A Multimodal Biometric Recognition System based on Fusion of Palmprint and Fingerprint

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***Abstract*- Basic aim of a biometric system is automatically discriminate between subjects as well as protect data. It also protects resources access from unauthorized users. We develop a biometric identification system that represents a valid alternative to conventional approaches. In biometric system physical or behavioral traits are used. A multimodal biometric identification system aims to fuse two or more physical or behavioral traits. Multimodal biometric system is used in order to improve the accuracy. Multimodal biometric identification system based on palmprint& fingerprint trait is proposed. Typically in a multimodal biometric system each biometric trait processes its information independently. The processed information is combined using an appropriate fusion scheme. Successively, the comparison of data base template and the input data is done with the help of Euclidean-distance matching algorithm. If the templates are matched we can allow the person to access the system. The experimental results demonstrated that the proposed multimodal biometric system achieves a recognition accuracy of 87% Multimodal biometric system provides optimal False Acceptance Rate (FAR) & False Rejection Rate (FRR), thus improving system accuracy & reliability.**

Index Terms— Biometrics, False Acceptance Rate (FAR), False Rejection Rate(FRR) ,KNN , Palmprint Fingerprint trait, Fusion technique, Identification system, Multimodal.

I.INTRODUCTION

In the recent years, biometric authentication has become popular in modern society. Multimodal biometric person authentication systems integrate multiple authentication techniques, and are important for many security applications such as government, defense, surveillance and airport security. Biometrics is defined as the science of recognizing an individual based on his/her physical or behavioral property . As password or PIN can lost or forgotten, biometrics cannot be forgotten or lost and requires physical presence of the person to be authenticated. Thus personal authentication systems using biometrics are more reliable, convenient and efficient than the traditional identification methods. Multimodal biometrics has become increasingly important, particularly because single modal biometrics has reached its bottleneck; i.e. non-universality, noise in sensor data and spoofing. Multimodal biometrics gives supplementary information between different modalities that increases recognition performance in term of accuracy and ability to overcome the drawbacks of single biometrics. There are two types of biometric techniques: Physiological (face recognition, iris recognition, and finger print recognition). And the other one is Behavioral (signature recognition, gait, voice recognition). In this paper we concentrate on the physiological features such as fingerprint recognition, face recognition and palmprint recognition. Authentication by using multimodal biometrics offers high reliability due to the presence of multiple piece of evidence and it is more difficult to simultaneously forge multiple biometric characteristics than to forge a single biometric characteristic.

Fusion is a promising approach that may increase the accuracy of systems. Many biometric traits including fingerprint , palm vein , finger surface, face , iris , and hand shape have been combined with palmprints at score level or at representation level. Combining other hand features such as hand geometry and finger surface with palmprints allows these features and palmprints to be extracted from a single hand image. Only one sensor is needed. Researchers have examined various fusion rules including sum, maximum, average, minimum, support vector machines and neural networks. Researchers also fuse features including appearance-based, line and texture features from palmprints. Kumar et al. even fuse user identities . Although fusion increases accuracy, it generally increases computation costs and template sizes and reduces user acceptance.

II. SYSTEM DESCRIPTION

A generic biometric system operates in two stages one is the capture and storage of enrollment biometric samples and the capture of new biometric samples and their comparison with corresponding reference samples. The proposed Multimodal Biometric Authentication system works in a six-stage process that consists of the following stages.

- Image Capture
- Image Preprocessing
- Feature Extraction
- Fusion
- Matching
- Decision

A. Image Capture Stage

A multimodal biometric authentication system collects the samples of biometric features. In the proposed system we took the images of fingerprint and palmprint from polyu database. To capture and palm high quality web camera is used. Fingerprint images are captured using optical fingerprint reader. Fingerprint image size is 320*240 pixels and palm is 128*128 pixels.

B. Image Preprocessing

The images must be preprocessed before going for the next stage. Image preprocessing is done with the intention of removing unwanted data in the image such as noise, reflections .The objective of image processing stage is to filter, binarize, enhance and skeletonize the original gray images obtained by three various biometric traits.

