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A Study of Multimodal Biometric System Recognition using Different Modalities and Fusion Techniques

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Abstract: *In present days, biometric based security systems achieved more attention due to incessant terrorism threats around the world. On the other hand, a security system comprised of a single form of biometric information cannot fulfil users' expectations and may suffer from noisy sensor data, and inter class variations and continuous spoof attacks. To overcome some of these problems, a multimodal biometric system became more popular due to increased recognition accuracy. Sequentially to take full advantage of the multimodal approaches, one of the main issues is to implement the fusion mechanism for different biometric information. In this work, we tried to utilize attributes (finger and iris) from a standard database and tried to improve the performance.*

Keywords: *Fingerprint, Gabor filter, Multimodal biometrics, Unimodal biometrics,*

1. INTRODUCTION

Biometrics refers to identity verification of persons according to their physical or behavioral characteristics. Many physical body parts and personal features have been used for biometric systems: fingers, hands, feet, faces, irises, retinas, ears, teeth, veins, voices, signatures, typing styles, gaits, odors, and DNA. Person verification based on biometric features has attracted more attention in designing security systems [1]. However, no single biometrical feature can meet all the performance requirements in practical systems [2]. Most of biometric systems are far from satisfactory in terms of user confidence and user friendliness and have a high false rejection rate FRR. There is a need for development of novel paradigms and protocols and improved algorithms for human recognition. Unimodal biometric systems use one biometric trait to recognize individuals. These systems are far from perfect and suffer from several problems like noise, non-universality, lack of individuality, and sensitivity to attack. Multimodal biometric systems use multiple modalities to overcome the limitations that arise when using single biometric trait to recognize individuals

Multiple biometric systems perform better than unimodal biometric systems. The use of only one biometric trait susceptible to noise, bad capture, and other inherent problems makes the unimodal biometric system unsuited for all applications.

2. LITERATURE SURVEY

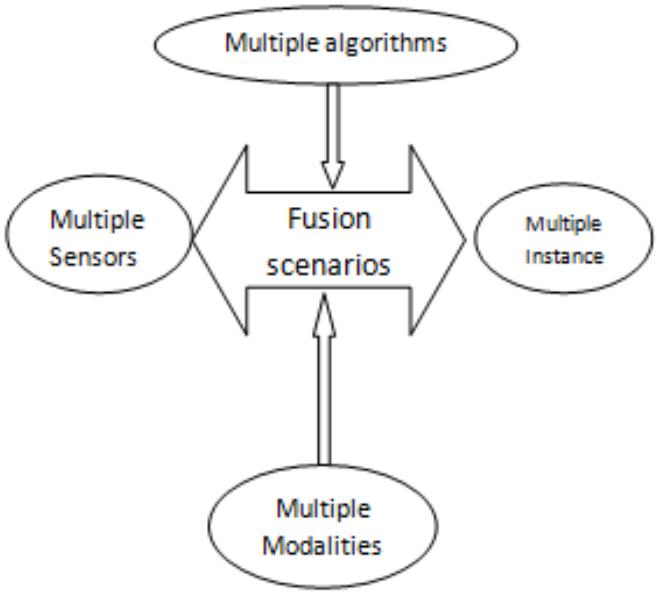
Multimodal biometrics has been proposed by Ross and Jain in 2003 [3].The concept of biometric multimodalities fusion is introduced with different fusion strategies and various levels of fusion are also presented [2, 4, 5]. Fusion of iris and fingerprint has attracted a lot of attention and researchers have presented variety of approaches in the literature [6, 7]. Baig et al. [6] in 2009 proposed a framework for multimodal biometric fusion based on utilization of a single matcher implementation for both modalities (iris and fingerprint). For their experiment they used the West Virginia University's multimodal database containing 400 images (4 enrolment images × 100 users) and the threshold is set to the equal error rate EER. The comparison is being made in terms of percentage improvement in EER rather than the EER values themselves. Jagadeesan et al. [7] in 2010 introduced a technique for cryptographic key generation by fusing fingerprint and iris biometrics. The fingerprint extractor is minutia based while the iris extractor is based on canny edge detector and Hough

transforms (Daugman's approach). The minutiae points and texture properties were first extracted from fingerprint and iris images, respectively, and then they were fused at the feature level to obtain the multi biometric template and subsequently a 256-bit secure cryptographic key from the multi biometric template is generated.

3. METHODS

Multimodal Biometrics System robustly depends on the application circumstances and refers to the use of a grouping of two or more biometric traits in an identification system. The proposed system espoused identification based on multiple biometrics represents a promising trend of an individual, to recognize the identity. The most convincing reason to merge different modalities is to enhance the recognition rate.

Many works in the literature have demonstrated that the drawbacks of the unimodal biometric systems are mainly genuine and imposters identification failure due to the intraclass variations and the interclass similarities, while the drawbacks associated with multimodal biometrics are increased complicity of the system with two or more sensors [2–4] and thus higher cost, as well as inconvenience of using several biometrics. So, identification of person with high accuracy and less complexity of the system is becoming critical in a number of security issues in our society. Iris and fingerprint biometrics are more simple, accurate, and reliable as compared to other available traits. These properties make their fusion particularly promising solution to the authentication problems today. Moreover, fusion of iris and fingerprint is more reliable than fusion of each one with another biometric like face. However, iris biometric has more features and stability and resistance to attacks than fingerprint biometric; despite this, the conventional fusion methods still use the same weight in fusion for each single biometric, and this is the reason for why their best error rates are far from perfect. False accept rate identifies the number of times an imposter is classified as a genuine user by the system and false reject rate pertains to misidentification of a genuine user as an imposter. Although ideally both FAR and FRR should be as close to zero as possible in real systems, however, this is not the case. For an ideal authentication system, FAR and FRR indexes are equal to 0. To increase the related security level, system parameters are then fixed in order to achieve the FAR = 0% point and a corresponding FRR point.



Further alignment also has been tried to enhance the result of work.

- **False Accept Rate (FAR)**

The false acceptance rate, or FAR, is the measure of the likelihood that the biometric security system will incorrectly accept an access attempt by an unauthorized user.

FAR typically is stated as the ratio of the number of false acceptances divided by the number of identification attempts.[14]

- **False Rejection Rate (FRR)**

The false rejection rate, or FRR, is the measure of the likelihood that the biometric security system will incorrectly reject an access attempt by an authorized user. FRR typically is stated as the ratio of the number of false rejections divided by the number of identification attempts. [14]

- **Equal Error Rate (EER)**

Equal error rate is the value at which false rejection rate and false acceptance rate is approx equal.

- **Genuine Acceptance Rate (GAR)**

The Genuine Acceptance Rate is depending on FRR. As FRR increases GAR decreases and vice-versa. The GAR value can be determined as –

GAR = 100 – FRR (2)

4. CONCLUSION

Several of the problems present in ununimodal systems are gracefully addressed by the multimodal biometric systems by merging multiple sources of information.

The proposed method is predominantly efficient for verifying low-quality fingerprint images that could not be recognized appropriately by conventional techniques and attained 99.9% accuracy whereas unimodal biometric system such as fingerprint identification system produces less compared to multimodal.

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