IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-6, June 2019 E-ISSN: 2347-2693

Enhance the classification and Score level Fusion Multi-model Biometric System Based on Fingerprint and Speech Recognition

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DOI: https://doi.org/10.26438/ijcse/v7i6.956962 | Available online at: www.ijcseonline.org

Accepted: 10/Jun/2019, Published: 30/Jun/2019

***Abstract*—** Biometric is the technique for the recognition of the physiological and biological features which are the face, iris, and fingerprint and pattern analysis. Biometric is the method of identifying the biometric features. Some issues in the uni-modal biometric scheme that reduced performance and accuracy. To overcome the effect in the uni-modal biometric, biometric fusion can be used through a multimodal biometric system. Biometric fusion is a method of using multiple biometric information and steps for the processing of the information to improve the biometric system. Multi-model biometric systems meet various security issues and sometimes un-acceptance false rejection errors, false rejection rate, and error rates. Some of these problems can be reduced by setting up multi-model biometric systems. It supports joining twice biometric traits in a verification system to enhance the accuracy rate and Specificity. However, features of different biometrics have to be independent. In this research work, proposes a multi-modal biometric recognized using fingerprint and speech recognition. In the proposed approach, a Novel, user authentication system, based on a combined acquisition of Fingerprint and Speech with high accuracy rate, Precision, false acceptance rate, and false rejection rate. In fingerprint using Minutiae method and Speech using MFCC method used for feature extraction method. In this research work, develop a project application in MATLAB 2016a simulation tool and has developed a score level fusion of various or multiple biometrics help to reduce the system error rates.

***Keywords*—** Score Level Fusion, Multi-model Biometric System, Minutiae, and MFCC feature Extraction.

I. INTRODUCTION

Biometric is the method of the specific structure of the physiological or conduct trait of the individual for the recognition and verification [1]. With the advancement of the biometric technology, there has been an increase in the machine devices, smart devices that are predominant due to the increase in the service station for better authentication (Passwords) [2][3]. Biometric authentication system presents an application for the verification of the passwords. Some features of an individual can be recognized like as fingerprint, iris, pattern analysis, face, voice, and so forth. Biometric system is determined through the various component, which are sensor component, extracted element, template dataset, and matching component. Sensor component handles the work of the biometric picture [4]. Also, in the extracted, a group of the native and global characteristics is removed from the observed biometric picture [5] [6]. Along with that, structural characteristics demonstration is located in be reduced template data set as template information [7]. In a matching component, linking of the queries and template information required for matching and non-matching data. Biometric system has been organized in various applications areas, which are finance or commercial, private citizen, medical forensic, and so forth [8] [9]. Multiple biometric systems acquired in multimodal biometric acquired with components of fusion [10] [11]. Biometric scheme emphasis on the scanning of the finger may recognize through the thin portion of the fingerprint. Biometric symptoms can be used for the verification of the passcodes and to recognition the authentication of person [12]. In biometric fusion, different stages of the fusion are categorized into two types, which are: - Fusion pre-matching and fusion post- matching [13]. The arrangement of the biometric is based on the matching of the data and quantity of the information may be decreased. Pre-matching fusion is the fusion at the device and extraction of characteristic levels and matching score and decision level at post-processing. The fusion method mainly based on the fusion approach that is required for the detection scheme [14] [15]. The quantity of the data in the detection scheme may be compacted from the device method to decision method, as shown in fig 1. In the next procedure of the feature group, matched scoring may be invariant matched that consist of the highest data of the internal pattern or design and combing the scoring levels. So,

a fusion of the matched scoring level is the most appropriate approach multimodal biometric system [9].

