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Online Multimodal Signature Verification Using Fractal Dimension

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Abstract - **Data glove is a new dimension in the field of signature verification, which can reflect the identity of a person and that renders the forging process nearly impossible. Multiple biometric modalities can overcome some of the practical limitations of current unimodal biometric technologies. In this work an online signature verification system and image verification system are combined as these modalities are widely accepted and natural to produce. Singular value decomposition techniques are applied for image extraction and fractal dimension to extract the feature values of different sensors locating on corresponding fingers in the signing process and evaluated the results for writer authentication. Finally the similarity factor is compared with the decision threshold for accepted or rejected as genuine or forgery, respectively. This paper presents a novel user authentication system based on a combined acquisition of signature using Data Glove signals and face images from webcam.**

Index Terms - **Biometrics, Multimodal, Data Glove Fractal Dimension, Singular Value Decomposition.**

I. INTRODUCTION

Biometrics is an emerging field of technology devoted to identification of individuals by employing biological traits, such as those used for iris scanning, fingerprinting, face recognition, and others. Signatures of some people vary a lot: even the successive impressions of their signature are significantly different. Further, the professional forgers can reproduce signatures to fool the unskilled eye. Although, the human experts can discriminate genuine signatures from the forged ones, modeling the invariance in the signatures and automating signature recognition process are challenging.

In off-line systems for which the signature is captured once the writing processing is over, and thus only a static image is available [2] [3]. On-line approaches to signature recognition: Input devices in this category are either digitizing tables or smart pens and hand gloves [2]. In digitizing table-based systems both global and local features that summarize aspects of signature shape and dynamics of signature production are used for signature verification.

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Successful multibiometric system is in an effective fusion scheme, which is necessary to combine the information presented by multiple domain experts. Multibiometric systems can significantly improve the recognition performance in addition to improving population coverage, deterring spoof attacks, increasing the degrees of freedom, and reducing the failure-to-enroll rate. The genuine distribution, which are used to establish the following two error rates

1. **False acceptance rate (FAR)**, which is defined as the probability of an impostor being accepted as a genuine individual.
2. **False rejection rate (FRR)**, which is defined as the probability of a genuine individual being rejected as an impostor.

The rest of the paper is organized as follows: Related work for recognizing in section 2, proposed work in section 3, conclusion in section 4

II. RELATED WORK

In 2010 Loo Chu Kiong [4] developed a signature verification using data glove based on dynamic signature verification system, using the Photometric measurement values collected simultaneously from photo plethysmography(PPG) during the signing process.

In 2005, Snelick et al. [11] developed a multimodal approach for face and fingerprint, with fusion methods at the score level. Three fingerprint recognition commercial systems and one face recognition commercial system were used in this study.

In 2004,Toh et al[14] developed a system using hand geometry, fingerprint, and voice biometric with weighted sum rule-based match- score-level fusion.

They treated the multimodal biometric biometric decision fusion problem as a two-stage Problem: learning and decision.

In 2003 Kumar et al [13] developed a multimodal approach for palm print and hand geometry, with fusion methods at the feature level by combining the feature vectors by concatenation, and the matching score level by using max rule.

III. SYSTEM DESCRIPTION

The proposed online signature verification, it consists of a data acquisition, feature extraction, training, and classification stage

