Finger And Face Recognition Biometric System

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Abstract - For human authentication the biometric systems are widely used to increase the systems security. In this paper we propose the multimodal biometric system using the biometric traits i.e. face and fingerprint. Gabor filter and haar transformation technique is used for extracting the features from fingerprint and face. The final decision is made by feature level fusion. In the proposed system has good accuracy and also the stored dataset is updated. This system is tested with the standard data sets of fingerprint and face.
Keywords - fingerprint recognition , fingerprint preprocessing , core detection, Gabor filter, haar like features, Face recognition.

1 INTRODUCTION

Traditionally, passwords or Token or cards have been used to restrict access to secure systems. However, security can be collapse when a password is known by unauthorized user or a token or card stolen by an impostor or misplaced. The emergence of biometrics can over the problems of traditional verification methods. Biometrics refers to the automatic identification (or verification) of an individual (or a claimed identity) by using certain physiological or behavioral traits associated with the person (e.g., fingerprints, hand geometry, iris, retina, face, hand vein, facial thermograms, signature, voiceprint). Biometric indicators have an edge over traditional security methods in that these attributes cannot be easily stolen or shared. Among all the biometric indicators, fingerprints and face are widely used biometric traits. Biometrics automatic systems are provides higher security the traditional authentication systems. In biometric authentication persons identification is based on their physiological and/or behavioral characteristics. Biometric systems are more accurate and provide more convenience.

Many researchers have used faces and fingerprint, with some considering score quality when fusing results [1]. Lin Hong and Anil Jain [5] developed a prototype biometric system which integrates faces and fingerprints, and decision fusion scheme enables performance improvement by integrating multiple cues with different confidence measures. For face eigenface approach is used and for fingerprint minutiae technique is used.A multimodal biometric system based on fusion of face and fingerprint in [7] introduced and compared different fusion methods. In this case, the fusion was using data quality information, it outperforms unimodal systems. Iftikhar Ali Usman Ali Abdul Malik [8] propose a model that integrate the output of face and fingerprint recognition by using Gabor filter for person identification. It also shows efficient biometric integration model, which utilizes Gabor filter for both fingerprint and face recognition. Integration of two biometric has generated better results than each biometric authentication technique used separately.

Our goal is to perform authentication using multimodal Biometrics, which combine multiple traits to establish identity with high accuracy. The corresponding output obtained by using Gabor filter is good as compared to the other methods. Gabor filter have the properties of spatial localization ,orientation selectivity and spatial-frequency selectivity. Therefore, Gabor filter have been applied to many fields, such as texture classification ,face recognition ,handwritten character recognition, fingerprint classification and fingerprint recognition. It handles sensitively the different orientations in the fingerprint image and it provide a robust representation is with respect to minor local changes thus, individuals can be recognized in spite of different facial expressions and poses.

The paper is organized as follows: in section II, we describe the steps of fingerprint preprocessing and face detection. In section III, we describe the procedure of feature extraction of fingerprint and face. In section IV, feature level fusion. Then, in section V we shows the experimental results. In section VI we draw the conclusion.

2 FINGERPRINT PREPROCESSING AND FACE DETECTION

2.1. Fingerprint Preprocessing

Originalimage Thresholdimage Binary image Thinned image
Fig.1 Steps of the fingerprint preprocessing

Steps of the fingerprint preprocessing are shown in Figure 1.Fingerprint preprocessing is for better identification.

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Such process increasing the clarity of ridge structure of fingerprint. The enhanced fingerprint image is binariged and thinned skeletanised image which has the ridge thickness to one pixel wide for precise location. Preprocessing removes the sensor noise and gray level background due to fingerprint pressure differences. The processed image is used to extract the features to form the template.

2.2.Feature Extraction

The ridge structure in a fingerprint has oriented texture patterns having a dominant spatial frequency and orientation in a local neighborhood. The frequency is due to inter ridge-spacing present in a fingerprint and the orientation is due to the flow pattern exhibited by ridge [2]. there is a little variation in the spatial frequencies among different fingerprints .The bandwidth filter, such as the Gabor filter, can be used to emphasize ridges. The steps followed in feature extraction are;1)core point detection2)cropping3)calculate the feature vectors using Gabor filter.

