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LPCC and SIFT Based Biometric Amalgamation of Iris and Speech for Authentication and Identification

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Abstract: Multimodal biometric system verifies a person's identity based on physiological (face, iris, fingerprint) or behavioral biometric traits (voice, signature). During this work, a brand new multimodal biometric system is developed i.e. using iris and speech. Initially, Iris and Speech recognition systems area unit developed singly by extracting their features from the Independent Component Analysis (ICA) technique for iris and from Gammatone Frequency Cepstral Coefficients (GFCCs) technique for speech. In proposed work, the speech and iris traits area unit combined along and also its performance is verified throughout authentication with the help of techniques Scale Invariant Feature Transform (SIFT) and Linear Predictive Cepstral Coefficient (LPCC). The performance evaluation of proposed method is done by Falsely Accepted Rate (FAR), Falsely Rejected Rate (FRR) and Accuracy, in MATLAB environment. The results obtained by proposed method are better than ICA and GFCC methods.

Keywords: Authentication, LPCC, SIFT, Iris, Speech.

I. INTRODUCTION

Personal identity refers to a set of attributes for example, name, social security numeral, and so on, which are related to a human being. Identity management is the procedure of creating, destroying as well as maintaining identities of individuals in a populace. A dependable identity management structure is urgently needed in order to combat the epidemic growth in identity theft and to meet the increased security requirements in a variety of applications ranging from international border crossing to accessing personal information. Establishing (determining or verifying) the identity of a person is called person recognition or authentication and it is a critical task in any identity management system. The three basic ways to establish the identity of a person are "something you be acquainted with" for example, personal identification number, password, and so on, "something you carry" for example, physical key, ID card and "something you are" for example, face, voice. Surrogate representations of identity such as passwords and ID cards can be certainly shared, misplaced, or else taken. Passwords could also possibly be easily guessed using social engineering and dictionary attacks. Hence, the effective security provided by passwords is significantly less than the anticipated security. Research studies done via the National Institute of Standards and Technology (NIST) have estimated that on average, an 8-character ASCII (7 bits/character) password effectively provides only 18 bits of entropy, which is much less than the expected 56 bits of security. Moreover, passwords and ID cards cannot provide vital authentication functions like non-repudiation and detecting numerous enrollments. For instance, operators can straight forwardly reject utilizing a service by claiming that their password has been stolen or guessed. Individuals can also conceal their true identity by presenting forged or duplicate identification documents. For that reason, it is becoming progressively obvious that knowledge-based and token-based mechanisms alone are not sufficient for reliable identity determination and stronger authentication schemes based on "something you are", namely biometrics, are needed.

II. FLOW CHART

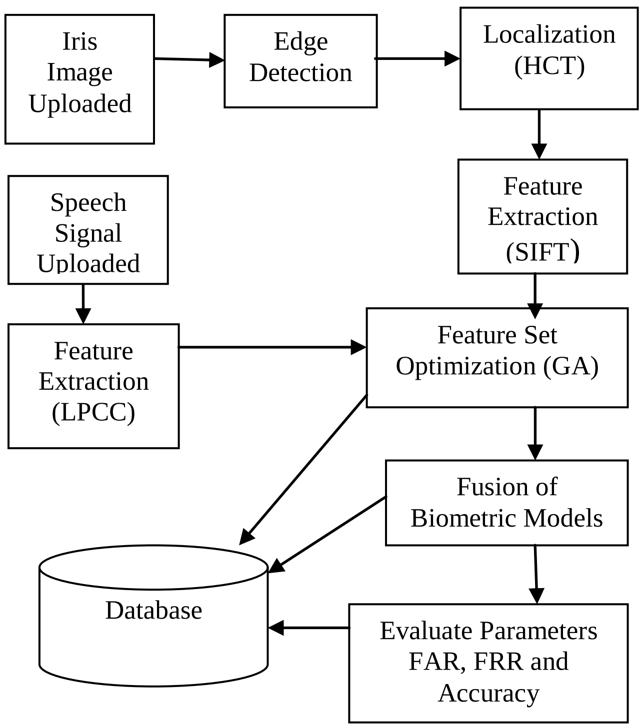

Fig. 1 Flowchart of Proposed work

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III.IMPLEMENTATION

A. Iris Image Upload

Iris images are taken from Iris Database. The proposed system is tested with 1 subject's samples (at a time 1 per each). With more modifications it can be used to test many users as per our requirements.

