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A Coupling of Voice and Iris Based Multimodal Biometric System for Person Authentication

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Abstract— Automatic human authentication by machine has been an active research area.This research work focus on development of Voice and Iris based Multimodal biometric system for human Authentication. The experimental work divided in three part, first and second part develop unimodel Voice and Iris biometric system and third experiment carried out for multimodal biometric fusion .we have achieve above form Multimodal biometric system results using KVKRG Voice and KVKR Iris database is FAR1.4% ,FRR 0.8%, Accuracy is 97.8%, ASV2015 voice and MMU Iris Database is FAR1.0% ,FRR 0.6%, Accuracy is 98.4% , Regional Voice Database and KVKR Iris database is FAR1.1% ,FRR 0.6%, Accuracy is 98.3%.

Keywords— Multimodel ,Voice ,Iris, MFCC, Fusion

I. INTRODUCTION

Automatic human authentication by machine has been an active research area for the past few years. The objective of human authentication system is to accept or reject the identity claim of a person using one or more physiological and behavioural characteristics associated with the person. Person authentication system makes use of one or more biometric system such as Voice, Face, Iris, Signature, and hand geometry to reject and accept the claim of individual person. Currently, biometrics system use in ATMs, computers, security installations, mobile phones, credit cards, health and social services, Government sector like ADHAR in India.Unimodal biometric system use single biometric feature [1]. It has some limitations that may have undesirable implications for the security of a system. While some of the limitations of biometrics can be overcome with the evolution of biometric technology through multimodal biometric system design. The research work focus on development of Voice and Iris based Multimodal biometric recognition system for human authentication based on Score level fusion .The purpose of such schemes is to ensure that the render services are accessed only by a legal user, and not anyone else. The significance of this research is, it focuses on the issue of selection of best feature extraction and classification techniques, by investigating different types of feature extraction techniques with different databases of given modality like voice and Iris [2].the organization of this paper first experiment carryout on voice biometric system development, and tested database and find accuracy results of Male and female sample. Then second part experiment carried out for Iris biometric development tested Male and Female sample of different database finding result accuracy. third experiment shows the fusion of Voice and Iris biometric results.

II. MULTIMODAL BIOMETRIC SYSTEM

Multimodal biometrics refers to the use of a combination of two or more biometric modalities in a verification system. Identification based on multiple biometrics represents an emerging trend. The most compelling reason to combine different modalities is to improve the recognition rate. This can be done when biometric features of different biometrics are statistically independent. There are other reasons to combine two or more biometrics. One is that different biometric modalities might be more appropriate for the different applications. Another reason is simply customer preference [3] Multimodal Biometric systems have following advantage over unimodal biometric systems.

- Systems are resistant to intra class similarity of data like facial fea3ture. They combine more than one modality causing reduced intra-class similarity.
- Noise resistance- Multimodal systems are more resistant to noise as compared to unimodal biometric systems, as they have more than one modality more data is available for matching.
- Less vulnerable to spoofing, as it is difficult to spoof more than one modality simultaneously.

III. MULTIMODAL BIOMETRIC FUSION

Sensor level Fusion: In sensor Fusion we combine the biometric traits coming from sensors like Thumbprint scanner, Video Camera, Iris Scanner etc, to form a composite biometric trait and process.

Feature Level Fusion In feature level fusion signal coming from different biometric channels are first pre-processed, and feature vectors are extracted separately, using specific fusion algorithm we combine these feature vectors to form a composite feature vector. This composite feature vector is then used for classification process.

Score Level Fusion : Here, rather than combining the feature vector, we process them separately and individual matching score is found, then depending on the accuracy of each biometric channel we can fuse the matching level to find composite matching score which will be used for classification.

