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A Combined Face, Fingerprint Authentication System

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***Abstract*—This work presents a multimodal biometrics system that combines face and fingerprint authentication modules. The proposed face verification module incorporates Gabor Wavelet texture features and face edge features. As for the fingerprint module, a simple algorithm is employed for extracting fingers' Minutia in order to build feature vector for each sample fingerprint. The proposed system can be used effectively for personal identification at international airports checkpoints.**

I. INTRODUCTION

Biometric solutions based upon a single (one-modal) biometric in many cases are incapable of meeting the intended overall performance prerequisites [1]. Multimodal biometric systems indicate employing some sort of fusion of several biometric modalities within a verification system. Probably the most persuasive motive towards incorporating several modalities would be to enhance recognition percentage. Moreover, Several biometric modalities would probably be more suitable for the diverse applications and consumers' demands [2]. Fig. 1 illustrates a data acquisition unite for both face and fingerprint modalities.

Fig. 1. Face, Fingerprint Combined Scanning Unite

We are concerned with developing a multimodal biometric structure that incorporates face, and fingerprint pertaining towards personal identification. The selection regarding these two particular biometrics is actually dependent upon the concept that has already been utilized repeatedly in the law enforcement community [3]. Such biometric modalities complement one another throughout their strengths. Our system is designed to detect terrorists and criminals at identity checking points in public facilities particularly international airports). Fig. 2. depicts a block diagram for our proposed multimodal biometric system.

II. THE PROPOSED MULTIMODAL BIOMETRICS SYSTEM

A. Face Identification Module

The proposed face recognition module combines two sets of facial features. The first set of features includes the face edge points extracted using the well known Canny edge method. Fig. 2. illustrates the process of extracting an edge map image from a face image collected from our private terrorists face dataset. The second set of features incorporates the texture features extracted from the face image using Gabor Wavelet. Gabor wavelets were introduced to image analysis due to their biological relevance and computational properties [4].

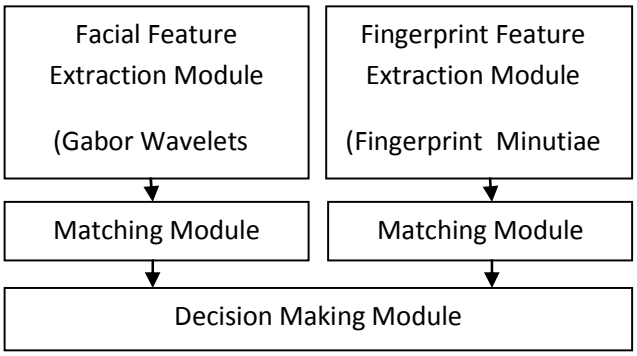

Fig. 2. The Proposed Multimodal Biometric System

Gabor wavelets are frequently employed as filters for extracting orientation and frequency information coming from a photo, leading to Gabor filtered photos. Discriminant facial features could then end up being obtained from such Gabor filtered photos as the particular foundation pertaining to facial recognition. The Gabor Wavelet kernels produced from the sample image in Fig. 3. are illustrated in Fig. 4, while Fig. 5 illustrates the Gabor wavelet representation (the real and imaginary parts) belonging to the sample image in Fig. 3.

B. Fingerprint Identification Module

Recently, the majority of fingerprint authentication platforms employ minutiae points (ridge bifurcation as well as ridge ending) as the distinctive attributes . The minutiae-based matching techniques are commonly used with regard to fingerprint identification, which usually first acquire the local minutiae (ridge bifurcations and ridge endings) out of the thinned ridge chart or the greyscale image [5], and after that

match their particular relative positioning within the query fingerprint together with the stored template.