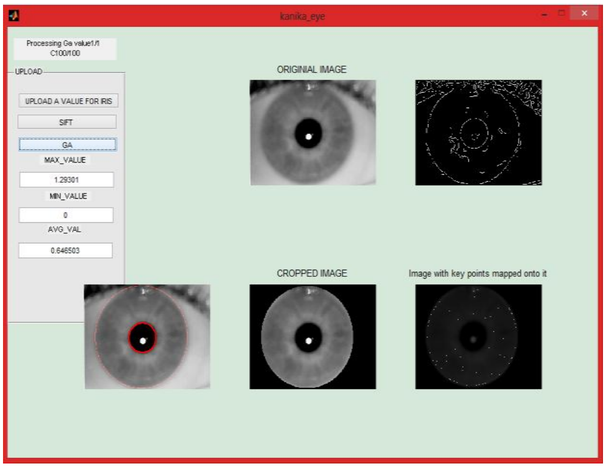

Fig. 2 uploading of iris signal

Figure 2 discusses about updation of iris image and edge detection. Iris normalization and key points are detected from the image.

B. Edge Detection

First of all, iris of image is to segment from eye region from image. Iris segmentation locates the iris boundary and pupil boundary, using canny edge detector and Circular Hough Transform. Initially, eye image is convolved with Gaussian filter to eliminate noise, then the gradient magnitude and the direction of the image is computed. The resultant image has some wide ridges. Non-maxima suppression approach removes the wide ridges by suppressing the edge points that do not constitute the local maxima. Finally hysteresis thresholding is applied, which make use of two thresholds to remove the false edge points. The above steps give the edge points of iris region. To detect the iris boundaries in the case of darker iris person, Circular Hough transform is applied, which takes each edge point as centre and draw circles of different radii. The circle through which large number of circle passes and its corresponding radius is chosen as iris boundary. The pixel values between the iris and pupil boundary gives the iris region.

C. Iris Normalization

Normalization overcomes the problem of iris stretching when the pupil changes in size. Normalization maps the pixels in circular iris region into rectangular form by choosing pupil centre as the reference point. Consider different radius between pupil and iris boundary. For each radius extract equal number of pixels in all directions (0-360) and then represent the pixels into a rectangular matrix.

D. Feature Extraction Using SIFT

The first step of key point detection involves identification of locations that can be assigned with a change in view as well as change in scale that is Scale-space local extreme detection. In such locations, which are invariant towards scale changes, are found by searching stable features across all the possible scales using scale space that is a continuous function of scale. Gaussian function is the only possible scale space function. Difference of Gaussian (DoG) function is convolved with the image to detect stable key-point locations. A point is decided as a local minimum or maximum when its value is smaller or larger than all its surrounding neighbouring points. This technique is scale invariant, hence is appropriate for annular iris images as the dimension of iris varies due to dilation and contraction of the pupil. Next step is Accurate Key-point Localization. To detect the importance points, DOG pictures are utilized also local maxima as well as local minima are computed across different scales. Each pixel of a DOG image is compared to 8 neighbours in the same scale and 9 neighbours in the neighbouring scales. After key point detection, the next step is performing the detailed fit to the adjoining data intended for location, the proportion of principal curve as well as the scale. The basic idea behind this is to reject all those keypoints which are low in contrast. These low contrast keypoints are not considered because as stated in, such key point are sensitive to noise or badly limited to a small area. Next is Orientation assignment. To attain invariance to picture rotations, an orientation is allocated towards each and every one of the key-point localities. The descriptor could possibly be represented comparative to this orientation. For determination of the key point orientation, a gradient orientation histogram is worked out in the neighbourhood of the key point. A Gaussian smoothed image is selected using the scale of a particular key-point and is calculated. This is followed by formation of the orientation histogram for gradient orientation around each of the particular key-points. The actual histogram encompasses 36 bins designed for 360 orientations and before adding it to the actual histogram, each and every example is weighted by means of gradient magnitude and Gaussian weighted circular frame, by means of σ of 1.5 times the scale of actual key-point. Peaks in histogram correspond to the orientations. Most important step is to find Key-point descriptor. In this stage, a particular descriptor is registered at every key-point. The picture gradient magnitudes and introductions, with respect to the significant introduction of the key point, are inspected inside a 16X16 locale around every key-point. These specimens are then amassed into orientation histograms summarizing the contents over 4X4 sub regions. Last step is trimming of false matches. The key-point matching procedure described may generate some erroneous coordinating focuses. We have evacuated spurious coordinating focuses using geometric limitations. We constrain ordinary geometric varieties to small rotations and displacements. Therefore, if we place two iris images side by side and draw matching lines true matches must appear as parallel lines with similar lengths.

