IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727,
PP 33-38
www.iosrjournals.org

Fingerprint Recognition System for Person Identification Using Termination And Bifurcation Minutiae

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Abstract: *Growing concern the world over, related to personal and property safety has propelled rapid growth of security and surveillance of the related technologies. Biometrics is an effective technology for personnel identity authentication. It has the capability to reliably distinguish between an authorized people. There are various types of applications for fingerprint recognition which is used for different purposes.*
This paper presents the well-known minutiae feature extraction method and Neural Network approach is used for Fingerprint Recognition System for Person Identification. This system takes the advantage of individual biometric system. The proposed method is used for recognition of person. Two major categories of minutiae, termination & bifurcation are used here. The system activate through artificial neural network. The proposed approach for feature level provides the better result. The recognition rate is increased & the error rate is decreased with the help of this system.

Keywords: *Fingerprint, Termination, Bifurcation, Minutiae, Feature level, Neural Network.*

I. Introduction

Biometrics is an effective technology for personnel identity authentication. It is a science which deals with verifying the identity of a person using his physical or physiological characteristics [1]. A biometric system is an automatic recognition of an individual based on some sort of unique features or characteristics possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, iris and retina etc. Biometrics technology verifies or identified a person based on physical or behavioral characteristics. [2]

In the identification mode, the system recognizes an individual by searching the templates of all the users in the database for a match. Therefore, the system conducts a one-to-many comparison to establish an individual's identity. [3, 4] We have used fingerprint trait for recognition process. Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints.

Fingerprint recognition is one of the most well known biometrics, and it is by far the most used biometric solution for authentication on computerized systems. The fingerprint images are classified into five categories: whorl, right loop, left loop, arch, and tented arch. Finger ridge patterns do not change throughout the life of an individual [5]. This property makes fingerprint an excellent biometric identifier. A fingerprint usually appears as a series of dark lines that represent the high, peaking portion of the friction ridge skin, while the valleys between these ridges appears as white space and are low, shallow portion of the friction ridge skin. The feature values typically correspond to the position and orientation of certain critical points known as minutiae. Fingerprint identification is based primarily on the minutiae, or the location and direction of the ridge endings and bifurcations long a ridge path [6].

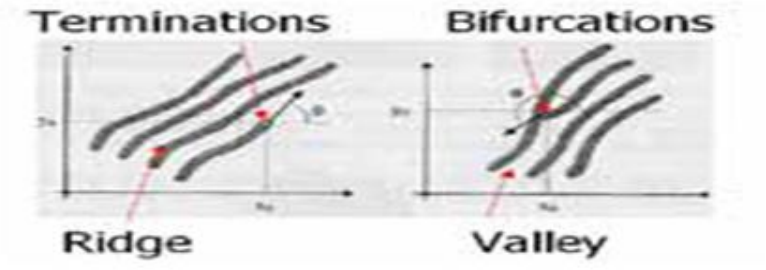


Fig. 1. Minutiae (valley is also referred as furrow, Termination is also called Ending and Bifurcation is also called Branch)

II. Methodology

Following figure shows that the proposed method for Fingerprint recognition system using neural network.

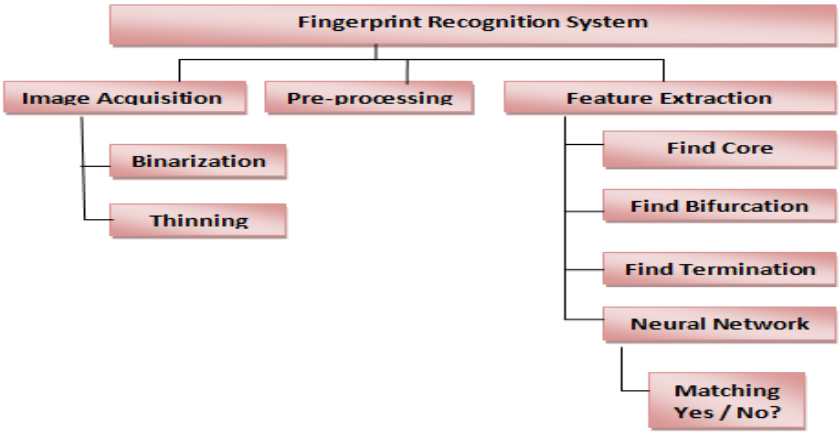


Fig. 2. Proposed method for fingerprint recognition system using neural network.

Following table shows the database specification of Fingerprint recognition system.

Table 1: Database Specification for Fingerprint Recognition System.