Decision level Fusion: The final classification is based on the fusion of the outputs of the different modalities. Decision level fusion is used to improve the decision level accuracy. Decision level fusion takes single decision on the basis of two or more hypothesis. Decision level fusion can take decision with the help of "AND" and "OR" rule, majority voting etc.[4]

IV. METHODOLOGY

The following methodology use for development of multimodal biometric system shown in fig.1

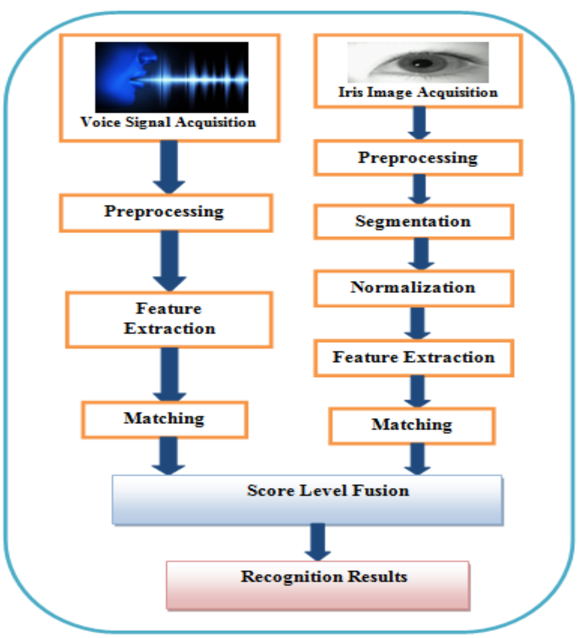


Fig.1. Block Diagram of Voice and Iris based Multimodal Biometric System

V EXPERIMENTAL WORK

Voice Biometric System: The development voice biometric system following method used and show the entire flow of development of voice biometric system. Voice biometric system is divided in two types Speaker verification and Speaker Identification, Speaker-verification systems authenticate that a person is who she or he claims to be. Speaker identification assigns an identity to the voice of an unknown speaker. There are different systems that use different methods to recognize a person's voice. Some of them are text dependent, while others are called text-independent. This experiment use text dependent speaker recognitions system.

This experiment we have tested three databases of Voice ASV spoof 2015 Voice Database, KVKRG Voice Database, and Regional Voice Database**.** All experiment carried out in MATLAB Environment.

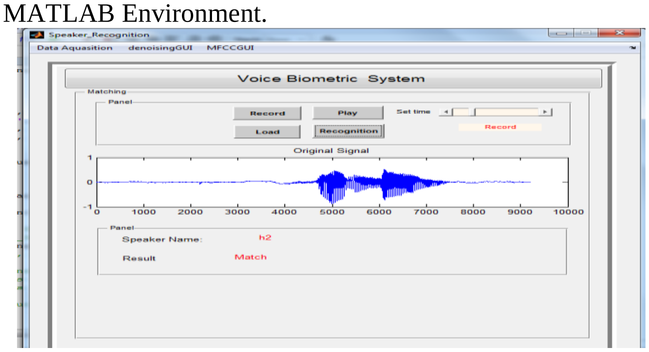


Fig.2. GUI of Voice Biometric System

Preprocessing: In pre-processing step use Wave Editor Tool for cropping a wave file from original file. After pre-processing data will be send for feature extraction.

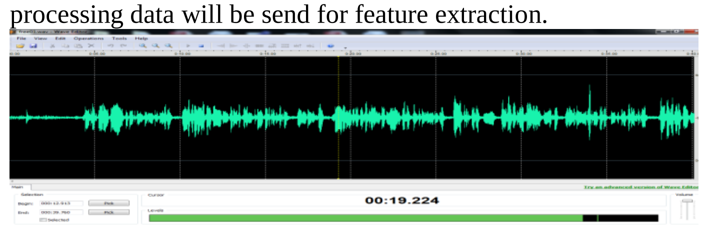


Fig3. Original sample file

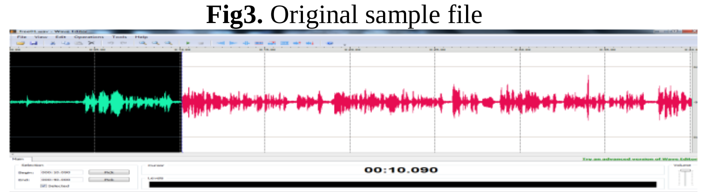


Fig.4. Crop sample file

MFCC Feature Extraction: objective of this section is to describe how we transform the input waveform into a sequence of acoustic feature vectors, each vector representing the information in a small time window of the signal. Now that we have a digitized, quantized representation of the waveform, we are ready to extract