E. Speech Signal Upload

To store the different types of speech signals there is need of device and then voice is stored as. Wav file. Two types of speech can be stored text dependent and text independent. A database of 3 speech signals is used, consisting of samples, to compare them.

F. Feature Extraction Using LPCC
Voice analysis is done after taking an input through microphone from a user. Speech is a complex signal. LPCC is quite good in feature extraction and also works well in noisy environment. So LPCC is used in this place as our signal is noisy.

G. Feature Set Optimization Using Genetic Algorithm (GA)
Genetic Algorithms are adaptive heuristic search algorithm based on the evolutionary ideas of normal range and inheritance. Firstly population set is created and then it follows main steps that our genes follow like selection of best, crossover of genes and mutation in genes.

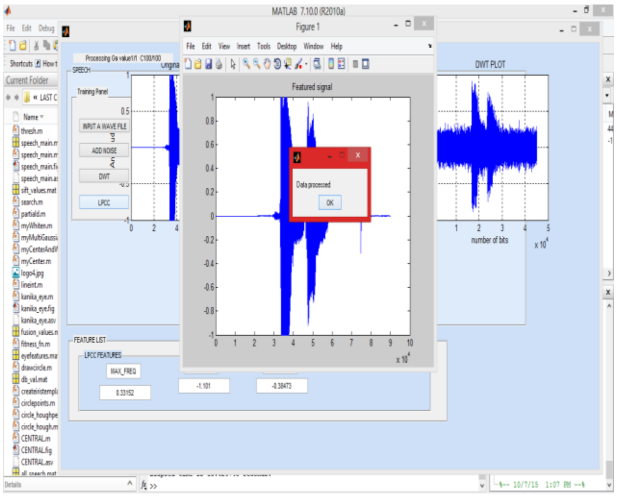

Fig. 3 Processing of Speech Signal

Figure 3 discusses about the processing of speech signal where noise is added to uploaded signal. Then DWT is taken and features are extracted from uploaded signal.

H. Fusion
Hamming Distance: Hamming distance is one of the metric for matching the fused biometric traits. It uses the mask of noise. It is calculated between two templates only for example 110011 and 111100. In hamming distance evaluation, “0” bits corresponds to noise in both patterns of iris. Formula: Given two vectors a, b∈Rn we define the hamming distance between a and b, Hd (a, b), to be the number of places where a and b differ. Thus the Hamming distance between two vectors is the number of bits we must change to change one into the other. For example, distance between the vector 110011 and 111100.

I. Evaluating Parameters
Template matching is the last process in the recognition of iris. This matching helps us to verify the authenticated person. The template matching compares the user template with the template from database using a matching metric. The matching metric compares similarity between two iris templates. Template matching can be classified into 2 cases according to the matching metric. They are: Intra-class comparison: When comparing templates are generated from the same iris.

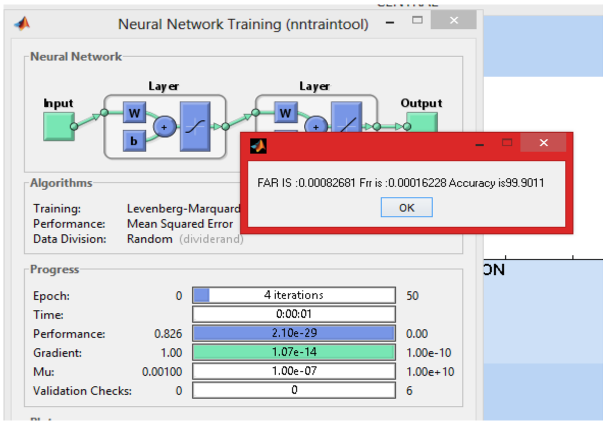

Fig. 4 Result and Evaluation

Figure 4 discusses about the fusion in neural network toolbox.

