Fusion Speech and Face Biometrics Using Enhanced Version of Genetic Algorithm

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Abstract— *The physiological biometrics like face is combined with behavioral biometrics like speech to achieve the robustness of fusion process of a multimodal system. The selection of the biometrics is dependent on the robustness and uniqueness of the biometric. That is why, the selection of these two biometrics is done in this work. Mel Frequency Cepstral Coefficients has been utilized for speech feature extraction and in addition to this fuzzy logic is also utilized for training purpose. Then, the optimized features values are reduced using genetic algorithm. In the end, fusion is achieved by combination of fuse values obtained from both 2 biometrics. The whole simulation is tested in MATLAB environment.*

Keywords— Biometric, MFCC,GA, Fuzzy Logic.

I. INTRODUCTION

Most of the existing biometric systems developed were based on single biometric features (fingerprint, ear, face, iris and so on). Each biometric trait has its own strength and weakness. Multimodal biometric system can be constructed using more than one physiological or behavioral characteristic for identification and verification purposes. These types of systems are developed for security purposes in various fields like crime investigation, e-commerce and military purposes. Multimodal biometric system developed using fingerprint, hand geometry, they required the concerned human to make physical contact with a sensing devices. Most of the biometric systems will serve one of the two basic purposes: *authentication/ verification* or *identification*. *Authentication* (or *verification*) is the process of positively identifying the user. *Identification*, on the other hand, is the process of distinguishing an individual from a larger set of individual records by comparing the presented biometric data with all entries in the system database. This is also referred to as *one-to-many* match and therefore, it is a much more time consuming operation than authentication, as it requires a large number of comparisons. Biometric identification and biometrics, refers to the process of identifying an individual based on his or her distinguishing individuality. It comprises method for uniquely recognizing humans based on one or more intrinsic physical or behavioral traits.

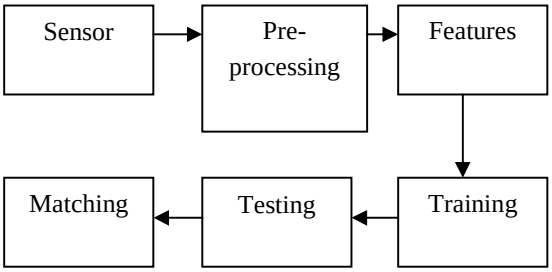

Fig.1: Biometric Procedure

Speech Acknowledgement System aids the technique to bring computers and human being's much closer than before.The improvement of programmed visual reconnaissance framework is a famous exploration point in PC vision. For observation as well as be utilized to plan frameworks for computerized finance, visual sensors, machine learning and so on.

Though biometric systems have been successfully deployed in a number of real-world apps, biometrics is not so far an entirely resolved problem. In other words, the challenge is to develop a biometric system that is highly exact as well as also secure, appropriate to utilize plus straightforwardly scalable towards a large population.

II. PROPOSED ALGORITHMS

2.1 MFCC(Mel Frequency Cepstral Coefficients)

The most popular spectral based parameter used in recognition approach is the Mel Frequency Cepstral Coefficients called MFCC. All extracted MFCC samples are then statistically analyzed for principal components, at least two dimensions minimally required in further recognition performance evaluation. Following are the stages in MFCC :

- Preemphasis
- Windowing
- Filter Bank processing
- Log Energy computation

- MFCC

Diagrammatically, the process is shown below:

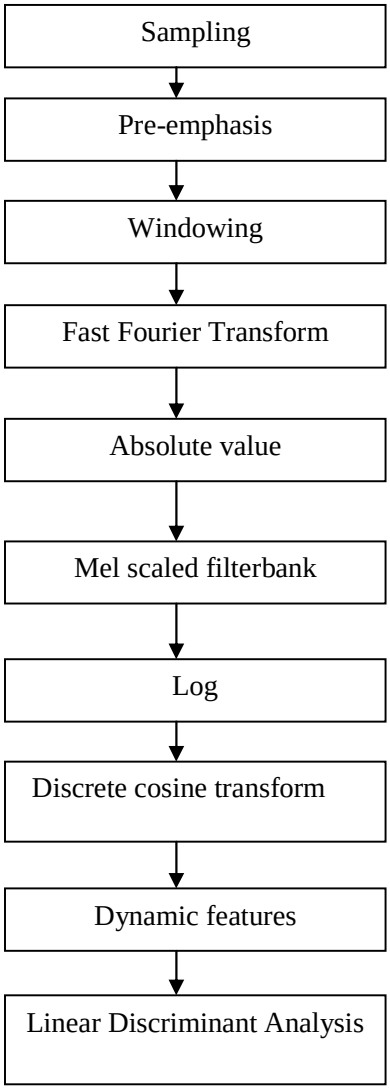

Fig.2: MFCC process

2.2 Genetic Algorithm

The Genetic algorithm is an optimization process based on law of evolution and it has three operations basically i.e. Selection, Genetic Operation, and Replacement [15]. A typical GA cycle is shown in Fig.2.The population consists of chromosomes. Each chromosome is selected from a population using fitness function.

Steps of Genetic Algorithm

Step1: Initialize random population consists of chromosomes.

Step 2: Compute fitness function in the population.

Step3: Develop new population consists of individuals.

Step4: Selection of parent chromosomes to get best fitness function.

Step5: Perform crossover to get copy of parents.

Step6: Perform mutation to mutate new off springs.

Step7: Place new offspring into the population.

Step8: Repeat steps to get a satisfied solution.

Step 9: Stop

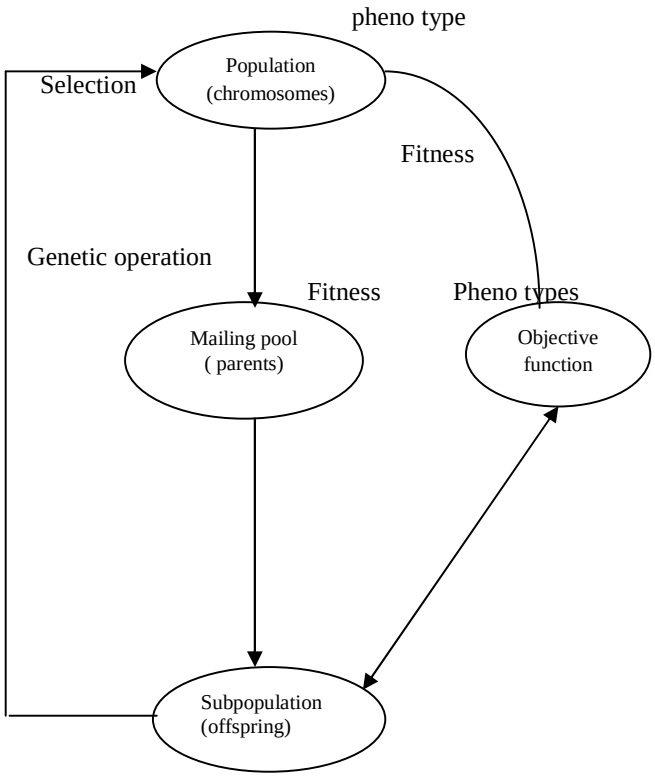

Fig.3: Basic GA procedure

2.3 Fuzzy Logic

Fuzzy logic is the difficult mathematical model for understanding and it gives the uncertainty in reasoning [21].Fuzzy logic is tolerant of imprecise data. Everything is imprecise if you look closely enough, but more than that, most things are imprecise even on careful inspection. Fuzzy reasoning builds this understanding into the process rather than tacking it onto the end [47]. Fuzzy logic is based on natural language. The basis for fuzzy logic is the basis for human communication.

The main feature of fuzzy logic are as follows:

- It contains matter of degree.
- Fuzzy logic is flexible
- Any system can be fuzzified.
- Information is decomposed into collection of variables.

