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Multimodal Fusion of Iris & Signature Using WLD Based Feature Extraction

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Abstract: *The standard method used for authentication is password, which is known to a specific person only. Password alone does not ensure security since an intruder can easily misuse it. Hence to overcome such a scenario; passwords should be replaced with more secure form of authentication which is biometric authentication. Biometric systems fall under unimodal and multimodal categories. Unimodal biometric system has some drawbacks. A Multimodal biometric system (MBS) removes these drawbacks. The proposed system is a MBS which combines two different types of biometric modality i.e. iris (physiological) & signature (behavioral) using a suitable fusion technology. For this research work the feature extraction of biometric traits of iris and signature is done by using a potent image descriptor called Webber Local Descriptor. Availability of multiple traits makes the multimodal system more reliable. This proposed MBS increases security of user data considering 2 categories of modalities. In MBS, if any one of the identifiers fails to work for known or unknown reasons, the system will still provide security by considering other trait and the weighted score fusion method; this makes the proposed multimodal system more accurate.*

Keywords - *FAR, FRR, Multimodal, Unimodal, WLD*

I. Introduction

In an increasingly digital word, protecting confidential information is becoming very tough. Traditional passwords and keys are no longer capable enough to ensure that confidential data is kept out of the hands of hackers and non-legitimate individuals.Also for day to day devices and platforms connected to the Internet of Things, the need for security is obvious. In such cases, biometric-based solutioncomes to rescue to provide security for confidential transactions and private data confidentiality. Biometric authentication devices use unique traits which are physiological or behavioral in nature. Biometric system is of two type i.e. unimodal or multimodal. [1] Multimodal biometric systemsare more efficient in nature than classic biometric system i.e. unimodal biometric system. A MBS can anticipate more accuracy. It is possible because it makes use of more than one distincttrait. The mentioned MBS confine the physiological & behavioral trait. The system proposed in this paper gives benefits like accuracy, security, liveness detection, universality which are useful in following 3 major sectors i.e. Government applications, Forensic applications & Commercial applications.

II. Biometrics

A biometric recognition system identifies individuals by considering their unique physiological characteristics. If the biometric system makes use of only one physiological/behavioralmodality; then it is considered as a unimodal biometric system. When more than onedistinct biometric traits are taken into consideration then they are termed as multimodal biometric recognition systems; the systems which makes use of multiple modalities if humans. For the recognition systems enrolment and verification are the important functions. The recognition systems enroll authorized users based on the information provided from the sensors units. It stores the data for matching purpose or any other future use. In verification process, the system checks if the entered data is true or fake. A biometric traitshould satisfy the condition of permanence, distinctiveness& universality always.Fusion technology holds very important aspect in any MBS. In fusion is the process of merging two or more biometric modalities from an Individual. It used to address severalproblems faced in biometric systems such as accuracy, efficiency, robustness & applicability. There are different levels of fusion technology which is used to increase robustness of the MBS. Namely there are 4 possible fusion scenarios i.e.First type of fusion occurs at sensor level. Then comes feature level fusion after classification there is score level fusion and decision level fusion.[6]. Fusionis of two types one which is performed before the classification and one which is performed after the classification. Generally, the fusion which is performed before the classification is very difficult and involves the complex procedure. That's why the fusion performed after the classification is given the preferences.

III. Literature survey

Anil K. Jain, Pioneer of MBS along with his colleagues SalilPrabhakar andArun Ross, give all the detailed information about biometric systems in "An Introduction to Biometric Recognition,"[1] paper. This paper talks about unimodal, multimodal systems, fusion scenarios, comparison in biometric traits etc. The problem is, many of the biometric systems are unimodal, which depends only on one identifier which have lot of disadvantages. These shortcomings can be overcome by setting up multi-modal biometric systems consisting of two or more biometric modalities. Authors,Almas M. N. Siddiqui along with their colleaguesdescribes in their paperthe variouspossible fusion scenarios in MBS. [2]

The Multimodal biometric system are facing the challenges like what modals will be appropriate, selection of proper feature extraction algorithm and fusion techniques and other challenging issues in designing. Jie Chen, with their fellow IEEE members explains WLD technology for feature extraction. [3] One of the most feasible and simple biometric recognition systems isbased on signatures. It can be used to identify precisely user identity by making use of numerical values of x, y variations of signature and pressure value from a tablet PC. [4] hence can be useful for signature verification application systems. In this research paper authors, has made the use of feature vector and their extraction mechanism is implemented using Webber Local Descriptor (WLD). One more robust physiological biometric trait found in human body is Iris." In this research work, H B Kekre, T K Sarode& V A Bharadi have used Kekre's Fast Codebook Generation Algorithm (KFCG). They have compared this algorithm against DCT. [5]

In biometric fusion process, we integrate more than one modality. In MBS, the designing of the fusion scheme is one the main concern. Based upon the selection of the fusion scenario the system offers different fusion outputs. The fusion technologiesare divided intoscore,sensor, feature,and decision level [6].SerestinaViriri and other author, gives details on user specific weighted method for multimodal system gives least rate i.e. 0.08% FRR and 0.01% of FAR which is quite appreciated [7]

IV. Problem statement

To design a MBS which will overcomes the limitations of conventional unimodal biometric systems by fusing physical as well as behavioral traits of humans to improve the precision and efficiency of security system.This research work talks about a multimodal biometric system based on iris and online signature which will possess following characteristics:

- A multimodal biometric system which increases security and privacy of user confidential data.
- Presence of 2 traits, and their multiple samples which makes the multimodal system more robust and reliable.
- A multimodal biometric system which conducts weighted score fusion strategies to merge decisions from each subsystem to deliver the final decision.
- If any of the subsystem becomes nonfunctional, the system will generate the final matching output based on the average of the scores of both the identifier.
- A multimodal system, which can handle spoofing attack by detecting liveliness of the samples.

