PERSONAL CREDENTIALS VERIFICATION USING SIGNATURE AND IRIS RECOGNITION

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Abstract - ***Biometric classification technique like signature verification and recognition is now a day considered as one of the essential personal identification scheme used to identify the distinct person. The use of particular recognition which leads to high FAR and low TSR. So by using fusion model can achieve an appropriate balance between recognition performances, processing time for fusion based is especially effective in coping the subjects with similar signature and iris may lead to a high TSR rate. This paper proposes signature verification based on transform domain features (directional feature) such as coherence, gradient, dominant. The obtained image is resized to bring all the signatures into standard size and the images are thinned using morphological method. The Discrete Wavelet Transform (DWT) technique is applied on signature images in order to get sub-bands. The directional feature is estimated from sub-bands and finally fusing the directional and textural feature in order to form the feature vector. For the iris recognition, pre-processing is done by segmentation and histogram equalizer. DWT technique is applied to extract the part of iris. These two feature abstraction of signature and iris is fused and Euclidean Distance method is used in the matching process. The effects of False Acceptance Rate (FAR), False Rejection Rate (FRR), and Total Successive Rate (TSR) are obtained for GPDS-960 and CASIA database. A total 540 images of signature and 756 images of iris are used for training and testing. It is noticed that the values of FAR, FRR, EER and TSR are improved compared to existing processes.***

Key Words: *False Acceptance Rate (FAR), False Rejection Rate (FRR), Total Successive Rate (TSR), Equal Error Rate (EER). Chinese Academy of Sciences Institute of Automation (CASIA), Discrete Wavelet Transform (DWT), and Local Binary Pattern (LBP).*

1. INTRODUCTION

Biometric is a technology which can measures the human body characteristics. This is used in mainly authentication and also in surveillance for identifying the individuals in groups. Biometric [1] is powerful combination of science and technology that can secure our valuable information.

Md. Iqbal Quarishi and Arindam Das et al., [2] proposed this method, which uses spatial and frequency domain techniques for transformation. To extract the signature features are done by using transformation such as Ripplet-II, Fractal Dimension and Log Polar Transformation are carried out to authenticate. The Artificial Neural Network (ANN) uses the Feed Forward Back Propagation algorithm.

Assia hamadene and Youcef Chibani et al., [3] proposed this method based on the contourlet transform and the co-occurence matrix. The contourlet transform is used to capture contour segment directions of the handwritten signature, while the co-occurrence matrix permits describing the number of directions. Experiments are conducted on the Center of Excellence for Document Analysis and Recognition (CEDAR) database and the classification is done by Support Vector Machines (SVM).

Suhail M. Odeh and Manal Khalil [4] proposed paper discusses the signature verification and recognition using a Neural Network. The paper has different stages of the process including: image pre-processing, feature abstraction and pattern recognition through neural networks and recognition by using Multi-Layer Perceptron's (MLP) neural network that used to extract four features such as eccentricity, kurtosis, skewness, and orientation, which can be extracted by image processing.

Yazan M. Al-Omari and Siti Norul Huda Sheikh Abdulla et al., [5] proposed this paper; provide the signature of forgery forms, features forms and recent methods used for features extraction in signature verification systems. In pre-processing stage it uses two steps: enhancement and segmentation. Local Random transform (LRT) are used to extract the features. In this paper Support Vector

Machines (SVM) with Radial Basis Function (RBF) is used as classifier.

Mohit Arora, Kulbir Singh and Guneet Mander et al., [6] proposes a new method for an online handwritten signature verification based on Discrete Fractional Cosine Transformation (DFrCT) for feature extraction. The approach for the hand-written signature verification is realized by characterizing three FIR scheme. The impulse responses of FIR scheme are used to calculate Euclidean norm.

Nidhi and Er. Pushpinder Singh [7] proposes this method which is based on Discrete Sub-band Transform (DST). Initially iris image is acquired and get segmented which involves employing canny edge detection to generate an edge boundaries. The segmented image is normalized and feature extraction is done by using Discrete Sub-band Transform.