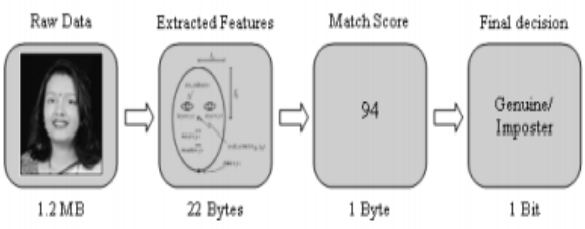


Figure 1. Quantity of the data in the biometric fusion system [9]

In existing approach, was implemented a fusion method of the integrated signal and electronic signal by using different classifiers such as k- nearest neighbor, linear discriminant analysis and error correct code support vector machine utilizing wavelet domain numerical featured data. Also, multiple wavelet data is acquired for segmentation of the integrated and electronic signal. The integrated and automated signal was fused with a future phase, whereas classification was done at the decision phase. Experimental approach on the recognition of individual utilizing fused features (integrated and electronic signal) with fused classification. The fuse characteristics like as fused signal vector from the classification of the integrated and electronic signal present high F-SCORE 91%, and that is linked to unique features of signal with unique classifier with 55% with integrated and 75% in electronic signal.

In the proposed approach, Novel user authentication system based on a combined acquisition of Fingerprint and Speech with high accuracy rate, Precision, false acceptance rat, and false rejection rate. In fingerprint using Minutiae method and Speech using MFCC method used for feature extraction method. Score level fusion using to fuse the multi-model biometric system. Improve the accuracy rate; reduce the mean square error rate.

Sections are described as follows:- Section 1 explained an overview of the biometric system. Section 2 described the literature survey about the multi-model biometric systems. Section 3 described about the proposed work and flow chart and section 4 described about the result description and comparison between proposed and existing work. Conclusion and future scope described about the multi model biometric fusion system.

II. RELATED WORK

Bashar, K et al., 2018[16] proposed a research on the recognition of the fusion of the integrated brain and heart digital signal using various classifiers utilising discrete wavelet feature. In addition, multiple data packet is acquired through signal component. Then, computation of the featured vectors are converted utilizing numerical data descriptor which is wavelet data. The integrated digital signal and electronic signal are fused through features component whereas the classification was done decision approach.
Along with that, fused characteristics were vectors of the integrated and electronic signal. The fused classification was with high rate of the F-score up to 91%. Comparison analysis was done along with unique characteristics in integrated and electronic signal among unique classification up to 75%.

Dehzangi O and Williams C et al., 2015 [17] proposed a research on the designing of the next level multimodal controller observing scheme in running scheme. The main goal of this research was that operating the controller system for acquiring security of the stage. They developed the reliable controller that contains automated device that arrest the actual data of the vehicular data and also different devices that link controlled biometrics (integrated signal and electronic signal). In this research, investigate the factor of the controller disturbance of controlled observing stage. They studied two perceptions of controllers using controlled investigating stage. Experimental analysis on the basis of the groups of the theta and beta in controlled road factors. Experimental analysis the extraction of features of brains with time range that emphasis on numerical features of the biometric system for initial recognition.

Evangelin L. N and Fred, A. L et al., 2017[18] proposed a research on the initial stage that are acquired for the designing of the best method for biometric verification detection related to finger impression, palm, face and knuckle impression. At initial stage, pre-processing was related data of the required processed data. In pre-processed method there was conversion from gray scale picture, then histogram data, and improvement of the picture value. In this research, the quality of the picture can be improved using extracted feature method.

Shunmugam, S and Selvakumar, R. K et al., 2014 [19] studied the behaviour of the biometric verification on the basis of the authenticated e- transaction such as ATM , online digital data , debiting and crediting functions in card. This research determines the unique biometric authenticated have the issues because of distorted information, class resemblance, spoofing threats and non-uniform data. In this research, detailed study of the unique modal biometrics along with the level of the fusion levels in multimodal technique.

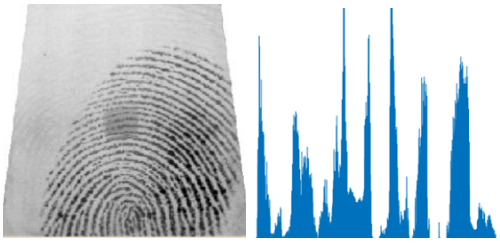
III. METHODOLOGY

In the proposed system, the main goal is to evaluate the performance of the behavioural multimodal biometric system based on user dependent weighted fusion approach.

- In the enrolment phase, fingerprint data and speech are acquired first and then processed according to the training and feature extraction algorithms.

