International Journal on Emerging Technologies (Special Issue on *RTIESTM-2016*) **7**(1): 45-49(2016)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

A Full Analytical Review on Fingerprint Recognition using Neural Networks

Jasleen Kaur*and Sukhdeep Kaur*
Department of Computer Science and Engineering,

(Corresponding author: Jasleen Kaur)
(Received 04 October, 2015 Accepted 04 November, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Fingerprints are the oldest and widely used biometric in fraud detection. A good fingerprint consists of 20 to 80 minutiae. Various mathematical models came into existence to recognize fingerprints effectively. But they cannot detect the minutia. In this paper, commonly efficient algorithms has been presented like, BPNN classifier, NB classifier and fuzzy logic. Fuzzy logic provides human reasoning capabilities by using mathematical models that cannot be handled by human. By using these algorithms ridges and bifurcations will be find precisely.

Keywords: Fingerprint Recognition, BPNN, Naive Bayes, Fuzzy logic

I. INTRODUCTION

Fingerprint recognition is the major biometric technology that depends on the fingerprint uniqueness, perseverance and ease of achievement [1]. As this problem is not fully solved yet and that too many real appliances are using this approach mostly in the low quality finger print pictures. Matching among the templates and the query fingerprint is the main step that affects the system accuracy. Numbers of solutions are used to boost the accuracy.

The algorithms for this purpose are used are Minutiae based approach [4], Correlation based approach and Feature based approach. Therefore, the mandatory thing is to make a prototype to make the fingerprint standardized template [3] for the improvement of the matching score.

This paper gives the review of the fingerprint identification system through the minutiae extraction algorithm with the neural network classification technique [9] and fuzzy classification technique [10]. Naive bayes [18] feature model for the verification of matched source is also discussed.

II. FINGERPRINT RECOGNITION- A REVIEW

For obtaining the digital demonstration of the fingerprint and for acquiring the stored digital version of fingerprint, fingerprint recognition is used [2-3]. From all biometric techniques, the finger print recognition is the most popular technique. The advantages of the fingerprint recognition are as follows [6-8]:

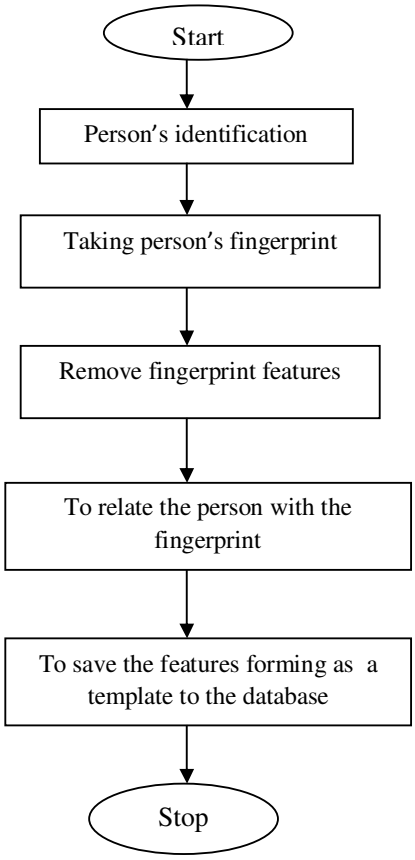

Fig. 1: Enrollment process.

(i) **Universality:** It is the size of the population having clear fingerprint that to the size of the population with passports.
(ii) **High Distinctiveness:** The similar twins with the similar DNA but different fingerprints.
(iii) **High performance:** A fetus fingerprint fully develops at the age of seven months with the characteristics that do not change in the lack of injury or skin disease.
Fingerprint recognition is divided into two processes that explain the Fingerprint Identification Algorithm. The processes are [15]:
1. Enrollment process: With the help of the fingerprint capturing device, person's fingerprint is captured that later saves in the database.
a**. Authentication process:** For matching purpose, the captured fingerprint is compared with the enrolled fingerprint. Computer would be unlocked if the fingerprint matching took place otherwise, an alert would occur.
Mostly, the fingerprint techniques [14] are based on the minutiae points by using the coordinate locations.