C. Feature Extraction Stage

Gabor transformation can capture prominent visual properties. Gabor filter can be used to extract the rich line features of palmprint. Palmprint is more reliable biometric feature at it covers larger area than the fingerprint. The rich line features remain unaltered throughout the person's life. In this paper Gabor filter approach can be used which transforms palmprint images into specific transformation domains to find useful image representations in compressed subspace. It computes a set of basis vector from a set of palmprint images, and the images are projected into the compressed subspace to obtain a set of coefficients called as Gabor code.

D. Fusion Stage

Different features are generated by fingerprint and palmprint recognizers respectively.

Since the matching scores output by the two traits are heterogeneous because they are not on the same numerical range, so score normalization is done to transform these scores into a common domain prior to combining them .Total score is generated by using weighted sum rule, which will passed to the decision stage.

E. Matching Stage

At the time of Enrollment, fingerprint and palmprint images will be acquired. Feature vectors are generated for each biometric trait and stored separately in the system database. At the time of authentication, when user wants to prove his/her identity fingerprint image will be acquired by using optical fingerprint reader. Palmprint image will be captured using web camera or CCD. These images again will undergo image preprocessing and feature
extraction stage. Template will be compared with the respective template created at the time of Enrollment. Before applying any distance measurement formula we take histogram of each Gabor code. Euclidean distance formula is used to compute the distance between the Gabor code coefficients of the template and the query palm image.

F. Decision Stage

Histogram of Feature fusion image will be compared against the set threshold value .This will decide whether this person is genuine or imposter. .In this system we have given equal weight to both fingerprint and palmprint at fusion. We can change the weights of the individual modality according the modality for which we can find best results.

III.PROPOSED DESIGN

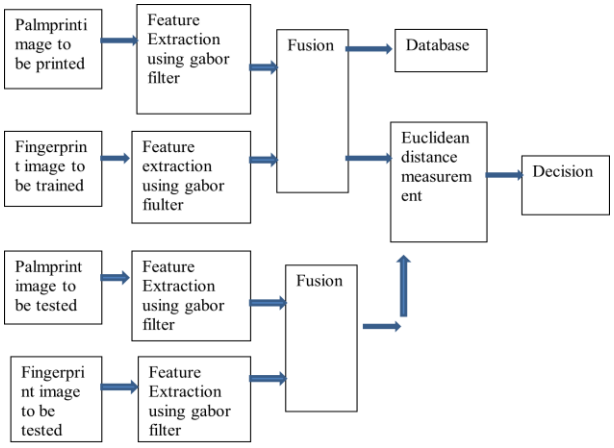

Fig.1 Proposed Design

Our methodology for testing multimodal biometric systems focuses on the feature level fusion. This methodology has the benefit of exploiting more amount of information from each biometric. Figure 1 comprises of histogram equalization, feature extraction using Gabor filter.. These features are fused and stored as a parameter for finding the matched image from the database. The feature vectors are extracted independently from the pre-processed images of palmprint and fingerprint. The feature vectors of input images are then compared with the templates of the database to produce the output. Combining more than one biometric modality progresses the recognition accuracy, reduces FAR and FRR. The proposed multimodal biometric system overcomes the limitations of individual biometric systems and also meets the accuracy requirements.

A. Gabor filter

Its impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions. The two components may be formed into a complex number or used individually,
Complex

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2})*\exp(i(2\pi\frac{x'}{\lambda}+\psi))$$

Real

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2})*\cos(2\pi\frac{x'}{\lambda}+\psi)$$

Imaginary

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2})*\sin(2\pi\frac{x'}{\lambda}+\psi)$$

Where

$$x'=x\cos\theta+y\sin\theta$$

And

$$y'=x\sin\theta+y\cos\theta$$

In this equation, λ represents the wavelength of the sinusoidal factor, θ represents the orientation of the normal to the parallel stripes of a Gabor function, ψ is the phase offset, σ is the sigma of the Gaussian envelope and ϒ is the spatial aspect ratio, and specifies the ellipticity of the support of the Gabor function.