Ashisk kumar Dewangan and Majid Ahmad Siddhiqui [8] proposes this paper. The iris recognition system consists of segmentation system based on Hough transform, and extracted iris region is normalized to rectangular block with constant dimension. Finally, the phase data from 1D Log-Gabor filters are extracted and quantized to four levels to encode the unique patterns of iris into biometric template and hamming distance are used for classification of iris templates.

Vanaja Roselin.E.Chirchi, Dr.L.M.Waghmare and E.R.Chirchi [9] proposed this paper focus on efficient methodology for identification and verification for iris detection. Initially acquired image is get segmented and extracting the features using 2D discrete wavelet transform with Haar up to 5-level decomposition and matched by using hamming distance.

Sheeba Jeya Sophia S and Veluchamy [10] propose this method uses canny edge detection provides localization and detection which provide time consumption. Iris normalization is performed using Gabor filter and feature vectors are extracted using Local binary pattern and classification is performed using Learning Vector Quantization (LVQ). Matching is performed using hamming distance.

Manisha, Gurdeep Kaur and Parminder singh [11] proposes this technique such as segmentation, standardization, feature extraction and matching (similarity). The problem is of scaling, illumination, rotation in vision problems had to be resolved were the reflections of the eye to the light source. The cost of designing and manufacturing of such is very high, so its cost gives disadvantage to the system.

2. PROPOSED SYSTEM

Proposed system consists of pre-processing, feature extraction and matching process shown in Fig 1. The concept of pre-processing is to normalize the variations of image. The intension of feature extraction is to select the finest features from signature and iris images. Fusion contains of combining the extracted data.

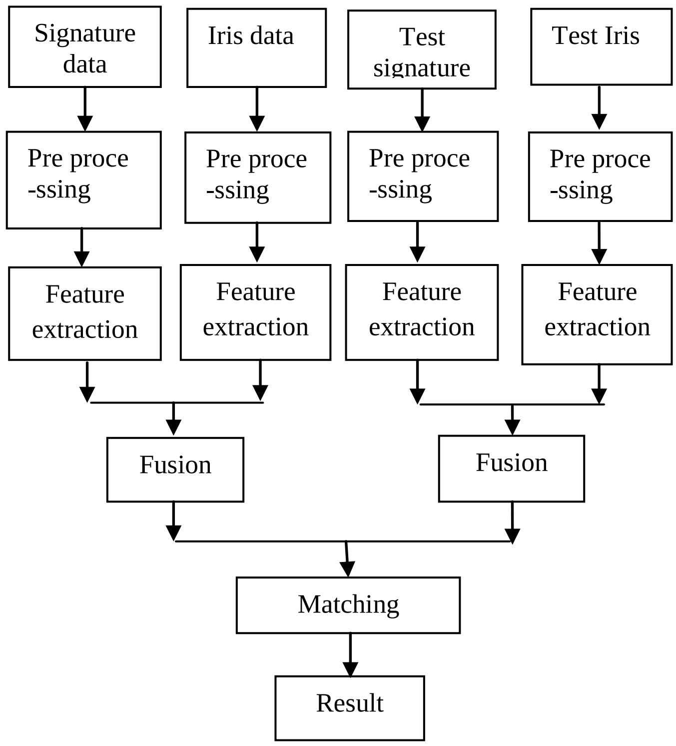

Fig-1: Fusion of signature and iris model

2.1 SIGNATURE

2.1.1 Pre-processing

First step of pre-processing [12] is applying DWT to the input signature of the image. Consider the original size of the image is (N x N) at the first level of applying DWT, this gives low pass filter and high pass filter. Low pass image contains complete image information with noise and high pass contain edge data of image. For this low pass image, resize is done to [256 256] because GPDS-960 database are employed for signature and for iris we employed CASIA database. Both databases involve distinctive image size in order to get same image size we go for resizing the image and also it reduces the stimulation time. Filtering is applied to low pass image in order to remove the noise by using Gaussian low pass filter. Fig 2 shows the pre-processing model.