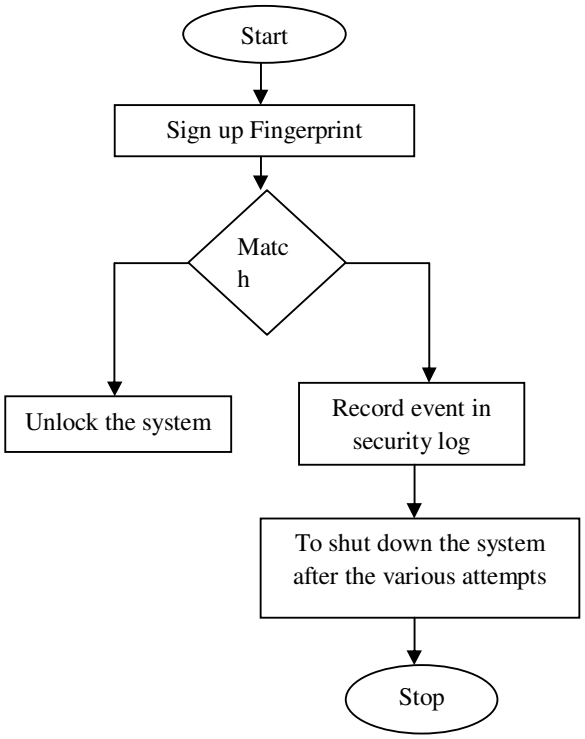

Fig. 2. Verification process.

Usually, when the fingerprint image is rotated with the enrolled image, matching problem is faced when the co ordinate locations are changed of the minutiae points and in the end, the performance came out to be very poor.

Above figure shows the image of the rotated fingerprint. As it can be seen that it is hard to match the minutiae as because of the rotation, the coordinate location of 3(b) got changed w.r.t 3(a).

Fig. 3. (a) Normal Fingerprint(b) Rotated Fingerprint.

Fig. 4. (a) Full Fingerprint (b) Partial Fingerprint Image.

Due to the missing part of the fingerprint, the coordinate locations of the minutiae points of 4(b) are changed w.r.t 4(a). So, the minutia matching is difficult for both images.
The minutiae matching [5-6] is for taking the reference point / line for deciding the starting the co-ordinates, translation and rotation of the image for having an image. The numbers of lines that flow in the different directions are Ridges and the space orthegaps between the ridges are the Valleys. The categorization of the minutia points is through the Ridge ending, Bifurcation, Core, Delta, Crossover and the island as shown in Fig. 5. The place where the ridge terminates is a ridge ending point that further splits into two path as the Y-junction [9-11].

1**. Naïve Bayes Classifier (NBC)**
It is a simple classifier that depends on the applying the bayes' theorem as of Bayesian statistics with naïve liberal assumptions. The Bayesian approach for the pattern recognition is explained as [18]:

Fig. 5. Minutiae points on fingerprint.

The random variables are not mutually independent. C's probability is depends on the previous occurrence of the B's event. The idea of Bayes rule is the output of the event C that can be shown over the dependence of number of evidences that can be seen. The bayes rule consists of the Priori Probability and the Posterior Probability.
The events probability before the observation of the evidence is the Priori probability and the events probability after the observation is the Posterior Probability.

Naive Bayes Classifier Algorithm

To begin a training set, for every class .

To calculate a prior function like a probability density function

To use Bayes theorem for obtaining the measurement conditioned probability.(y)

To choose so that for all

III. FUZZY IMAGE

Number of the mathematical models cannot describe the human reasoning capabilities to capture the uncertainties whereas the fuzzy logic can describe the reasoning part having the particular knowledge.
The relationship between the fuzzy logic [10] theory and the pattern identification has a stronger fact that the fingerprint patterns are fuzzy in nature [13] [15].
The fuzzy feature image encored is given for showing the model of bifurcation point features taken from the fingerprints. The encoder is the type of the changes from the crisp to the fuzzy set.
There are number of reasons for the usage of fuzzy techniques in the Digital Image Processing. An expert knowledge is required for overcoming the difficulties of the image processing applications.