Characteristics	FVC 2002	FVC 2004	KVK Fingerprint
Camera	Capacitive Sensor	Optical Sensor	L scan 500P
Illumination	569 dpi	500 dpi	700 – 900 NM
Detection	Automatically	Automatically	Automatically
File Format	.JPEG	.JPEG	.BMP
Image Size	300x300 (88 K pixels)	640x480 (307 K pixels)	480 * 480
No. of subjects	40	40	40
Image (Subject)	1680 images	1440 impressions	2000

III. Experiments and results

The proposed approach is based on minutiae based fingerprint recognition. The process includes the following steps:

(1) Image acquisition.
(2) Image Pre-processing.
(3) Image enhancement.
(4) Feature extraction.
(5) Matching.

1. Image acquisition: FVC 2002 fingerprint database, FVC 2004 fingerprint databases are standard databases. KVK fingerprint database captured from LSCAN 500p cross-match device.

2. Image Pre-processing: The initial step in the proposed identification system is computing the binary image from the input gray scale fingerprint image, by applying threshold value.

2.1: Binarization:

The fingerprint binarization is an algorithm producing a 1-bit type image, with 0 as ridges which are tinted with black and 1 as valleys which are tinted with white [8]. However, the adaptive Binarization method is based on a threshold t, with gray-level pixels lower than t assigned to 0 and the others to 1.

$$IB(x,y)= \begin{cases} 1 & if\ f(x,y) \le 1/W \sum_{i=-1}^{1} \sum_{j=-1}^{1} f(x+i,y+j) \\ 0 & Otherwise \end{cases} \quad \ldots.(1)$$

Where f(x, y) is a gray-level at (x, y), and W is the widow size, the black pixels are denoted by zero while white pixels are represented by one.

3. Image enhancement:

During this stage, the characterization of each feature is carried out by determining the value of each pixel and each ridge is thinned to its centre pixels.

In order to improve the quality of fingerprint there are various pre-processing methods are available. In this experiment we analyzed the existing methods and find the drawbacks and some issues. In order to overcome these issues and get better performance we proposed an efficient methodology for finger print pre-processing and evaluated some statistical measures by estimating the MSE and PSNR values.

Following table shows that different filter techniques used for fingerprint recognition using statistical measures.

Table 2: Different filter techniques used for Fingerprint Recognition

Methods	MSE	PSNR
Gabor filter	5.3	15.11
Wiener filter	205.26	28.59
Median	356.48	26.22
Gaussian	124.92	30.79
Proposed	1.1	42.62

Following figure shows that the performance evaluation for fingerprint recognition system

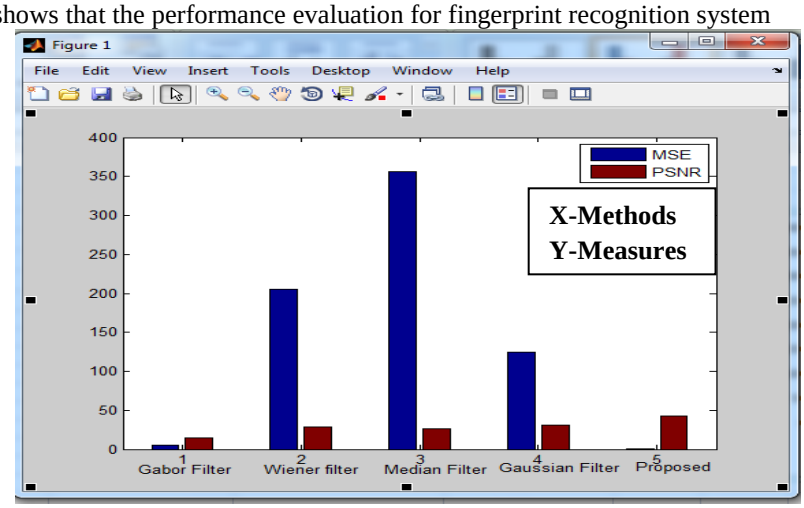


Figure 3: Statistical Performance Evaluation for filter techniques on Fingerprint system.

4. Feature extraction:

The concept of Crossing Number (CN) is widely used for extracting the minutiae. The crossing number for a pixel P is:

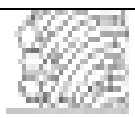
$$CN = 1/2 \sum_{i=1}^{8} |P_i - P_{i+1}|$$

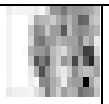
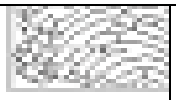
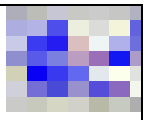
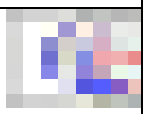
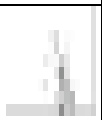
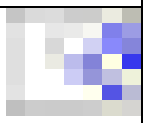
where Pi is the binary pixel value in the neighborhood of P with Pi = (0 or1) and P9=P1.

