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Multimodal Biometric System

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Abstract-- In today`s networked world the need for security systems are growing due to increase in crimes like computer hacking, illegal access of ATM &cell phone and security breaches in govt. and private buildings. Criminals take advantage of fundamental flaws in the conventional security systems. For these security issues biometric recognition system are used for personal identification. Biometrics of individual can`t be hacked easily rather than password, personal identification no. , smart card etc. Multimodal system can combine any number of independent biometrics and overcome some of the limitations presented by using just one biometric as your verification tool . The fusion of multiple biometrics helps to minimize the system error rates. Fusion methods include processing biometric modalities sequentially until an acceptable match is obtained. More sophisticated methods combine scores from separate classifiers for each modality. This paper presents an overview of multimodal biometrics, challenges faced by multimodal biometric system . The main research areas for multimodal biometric system is wide. It also discuss their applications to develop the security system for high security areas. We also discuss the application of biometric systems and their advantage over unimodal biometric system. The fusion of multiple biometrics helps to minimize the system error rates. Section 1 of paper presents introduction to biometric system. Multimodal biometric system are described ,in the next section. The literature work about multimodal biometric system described in subsequent section. Then application area , conclusion and future workpossiblities about multimodal biometric system are discussed.

Keywords- Biometrics, Multimodal biometric system ,Feature extraction, fusion of data, spoofing.

I. Introduction

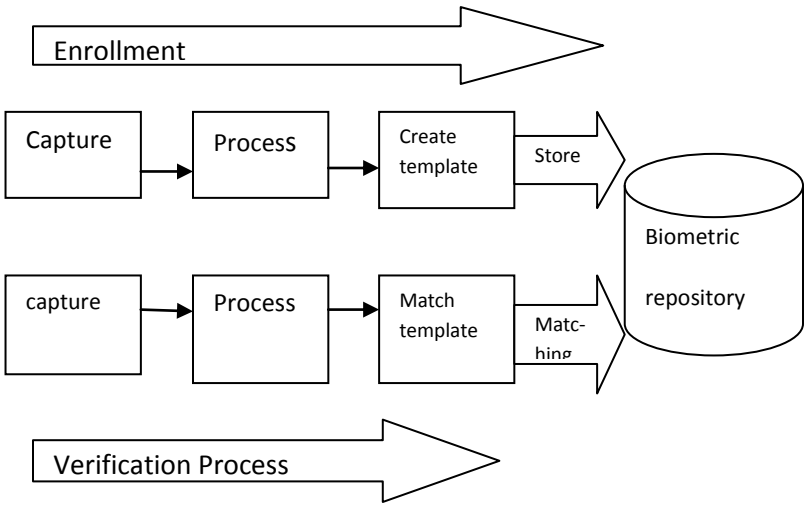
Biometric system

Biometrics is the science and technology of measuring and analyzing biological data of human body, extracting a feature set from the acquired data, and comparing this set against to the template set in the database and these system are called Biometric system. These system may operate in following two modes :

1. Enrollment mode
2. Verification mode

In the Enrollment mode, the system recognizes an individual by searching the templates of all the users in the database for a match. In the verification mode, system validate identity of person by comparing the captured biometric data with her own biometric template(s)which are stored system database.

sstore



The biometric system consist of following four modules :

1. Sensor module
2. Feature Extraction
3. Matcher
4. System database

1. **Sensor module:** It captures the biometric data of individual. Fingerprint sensor is example of sensor module,it captures the ridge and valley stucture of user finger .
2. **Feature extraction :** In this module captured biometic data is processed and set of features are extracted.
3. **Matcher module :** In this module to generate matching score during recognition , features are compared against the stored templates.
4. **System database module:** This module stores the templates of users. It stores the multiple templates of user to account for variations observed in biometric data & templates in database are updated over time.