Difficulties usually occur because of the uncertainty of the tasks. The fuzzy encoder follows the three steps that are as below [17]:

Table 1: Rules for inspecting fingerprint in a rule based fuzzy system.

Bifurcations	Place	User Id
Plenty	Upper right corner	Alex
Plenty	Lower right corner	Bob
Thin &Plenty	Upper right corner and lower right corner	Charles

Segmentation of the fingerprint image into grids shown in the figure below:

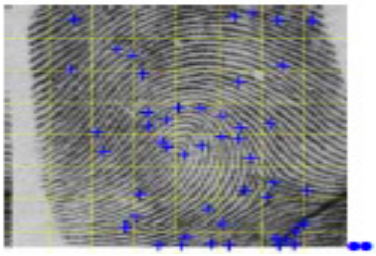

Fig. 6. Grids for bifurcation.

The view of grid region w.r.t fuzzy set is shown in the figure 7 and a membership function is used for designing the fuzzy encoder.

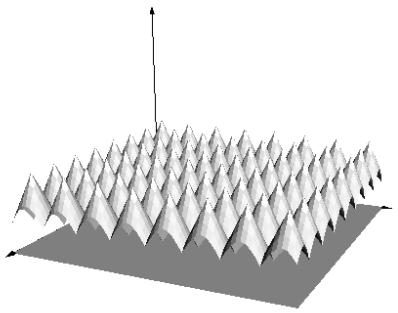

Fig. 7. Fuzzy encoder membership function.

ii) For bifurcation, membership value is used and to present the structure of the bifurcation feature, triangle membership function is used for the grid purpose to present the structure if the bifurcation features. The membership function of grid (x,y) is calculated as:

Grid has a membership function. is the bifurcation number.

iii) The sum of the membership function are calculated in the end for every grid. By using the equation 4, the fuzzy_image is obtained:

(4)

Where, is the fuzzy image system

IV. BACK PROPAGATION NEURAL NETWORK

Usually, BPNN is used for solving many problems by using the simple output elements [13]. It is the mostly used learning algorithm in the neural network. BPNN is used with fuzzy encoder for understanding the human like reasoning activities of the fuzzy logic system.

BPNN consists of three layers that are: Input layer, Hidden layer and the output layer [16]. The basic use of training the BPNN is for adjusting the weights among the layers for producing the expected output [17]. The activation function of the hidden and the output layer with the sigmoid function and is given by:

(5)

The value ranges from 0 to 1 for every unit range.

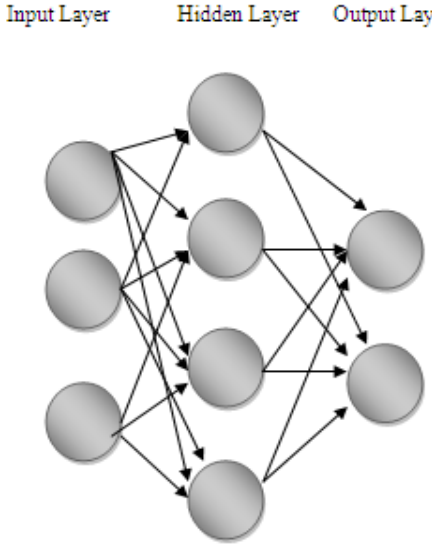

Fig. 8. Back Propagation Neural Network.

BPNN Algorithm

The input layer size and the fuzzy image size=8*8=64 neurons

The number of hidden layers=2

The neuron number of every hidden layer= 10

The learning rate =0.33

The momento facto=0.6

The minimum root mean square error (RMSE)= 0.02

Maximum learning iteration number=10000

Initialize the BPNN hidden layer identification randomly.

With the use of the basic parameters, the training of the BPNN identification starts

The training results further saves to the database

V. CONCLUSION

There are many factors included in the interruption of recognition of fingerprints like pressure, small pressing spot, atmosphere factors, device noise, skin suppleness etc. So, in this paper, various algorithms have been reviewed to recognize fingerprints like NV Classifier, BPNN classifier and Fuzzy logic in recognition of fingerprints accurately. These algorithms can be used in future work

REFERENCES

[1] A. Jain, L. Hong, and R. Bolle, (1997). "On-linefingerprint verification," *IEEE Trans. Pattern Anal. Machine Intell*, vol.**19**, pp 302–314, 1997.