- In fingerprint recognition, feature vector of the iris data is derived from Minutiae features and optimization technique used. The feature vector is the voice template in the knowledgebase.
- In Speech recognition the feature component is combinations of static and dynamic structures which has been removed by feature and reduce the data through Genetic algorithm.
- The feature vector thus obtained is the fingerprint template in the knowledgebase. In the identification phase, the matching score of the test template and the training templates are derived. Classify both biometric model.

Step 1:- Image Acquisition (Fingerprint and Speech)

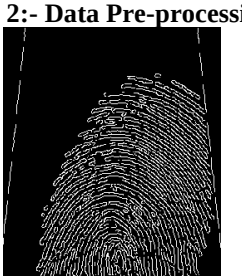


(i) **(ii)**

Figure 2(i) Fingerprint and Speech Samples

Fig 2(i) defines that the upload fingerprint sample image from the training state. It reduces the dimensionality of the image pixels and defines in black and white format and extension used .tiff format. 2(ii) above figure shows that the speech recognition phases upload the wave form, feature extract using MFCC algorithm.

Step 2:- Data Pre-processing



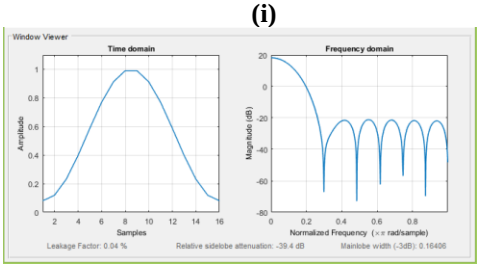
(i)

Figure 3(i) Edge Detection in Fingerprint Image

In edge detection using canny operator to detect the regions or edge in the given image and calculate the maximum, minimum and average value in the input image.

Step 3:- Feature Extraction in Minutiae and MFCC Algorithm

(i)



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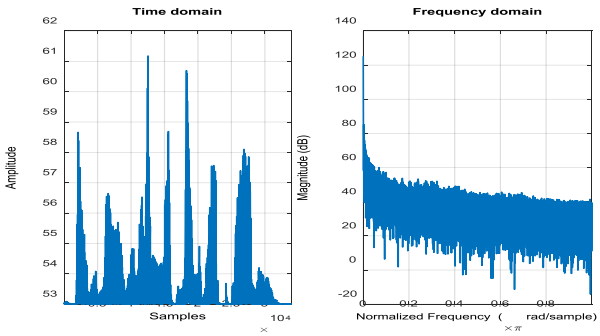

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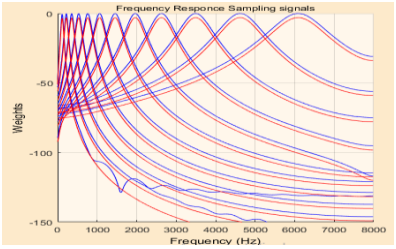

(iv)

Figure 4(i) Minutiae Extraction (ii) Frequency Sample Signal (iii) Window Viewer Line Format and (iv) Window Viewer Spectrum Format

Figure 4. (i) define that the feature extraction method using minutiae points . First out is a binary image (0,1), Thin image means small layer for ridges and valleys verification and after that extracted feature which is Minutiae points. 4(ii) and (iii) define that the feature extraction output. In this phase we calculate the extracted feature using MFCC algorithm based. In this figure defined that the window viewer line format, window viewer spectrum format and 4 (iv) final frequency sample signal.

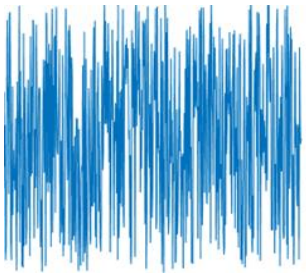

Figure 5 Optimized Feature Set

Fig 5 defines that the evolution methods used to select the genuine feature points and feature vectors. It has to give a best result with the help of fitness function. In this method using three operators:- (i) Selection (ii) crossover and (iv) Mutation.

