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COMPARATIVE ANALYSIS OF FINGERPRINT RECOGNITION USING NEURAL NETWORK AND GENETIC ALGORITHM

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ABSTRACT

Fingerprint recognition have become one of the most popular biometric systems used in many applications, including law enforcement, border control, and forensics. The most common used biometric parameters are signature, fingerprints, face, keystroke and iris. Fingerprint authentication states the automatic way of identifying a counterpart between two persons using their fingerprints. An ANFIS-FRS has been proposed in this work to meet the demands in the forensics & the civilian applications. Our proposed work is able to improve performances in terms of the sensitivity, accuracy & matching speed. Human fingerprints are uniform in nature as they have been used for very long time. Forty fingerprint images were chosen from FVC database where these images were taken from ten peoples, four impressions were taken from each person. Our methodology reduces the training time, the computation time & the elapsed time. The result of present investigation achieves the recognition rate of 98.34 the classification rate of 98.78%, & the accuracy of 97.12% for recognition of the fingerprint images.

KEYWORDS: Biometric, Fingerprint, Genetic Algorithm, Fuzzy Logic, Performance Analysis .

The physiological or behavioral characteristics are distinguished between unknown person and unauthorized person. It is done by biometric methods and may be retina recognition, face recognition and finger print recognition. The main characteristics of biometric are different for individual persons and can't forget or lost (CarstenGottschlich, 2014).

There are some traditional knowledge based and token based technique to make biometric system more reliable. The remedy like id card or passport is rushed out, the same can be easily replaced. It is like if a person has different account with different passwords and one account is hacked then another account remains safe (DaxinTian, 2014).

Among the different biometric authentication Fingerprint is most efficient and secure technique to identify a person (Marasco, 2014).

In present digital era, the biometric systems play a pivotal role in digital transaction, smart card, credit card almost in every field used by individuals. Further different online transaction, web access biometric systems are used for accessing physical control applications (Anil K , 2016).

The main problem is security of identification. As biometric application increases day by day so these technology may be used for remote login and data access application. These are traditionally knowledge based authentication and in biometric systems will become more trust worthy as compare to other systems (Myers,2016)Further, it finds more application in other day to day activities such as voter ID, pan card registration, driving licence, attendance of persons etc (Belguechi , 2016).

The paper is organized asSection II presents a frame work of related work carried out by the researcher and authors in Section III offers the methodology used for proposedwork. Result analysis is demonstrated in section IV following the concluding remarks in section V.

LITERATURE REVIEW

The literature survey presents the fingerprint recognition which includes SVM, SVD techniques. A brief framework of literature presented by the authors is demonstrated in present section.

Carsten Gottschlich, et al., in 2014comparedthe average accuracy with proposed technique to traditional technique. The best algorithm applied to a data LivDet 2013 to provide device diversity using the same evaluation protocol.

Daxin Tianet al., in 2014 proposed new inspired model based on biometric for handoff decision in the heterogeneous network applied for different fingerprints.

Gargiet.al, in 2015 demonstrated Gaussian filter and SVM method for vehicle image identification. Authors presentedthe recognition rate about 90% for identification.

Nishaet.al in 2015 proposed a new approach for gesture representation in face detection arrangement.

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Sandeepet.al in 2015presented the hybrid approach for the face detection. The recognition rate is obtained by authors about 91.5%.

Marasco, Emanuelag Wu et al., in 2014discussed many issues related to the security of the fingerprint recognition such as highly high-lighted with different attacks.

Jain, Anil K., et al., in 2016described about the fingerprint recognition. The performance parameters were true accept rate, false accept rate .The result analyzed by the authors that true accept rate is 98.9 % & false accept rate was 0.1 %.

Myers, L. J. et al., in 2016investigated a minimized cost fingerprint recognition system by using the combination of a least quality images and cropped fingertips. These were a minutia overlay, Fourier wedge-ring detector, SVD invariants and moment invariants. 100 % recognition rate was achieved for various techniques.

Belguechi, Rima, et al., in 2016 offered about template protection scheme. Experiments were conducted onfingerprint databases from the FVC. The overall result shows that context was used on the texture features.

Di Martino et al., in 2016presented the estimation of reliability of different biometric output of the systems. The authors performed a lot of experiments with the different database. These database images were used to compare their performance parameter.

Wang, Kejun, et al., in 2016designed a touch less fingerprint recognition system. These systems had more advantages with high security, high acceptance rate.

Mohammed et al., in 2016designedan EVM machine using fingerprint recognition system. The proposed system allowed voter to scan his fingerprint, and compares it with the pre-saved fingerprints in the database.

Zhang, Qing, et al., in 2016 proposed different matching methods in the fingerprint recognition. In order to improve the recognition accuracy of the fingerprint system unsuccessful minutiae system was used. In this paper, fingerprint recognition accuracy was improved as compared to traditional systems.