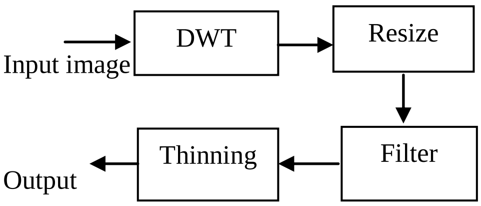

Fig-2: Pre-processing block

The unwanted noise is removed to improve the image quality and smoothening, sharping is done by Gaussian low pass filters. For the filtered image, thinning is approved to decrease the image thickness to one pixel i.e., extra unwanted pixels are erased. Thinning is morphological process which is used to join the connectivity of the signature image because while doing filtering some connectivity of the signature will be loss. The bwmorph-thin is the MATLAB function for thinning process.

2.1.2 Feature extraction

The next step is feature extraction [13] in which distinctive features of transform, directional and textual are extracted. The extracted features are combined to form a single array which is deposited in the database. This array can be retrieved in upcoming for comparison with a test signature.

i) Transform: Before extracting the directional features, now need to apply second level of DWT resulting in four sub-bands namely LL, LH, HL and HH where LL band offers the data about image, LH band offers horizontal data, HL offers vertical data about the image and HH offers diagonal data around the image. Only LL band is taken for the next process because it contains complete data of signature image.

ii) Directional features

a.Gradient: It implies the directional change in the color or intensity in an image. The gradient and equivalent angle at the locus/ position (m, n) is given in below equation respectively.

$$G_{mn} = M * \left(|G^x_{mn}| + |G^y_{mn}| \right) \qquad (1)$$

$$\theta_{mn} = \tan^{-1}(G^x_{mn} / G^y_{mn}) \qquad (2)$$

Where G^x_{mn} and G^y_{mn} represents the components of G_{mn} in horizontal and vertical directions.

b. Coherence: It implies how comparable two given pixels are over the entire image. In other words, coherence is a measure of correlation. The equation can be specified as below,

$$\delta_{mn} = \frac{\Sigma\, G_{ij} * \cos(\theta_{mn} - \theta_{ij})}{\Sigma\, G_{ij}} \qquad (3)$$

Where i and j varies from 1 to 5 (because window size is 5 x 5).

c.Dominant: All directional data about the image is offered by dominant local orientation. Dominant precedes the major/chief letter in the signature. Using gradient and coherence, dominant local orientation is calculated by below equation,

$$\theta = 0.5 * \tan^{-1} \frac{\sum_{m=1}^{N}\sum_{n=1}^{N} \delta^2_{mn} \sin 2\theta_{mn}}{\sum_{m=1}^{N}\sum_{n=1}^{N} \delta^2_{mn} \cos 2\theta_{mn}} \qquad (4)$$

Where N = 8. Thus window size is 8 x 8 which represent one of the directional information.

iii) Textual features

a.Correlation: It is relationship between the two causal variables or two data sets. It is a measure of related (correlated) a pixel is to its nearby over the whole image.

$$\text{Correlation} = \sum_{i=1}^{N}\sum_{j=1}^{N} \frac{(i-\mu_i)(j-\mu_j)P(i,j)}{\sigma_i \sigma_j} \qquad (5)$$

Wherever μ = mean and σ = standard deviation.

Linear Binary Pattern (LBP) [14] is a type of feature used for texture classification. LBP transforms an image into an array or integer labels of the image. These labels histogram is used for further image analysis. The LBP operator takes eight neighboring pixels which use 3 x 3 pixel block image. The Fig 3 gives gradual way for LBP procedure.

8	7	10
6	9	24
4	12	5

0	0	1
0		1
0	1	0

Fig -3: working out the LBP code of pixel (x, y). In this case I(x, y) =9

The middle value of a pixel block is taken as threshold value. Now adjacent pixel value is matched with the threshold value along clockwise or counter-clockwise. When the adjacent pixel value is greater than threshold value then enter "1", else "0". Upcoming binary digital number is computed to histogram. Lastly standardize the histogram image is concatenated which gives the feature vector and then progressed using some algorithm to gather the images. The adjacent binary codes denote the 8-bit number. The Fig 3 gives gradual way for LBP, considering the block 1 as a signature pixel value, this pixel is matched with threshold value I(x, y) and resultant binary codes are denoted in block 2.