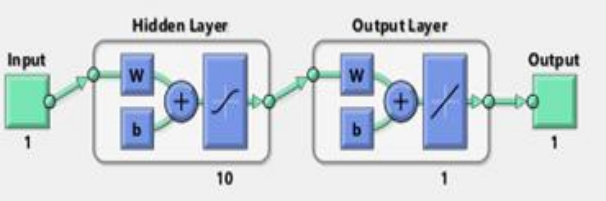

Figure 6 Multi-Layer Neural Network

Above figure 6 shows that the Feed Forward Neural Network performance based on MSE (Mean Square Error Rate) and Calculate the time consumption, epochs, gradient, mutation and validation checks parameters.

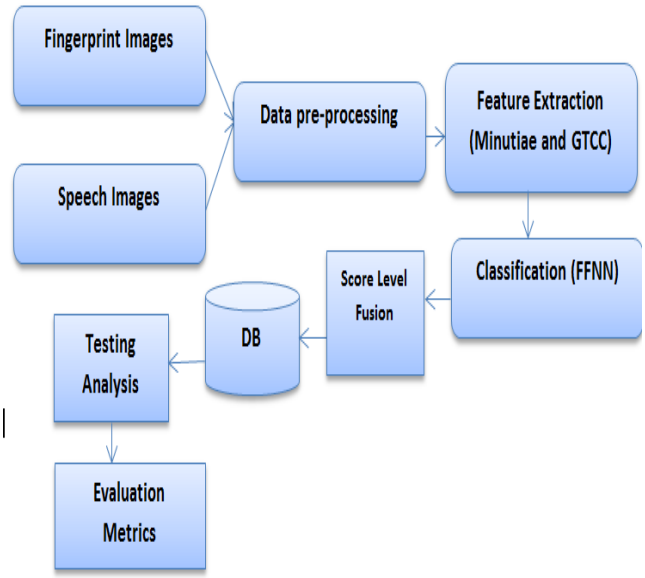

Figure 7. Research Proposal Flow Chart

IV. RESULTS AND DISCUSSION

CASIA Unique finger impression Picture Database Form 5.0 (or CASIA-FingerprintV5) contains 20,000 finger impression pictures of 500 subjects. The unique finger impression pictures of CASIA-FingerprintV5 were caught utilizing URU4000 unique finger impression sensor in one session. The volunteers of CASIA-FingerprintV5 incorporate alumni understudies, specialists, servers, and so on. Each volunteer contributed 40 unique finger impression pictures of his eight fingers (left and right thumb/second/third/fourth finger), for example 5 pictures for every finger. The volunteers were approached to turn their fingers with different dimensions of strain to create huge intra-class varieties. All unique mark pictures are 8 bit dim dimension BMP documents and the picture goals is 328*356.

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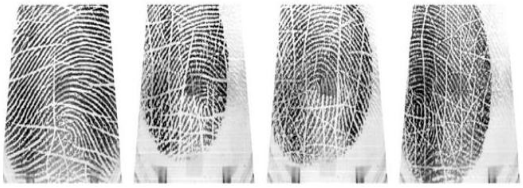


Figure 8. CASIA Fingerprint Recognition [20]

The database was gathered bit by bit and in all respects at an early stage calculated. The documents were gathered in 2000-2001 from an assortment of sources including individual Compact discs, radio, amplifier chronicles, so as to speak t4o an assortment of account conditions. Nevertheless they have been giving it to specialists upon solicitation for the most part for correlation purposes and so on.

The dataset comprises of 1000 sound tracks every 30 seconds in length. It contains 10 classifications, each spoken to by 100 tracks. The tracks are generally 22050Hz Mono 16-bit sound records in .wav group.

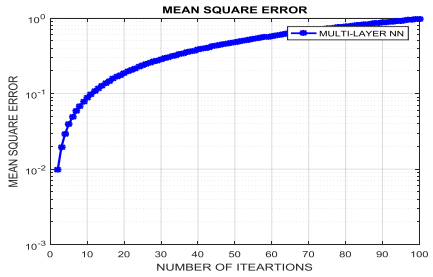
Figure 9. Speech Sample [21]

Table 1 shows that performance metrics MSE value is 0.97, FAR value is 0.000683, FRR value is 0.0097, Specificity value is 0.9, F-score 0.99 and Accuracy Rate value is 98.614.