[2]. X. Jiang, W. Y. Yau (2000). "Fingerprint minutiae matching based on the local and global structures", ICPR2000, vol. **2**, 2000, pp 1042-1045.

[3]. A.K. Jain, S. Prabhakar, L. Hong, S. Pankanti, "Filter bank- Based Fingerprint Matching", *Image Processing,* vol. **9**, 2000, pp 846-859.

[4]. B. Bhanu, X. Tan, (2001). "Learned templates for feature extraction in fingerprint images," *Proceedings of the IEEE Conference on Computer Vision and Pattern recognition*, vol. **2**, 2001, pp. 591-596.

[5]. L. Sha,F. Zhao, X. Tang, (2006). "Minutiae-based Fingerprint Matching Using Subset Combination", *The 18th International Conference on Pattern Recognition -ICPR'06*, vol. **4**, 2006, pp 566-569.

[6]. X. Jiang, W. Y. Yau, (2000). "Fingerprint minutiae matching based on the local and global structures", ICPR2000, vol. **2**, 2000, pp. 1042-1045.

[7]. X. Luo, J. Tian, Y. Wu, (2000). "A Minutiae Matching Algorithm in Fingerprint Verification", *Pattern Recognition*, vol. **4**, 2000, pp 833 - 836.

[8]. Nalini Ratha and Ruud Bolle, "Automatic Fingerprint Recognition Systems," Springer-verlag, 2003.

[9]. Davide Maltoni, Dario Maio, A.K. Jain and Salil Prabhakar, (2009). "Handbook of Fingerprint Recognition," Second Edition, Springer, 2009.

[10]. Pravesh Kumar, (2009). "Use of Fuzzy Set and Neural Network to Extract Fingerprint Minutiae Points and Location", M.E. Thesis, Computer Science and Engineering Department, Thapar University, June 2009.

[11]. Nasim Mir Armandehi, "Fuzzy Image Restoration", Final Project, Sharif University of Technology, 2007.

[12]. Roli Bansal, Priti Sehgal and Punam Bedi, (2011). "Minutiae Extraction from Fingerprint Images - A Review" IJCSI, 2011.

[13]. Lin Hong, Student Member, IEEE, Yifei Wan, and Anil Jain, Fellow, IEEE, (1998). Fingerprint Image Enhancement: Algorithm and Performance Evaluation, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. **20**, NO. 8, AUGUST 1998.

[13]. Mohamed Suliman M and Henry Nyongesa, (2002). "Automatic Fingerprint Classification System Using Fuzzy Neural Techniques" *IEEE International Conference on*, Vol. **1**, 12-17 May 2002.

[14]. Sen Wang; Yangsheng Wang, (2004). "Fingerprint Enhancement in the Singular Point Area " *IEEE*, Vol. **11**, Issue: 1, pp:16-19 Jan. 2004.

[15]. Sagar, V. K.; Ngo. D.B.L.; Foo K.C.K.; (1995). "Fuzzy Feature Selection for Fingerprint Identification" *International Carnahan Confrence on,* 18-20, pp: 85-90, Oct. 1995.

[16]. Ming Lu, (2002). "Improved Neural Network Modeling Approach for engineering Applications", *9th International Conference on*, pp:1810-1814, 18-22 Nov. 2002.

[17]. Mohamed. S. M and Nyongesa. H, (2002). "Automatic Fingerprint Classification System using Fuzzy Neural techniques," *IEEE International Conference on Artificial Neural Networks,* vol. **1**, pp. 358-362, (2002).

[18]. Parvathi R, Sankar M, (2012). "Fingerprint Authentication System using Hybrid Classifiers," *International Journal of Soft Computing and Engineering (IJSCE)* ISSN: 2231-2307, Vol. **2**, Issue-3, July 2012.