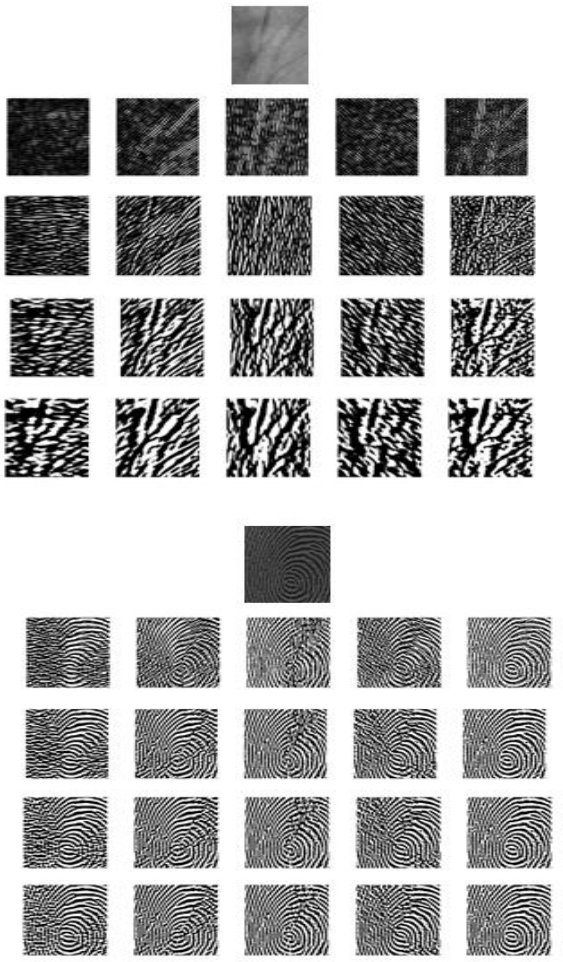

Fig.2 : Palmprint and fingerprint image response to above Gabor filter: (i) original palm image and fingerprint image, (ii) Palmprint and fingerprint features generated by the 12 filters (lambda increase with row 10,15,20,25 and orientation increase with column 0,45,90,135, 5th column in each side fusion of four image)

Fig.2 shows Palmprint and fingerprint image response to different Gabor filter. And Fig.3 shows that fusion of palmprint and fingerprint image.

Fig.3 : Fusion Of Palmprint and fingerprint image

B. Distance and Nearest Neighbor Classifier

The distance calculation is based on Euclidean distance weight function. If the value is too far, it is not taken into consideration .In 2-D, the Euclidean distance (Hu *et al.*, 1962) between (x1, y1) and (x2, y2) is given by Eqn.9

$$\sqrt{(x1-x2)^2+(y1-y2)^2}=c$$

Euclidean distance algorithm of classification is non-parametric as their classification is directly dependent on the data Oren Boiman et al. (2008).So we use nearest neighbor classifier. The nearest neighbor classifier is used to distance between the input image and the images already stored in the database. Let C11, C21, C31,… Ck1 be the k clusters in the database. The class is found by measuring the distance T(x(q),Ck) between x(q) and the kth cluster Ck1. The feature vector with minimum difference is found to be the closest matching vector.

$$T(x(q),C_k)=\min\{\| x(q)-x\|: x\in C_k$$

C. Experiment and Result

In our experiment we took a total of 5 images of fingerprint and palmprint of 7 persons having 5 similar samples. First of all we fused the 5 different finger and 5 different palmprint and make the database of total 250 fused images .Then we take 1 palmprint and one fingerprint as a test image for verification test .And from all of these we get results as follow .The similarity percentage of the matched image 78 by using 250 images of the trained image from the database.

IV.CONCLUSION

Biometric systems are widely used to overcome the traditional methods of authentication. But the unimodal biometric system fails in case of biometric data for particular trait. Thus the individual score of two traits (palmprint and fingerprint) are combined at feature level to develop a multimodal biometric system .Features were extracted using Gabor filtering. The average verification accuracy obtained was 87% when only 250 features were used. This is higher than 76% when only palmprint images are considered. Multimodal system performs better as compare to unimodal .

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