MFCC features. The seven steps of this process are shown in Figure 5.and Fig.6.

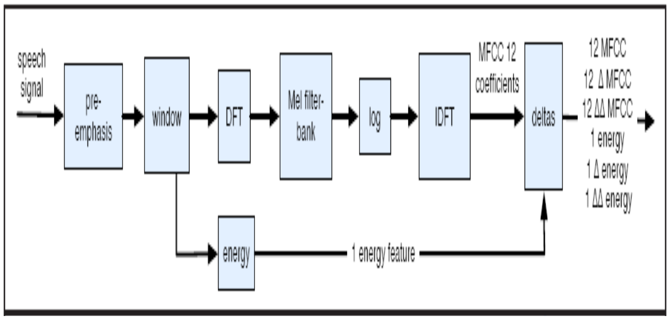


Fig.5. Extracting a sequence of 39-dimensional MFCC feature vectors from a quantized digitized waveform

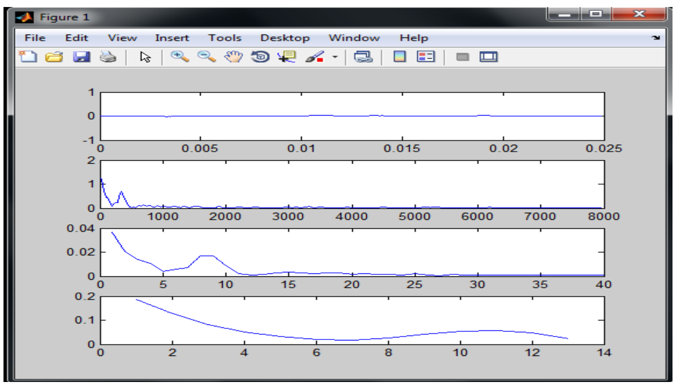
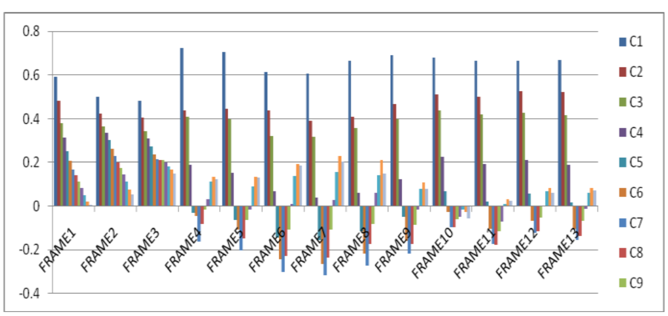


Fig.6 Voice sample MFCC Feature Extraction in MATLAB.