Table 1:- Performance Analysis

Parameters	Fusion + FFNN
MSE	0.97
Accuracy	98.2
Specificity	0.99
F-Score	0.99

FAR	0.00068
FRR	0.0097



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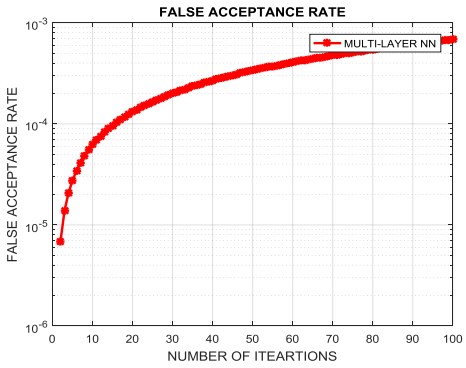
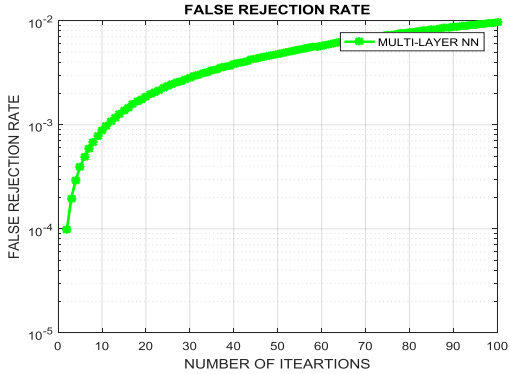


(ii)

Figure 10.(i) MSE (Mean Square Error Rate) and Far (False Acceptance Rate)

Above figure 10 (i) shown that the training error and testing error is equal to Mean Square Error. The figure 10(ii) determined about the fake approval rate which recognise the positive information for searching the classified approach for test element and extraction of the specific structures. The fake approval rate is the possibility that the approach wrongly authorise a non-authorised individual because of the wrong match with biometric feature inserting the template. The fake approval rate recognise the values is proposed value is 0.00068.



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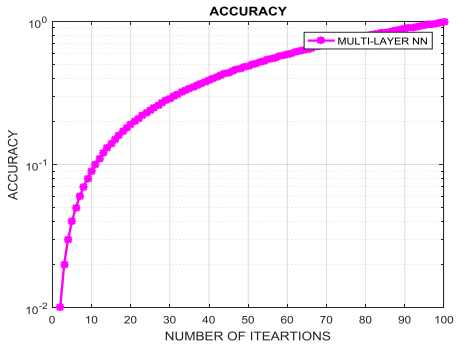
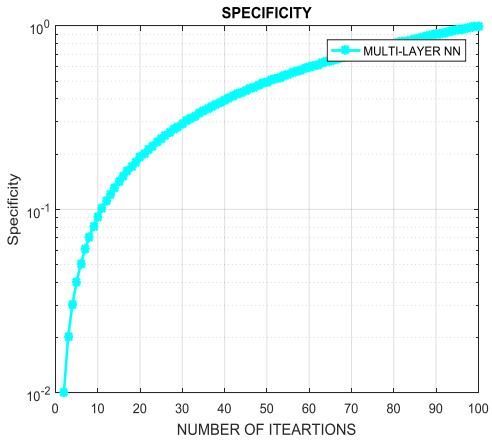


(ii)

Figure 11(i) FRR (False Rejection Rate) and (iii) Accuracy Rate

Figure 11(i) False Rejection rate is the method of the measurement of the biometric safety system that will wrongly access the approach by identified individual or user. The system fake rejection rate is that classically determine the proportional value of the amount of the fake rejections divisible by the amount of the recognition approach. Fig 11(ii) Accuracy is the method of the set of procedure for the measuring the value of the similar quantity that gives the precise values and the actual value. The elements may be independent of other values.