Need for multibiometric system

Biometric systems have now been implemented in various commercial, civilian and forensic applications as a means of establishing identity . These systems rely on the evidence of fingerprints, hand geometry, iris ,retina, face, hand vein, facial thermo gram, signature, voice, etc. as shown in figure 1. to either verify or determine an identity . Biometric system which rely on the evidence of a single source of information for authentication are called Unimodal system . Unimodal biometric systems suffer a variety of problems such as:

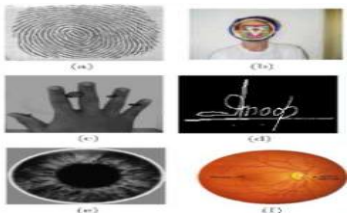


Fig1. Biometric traits associated with a individual.(a)fingerprint,(b)face,(c)hand geometry,(d)signature,(e)iris and (f)retina

- Noise in sensed data,
- Intra-class variations,
- Distinctiveness ability etc.

These limitations of unimodal biometric system discussed leads to high false acceptance rate (FAR) and false rejection rate (FRR), limited discrimination capability, upper bound in performance so multimodal biometric system are developed to meet the stringent performance requirements.

II. Multimodal Biometric System

A biometric system which rely on presence of multiple pieces of evidence for personal identification is called multimodal biometric system . A multimodal system can combine any number of independent biometrics and overcome some of the limitations presented by using just one biometric as your verification tool. Multimodal are generally much more vital to fraudulent technologies, because it is more difficult to forge multiple biometric characteristics than to forge a single biometric characteristic thus provide higher accuracy rate and higher protection from spoofing. Multimodal biometric systems provide anti-spoofing measures by making it difficult for an intruder to simultaneously spoof the multiple biometric traits of a legitimate user. By asking the user to present a random subset of biometric traits (e.g., right index and right middle fingers, in that order), the system ensures that a "live" user is indeed present at the point of data acquisition. Thus, a challenge-response type of authentication can be facilitated using multimodal biometric systems.

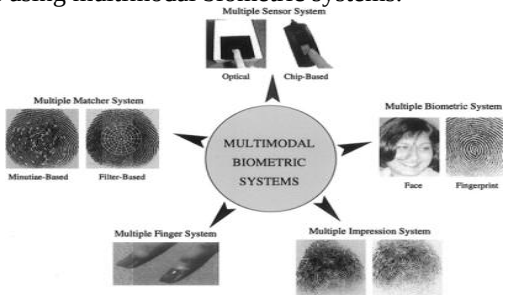


Fig 2. Multimodal Biometric System

Biometric data from two or more biometric system can be combine using possible four level of fusion:

1. Fusion at Sensor level: the biometric traits taken from different sensors are combine to form a composite biometric trait and process.
2. Fusion at Feature extraction level:
   In this different biometric traits are first pre-processed, and Feature vectors are extracted separately, using specific algorithm and we combine these vectors to form a composite feature vector. This is useful in classification.
3. Fusion at Matching score level :
   Rather than combining the feature vector, we process them separately and individual matching score is found, then depending on the accuracy of each biometric matching score which will be used for classification.
4. Fusion at Decision level : Each modality is first pre-classified independently. Multimodal biometric system can implement any of these fusion strategies or combination of them to improve the performance of the system.

III. Applications of Biometric Systems:

The applications of biometrics can be divided into the following three main groups:

Commercial applications such as computer network login, electronic data security, ecommerce, Internet access, ATM, credit card, physical access control, cellular phone, PDA, medical records management, distance learning, etc.

Government applications such as national ID card, correctional facility, driver's license, social security, welfare-disbursement, border control, passport control, etc.

Forensic applications such as corpse identification, criminal investigation, terrorist, identification, parenthood determination, missing children, etc.