There are five attributes associated with fuzzy expert systems:

1) Input variables,
2) Output variables,
3) Subsets of the inputs and the outputs and the membership functions corresponding to the various subsets leading to fuzzy set
4) Rules connecting the input fuzzy subsets and the output fuzzy subset
5) Procedure (or methodology) for de-fuzzification of the Output.

III. RELATED WORK

Mohamed et al explained fingerprint features such as singular points, positions and direction of core and delta obtained from a binarised fingerprint image. The method is producing good classification results. Z. Maruis et al proposed Linear Predictive Coding (LPC), powerful speech analysis technique which is very useful for encoding speech at a low bit rate and provides extremely accurate estimates of speech parameters. Jinwei Gu presented a method for fingerprint verification which includes both minutiae and model based orientation field is used. It gives robust discriminatory information other than minutiae points. Ching-Tang Hsieh et al developed anoid method for Fingerprint recognition. Ridge bifurcations are used as minutiae and ridge bifurcation algorithm with excluding the noise–like points are proposed. Experimental results show the humanoid fingerprint recognition is robust, reliable and rapid. Raju Sonavane et al presented a method by introducing a special domain fingerprint enhancement method which decomposes the fingerprint image into a set of filtered images then orientation field is estimated. Duoqian Maio et al explained algorithm by kegl to obtain principal curves for auto fingerprint identification system. From principal curves, minutiae extraction algorithm is used to extract the minutiae of the fingerprint. The experimental results shows curves obtained from graph algorithm are smoother than the thinning algorithm.

IV. SIMULATION MODEL

A feature extraction method for speech and face based on minutia and MFCC is proposed with feature reduction method for speech and face based on GA. Fuzzy logic is used for determining the influential or associational relationships among the matching templates by giving them scores considering their effect on defect proneness. In the proposed system, the main goal is to evaluate the performance of the behavioral multimodal biometric system based on user dependent fusion approach.

- In the enrolment phase, speech data and face are acquired first and then processed according to the training and classification algorithms.
- In speaker recognition, feature vector of the speech data is derived from spectral and MFCC coefficients. The feature vector is the voice template in the knowledgebase.
- In face recognition the feature vector is combination of static and dynamic features which has been extracted by minutia.
- Feature reduction will be done using GA.
- The feature vector thus obtained is the face and speech template in the knowledgebase. In the identification phase, the matching score of the test template and the training templates are derived using fuzzy logic.

4.1 Simulation results

1. The main GUI has training, fusion and testing panel. Firstly we train the samples then have tested many samples for matching.

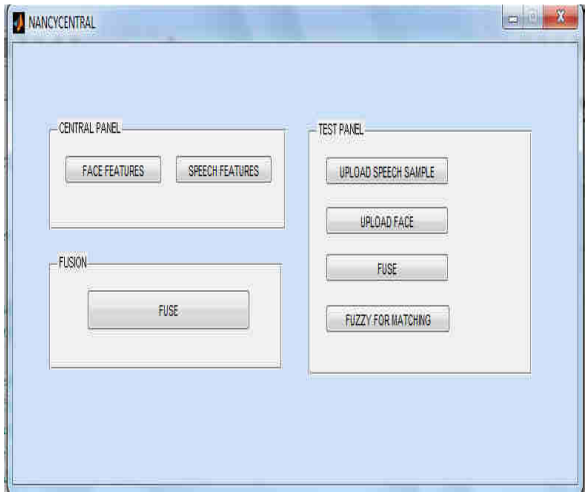

Fig.4: Main GUI

2. The speech training GUI include the sample uploading option after which MFCC algorithm is applied to extract features which are further optimized by GA.

