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TRIMODAL BIOMETRIC SYSTEM USING HAND AND VOICE BIOMETRICS

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ABSTRACT

Tri modal biometrics systems are becoming increasingly efficient over the unimodal system, especially for the securing mobile devices like PCA, PC, tablets, etc. In this project, we propose a bi-modal biometric recognition technique using finger and voice as biometric traits. This project addresses the issues of score fusion techniques in Tri imodal biometrics verification systems. Fusion techniques namely weighted sum rule, KNN classifier and support vector machine (SVM) has been evaluated with the matching scores of the two biometrics modalities namely finger and voice. The experiments with the fusion techniques were conducted over a BioChave database collected from 10 individuals with multiple instances of the two traits. Experimental results showed that SVM rule gave the best performance among the fusion techniques. Hence, we confirmed that the proposed Support Vector Machine fusion method outperformed other fusion techniques and unimodal classifiers.

Keywords: *Support Vector Machines, Tri Modal Biometrics, Contactless Biometrics, Security, Segmentation*

INTRODUCTION

Iron Personal computers have currently given users an unprecedented level of convenience and flexibility. However, the security and privacy issues related to personal computers are unfortunately becoming a major problem due to data loss and security. Not only have the users worried for lost gadgets but also about the revelation of sensitive information stored within these devices. Therefore, there is a need for offering to the user a more reliable and a friendly way of identification or authentication.

Biometrics, which refers to identify an individual based on his or her physiological or behavioral characteristics, can distinguish between an authorized person and an imposter. Since biometric characteristics are distinctive, cannot be forgotten or lost and the person to be authenticated needs to be physically present at the point of identification, biometrics is inherently more reliable and more capable than traditional knowledge-based and token-based techniques. Biometrics may be unimodal or tri modal. Tri modal systems have an increase in performance when compared to unimodal systems. Tri modal biometrics improves resilience to spoofing.

The Proposed System is based on Tri modal biometrics. It focuses on contactless hand biometrics and voice biometrics to provide security to mobile devices. It fuses information obtained from palm and voice modalities using “Support Vector Machine” technique to improve performance of the system. The features from hand images are extracted using “Hand Contour Processing” and voice recognition is done using “Mel Frequency Cepstral Coefficient (MFCC)” and “Gaussian Mixture Model (GMM)” techniques. This system is very convenient. Here the passwords are not user-friendly. This system is perceived as more secure than unimodal systems.

Byung Jun Kang proposes a new tri modal biometric recognition based on the fusion of finger vein and finger geometry (Kang & Park, 2009). This research shows three novelties compared to previous works. First, this is the first approach to combine the finger vein and finger geometry information at the same time. Second, the proposed method includes a new finger geometry recognition based on the sequential deviation values of finger thickness extracted from a single finger. Third, we integrate finger vein and finger geometry by a score-level fusion method based on a support vector machine. Results show that recognition accuracy is significantly enhanced using the proposed method. The EERs finger vein recognition, finger geometry, and the proposed tri -modal authentications were 1.1, 12.21, 0.73% respectively (Figures 1-3).

Sotiris Malassiotis purposed a biometric authentication system based on measurements of the user’s 3D hand geometry (Malassiotis et al., 2006). The system relies on a novel real-time and low-cost 3D sensor that generates a dense range image of the scene. By exploiting 3D information we are able to limit the constraints usually posed on the environment and the placement of the hand, and this greatly contributes to the unobtrusiveness of the system. Efficient, close to real-time algorithms for hand segmentation, localization and 3D feature measurement are described and tested on an image database simulating a variety of working conditions. The performance of the system is shown to be similar to state-of-the-art hand geometry authentication techniques but without sacrificing the convenience of the user. In this system the test cases is divided into two subsets. In the first set the image is taken by keeping the hand closer to the camera. In the second set the image is taken by keeping the hand at a distance of 15cm from the camera. The average hand size for first set is 50% and EER is 3.2%. The average hand size for second set is 38% and EER is 3.7%. This system provides granting access to high security infrastructures.