1)core point Detection

In the proposed system we first detect the core point. The core point is the special point which has the most variant changes in the directions of the lines,i.e.high curvature point of ridges. To differentiate the fingerprint singular points are used. Singular points are the points that can be consistently detected in a fingerprint image and can be used as a registration point. Typically there are two types of singular points: core point and delta point. A fingerprint can have two structures, the global and the local structure. In the global structure the overall pattern of the ridges and valleys are considered where as in local structure the detailed pattern around a minutiae point is considered. A minutiae point is a position in the fingerprint where a ridge is suddenly broken or two ridges are merged.

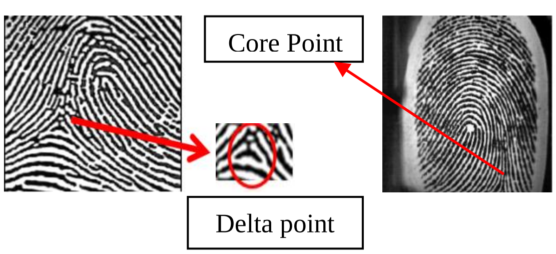

Fig. 2 core and delta point of fingerprints

The global structure is used because it is more stable even when the fingerprint is of poor quality[18]. Core points have special symmetry properties which make them easy to identify also by humans. To detect the core point different techniques are used. In our paper core Point detection can be done by using complex filtering. The algorithm proposed for core point detection is:

1. Complex filter of order m are modeled by exp $\{im\Phi\}$. A polynomial approximation of these filters in Gaussian windows yield $(x+iy)g(x,y)$ where g is a Gaussian defined as $g(x,y)=\exp\{-x^2+y^2/2\sigma^2\}$
2. Now these filters are applied not directly to the original enhanced fingerprint image but they are applied to the complex valued orientation tensor field image $z(x,y)=(f_x+if_y)^2$wheref_x is the derivative of the original image in the x-direction and f_y is the derivative in the y-direction.
3. Filters of first order symmetry are used

i.e. For core Point:

$h_1(x,y)=(x+iy)g(x,y)$

$=r\exp(i\Phi)g(x,y)$ (1)

For delta point:

$h_1(x,y)=(x-iy)g(x,y)$

$=r\exp(-i\Phi)g(x,y)$ (2)

Then gradient values are calculated and find the non-zero values. Find the density of the ridges of fingerprint. Then move the 8×8 window and fix the threshold value to 20.Thevalues got from core window get convolved .From the extracted image block the median and variance values are calculated. Then find the maximum variance position that is the core point of the fingerprint image.

2)cropping of image

After locating core point of finger image cropping is done to get only interested area of image and remove unwanted part of the finger for better feature extraction. In our paper the size of cropped image is 175×175.

3)feature vector calculation

After cropping we applied the Gabor filter with sector normalization. A circular region around the core point is located and tessellated into 64 sectors with k=10 and variance=32. The pixel intensities in each sector are normalized to a constant mean and variance.In the sector normalization we calculated the average mean value of feature vectors then applied the Gabor filter. Gabor filter is a well known technique to capture useful information in specific band pass channels. The average absolute deviation with in a sector quantifies the underlying ridge structure and is used as a feature. There are 1280 values in length of the feature vector, which is the collection of all the features, computed from all the 64 sectors, in every filtered image. The feature vector captures the local information and the ordered enumeration of the tessellation captures the invariant global relationships among the local patterns.

x=cos(angle*pi/num_disk);

y=sin(angle*pi/num_disk);

w=(2*pi)/k;

xx(p)=sinp(i)+cosp(j); (1)

yy(p)=cosp(i)-sinp(j); (2)

gaborp(p)=1×exp(-((xx(p)×xx(p))+(yy(p)×yy(p)))/ variance) × cos(w*xx(p));

gaborp_2d(i,j)=gaborp(p); (3)

Equation (3) is used to calculate the Gaussian parameters ,the output gives the Gabor values. It is desirable to obtain representations for fingerprints which are translation and rotation invariant. In the proposed scheme, translation is taken care of by a reference point which is core point during the feature extraction stage and the image rotation is handled by a cyclic rotation of the feature values in the feature vector. The features are cyclically rotated to generate feature vectors corresponding to different orientations to perform the matching. Hence, the finger can examined at different orientations and this correspond to θ values. These Gabor features are stored in database as template. At the matching stage the gabor features of train and test image are compared and distance has been calculated, if the distance is within threshold limit the image is said to be similar.