m001\s1.wav													
	FRAME1	FRAME2	FRAME3	FRAME4	FRAME5	FRAME6	FRAME7	FRAME8	FRAME9	FRAME10	FRAME11	FRAME12	FRAME13
C1	0.592702	0.500827	0.482317	0.722828	0.703514	0.612109	0.60522	0.66283	0.688497	0.680269	0.664679	0.665153	0.667616
C2	0.481276	0.42406	0.404341	0.439524	0.445934	0.437586	0.39067	0.40883	0.466305	0.511438	0.501032	0.527339	0.521269
C3	0.377814	0.363516	0.342549	0.406852	0.397054	0.319339	0.31661	0.35818	0.396507	0.436574	0.420017	0.425093	0.416937
C4	0.31164	0.334437	0.310038	0.189019	0.153172	0.066847	0.04047	0.06011	0.124997	0.226657	0.194418	0.212508	0.1876
C5	0.25304	0.303937	0.274206	-0.03224	-0.06159	-0.14267	-0.155	-0.11532	-0.04917	0.066887	0.021359	0.056052	0.015782
C6	0.205903	0.262352	0.235333	-0.04384	-0.10716	-0.2443	-0.2629	-0.21738	-0.15708	-0.02641	-0.1034	-0.06534	-0.10223
C7	0.167363	0.228179	0.215985	-0.16202	-0.20252	-0.30279	-0.3163	-0.27278	-0.21545	-0.09694	-0.17328	-0.12136	-0.15535
C8	0.14213	0.200874	0.211621	-0.07991	-0.14656	-0.22968	-0.2367	-0.17416	-0.17464	-0.09458	-0.17835	-0.11442	-0.13526
C9	0.112278	0.172823	0.211906	-0.01742	-0.0619	-0.1072	-0.1071	-0.08089	-0.08484	-0.06079	-0.11527	-0.05248	-0.06637
C10	0.082614	0.144047	0.199206	0.030346	-0.01617	0.011236	0.0296	0.06159	-0.01466	-0.04879	-0.07124	0.003809	-0.01092
C11	0.051744	0.111174	0.182399	0.111816	0.088659	0.137772	0.15611	0.14051	0.077724	-0.01517	0.008599	0.067914	0.059577
C12	0.020974	0.075892	0.168783	0.134985	0.133833	0.19424	0.2289	0.21045	0.10948	-0.02577	0.03042	0.084627	0.083742
	0.005402	0.05472	0.148552	0.124651	0.132151	0.185992	0.2022	0.14813	0.078996	-0.05668	0.024774	0.062025	0.072974

Table.1. MFCC Sample Feature Extraction Matrix

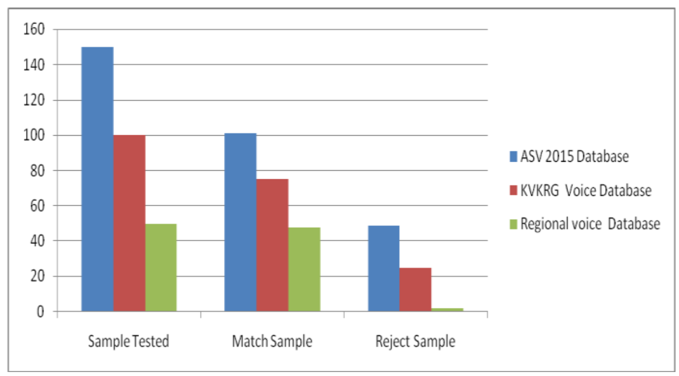


Graph.1.MFCC Sample Feature Extraction Matrix Graph

Results of Voice Biometric System: This experiment perform in two step ,first step for feature extraction MFCC technique use for matching process VQ use and finding the results accuracy of all three database.The database also include Male and Female voice sample.The overall system accuracy of all three databases is shown in below table.

Table 2. Overall Voice Biometric System Result of three databases

Sr.No.	Database	No of Sample Tested	Match Sample	Reject Sample	Recognition Rate
01	ASV 2015 Database	150	101	49	**67.33 %**
02	KVKRG Voice Database	100	75	25	**75 %**
03	Regional voice Database	50	48	02	**96 %**



Graph.2. Overall Voice Biometric System Result of three databases

Iris Biometric: Iris biometric experiment carried out in following steps.

Image Acquisition: In the first step image acquisition is taken from the available database. The Iris recognition system is evaluated using two different data bases of iris images i.e. MMU Iris database and KVKR Iris database.

Pre-processing: The preprocessing module first transforms the true color (RGB) into intensity image. Preprocessing removes the effect of spots/holes lying on the papillary area. The detection of pupil fails whenever there is a spot on the pupil area. The processing is composed of two steps Iris Localization and Edge Detection.