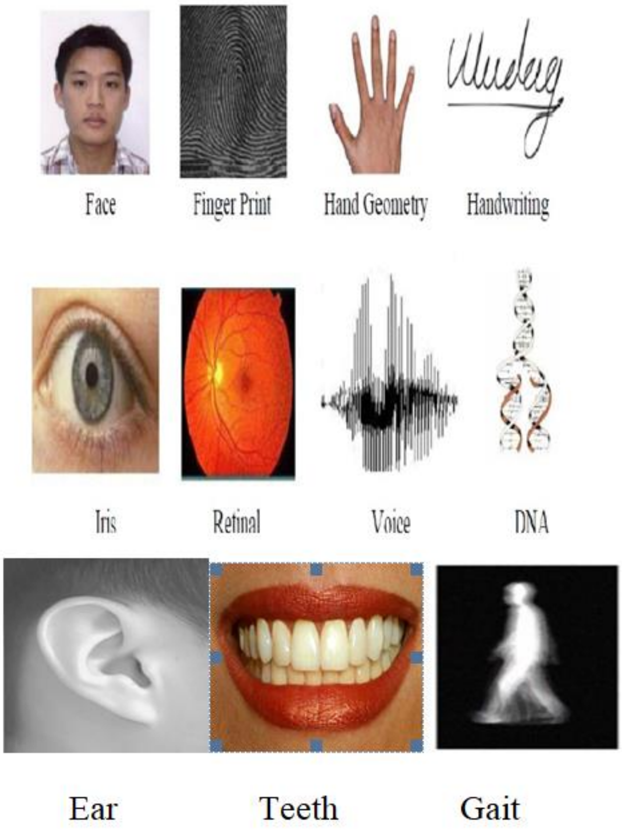

FIGURE 1
BIOMETRIC CHARACTERISTICS WHICH HAVE BEEN USING FOR BIOMETRIC RECOGNITION

Erdem Yoruk proposed a Shape-Based Hand Recognition system (Yoruk et al., 2006). Two feature sets have been comparatively assessed, Hausdorff distance of the hand contours and independent component features of the hand silhouette images. Both the classification and the verification performances are found to be very satisfactory as it was shown that, at least for groups of about five hundred subjects, hand-based recognition is a viable secure access control scheme.

PROJECT MODULES

The project will include the following main tasks:

- Evaluation of finger verification system
- Evaluation of voice verification system
- Evaluation of score fusion techniques
- Performance comparison between unimodal biometric systems and tri modal biometric score fusion systems.

- Performance of the system using Support vector machine (SVM) technique.

HAND BIOMETRICS

This uses hand images to identify individuals to provide authentication. The features are extracted using hand contour processing and segmentation.