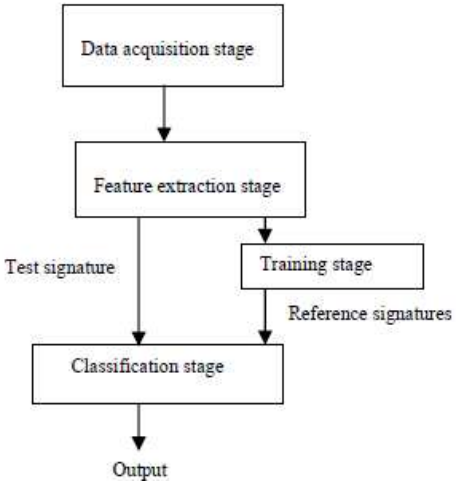

Figure1. Stages of Verification System

IV. PROPOSED METHOD FOR MULTIMODAL SIGNATURE VERIFICATION

Some researchers have worked on simple or random forgeries while others have dealt with skilled forgeries. Present Researchers deals with signature verification of skilled forgeries using signature (data glove) and image verification (multimodal). Multi-modal biometrics combines different biometric applications. By integrating two or more biometric methodologies, these types of solutions meet the highest and most stringent security requirements It is very challenging to develop face recognition techniques which can tolerate the effects of aging, facial expressions, slight variations in the imaging environment and variations in the pose of face with respect to camera.

Proposed system is divided into two phases such as enrollment phase and verification phase. During enrollment, biometric measurements are captured from a given subject, relevant information from the raw measurement is gleaned by the feature extractor, and information is stored in a database. In identification mode , the system senses the biometric measurements from the subject, extracts features from the raw measurements, and searched the database using the features thus extracted. The system may either be able to determine the identity of the subject or decide the person is not represented in the database.

V. DATA GLOVE

The data glove is used for dynamic signature verification and that is easy to use, free from image and material of signature medium as well as no scanning process.

It involves only a direct acquisition of signals from the subjects while they write down their signatures, preprocess it, extract the feature, match it to classify and decision making. The data glove offers the users comfort, ease of application, and it comes with a small form factor with multiple applications.

Drivers, high data quality, low cross-correlation and high frequency data lodging. It measures finger flexure (2 sensors per finger) as well as the abduction between fingers.

The system interfaces with the computer via a cable to the USB port(platform Independent). It features an auto calibration function , 8-bit flexure and abduction resolution, extreme comfort, low drift and an open architecture. It can also be operated wirelessly to interface with the computer via Bluetooth technology up to 20 m distance. One glove fits many hands since it is made-up of stretchable material “A”.

Figure 2. Sensor mappings for 5DT data glove14 ultra

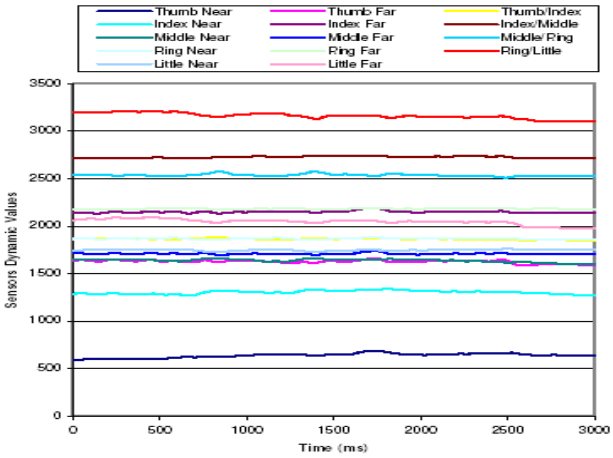

Figure 3. Signals from the Data Glove of a Signature

VI. FACE RECOGNITION

Face Recognition is a noninvasive process where a portion of the subject’s face is photographed and the resulting image is reduced to a digital code. Facial recognition records the spatial geometry of distinguishing features of the face. Theoretically, singular valued decomposition (SVD) has been defined as one method used to efficiently decrease the amount of data processed. Basically, the basic concept of SVD is to represent an image of size m x n as 2D m x n matrix. SVD is then applied to this matrix to obtain the u, s and v matrices. Where ***s*** matrix is an n by 1 matrix known as the diagonal. In face recognition face specifically, singular valued decomposition (SVD) Method had functioned as a new way for extracting algebraic features from an image[5].

Thus, this method has been introduced and been used in many fields such as data compression, signal processing and pattern analysis. Among the properties which made SVD approach favorable in defining the face recognition process is defined as follows; The SVD of a face image has good stability in which it defined that whenever a small perturbation is added to a face image, a large variance of its singular values (SVs) didn’t occur.