Localization: In this stage, we should determine an iris part of the image by localizing the position of the image derived from inside the limbos (outer boundary) and outside the pupil (inner boundary), and finally convert the iris part into a suitable representation. An integro-differential operator for detecting the iris boundary by searching the parameter space.

Daugman's Integro-differential Operator: Modification to the Integro-differential operator is proposed to ignore all circles if any pixel on this circle has a value higher than a certain threshold. The sequence of the Algorithm procedure is cleared in the following steps: Optimized Daugman's localization algorithm operation for iris recognition algorithm removes pixel having less number of counts than threshold [5].

Step1: Determine the connected component of binary image

Step2: Computing area of each component of binary image

Iris Normalization: Mapping the extracted iris region into polar coordinate system. The coordinate system is changed by un wrapping the iris from Cartesian coordinate their polar equivalent. The annular ring is transformed to rectangular ring. After extracting pupil achieve circular iris, which is to be converted to rectangular form. The normalization process will produce iris regions, which have the same constant dimensions, so that two photographs of the same iris under different conditions will have characteristic features at the same spatial location. The eye is transformed from rectangular into polar coordinate system so as to facilitate the following feature extraction module [6].

Cartesian and polar coordinate: The coordinates of a point can be given in two ways: using the Cartesian Coordinate System (CCS) or using the polar coordinate system (PCS).

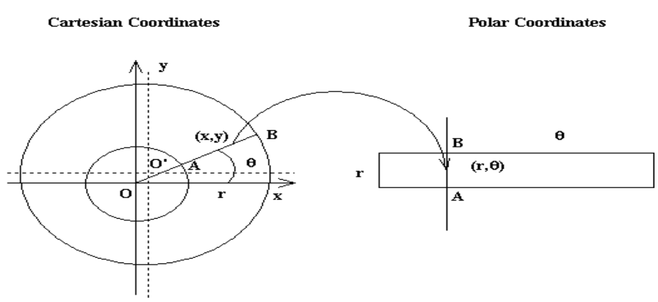


Fig: 7. Cartesian coordinate to polar coordinate

Fig: 8.Normalizing Image

Edge Detection: It is used to find complex object boundaries by marking potential edge points corresponding to places in an image where rapid change in brightness occurs. After edge points have been marked, they can be merged to form lines.

MMU Iris Database:MMU Iris database consist of 450 iris images from 45 people capture with most 43 common iris camera LG Iris Access 2200.Left and right eyes are captured five times each that makes a total of 90 classes. Each image has 320*240 pixels resolution in gray scale.

KVKR-Iris Database: KVKR-Iris database consist of 100x10= 1000 images of 8 bit gray Level JPEG images of left and right eyes. The iris are having different variance illumination And challenging conditions. Following figure shows some images from MMU Iris database and some images from KVKR Iris database of Iris biometric [7].

Iris Feature Extraction Using Gaussian filters (Method-I)

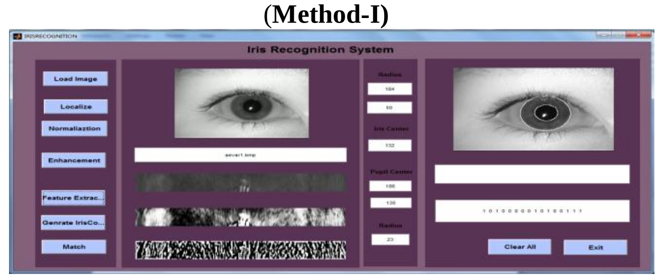


Fig 9. Iris Feature Extraction Using Gaussian filters

Iris Feature Extraction by using Gabor wavelet (Method: II)

