduced by about 34.5%. The proposed system has also succeeded in achieving a lower equal error rate (EER), and a recognition accuracy up to 99%.

KEYWORDS

Deep Belief Network, Feature-Level Fusion, Multimodal Biometrics, R-HOG

1. INTRODUCTION

As the security issue increases in modern societies, human recognition using biometrics has gained an increasing attention over the last years. Biometrics literally means to all technological techniques utilized to authenticate or identify persons relying on their physical and/ or behavioural characteristics.

Biometrics appoint technologies that investigate and measure human body characteristics just as irises and eye retinas, facial patterns, DNA, fingerprints, voice patterns, and hand measurements as shown in Figure 1, for authentication purposes (Liao & Chiu, 2016).

Biometrics may be categorized as physiological or behavioural biometrics. The physiological biometric are related to the shape of the body like face recognition, iris recognition, fingerprint, and DNA. Otherwise, the behavioural biometric are allied to the behaviour of a person such as voice, signature, gait, and keystroke (Sang et al., 2018).

Multi-biometric system is a biometric recognition system which collects the biometric information through multiple biometric resources to verify a person's identity. The process of combing the collected information is known as information fusion process (Howard, 2009).

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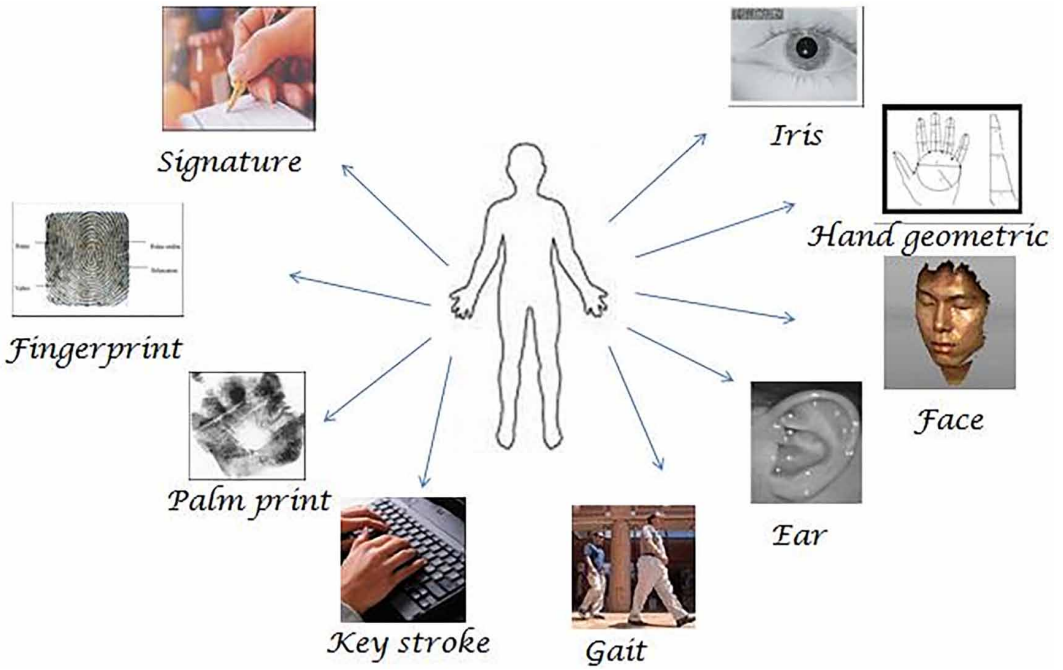
Figure 1. Common biometrics traits (Liao et al., 2016)



Generally, the limitations of unibiometric system have directed the attention of researchers towards multi-biometric systems because of where the biometric source may become unreliable due to a set of reasons which includes sensor or software malfunction, noisy data, non-universality ... etc. Moreover, many applications have stringent accuracy requirements, such as US-VISIT software, which cannot be met using unibiometric systems (Jain et al., 2004). Multi-biometric systems depend on demonstrating each client by multiple evidences that can be independently used to identify a person. Based on the adopted way in representing each client, multi-biometric systems can be categorized into six classes including multimodal, multi-algorithm, multi-sample, multi-instance, multi-sensor, and hybrid systems (Ary et al., 2012).

Multimodal system is a common method used to build a multi-biometric system in which several biometric traits are used such as face, iris, finger, and palm. Building a more powerful and effective biometric system can be done via fusing the information gotten from various biometric traits through manipulating the strengths of each trait for achieving better authentication accuracy (Wang et al., 2009). In multimodal biometric systems, the fusion process can be operated through different approaches including feature fusing, match scores, and decision fusing. Applying the fusion at each level has its advantages and disadvantages. However, feature level fusion can take advantage of the most distinguished information and remove any redundancy and/or adverse information from the raw biometric data; therefore, fusion in feature level is expected to achieve better performance when compared to other fusion levels as match scores, and decision fusing (Prasad et al., 2017).

There are many distinct biological methods used to achieve the task of identification. Face and iris are the two most widely adopted biometric traits currently used in many applications. Meeting the security requirements of many applications at the present time, with the amazing progress in the identification of patterns by computer through face and iris recognition, is a motivating research topic due to its applicability in many actual applications such as airport security, banking transaction authentication, and Law Enforcement. In the present study, a multimodal biometric authentication method is presented to confirm the identity of a person based on his face and iris features.