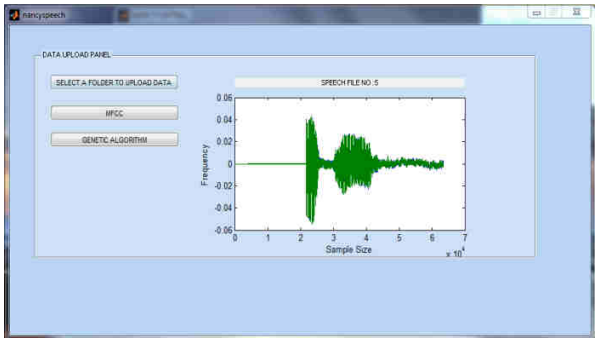

Fig.5: Speech GUI panel

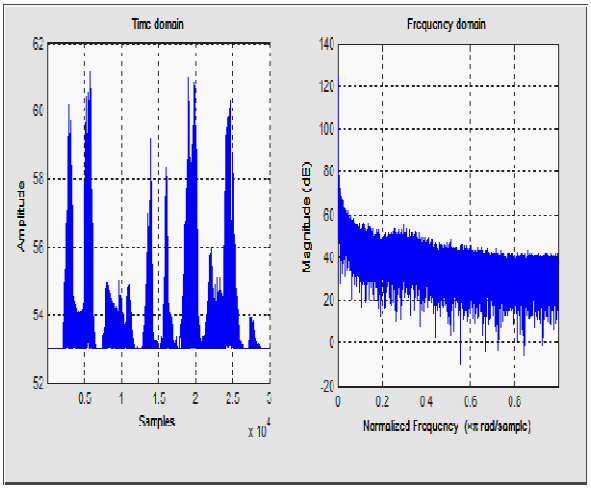

Fig.6: Mel Frequency Cepstrum Coefficient

The above figure shows the MFCC feature extraction process which converts the time domain signal to frequency domain using Fast Fourier Transform.

GA feature reduction is done after MFCC feature extraction.