Inter-class comparison: When comparing templates are generated from different irises. The above two comparisons are then applied to the extracted features of the iris using Hamming distance. The bit obtained after the application decides the final output to be given. The bit 0 is obtained when intra-class comparison is performed and 1 bit is obtained when inter-class comparison is done. After fusing the features of both Iris and speech, the values can be stored in the database. For testing purpose, three modalities extract features & then fuse them by using this proposed technique and after fusing the value can be compared with the stored values in the database and give the results of Falsely Accepted Rate (FAR), Falsely Rejected Rate (FRR) and Accuracy. Falsely Accepted Rate (FAR) is defined as the number of samples that is wrongly accepted by it. These are those values that are not true but are accepted and evaluated. Falsely Rejected Rate (FRR) is defined as the number of samples that are true but are not accepted by it. These values are rejected and their values are not used for evaluation. Accuracy is defined as number of samples that are accepted by it correctly.

IV. RESULTS

In order to evaluate the performance of our algorithm, Falsely Accepted Rate (FAR), Falsely Rejected Rate (FRR) And Accuracy have been calculated using the following formulas:

TO CALCULATE FALSE ACCEPTED RATE (FAR):

FAR= Total No. of Samples−Number of Samples that falsely accepted Total Number of Samples

TO CALCULATE FALSE REJECTED RATE (FRR):

FRR= Total No. of Samples−Number of Samples that falsely rejected Total Number of Samples

TO CALCULATE ACCURACY:

Accuracy = 1-(FAR + FRR)*100

Falsely Accepted Rate (FAR) is defined as the number of samples that is wrongly accepted by it. These are those values that are not true but are accepted and evaluated. Falsely Rejected Rate (FRR) is defined as the number of

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samples that are true but are not accepted by it. These values are rejected and their values are not used for evaluation. Accuracy is defined as number of samples that are accepted by it correctly.
The algorithm is tested on several high resolution images containing iris and speech signals. The image of iris and speech signal taken in this dissertation had a Falsely Accepted Rate (FAR) value of 0.0010614, Falsely Rejected Rate (FRR) value of 0.00027944 and Accuracy of 99.8659. Table 5.1 shows the comparison between ICA, GFCC Based Method and proposed method.

Table I Comparison between ICA and GFCC Based Method and proposed method

Parameters	Using ICA and GFCC	Proposed Method
FAR	0.0080494	0.0010614
FRR	0.00018294	0.00027944
Accuracy	99.176	99.8659

V. CONCLUSION

The various fusion and matching levels are available in multimodal biometric systems, but feature level fusion is best suited in the multimodal system. In the proposed system a new technique is generated at feature level for feature extraction and fusion of iris and speech verification system to increase the accuracy of the authenticated systems. In this work, SIFT features are extracted for iris and LPCC features are extracted for speech. This proposed method decreases the FAR as well as FRR, and increases the system performance on the given data set. This system has been compared with the other bimodal system where score level fusion is done using the same modalities.
Future works could go in the direction of using more robust modelling techniques against forgeries and hybrid fusion level can be used. Multimodal modalities can be used together to make forgeries more difficult. Also, the system should be tested on a larger database to validate the robustness of the model like at airports where passports can be replaced by biometry.

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BIOGRAPHIES

Kanika Mehra was born on 23rd, April, 1990. She is graduated (B. Tech) from HPU, Shimla. She has successfully completed her Six Weeks Industrial training (June 2012) at **HCL, Mohali (Punjab), India**. She worked on GSM Based Wireless Controlled Robot. She is research scholar of Sri Sai University, Palampur (H.P.). Her field of interest is Digital Image Processing.

Parul Malhotra is graduated (B.Tech) from PTU, Jalandhar and postgraduate (M.Tech) from Kurukshetra University, Kurukshetra. Her employment experience is about 4 years. Her special fields of interest include Digital Signal Processing and Image Processing. She has successfully completed her Six Weeks Industrial training from (18 June 2007 to 30 July 2007) at **BSNL, Bhiuli, Mandi (Himachal Pradesh), India**. Also during her Six Month Industrial Project she worked on Fake Currency Detector from (1 July2008 to 31Dec 2008) at **Central Scientific Instruments Organization (CSIO), Sector-30C, Chandigarh-160030, India**. She has published six papers in International journals, International and National conferences. She is working as an Assistant Professor (Electronics & Communication Engineering Department), Sri Sai University, Palampur (Himachal Pradesh), INDIA.