IV. RELATED WORK

Ratha *et al.* [13] Proposed a unimodal distortion-tolerant Fingerprint authentication technique based on graph representation. Using the Fingerprint minutiae features, a weighted graph of minutiae was constructed for both the query Fingerprint and the reference Fingerprint. The proposed algorithm had been tested with excellent results on a large private database with the use of an optical biometric sensor. Concerning Iris recognition systems in the Gabor filter and 2-D wavelet filter were used for feature extraction. This method was invariant to translation and rotation and was tolerant to illumination. The classification rate on using the Gabor was 98.3% and the accuracy with wavelet was 82.51% on the Institute of Automation of the Chinese Academy of Sciences (CASIA) database. In the approach proposed in multichannel and Gabor filters had been used to capture local texture information of the Iris which were used to construct a fixed-length feature vector. The results obtained were FAR = 0.01% and FRR = 2.17% on CASIA database. Generally, unimodal biometric recognition systems present different drawbacks due its dependency on the unique biometric feature. For example feature distinctiveness, feature acquisition, processing errors, and features that are temporally unavailable can all affect system accuracy. A multimodal biometric system should overcome the aforementioned limits by integrating two or more biometric features. Conti *et al*. [14] proposed a multimodal biometric system using two different Fingerprint acquisitions. The matching module integrates fuzzy-logic methods for matching-score fusion. Experimental trials using both decision-level fusion and matching-score-level fusion were performed. Experimental results have shown an improvement of 6.7% using the matching score- level fusion rather than a monomodal authentication system.

Yang and Ma [15] used Fingerprint, palm print, and hand geometry to implement personal identity verification. Unlike other multimodal biometric systems, these three biometric features can be taken from the same image. They implemented matching score fusion at different levels to establish identity, performing a first fusion of the Fingerprint and palm-print features, and successively, a matching-score fusion between the multimodal system and the palm-geometry unimodal system. The system was tested on a database containing the features self-constructed by 98 subjects.

Besbes *et al.* [16] proposed a multimodal biometric system using Fingerprint and Iris features. They use a hybrid approach based on: 1) Fingerprint minutiae extraction and 2) Iris template encoding through a mathematical representation of the extracted Iris region. This approach was based on two recognition modalities and every part provided its own decision. The final decision was taken by considering the unimodal decision through an ―AND‖ operator. No experimental results have been reported for recognition performance.

Aguilar *et al.* [17] proposed a multibiometric method using a combination of fast Fourier transform (FFT) and Gabor filters to enhance Fingerprint imaging. Successively, a novel stage for recognition using local features and statistical parameters was used. The proposed system uses the Fingerprints of both thumbs. Each Fingerprint was separately processed; successively, the unimodal results were compared in order to give the final fused result. The tests have been performed on a Fingerprint database composed of 50 subjects obtaining FAR = 0.2% and FRR = 1.4%.

Subbarayudu and Prasad presented experimental results of the unimodal Iris system, unimodal palm print system, and multibiometric system (Iris and palm print). The system fusion utilizes a matching score feature in which each system provides a matching score indicating the similarity of the feature vector with the template vector. The experiment was conducted on the Hong Kong Polytechnic University Palm print database. A total of 600 images are collected from 100 different subjects.

V. CONCLUSION & FUTURE WORK

Biometrics provides security benefits across the spectrum, from IT vendors to end users, and from security system developers to security system users. For decades, many highly secure environments have used biometric technology for entry access. Today, the primary application of biometrics is in physical security: to control access to secure locations (rooms or buildings).. Biometric system which rely on the evidence of multiple sources of information for establishing identity are called Multimodal biometric system. This paper presents an overview of multimodal biometrics, challenges faced by multimodal biometric system . It also discuss their applications to develop the security system for high security areas. We also discuss the application of biometric systems and their advantage over unimodal biometric system. Biometrics permits unmanned access control. Biometric devices, typically hand geometry readers, are in office buildings, hospitals, useful for high-volume access control. . A lot of research work is still need in this area. In near future combination of more than two biometrics can apply to enhance the security of our system.

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