3 FACE DETECTION

Face detection very tough, due to the change in environment, light effects, facial expressions and different poses of the face. The most popular approaches to face recognition are based on i)the location and shape of facial attributes such as eyes,eyebrows,nose,lips and chin and there spatial reletionships,ii)the overall analysis of face image reprents a face as a weighted combinations of number of conical faces. In our proposed system we simply used the gabor filter for feature extraction from face which are used for face recognition

Face detection is defined as to determine whether or not there are any faces in the image and if present, return the image location and extent of each face. This is the first step of any fully automatic system that analyzes the information contained in faces (e.g., identity, gender, expression, age, race and pose) [14]. The most popular approaches to face recognition are based on i)the location and shape of facial attributes such as eyes, eyebrows, nose ,lips and chin and there spatial relationships ,ii)the overall analysis of face image represents a face as a weighted combinations of number of conical faces.

In our proposed system we simply used the Gabor filter with Haar Transformation technique for feature extraction from face which is used for face recognition. Before extracting the features from face we followed some preprocessing steps which includes apply Haar transformation algorithm [14] for detecting the face, cropping of image, centralization. Similar like fingerprint the center point of face image is also detected and gabor filter is applied for feature extraction.Then extracted features are stored as template. In proposed system we use the haar like feature algorithm for face detection from open CV library and detect the face.

4 PROPOSED MULTIMODAL SYSTEM

To overcome the problems in the unimodal biometric system Multi-biometrics are use. With the lower hardware cost a multi biometric system uses multiple sensors for data acquisition.

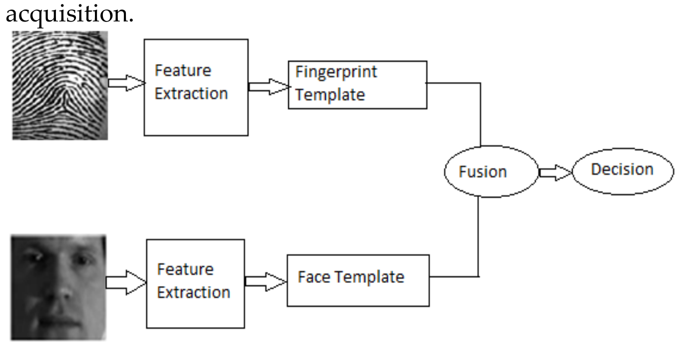

Fig.3 Block diagram of multimodal system

Fusion

Multimodal biometric systems integrate information presented by multiple biometric indicators[4].The information can be consolidated at various levels.

a)feature extraction level
b)matching level
c)decision level
In our proposed systemwe used fusion at feature extraction level because it is considered as a combination scheme applied as early as possible in the recognition system is more effective. i.e an integration at the feature level typically results in a better improvement than at the matching score level.

Our system is basically divided into two parts (i)crating profile (ii)identification. In first part the images are acquired from sensors, features are extracted using Gabor filter , extracted features are get fused then a single feature is saved as template in dataset. In the second part the fingerprint images is taken as query images again the features are extracted and single fused template is compared to the templates stored in dataset for identification. The data set is get updated every time i.e. the stored template is replaced by new extracted template at the time of next authentication.