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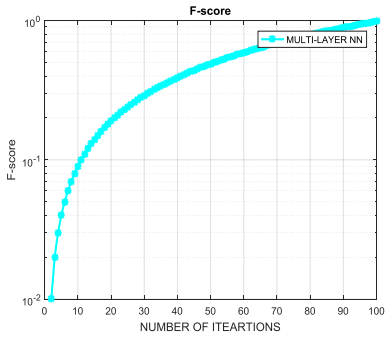

(ii)

Figure 12(i) Specificity and (ii) F-Score

Fig 12 (i) Specificity define is the measurement of the proportional value of the exact negative that are recognised. Fig 12 (ii) F score is the also known as f measure or F scores that is used for the measurement of the accuracy of the test approach. F score is determined by mass harmonic sum of the precision and the recall value.

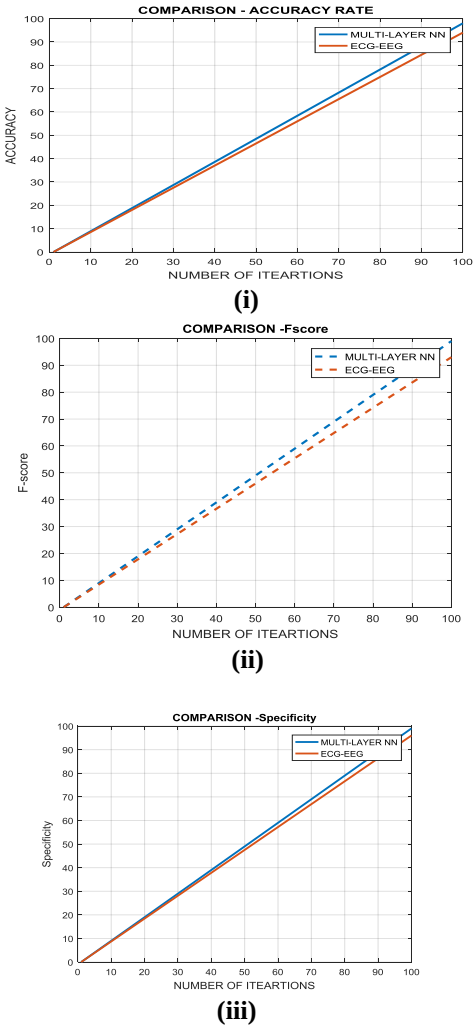

Figure 13 (i) Comparison –Accuracy Rate (ii) Comparison – F-score and (iii) Comparison – Specificity

Figure 13 (i) show the comparison between proposed and existing work with accuracy rate in proposed work accuracy rate value is 98% and Existing work accuracy rate value is 94%. Figure 13(ii) shows the comparison between proposed and existing work with F-score in proposed work F-score rate value is 0.99% and Existing work F-score rate value is 93%. Figure 13(iii) shows the comparison between proposed and existing work with Specificity in proposed work specificity rate value is 0.99% and Existing work specificity rate value is 96%.

Table 2. Comparison between Proposed and Existing Work in Multi-model Biometric System with Fusion

Parameters	Genetic-Multilayer Neural Network	ECG-EEG
Accuracy Rate (%)	98	94
F-Score (%)	0.99	0.96
Specificity (%)	0.9	0.93

Table 1 shows the proposed metrics with FAR, FRR, Accuracy, MSE, F-score and Specificity and Table 2 comparison performance shows the proposed and existing work with Specificity, Accuracy Rate and F-score.

V. CONCLUSION AND FUTURE SCOPE

Biometric is technological factor that permits the recognition and authentication of an individual in accordance to unique information. With the advancement in the biometric recognition it becomes easy to identify the individual. Some issues occur in the uni-modal, so multimodal fusion is used for improving the accuracy of the system. Biometric system has some application areas which are physiological controller, physical access, surveillance system and authentication and verification. In proposed work, it has been developed a score level fusion of fingerprint and speech recognition is found to be maximize the accuracy rate. The research work is successful in reducing the problems of individual phases in multimodal biometric system. The score level of security is the most significant criterion for the multi-model biometric system. Its feature compared or match score value has been selected minimum FAR and FRR. Experiments show that the research technique for MLNN classification is feasible and efficiency.

Future Scope, will implement an authentication process with encryption method in multi-model biometric system. It can improve the security levels and security.

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