V. Background of technology used

1. C# .net

A MBS is a pattern recognition system which encompasses data procurement, feature extraction, fusion, classification and finally decision making. It can be better implemented using C# .net. It is a multi-paradigm programming.

2. WLD

Webber's lawtells that, the change in a stimulus which is just noticeable difference(JND) is a constant ratio of the original stimulus.

$$\Delta I/I = k$$

Where, 'ΔI' is the increment threshold value& 'I' is the initial stimulus intensity value and 'k' is the constant.
For example, when you are in a noisy room you must yell hard to be heard while a small whisper works in a quiet room.

VI. Methodology

The overall system module consists of following components:

Sensor: It is a storehouse for the biometric modalities i.e. iris & signature samples. At sensor module, we capture the biometric traits. Later these traits are given as inputs for feature extraction module.

Feature extraction: In feature extraction module, the features of different biometric identifier are extracted after pre-processing step. These feature vectors are weighted. And scores are calculated. Average score from the both

the biometric trait is used for the matching purpose.The proposed system will implement WLD for feature extraction of signatures & for iris.
For each user 6 iris samples, 3 for left eye and 3 for right eye

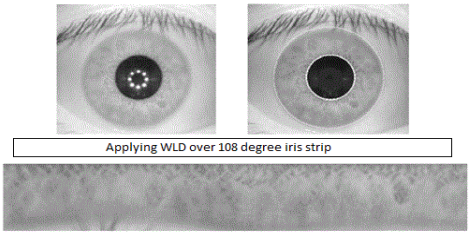

Fig.1: Feature extraction over180-degree IRIS STRIP

For each person, there will be 10 signature samples.

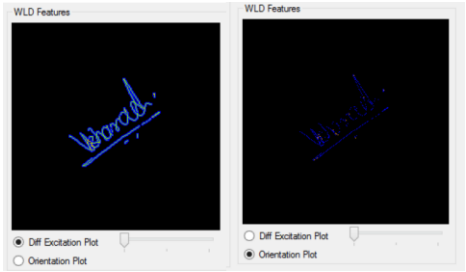

Fig.2: Differential excitation plot and orientation plot of a signature.

WLD has two components i.e. differential excitation and orientation. A differential excitation is said to be a function of the ratio between two important parameters namely: i) the relative intensity value differences ii)The intensity of the current pixel value. WLD histogram feature vector is constructed with the help of differential excitation and the orientation components. [3]

Matching: In matching module extracted features are compared against the templates which are stored in database. Matching is done by using Euclidean distance formula.
Fusion Module: In this MBS matching score level, fusion technique is employed. In this type of fusion level, the feature vectors are processed separately rather than combining them. Then an individual matching score is found and based on the accuracy of each biometric channel, we then fuse the matching level to find a composite matching score which will be used for classification. It is observed that user specific weighted methoddelivers aleast FAR and FRR values. [7] It increases the authentication rate of multi-modal biometric systems.
Decision making: In this phase user is accepted or rejected based on the matching in the matching module.

VII. Proposed System Architecture

This proposed system focuses on eliminating and reducing the flaws of tradition security system and unimodal biometric system. The MBS systems are robust, effective, and secure in nature. It takes account of two biometric modality ie. iris and signature. Iris and signature images are taken from the existing online database.

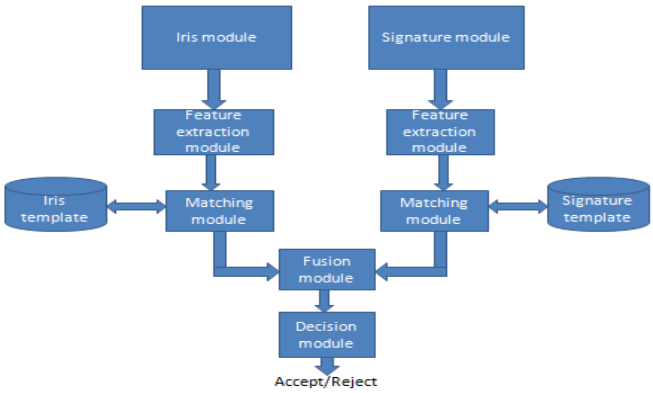

Fig.3: Proposed System Architecture

Expected output will be in following manner:

1) Feature extraction from iris and signature samples using WLD.
2) Matching of biometric trait against the stored template using Euclidean distance formula.
3) Fusion of iris and signature traits using Score level fusion technique
4) Decision making for a legitimate user.
5) Performance improvement.

VIII. Conclusion

Multi-modal biometric systems have performed well in addressing the problems of unimodal systems by combining information from different sources and improve the systems performance, the use of more than one biometric traits for recognizing persons, has been proved to enhance precision of the security system, while decreasing vulnerability to other types of flaws from unimodal system. Weighted score method helps to make the MBS system robust and deliver least FAR & FRR rates.

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