2.2 Iris

2.2.1 Pre-processing

The pre-processing starts from segmentation processes [15], the original iris image is adjusted to the intensity level. Now the original image and adjusted image is get subtracted in order to extract the iris part. The inbuilt labeling function is used which is mentioned below.

Bwlabel is one of the labeling functions, used for connectivity of the components in 2-D binary image. To extract features from a binary image using regionprops with default connectivity, just enter BW directly into regionprops. Regionprops is the mat-lab function which is used to measure the properties of image regions.

Region props measures a set of properties for each labeled regions in matrix L. Integer (positive) fundamentals of L corresponds to different regions. For example, the set of element of L equal to 2 corresponds to region 2 and so on. If properties is not mentioned, we can calculate the properties such as 'Area', 'BoundingBox', 'Centroid', 'PixelIdxList', 'FilledArea', 'EquiDiameter', 'Image', , etc. For iris recognition we are using the properties parameter like 'EquiDiameter', 'Centroid', and 'BoundingBox'. EquiDiameter denotes the diameter of the circle with the same area as the region. Computed as sqrt (4*Area/pi). EquiDiameter property supports only for 2-D input label matrices. Centroid specifies 1 by Q vector that indicates the center of mass of the region. The below Fig 4 shows the bounding box and centroid.

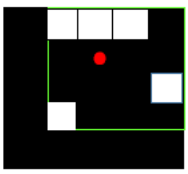

Fig-4: Bounding box and centroid

First element of centroid value is horizontal coordinates of the center of mass and second elements are vertical coordinates. Other centroid elements are in the order of dimension. The region involves white pixels; the green box is the bounding box and red dot is the centroid.

2.2.2 Feature extraction

DWT is used to extract the features of iris image. DWT resulting in four sub-bands namely LL, LH, HL and HH where LL band presents the data about image, LH band presents horizontal data, HL presents vertical data about the image and HH presents diagonal data about the image. Only LL band is taken for the next process because it contains complete data of iris image. The resulting LL band is reshaped.

2.3 Fusion

In fusion block, it continue the process of linear binary pattern(LBP) [14] that is by multiplying the block of signature and iris is as shown in below Fig 5.

0	0	0
0		1
4	1	0

14	24	128
64		10
32	34	100

0	0	128
0		10
0	34	0

Fig-5: working out the LBP code of pixel (x, y). In this case I(x, y) =9, and LBP code is LBP(x, y) =172.

block-2 is the signature pixel value resulting in binary code and block-3 is the iris pixel value, now block-2 and 3 get multiplied in the fusion block which results in block-4 that is LBP= 0+0+128+0+10+0+34+0=172.

2.4 Matching

The matching metric can be used to match two templates is the Euclidean distance [15]. This metric can be used especially when the two templates comprises of integer values. The Euclidean distance is given by an equation

$$\text{Euclidean distance} = \sqrt{E(X_{data}^2 - X_{ref}^2)^2} \qquad (6)$$

Finally the resultant of the verification is given as the person is within the database and in acceptance or that person is not someone the system recognize as the one in the database signature and hence reject (eliminate).

3. RESULT AND DISCUSSION

The biometric features of a signature and iris samples can be exactly the same as those provided during the registration system for the same id. This needs the matching algorithm to return outcomes which are near matches to the features given, and hence the need for a threshold rises. The performance of a biometric technique is computed in certain standard conditions. These are False Rejection Rate (FRR), False Acceptance Rate (FAR), Equal Error Rate (EER), and Total Successive Rate (TSR). FRR is the relationship of number of persons rejected in dataset to the total number of persons in dataset. FAR is the relationship of number of accepted authorized person to the total number of persons out of database. TSR is the amount at which the system distinguishes all the persons in the dataset as particular individuals correctly. It determines the accuracy of the technique used for recognition. EER is a point where FAR and FRR gather.