Previously, it has been stated that singular values represents algebraic properties of an image. Hence, SV features possess algebraci and geometric invariance as an instance.

SVD approach treats a set of known faces as vectors in a subspace, called "face space", spanned by a small group of "base faces". It likes Principal Component Analysis (PCA). Recognition is performed by projecting a new image onto the face space, and then classifying the face by comparing y comparing its coordinates (Position) in face space with the coordinates (positions) of known faces. However, the SVD approach has better numerical properties than PCA. The SVD algorithm takes facial image, measures the unique characteristics and computes the template corresponding to each face. Using templates, the algorithm then compares that image with another image and produces a score that measures how similar the images are to each other.

In addition, SVD approach is very much needed in the face recognition field especially when images were taken under different noise and view point conditions.

VII FUSION

The different biometrics systems can be integrated at multi-modality level to improve the performance of the verification system. It can be thought to combine evidence provided by different biometrics to improve the overall decision accuracy. This proposes an efficient multimodal biometric system which can be used to reduce / remove the limitations of unimodal systems. The signature recognition algorithm (FD) consists of three major modules i.e., preprocessing and noise removal, feature extraction and computation of Euclidean distance.

Fractal Dimension is a measure of how fragmented a fractal object is, and it may be understood as a characterization of its self-similarity. For Face Recognition, First, images are pre-processed by using certain technique. Then, singular values as the feature vectors obtained from SVD algorithm to those preprocessed images. Finally compare the signature and Face imagesusing Euclidean distance and find out whether it is the original signature or forgery one. Euclidean distance is only a summation of the pixel-wise intensity differences, and consequently small deformation may result in a large Euclidean distance.

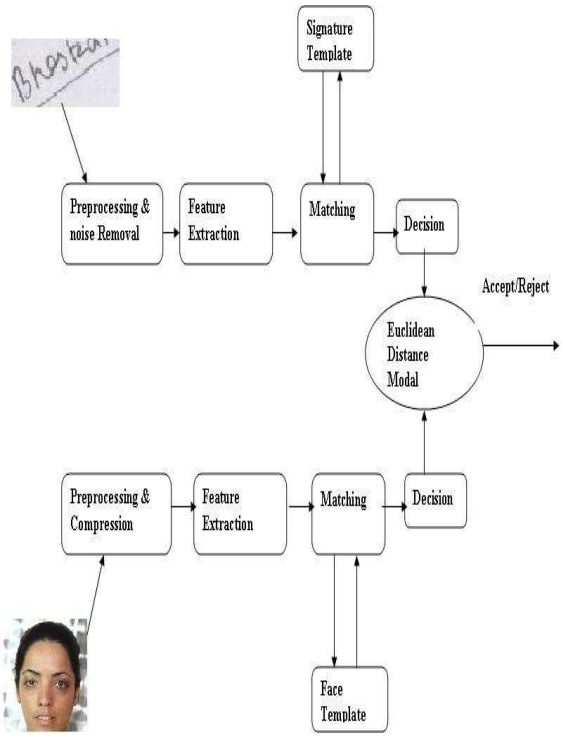

Figure 4. Block Diagram of Proposed system

VIII CONCLUSION

This proposed paper presents a Novel Approach for Multimodal signature verification using Data glove and singular value decomposition on the extracted feature of images. This is specifically for good combination of biometrics traits to get the optimal solution. In future, a better result can be obtained by improving the genuine acceptance rate and decreasing the false acceptance rate. This can be done by reducing the feature size by means of reducing sensor in the data glove as well as reducing timing in the PPG and some specific algorithm for each database.

We can obtain a better result for complex image such as vary large size 2D image or 3D images , video sequence, near infrared, Facial thermograms with SVD technique for image compression and recognition.

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