Kundu, Sumana et al., in 2017 proposed a neural network classifier based on optical character recognition. On the other hand second learning was integration of backbone learning, perception learning. The true positive rate was improved up to 76.9.

Peksinski, Jakub, et al., in 2017offered a new performance parameter for measure the digital image quality and measuring parameter for image quality index. The image quality index was improved as compare to traditional one.

The overall survey of fingerprint indicated that fingerprint matching is done with the optimization of algorithm with high recognition rate.

FRAME WORK OF IMPLEMENTATION

The proposed architecture numerates a detailed design for automatic identification fingerprint images. In the proposed work, design new ANFIS –FRS as show in Fig 1. The images are collected from the Latent fingerprint database initially; Fingerprint image as input process firstly. After that, different statistical orders are made. These are like 1st -order features, 2nd-order statistical features, and 3rd-order features for images are calculated. In research work, the study related to identifying the images without any human intervention. The proposed work is studied for different identification of finger print with the genetic and the neural network identification. For miniature extraction genetic algorithm is used.

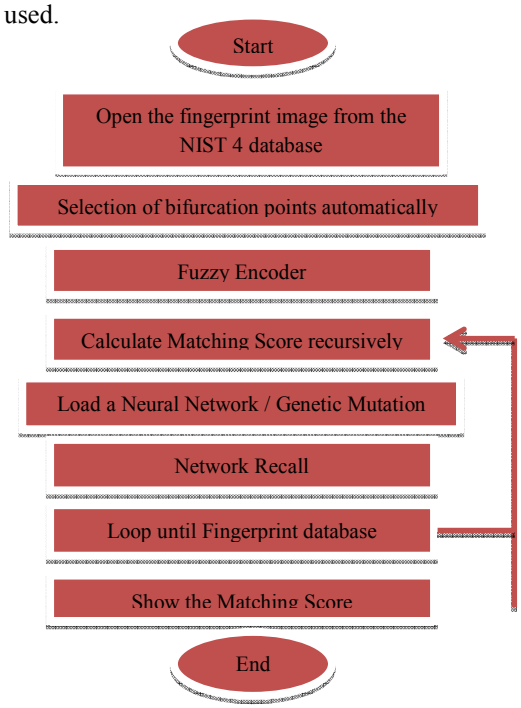

Figure 1: Proposed flow Chart for the fingerprint recognition

Objective

The main objectives of the study are:

i) To Study and analyze various fingerprint recognition mechanisms.

ii) To Proposeda Genetic algorithm based method for fingerprint identification.

iii) To implement and evaluate the proposed scheme using various metrics such as FAR, FRR, Accuracy etc.

Methodology

The discussed objective will be achieved by using the methodology presented in the section complete fingerprint image is classified in three statically features, 1st order image statistical features, 2nd order statistical features and 3rd order statistical feature. After calculating all the features, a feature vector is constructed for the given fingerprint images having direction 45°, 90°, 135°and180°. Then the calculated values will be applied to classifier. In the classifier, image with trained set and test set are classified differently. The sets are differently carried out in different phase as indicated in the flow chart. ANFIS classifiers are used to identify the fingerprint recognition. Orientation field separation algorithm is used to separate the overlapped fingerprints. But during the separation, some valleys and ridges of the fingerprints are lost. Therefore the template fingerprint images are difficult to match. Hence Hough transformation alignment algorithm is used to reconstruct the orientation field. After the alignment, feature extraction with minutiae and pores are used. For fingerprint matching the pore-matching algorithms are executed. Genetic algorithm is used to provide better approximation of the solution for the survival of fitness. According to level of fitness, a new set of approximation are created by the process of selection at each generation. By the use of genetic algorithm, level of fitness in problem domain and breeding together easily solve. From this process evaluation of population is done for proper suit. These are exempted by natural adaption. Energy is calculated by using the following equations (Wang, Kejun , 2016)

$$e = \sum_{i=1}^{k}\sum_{j=1}^{k} P_{ij}^{2} \quad \text{………………………………. (1)}$$

Homogeneity is calculated as presented in Eq. (2)

$$s = \sum_{i=1}^{k}\sum_{j=1}^{k} \frac{P_{ij}}{1+|i-j|} \quad \text{……………….............. (2)}$$

Correlation is obtained as (Chan, Kevin , 2016)

$$cor = \sum_{i=1}^{k}\sum_{j=1}^{k} (i-m_r)(j-m_c)P_{ij} \quad \text{………...(3)}$$