Table -1: Result obtained after fusing signature and iris recognition technique

Threshold	FRR	FAR	TSR
0	20	0	0
0.1	0	10	95
0.2	0	10	95
0.3	0	10	95
0.4	0	10	95
0.5	0	10	95
0.6	0	10	95
0.7	0	10	95
0.8	0	10	95
0.9	0	10	95
1	0	10	95

The table-1 shows result obtained after fusing both signature and iris recognition .Fusion comprises of two techniques so as to holding on to its benefits, excludes the problem of the individual code. From the fusion results it is clear that Total Successive Rate is of 95% increases with decrease in False Rejection Rate of 0% and False Acceptance Rate is of 10%. And also Equal Error Rate (EER) is reduced to 0.5 for the threshold value of 0.05.

Result obtained for fusion of signature and iris recognition:

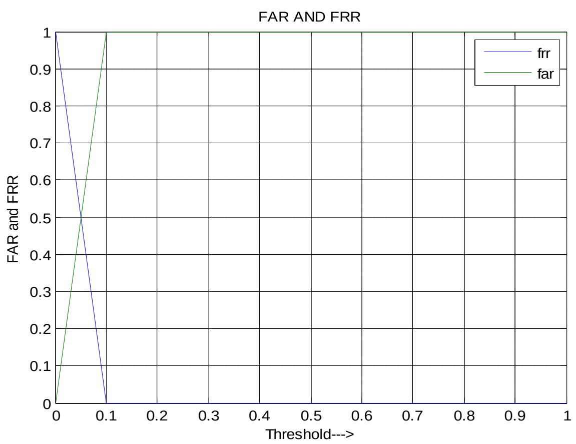

Fig-6: Threshold verses FAR and FRR

The Fig 6 shows the plot of False Acceptance Rate (FAR) and False Rejection Rate (FRR) verses threshold. The intersection point of FAR and FRR is called as Equal Error Rate (EER).The Equal Error Rate graph having threshold as one of its factor makes it unsuitable for matching different algorithms performance of different implementations of an algorithm. By plotting the FAR and FRR, this dependence can be detached. This allows us to match several different biometric system performances. The closer a plot lays to the axis the better performance of the biometric system. Equal Error Rate is about 0.5 in the Threshold value of 0.005. Always FAR and FRR should be lower rate with increase in TSR value.

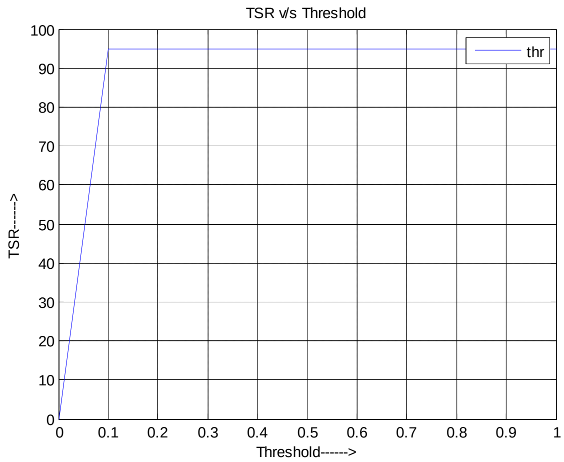

Fig-7: Threshold verses TSR

The Fig 7 is used to know the performance of their authentication system. It shows the Total Successive Rate (TSR) against the threshold value. For 0.5 of EER, we are receiving TSR is about 48%. Here we can see TSR value is constantly maintaining 95% for different threshold value differs from 0.1 to 1.

3. CONCLUSIONS

In this paper, integrating a physiological biometrics trait, the iris, and behavioral trait, the signature, is proposed. The proposed signature verification based on Transform domain feature such as coherence, gradient and dominant local orientation and Textural feature like correlation is presented. Iris recognition based on segmentation. Experimental results show that the proposed achieved with a FRR of 0% on a FAR of 0.1% and TSR of 95%. Further analysis of the effect of the proposed approach with other distinct biometric modalities is envisaged.

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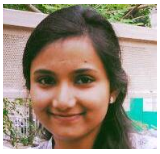
BIOGRAPHIES



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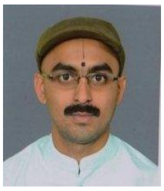

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