5 EXPERIMENTAL RESULTS

The reliability of the proposed unimadal system is described with the help of experimental results. The system has been tested on standard datasets for face (att,ifd) and fingerprint(FVC2004 db1,db3),each dataset has nine images of each individual person with different orientation as well as with different facial expressions and also th We implemented this method in MATLAB7.5.0(R2007b version) and processed on Pentium machine 20.2 GHz. In result analysis we shown difference between the values after comparing test image with the each image stored in the dataset and whichever is less difference it is matched image. During analysis match the test image with the stored images in which test image already stored in dataset i.e. genuine recognition. Also test the image when test image is not stored in the data set i.e.imposter recognition

5.1 Result Analysis of fingerprint:

Table I.A. Genuine Recognition of fingerprint

Imposter recognition

Image No	1_1	2_1	3_1	4_1	5_1	6_1	7_1	8_1
1_1	X	1.9745e+004	1.4153e+004	2.3290e+003	1.1944e+004	6.1820e+003	-1.0469e+004	2.3465E+003
2_1	X	X	5.5924e+003	-1.7416e+004	-8.4017e+003	-1.3563e+004	-3.0215e+004	-1.7399e+004
3_1	X	X	X	-1.1824e+004	-2.8093e+003	-7.9708e+003	-2.4622e+004	-1.1806e+004
4_1	X	X	X	X	-2.4310e+003	3.8530e+003	-1.2798e+004	17.5062
5_1	X	X	X	X	x	-5.1615e+003	-2.1813e+004	17.5062
6_1	X	X	X	X	x	X	-1.6651e+004	17.5062
7_1	X	X	X	X	x	X	X	1.2816e+004
8_1	-	-	-	-	-	-	-	X

Table I.B. Imposter Recognition of fingerprint

Genuine Recognition ((for the range res1 <= 1.0735e+003) (rec1 > -3.2e+003))

Image No.	**N-1**	**-2**	**-3**	**-4**	**-5**	**-6**	**-7**	**-8**
1_1	0	-347.2003	121.3903	1.0635e+003	62.8145	-292.3143	296.2974	-306.9133
2_1	0	-824.7752	-2.578e+003	1.1240e+003	-1.3707e+003	-3.1157e+003	1.1907e+003	-2.1641e+003
3_1	0	1.3728e+003	1.4538e+003	-821.2621	2.2800e+003	-792.0281	-171.0250	-1.0535e+003
4_1	0	2.6347e+003	1.7121e+003	2.5125e+003	3.0503e+003	-127.3669	2.9816e+003	2.4126e+003
5_1	2.8093e+003	-560.5406	692.64	-908.1906	-420.3718	-2.1414e+003	-2.9522e+003	-371.6179
6_1	0	-829.6960	1.6168e+003	-841.7811	-1.8360e+003	-469.1589	-885.2578	-1.2609e+003
7_1	2.3116e+003	-3.1185e+003	5.5950e+003	-5.6850e+003	-6.8124e+003	-9.3562e+003	-1.0837e+003	-4.0900e+003
8_1	0	-3.1954e+003	601.6095	91.3040	-416.6923	-1.0576e+003	-9.6932e+003	-4.4747e+003

5.2 Result Analysis of Face

Table II A) Genuine Recognition of Face

Genuine Recognition (distance minima < 1.2)

Image No.	N-000000	-000001	-000002	-000003	-000004	-000005	-000006	-000007
1-000000	0	1.3513	0.9833	0.4877	1.0704	1.0445	1.1641	1.1395
2-000000	0	1.0535	1.1202	1.0578	0.7319	0.8278	0.8189	0.7087
3-000000	0	0.5465	0.4032	0.4232	09621	1.2637	0.4635	0.5128
4-000000	0	1.0078	0.5501	0.8605	10583	1.1052	0.7294	1.0468
5-000000	0	0.9889	0.7467	0.9193	0.2334	0.6339	0.6600	0.6435
6-000000	0	0.7294	0.8247	0.6283	0.7981	0.7401	0.8272	0.8441
7-000000	0	0.7409	0.4384	0.4137	0.4579	04408	0.5035	0.429
8-000000	0	0.5555	0.7223	1.0125	0.5335	0.6343	0.8369	0.4176

