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Multimodal Biometric Based on Fusion of Ridge Features with Minutiae Features and Face Features

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ABSTRACT

Multimodal biometrics refers to the exploiting combination of two or more biometric modalities in an identification of a system. Fingerprint, face, retina, iris, hand geometry, DNA, and palm print are physiological traits while voice, signature, keystrokes, gait are behavioural traits used for identification by a system. Single biometric features like faces, fingerprints, irises, retinas, etc., deteriorate or change with time, environment, user mode, physiological defects, and circumstance therefore integrating multi features of biometric traits increase robustness of the system. The proposed multimodal biometrics system presents recognition based on face detection and fingerprint physiological traits. This proposed system increases the efficiency, accuracy and decreases execution time of the system as compared to the existing systems. The performance of proposed method is reported in terms of parameters such as False Rejection Rate (FRR), False Acceptance Rate (FAR) and Equal Error Rate (EER) and accuracy is reported at 95.389%.

KEYWORDS

Feature Level, Min-Max Technique, Multimodal Biometric, Principal Component Analysis, Support Vector Machine

1. INTRODUCTION

Biometric authentication is one of most popular, secure and trusty authentication techniques of a system. Biometric systems use physiological traits like fingerprint, face, retina, iris, hand geometry, DNA, palm print and behavioural traits like voice, signature, key strokes, and gait for the identification of a system (Dessimoz, Richiard, Champod & Drygajlo, 2007; Pichard, Hebrard & Chilliard, 2004). These biological features are more reliable and have more discrimination features than any knowledge based or token-based technique due to its uniqueness property. Uni-modal biometric uses single trait while multimodal biometric uses more than one trait for the purpose of recognition (Li, Sun, Tan, Pankanti, Chollet, & Zhang, 2005).

Confirmation of a user's identity is done on the basis of features extracted from the input trait which are compared to the features stored as template database. A number of feature extraction techniques have been discussed in the published literature. Features obtained from the input image can be fused at different levels of fusion according to the need of the system. The fusion is divided

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into five types (i) Sensor level (ii) Feature level (iii) Match score level (iv) Rank level and (v) Decision level. Feature level fusion has been implemented in our proposed system.

A biometric works in two phases (i) Enrolment phase and (ii) Verification phase. In enrolment phase a user is registered to the system. For this purpose, user's features are fused and stored as template in database. In the verification phase a true or legitimate user is identified on the basis of score generated by matching previously stored database template and the runtime fused features of the user. Variety of issues like non-universality, noisy data, intra-class variations, restricted degrees of freedom, spoof attacks and unacceptable error rates in uni-modal biometric systems (Das, Karthik, & Gara, 2012) can be reduced by deploying multimodal biometric system. Confirmation of a user's identity is implemented on the basis of features extracted from the input trait which are compared to the features stored as template database. Features obtained from the input image are fused at different levels of fusion according to the need of the system. As already mentioned in this empirical study feature level fusion have been implemented.

In recent past, researchers have proposed five types of multimodal biometrics: Multi-sensor multimodal biometrics, multi-algorithm multimodal biometrics, multi-instance multimodal biometrics, multi-sample multimodal biometrics, and hybrid multimodal biometrics system; this gives us the inspiration to research and propose technique based on hybrid multimodal biometrics system.

All the experiments have been performed on the standard dataset, discussed later, and the computed results comes out to most promising in case of proposed approach.

The paper is organized into the following sections. Section 2 presents a report on literature review on prior published studies. A detailed description on many similar studies is also presented in this Section. Section 3 describes the proposed methodology. Section 4 contains a comprehensive description of the experimentation process and meticulous report on performances of various approaches on diverse parameters of efficiency. Finally, Section 5 presents the conclusion of the study along with possible future enhancements.

2. PRIOR PUBLISHED STUDIES

We have gone through several studies which resemble the proposed work; some of the prominent work which resembles our work is discussed in this section. Authors (Jain, Ross, & Prabhakar, 2004) presented comparative approach among different traits and presents error rates in terms of False matched rate (FMR) and False Non-Matched Rate (FNMR). In the next study authors (Darwish, Zaki, Saad, Nassar, & Schaefer, 2010) proposed an effective approach to multimodal biometrics using face and fingerprint recognition where Facial image representation is performed using local binary pattern (LBP) textures, while fingerprints are recognised on the basis of minutiae extraction.

In this study, Phillips, Martin, Wilson, and Przybocki (2000) emphasized on performance estimation of the biometric system in which the author elaborates the parametric of multi biometric systems. Subsequently authors (Dahel & Xiao, 2003) proposed the multimodal biometrics to overcome the potential limitations of any individual biometric system by improving system security level and anti-spoofing. Authors computed False Acceptance Rate (FAR) and False rejection Rate (FRR) with the intend of improving accuracy as well as the convenience of biometric applications. (Jain, Ross, & Pankanti, 2006) proposed an identification system based on face and fingerprint; where matching of finger is applied followed by pruning the database via face matching. In the next paper authors (Yang, Zhang, Frangi, & Yang, 2004) performed a detailed investigation of various features extracted from the particular region of human faces for biometric identification. Simple distance measures were used to determine the verification rate (VR) along with several filter-based techniques and local feature extraction methods. (Ratha, Bolle, Pandit & Vaish, 2000) presented an efficient fingerprint authentication technique based on graph representation.

In the next study, the authors Lakshmiprabha, Bhattacharya, and Majumder (2011) proposed a new multimodal biometric approach using face and periocular biometric. A method which can extract