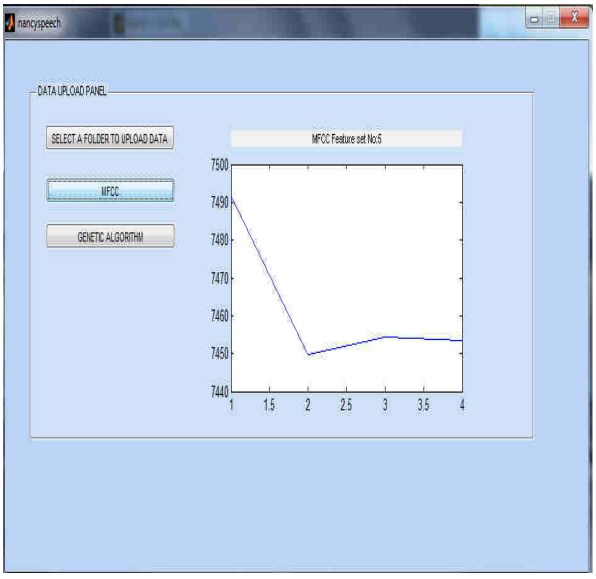

Fig.7: GA utilization

3. The face GUI shows the upload, minutia feature extraction and GA for feature reduction.

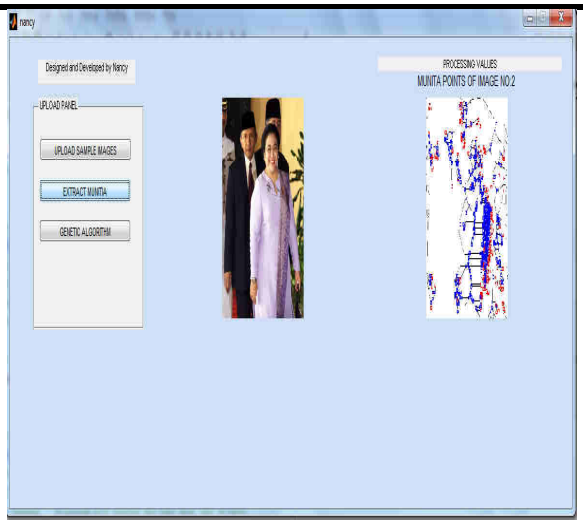

Fig.8: Face GUI panel

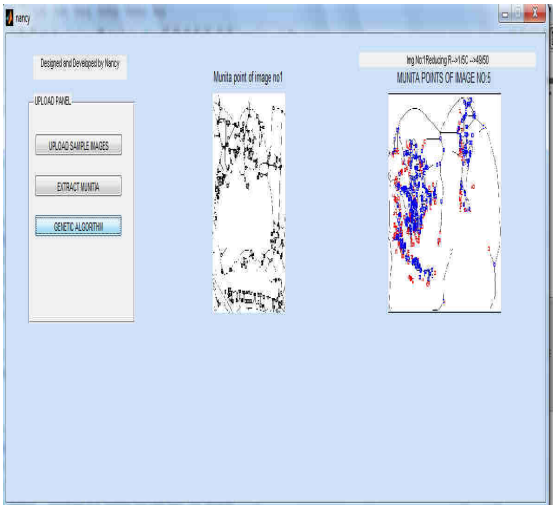

Fig.9: Feature extraction

The above figure will be obtained after applying Minutia feature extraction and then the mentioned message box is appeared that the feature extraction is done for the particular uploaded image then move to GA.

1. In the final step fusion of both the extracted features is done and results are saved in the database for testing.

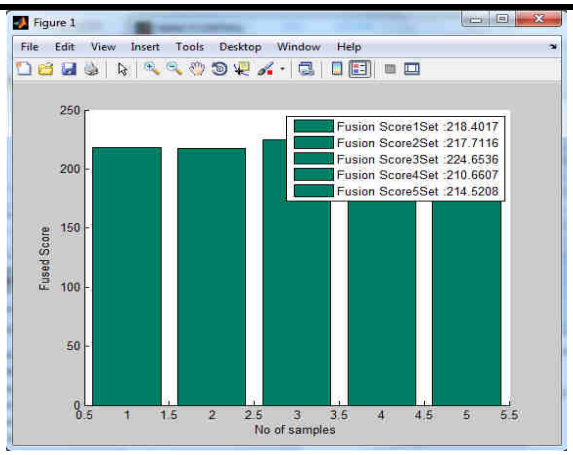

Fig.10: Fusion Graph

The above figure shows the graph of fusion of speech and face with respect to the number of identities.

V. CONCLUSION

In this research, two basic biometric characteristics, face and speech are proposed. The reasons for selecting these two traits are that face is unique and very discriminative and speech is acceptable personally, socially and legally as an identification procedure.

A multimodal biometric technique, which integrates multiple biometrics in making a personal identification, can be utilized to solve the limitations of the single biometric modality. In this work, a multimodal biometric system combining face and speech was developed using MFCC and minutia extraction feature extraction method. GA was used to optimize MFCC result. The results show that the proposed biometric system leads to better security than the existing unimodal biometric identification systems.

REFERENCES

[1] A. K. Sara, N. S. Ahmed, (2013) "Biometric Detection and steganography", International Journal of Computer Networks and Communications Security, Vol. no.1, Issue no.5, pp: 180-188.

[2] Alessandra Lumini, and Loris Nann, “Advanced Methods for Two-Class Pattern Recognition ProblemFormulation for Minutiae-Based Fingerprint Verification”, the Journal of the Pattern Recognition Letters, vol. 29, pp. 142-148, (2008).

[3] B. G. Iwasokun, C. O. Akinyokun, O. C. Angaye, (2013) “Fingerprint Matching using Neighborhood Distinctiveness”, International Journal of Computer Applications , Vol. no.66, Issue no.21, pp: 1-8.

[4] Bhupesh Gour, T. K. Bandopadhyaya and Sudhir Sharma, “Fingerprint Feature Extraction using Midpoint Ridge Contour Method and Neural Network”, International Journal of Computer Science and Network Security, vol. 8, no, 7, pp. 99-109, (2008).