Fig. 3. Terrorist original Gray Scale Face Image, and Edge Map Image

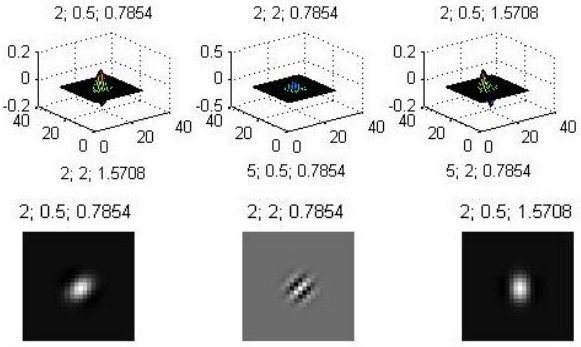

Fig. 4. Gabor Kernels for the First Three Components

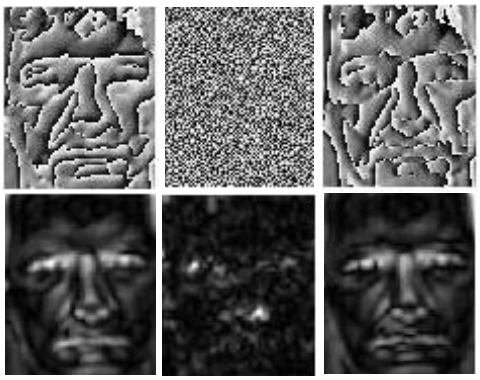

Fig. 5. Gabor Responses for the First Three Components

The particular steps associated with minutiae extraction are illustrated Fig. 6. Typically the main procedures needed for fingerprint identification using minutiae matching technique following photograph acquisition are photo improvement, minutiae extraction, and minutiae matching. The processed photograph is utilized for extracting minutiae points which include the points of ridge endings and bifurcations. The position of minutiae points together with the orientation are extracted and stored in order to create a fingerprint feature set. Typically the minutiae based matching involves acquiring alignment in between the template and the input minutiae sets which result in the highest number of minutiae pairings.

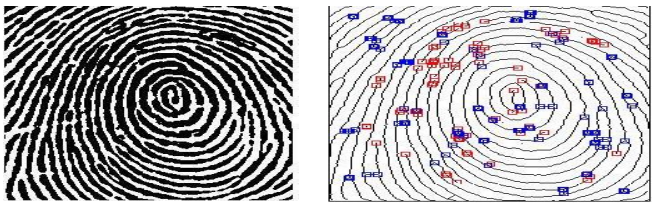

Fig. 6. Minutia Extraction Main Steps

III. EVALUATION RESULTS

The evaluation of the proposed multimodal biometrics system is performed over private terrorists face database and the Fingerprint Verification Competition (FVC) 2004. The evaluation procedure is carried out in term of classification accuracy, mean absolute error, and the time required for feature extraction are illustrated in TABLE I.

TABLE I
CLASSIFICATION ACCURACY FOR DIFFERENT FEATURES

Feature	Classification Accuracy (%)	Mean Absolute Error	Feature Extraction Time (Sec)
Face Edge Map	60	0.41	2.263
Gabor Wavelet	77.27	0.2523	2.913
Fingerprint Minutia	89.96	0.0043	2.89
Combined Features	96.45	0.0028	8.066

IV. CONCLUSION

The results of evaluating our proposed multimodal biometrics system demonstrate the effect of combining multiple biometrics modules over the classification accuracy. The maximum classification accuracy was reported when both of the face and the fingerprint modules were fused at the score level using simple summing rule. Future work would include enhancing the overall processing time and testing the system over benchmarking datasets.

REFERENCES

[1] A. Ross and A.K. Jain, "Information Fusion in Biometrics", Pattern Recognition Letter 24, pp.2115-2125, 2003.

[2] Ko, Teddy, "Multimodal biometric identification for large user population using fingerprint, face and iris recognition." Applied Imagery and Pattern Recognition Workshop, 2005. Proceedings. 34th. IEEE, 2005.

[3] Liu, Chengjun, and Harry Wechsler. "Gabor feature based classification using the enhanced fisher linear discriminant model for face recognition." Image processing, IEEE Transactions on 11.4 (2002): 467-476.

[4] Fierrez-Aguilar, Julian, et al. "Adapted user-dependent multimodal biometric authentication exploiting general information." Pattern Recognition Letters 26.16 (2005): 2628-2639.

[5] Y.Jie, Y.Yifang , Z.Renjie and S.Qifa, "Fingerprint minutiae matching algorithm for real time system, " Pattern Recognition , pp. 143–146, 2006.