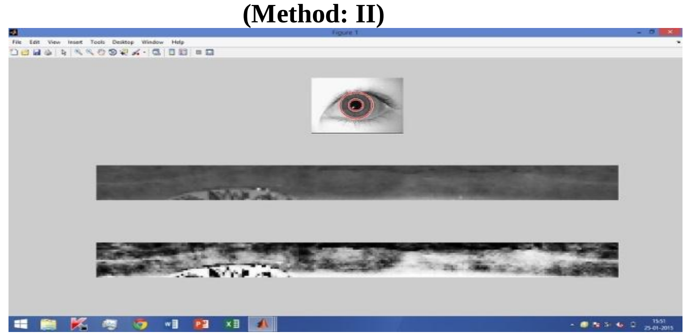


Figure 10. Iris feature extraction technique by using Gabor wavelet

Table.3 Iris Biometric Result

Sr.No.	Database	Method	FAR (%)	FRR (%)	Accuracy (%)
1	KVKR Iris Database	Feature extraction by using Gabor Wavelet and matching by using Hamming distance	2.0	1.7	96.3
2	MMU Database	Feature extraction by using Gabor Wavelet and matching by using Hamming distance	1.6	1.0	97.4

Multimodal Biometric Fusion:

Score Normalization: This step brings both matching scores between 0 and 1.The normalization of both the scores are made by [8]

Nvoice= Msvoice-minvoice/ max voice- minvoice ------ (1)

Niris = Msiris-miniris/ maxiris-miniris---- (2)

Where minvoice and maxvoice are the minimum and maximum scores for voice recognition and miniris and maxiris are the corresponding values obtained from Iris trait.

Fusion: The two normalized similarity scores Nvoice and Niris are fused linearly using sum rule as follows

$$MS = \alpha * N\ Voice + \beta * N\ Iris \quad (3)$$

Where α and β are two weight values that can be determined using some function. The value of weight is assigned linearly if the value of matching score is less than the threshold; otherwise exponential weight age is given to the score [9]. The value of MS is used as the matching score. so if MS is found to be more than the given threshold value is accepted otherwise it is rejected [10].

Table.4.Multimodal Biometric Fusion Results

Trait & Database	Method	FAR (%)	FRR (%)	Accuracy (%)
KVKRG Voice Database+ KVKR Iris Database	For Voice (MFCC+VQ) and for Iris (Gabor Wavelet and matching using Hamming distance)	1.4%	0.8 %	97.8%
ASV 2015 Voice Database+ MMU Iris Database	For Voice (MFCC+VQ) and for Iris (Gabor Wavelet and matching using Hamming distance)	1.0%	0.6 %	98.4%
Regional Voice Database + KVKR Iris Database	For Voice (MFCC+VQ) and for Iris (Gabor Wavelet and matching using Hamming distance)	1.1 %	0.6 %	98.3%

VI. CONCLUSION

This research work focus on development of Voice and Iris based Multimodal biometric system for human Authentication. First experiment conduct for development of Voice Biometric System, Voice biometric speaker recognitions experiment tested three databases like, ASV2015 voice Database, KVKRG Voice Database, Regional Voice Database using MFCC feature extraction technique and Vector Quantization is use for matching. The average recognitions rate of three databases Male and Female sample is 79.44%.The second Experiment conducted for development of Iris Biometric System, Iris biometric recognitions experiment tested two databases like KVKR Iris Database and MMU Iris Database, Feature Extraction Using Gabour Wavelet technique and Hamming distance for matching and find FAR 2.0 % ,FRR 1.7 % ,and recognition Accuracy of KVKR Iris Database is 96.03% ,for MMU Database FAR 1.6% ,FRR 1.0 % ,Recognitions Accuracy 97.04%.Score level fusion results obtain form KVKRG Voice and KVKR Iris database is FAR1.4% ,FRR 0.8%, Accuracy is 97.8%, ASV2015 voice and MMU Iris Database is FAR1.0% ,FRR 0.6%, Accuracy is 98.4% , Regional Voice Database and KVKR Iris database is FAR1.1% ,FRR 0.6%, Accuracy is 98.3%.

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