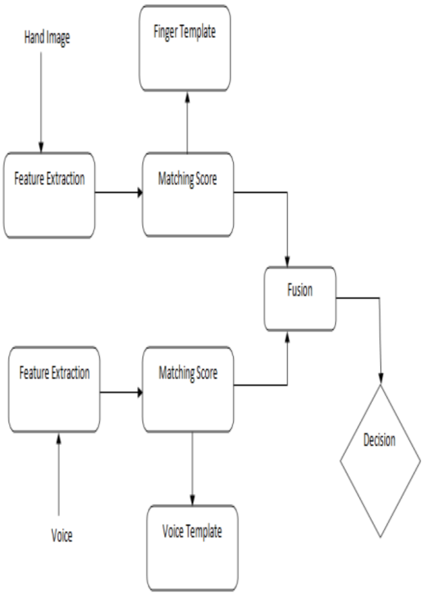

FIGURE 2
FLOW DIAGRAM

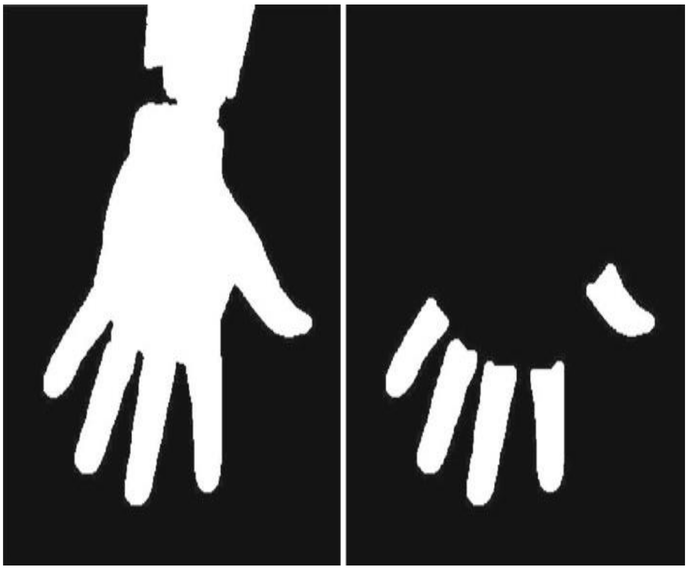

FIGURE 3
FINGER RECOGNITION

Segmentation is used to separate hand images from the background. Hand contour processing is used to segment finger from palm (Dong et al., 2010).

FEATURE EXTRACTION

The feature extraction from hand database is done using hand contour processing. This procedure seeks to find nine points: four extremities (finger tips) and five valleys (finger base). This method first isolates fingers from palm. Opening morphological operator is proposed with a disk structural element of size 40, which conserves rounded palm shape, but erases those blobs corresponding to fingers. Therefore, fingers are obtained by subtracting palm blob image from original image (Alberto, 2011).

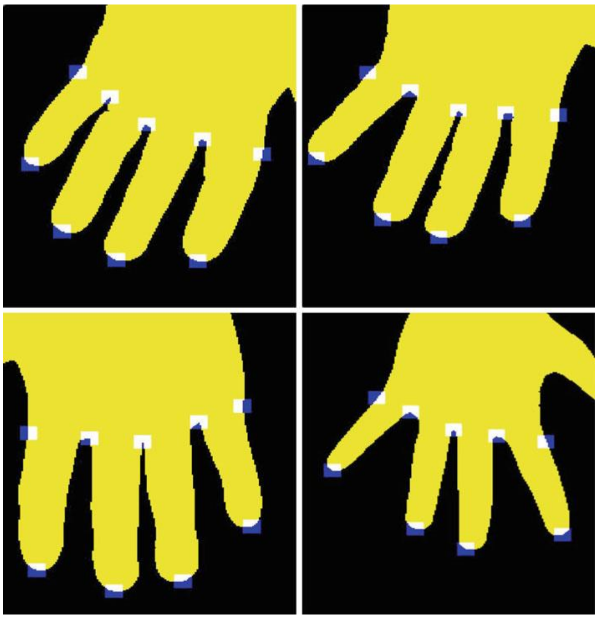

FIGURE 4
TIPS AND VALLEYS

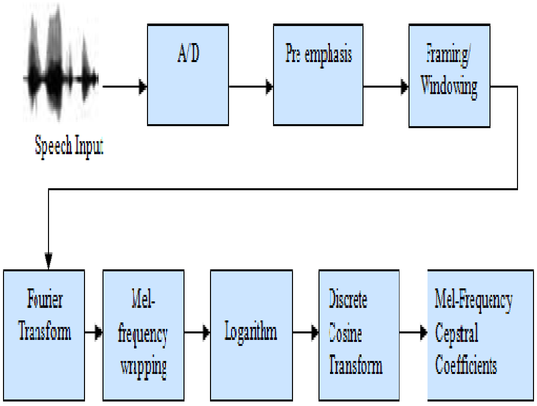

FIGURE 5
FLOW DIAGRAM OF MFCC

A centroid is used to divide the obtained fingers into two groups: One group containing four fingers (index, middle, ring, little) and another containing the thumb region. Tip is the blob point furthest from hand centroid. Valley is the closest point to hand centroid of the boundary between the corresponding tips. These set of calculations provide the points required (Su, 2007).

TEMPLATE STORAGE AND MATCHING SCORE

The points acquired in the feature extraction process are stored in a file or database called as template. This file is used in the process of finding the matching score. The required features are extracted from the user input data. These features are compared with the points stored in the template and the matching score is found (Figures 4-6).