[5] Ching-Tang Hsieh and Chia-Shing –u, “Humanoid Fingerprint Recognition Based on Fuzzy Neural Network”, International Conference on Circuit, Systems, Signal and Telecommunications, pp. 85-90, (2007).

[6] D. Nidhi , D. Kinnal, D. Vijayendra, (2013) “Feature Extraction and Classification Techniques for Speech Recognition: A Review”, International Journal of Emerging Technology and Advanced Engineering, Vol. no.3, Issue no.12, pp: 367-371.

[7] D. Urun, G. Tobias, I. Christian, (2011) “Fast Training of Multi-class Support Vector Machines”, FACULTY OF SCIENCE, UNIVERSITY OF COPENHAGEN, Technical Report no. 03.

[8] Duresuoquian Miao, Qingshi Tang, and Wenjie Fu, “Fingerprint Minutiae Extraction Based on Principal Cures”, the Journal of the Pattern Recognition Letters, vol. 28, pp. 2184-2189, (2007).

[9] E. Youssef, E. Zakaria, A. Reda, (2014) “Score Level Fusion Based Multimodal Biometric Identification (Fingerprint & Voice).” IEEE Systems Journal, Vol. no.3, Issue no.4, pp: 146-150.

[10] Eric P. Kukula, Christine R. Blomeke, Shimon K. Modi, and Tephen J. Elliott, “Effect of Human Interaction on Fingerprint Matching Performance, Image Quality, and Minutiae Count”, International Conference on Information Technology and Applications, pp. 771-776, (2008).

[11] F. I. Mycel, B. Josef, (2007) "Synergy of lip-motion and acoustic features in biometric speech and speaker recognition." Computers, IEEE Transactions on computers, Vol. no.56, Issue no.9, pp: 1169-1175.

[12] G. Christos, P. Stavros, P. Maja, (2014) "Visual-only discrimination between native and non-native speech.", IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp: 4828-4832..

[13] G. Hitesh , W. S. Deepinder, (2014) “Speech Feature Extraction and Recognition Using Genetic Algorithm”, International Journal of Emerging Technology and Advanced Engineering, Vol. no.4, Issue no.1, pp: 363-369.

[14] G. R. Moheb, M. M. Tarek, H. A. Tarek, (2007) "An Approach to Image Extraction and Accurate Skin Detection from Web Pages.", International Journal of Computer, Control, Quantum and Information Engineering, Vol. no.1, Issue no.3, pp: 678-686.

[15] G. Vipul, K. Harsh, S. Rohit, (2013) "Speech Based Emotion Recognition Based on Hierarchical Decision Tree with SVM, BLG and SVR Classifiers", IEEE National Conference on Communications (NCC), pp: 1-5.

[16] G.Sambasiva Rao, C. NagaRaju, L. S. S. Reddy and E. V. Prasad, "A Novel Fingerprints Identification System Based on the Edge Detection", International Journal of Computer Science and Network Security, vol. 8, pp. 394-397, (2008).

[17] G.Sambasiva Rao, C. NagaRaju, L. S. S. Reddy and E. V. Prasad, "A Novel Fingerprints Identification System Based on the Edge Detection", International Journal of Computer Science and Network Security, vol. 8, pp. 394-397, (2008).

[18] Georghiades, A.S., Belhumeur, P.N., & Kriegman, D. (2001). From few to many: Illumination cone models for face recognition under variable lighting and pose. IEEE Transactions on Pattern Analysis and Machine Intelligence, 23, 643-660

[19] Gonzalez, Rafael C, (2009) " Digital image processing. Pearson Education India".

[20] H. Chengwei, L. Ruiyu, W. Qingyun, X. Ji, Z. Cheng, Z. Li, (2013) "Practical Speech Emotion Recognition Based on Online Learning: From Acted Data to Elicited Data", Hindawi: Mathematical Problems in Engineering, Vol. 2013, Article ID. 265819, pp: 1-9.