Contrast is achieved by following Eq. [13]

$$con = \sum_{i=1}^{k}\sum_{j=1}^{k} (1-j)^2 P_{ij} \quad \text{………………….. (4)}$$

RESULTS ANALYSIS

The present work provides three types of features are essential for fingerprint matching such as Level 1, Level 2 and Level 3 respectively. Level 1 indicates address singular points, Level 2 indicates ridge ending and bifurcation and level 3 indicates pores, dots and ridge contours. The image quality is computed from 1 to 5 integer value. The highest quality is denoted by 1 and the worst quality is denoted by 5. There are two features of minutiae one is ridge ending and another one is bifurcation. The point where a ridge ends abruptly known as ridge ending minutiae and the point where a ridge forks or diverge into branches known as ridge bifurcation. The ridges are shown in Fig 2.Fig 3 indicates the orientation of fingerprint. Fingerprint 1 is input image and fingerprint 2 is database fingerprint. Apart from the figures 2 and 3, Fig 4 presents finger print separation of twoimages. Fig 5 presents the minutiae extraction of an image. In the genetic algorithm, different processes occur like selection, crossover, and mutation genetic operators being applied to a population. These are part of neural networks represented as vectors. In addition to these Meta heuristic algorithm is used based on population train of neural networks with back propagation. These are used along with momentum and differential evolution. Genetic algorithm based search is shown in Fig 6

Different fingerprint images are tested as presented in Table 1. These fingerprint images store in the database. All the fingerprint images are loaded into proposed system for the verification. It is observed that 90% data is matched correctly.The user interface of fingerprint identification system enables users to perform some works on the system. Fig 7 shows the user interface in this work. There are 5 pushbuttons for user to choose for different purposes.

In this FVC 2002 Database from 40 images. Qiongxiu Li accuracy is 82.93% and with the presented work accuracy is achieved up to 97.12%.

Figure 2: fingerprint 1 and 2 Region

Figure 3: Fingerprint 1 and 2 orientation

Figure 4: Separate Fingerprints

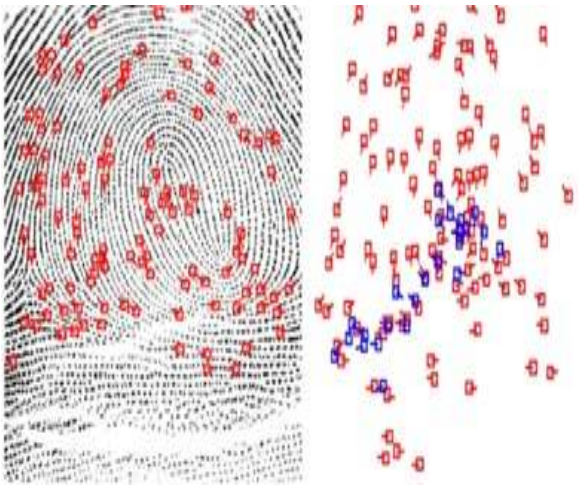

Figure 5: Minutiae Extraction

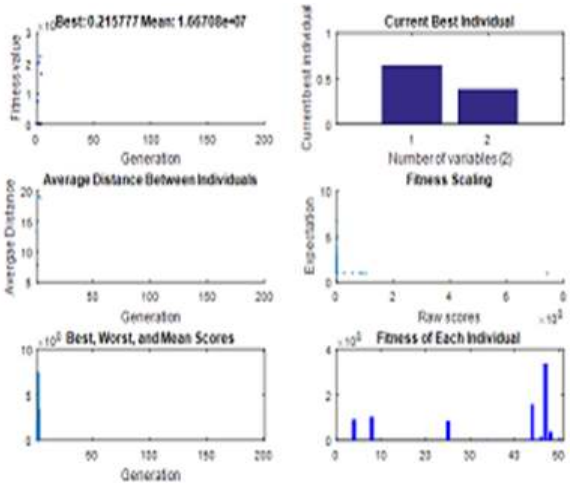

Figure 6: Genetic Algorithm based optimization of the features (initial phase)

Figure 7: The user interface of fingerprint identification system

Table 1: shows the result verification with different fingerprint impressions that belong to the same person

Input Fingerprint	No. of Fingerprint Images	Database Fingerprint Images from People No.					Correctness
		1	2	3	4	5	
1	4	4M	0	0	0	0	100 %
2	4	0	4M	0	0	0	100 %
3	4	1	0	0	0	0	80 %
4	4	0	0	0	0M	1M	80 %
5	4	0	0	4M	0	0	80%
6	4	0	0	0	4M	0	100%
7	4	0	0	0	0	1	80%
8	4	0	0	0	0	4M	100%
9	4	0	1	0	0	0	80%
10	4	0	0	0	0	0	100%
Total Percentage of Correctness							90%

Table 2: Shows the accuracy table for different methods

FVC 2002 Database	Base paper Qiongxiu Li	Proposed Work
40 images (10 person)	82.93%	97.12%

CONCLUSION

Fingerprint images are minutiae extracted using genetic algorithm. False minutiae in the fingerprint images are deleted using neural network. For post-processing Neuro-Genetic algorithm is used. Before training the network with the extracted features the optimal weights are calculated using Genetic parameters. The result shows that genetic algorithm is used and the recognition rate and accuracy is achieved up to 98.34 % and 97.12 % as compare to texture extractions. ANFIS-FRS reduces the training time, the computation time & the elapsed time.

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