Table II B) Imposter Recognition of Face

Imposter recognition

Image No.	1-000000	2-000000	3-000000	4-000000	5-000000	6-000000	7-000000	8-000000
1-000000	X	0.7657	0.8526	1.2315	0.8058	0.8587	0.9905	0.8119
2-000000	X	X	0.8526	1.1777	0.8058	0.8587	0.9909	0.8119
3-000000	X	X	X	1.1777	0.8058	0.7886	0.9909	0.8119
4-000000	X	X	X	X	0.8058	0.7886	0.9929	1.0119
5-000000	X	X	X	X	X	0.7886	0.9712	0.9277
6-000000	X	X	X	X	X	X	0.9795	0.8049
7-000000	X	X	X	X	X	X	X	0.7461
8-000000	X	X	X	X	X	X	X	X

5.3 Result Analysis of Fusion

Table III A) Genuine Recognition of Fusion

Genuine Recognition ((for the range res1 <=(10.0 &&res1<-10)&&res2 < = 0.83&&res2>=-15))

Image No.		N-1	N-000000	_2	000001	_3	000002	_4	000003	_5	000004	_6	000005	_7	000006	_8	000007
1_1	1-000000	0	0	999	999	-0.1214	-8.9733	-1.0635	-2.2679	-0.0628	-4.2232	0.2932	-1.7407	-0.2963	-4.7770	0.3069	-6.0683
2_1	2-000000	0	0	0.8248,	-4.0055	2.5789	0.3577	999	999	999	999	3.1157	-4.3048	-1.1907	-1.4252	2.1641	0.7866
3_1	3-000000	0	0	999	999	1.4538	-2.1355	0.8213	-2.6285	999	999	999	999	3.3145	0.3328	1.0535	0.3428
4_1	4-000000	0	0	-2.6347	-1.0044	999	999	-2.5125	-0.2878	-3.0503	-2.3453	999	999	-2.9819	0.6179	-2.4126	-1.8319
5_1	5-000000	0	0	999	999	999	999	0.9052	-3.2301	0.4204	0.6067	-9.6824	0.0605	-9.0145	0.0550	999	999
6_1	6-000000	0	0	999	999	-7.3977	-3.9882	-4.3193	-0.5813	-3.3255	-3.5985	1.8360	-1.6908	-9.5075	-4.6573	-1.5484	-2.2331
7_1	7-000000	0	0	7.759	-0.7220	999	999	999	999	4.6407	-2.0555	1.7321	0.8225	8.7307	-0.3044	4.6407	-0.7219
8_1	8-000000	0	0	7.8361	-2.7090	999	999	0.0913	0.1811	-1.9124	0.1866	999	999	999	999	4.4747	-0.1304

Table III B) Imposter Recognition of Fusion

Imposter recognition

Image No.		1_1	1-000000	2_1	2-000000	3_1	3-000000	4_1	4-000000	5_1	5-000000	6_1	6-000000	7_1	7-000000	8_1	8-000000
1_1	1-000000	X	X	999	999	999	999	999	999	999	999	999	999	999	999	6.2626	0.7721
2_1	2-000000	X	X	X	X	5.5924	-1.1443	999	999	8.4017	-2.5878	999	999	999	999	999	999
3_1	3-000000	X	X	X	X	X	X	999	999	999	999	999	999	999	999	999	999
4_1	4-000000	X	X	X	X	X	X	X	X	-9.0145	-6.3172	999	999	999	999	999	999
5_1	5-000000	X	X	X	X	X	X	X	X	X	X	999	999	999	999	999	999
6_1	6-000000	X	X	X	X	X	X	X	X	X	X	X	X	999	999	999	999
7_1	7-000000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	999	999
8_1	8-000000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

6 COCLUSION

Now a day's biometric systems are widely used to overcome the problems of traditional authentication systems. But most of the unimodal systems are fails to give results effectively due to lack of biometric information of particular trait .We presented an effective biometric multimodal system which utilizes Gabor filter for both fingerprint and face recognition. Fusion is done at feature extraction level. The performance table and accuracy curve shows that multimodal system performs better as compared to unimodal system with 97% accuracy. In future our next step will be to improve the response time of the system.

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