VOICE BIOMETRICS

Voice or Speaker recognition uses vocal characteristics to identify individuals using a passphrase. The features to be extracted are Mel Frequency Cepstral Coefficients (MFCC). The Gaussian Mixture Model is adopted as the speaker model used to generate the scores which can be used for decisions.

The feature extraction from voice database is done using MFCC and GMM techniques. To obtain MFCC, the voice is first pre-emphasized using a pre-emphasis filter to spectrally flat the signal. The pre-emphasized voice signal is then separated into short segments called frames using a Hamming window.

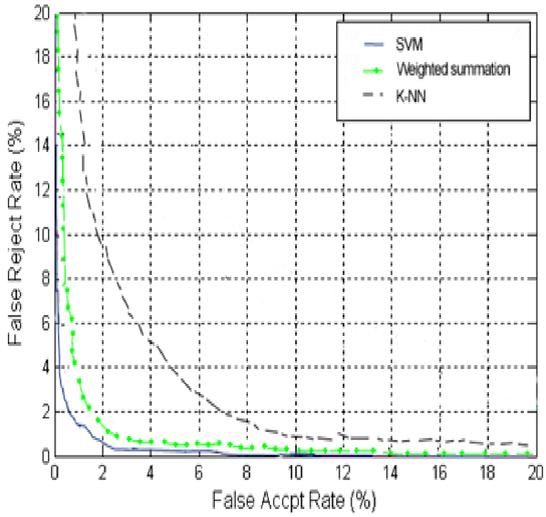

FIGURE 6
PERFORMANCE COMPARISON GRAPH

The pre-processed voice signal is converted into the frequency domain using a discrete Fourier transforms (DFT), and a log magnitude of the complex signal in the frequency domain is obtained. Mel scaling is then performed on the log magnitude signal using triangular filters. The resultant signal of filtering is then transformed using an inverse DFT into the cepstral domain. The lower order coefficients are selected as the feature parameter, i.e. MFCC, of the voice signal. The feature vectors are then used by the observation vector of the GMM algorithm.

TEMPLATE STORAGE AND MATCHING SCORE

The GMM points obtained during the feature extraction process is stored in a file or database called as template. The features are extracted from the user input data. These features are compared with the features stored in the template and the matching score is obtained.

SCORE LEVEL FUSION

The feature extracted from both the systems is compared with the corresponding templates separately and the matching score is produced. The matching score is then fused using fusion techniques. Some of the fusion techniques are weighted sum rule, SVM…etc.

WEIGHTED SUM RULE

In WSR the input scores are combined to achieve a final score. The performances of different classifiers are different, so it is necessary to use different weights to combine the component classifiers. Here, we utilize the EER (Equal Error Rate, where FAR=FRR) of each classifier as weights.

The weighted sum rule is defined as:

Assign

$$\sum_{i=1}^{2} W_i P(\omega_j | x_1, x_2) = \max_{k=0}^{1} \sum_{i=1}^{2} W_i P(\omega_k | x_1, x_2) \quad j=0,1$$

Where,

I = the individual classifier

W_i = The weight assign to classifier i

SUPPORT VECTOR MACHINE

SVM is used in order to provide not a binary verification decision, as it has been reported in related works, but rather a merged score combining the outputs of the considered monomodal experts. Now the approach providing references for further details is introduced. The principle of SVM relies on a linear separation in a high dimension feature space where the data has been previously mapped, in order to take into account the eventual non-linearity's of the problem. In order to achieve a good level of generalization capability, the margin between the separator hyperplane and the data is maximized. Formally, the training set X= (Xi)li=1, where l is the number of training vectors.

SVM technique is used to classify the non-linear elements using a hyper plane. SVM is used to reduce misclassifications. The fused score is then compared with the threshold value and the acceptance or rejection process is decided based on the comparison results.

CONCLUSION

Tri modal systems are the way forward to robust identity establishment. Fusion schemes can improve effectiveness of the process. Experimental results showed that SVM rule gave the best performance among Weighted Sum rule, KNN classifier and the SVM. Hence, we confirmed that the proposed binary Support Vector Machine fusion method outperformed other fusion techniques and unimodal classifiers.

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