5. Matching: once the features are extracted using minutiae we estimated similarity between two fingerprint images using neural network.

Experiment 1: Results for fingerprint recognition system at feature extraction level on FVC 2002 fingerprint database.

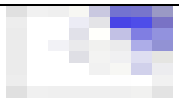
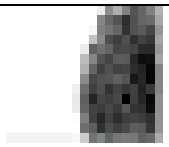
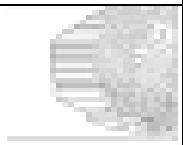
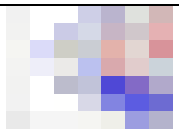
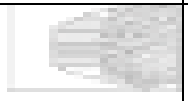
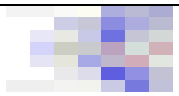
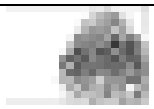
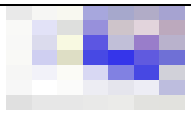
Table 3: Fingerprint recognition system at feature extraction level at FVC2002 fingerprint database.

Sr. No.	Original Image	Binarization	Thinned image	Minutiae Extraction
101_1.tif				

101_2.tif				
101_3.tif				
101_4.tif				

Experiment 2: Results for fingerprint recognition system at feature extraction level on FVC 2004 fingerprint database.

Table 4: Fingerprint recognition system at feature extraction level at FVC2004 fingerprint database.

Sr. No.	Original Image	Binarization	Thinned image	Minutiae Extraction
101_1.tif				
101_2.tif				
101_3.tif				
101_4.tif				

Experiment 3: Results for fingerprint recognition system at feature extraction level on KVK fingerprint database.

Table 5: Fingerprint recognition system at feature extraction level at KVK Fingerprint database.

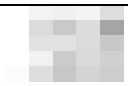
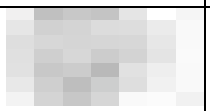
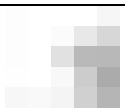
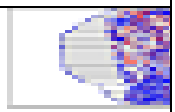
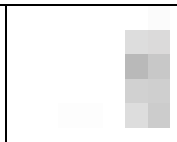
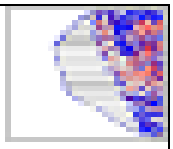
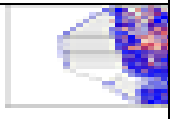
Sr. No.	Original Image	Binarization	Thinned image	Minutiae Extraction
Image_00				
Image_01				
Image_02				

Image_03				
Image_04				

There are many fingerprint matching techniques. We perform Neural Network to check whether they belong to the same person or not. Using Neural Network minutiae based fingerprint matching gives accurate matching results. [9]

We perform Neural Network to check whether they belong to the same person or not. Using Neural Network minutiae based fingerprint matching gives accurate matching results. There are many different types of the neural networks such as perceptron, back propagation network, counter propagation network, Hopfield networks, etc... [10]. In this paper we have used feed forward back propogation network. It is a collection of processing units and adaptive connections that are designed to perform a specific processing function. Neural networks are very good at pattern-recognition and pattern-matching tasks [11].

Three different kinds of samples are applied on the network to perform different activities:

1. Training: These are presented to the network during training and the network is adjusted according to its error.

2. Validation: It is used to measure network generalization, and to halt training when generalization stops improving. [12]

3. Testing: It is used only for testing the final solution in order to confirm the actual predictive power of the network. In our work we have conducted several training sessions. The training measures the performance on the basis of Mean Squared Error. It is the average squared difference between output and target. Lower values of mean square errors are considered as better one while zero denotes no error.

However, its performance is needed to be evaluated. This is carried out in two ways. [13]

i. Confusion matrix

ii. Receiver Operating Characteristic.

i. Confusion matrix:

Confusion matrix is a table layout, which visualizes the performance of an algorithm. The term confusion matrix defines a table which contains the information regarding the actual and anticipated classifications processed by the classification system. The evaluation is done with the help of the data in the matrix. [14]

ii. Receiver Operating Characteristic:

Receiver Operating Characteristic (ROC) graphs is employed for organizing the classifiers and visualizing their performance. Here, it is used to compute the accuracy of fingerprint.

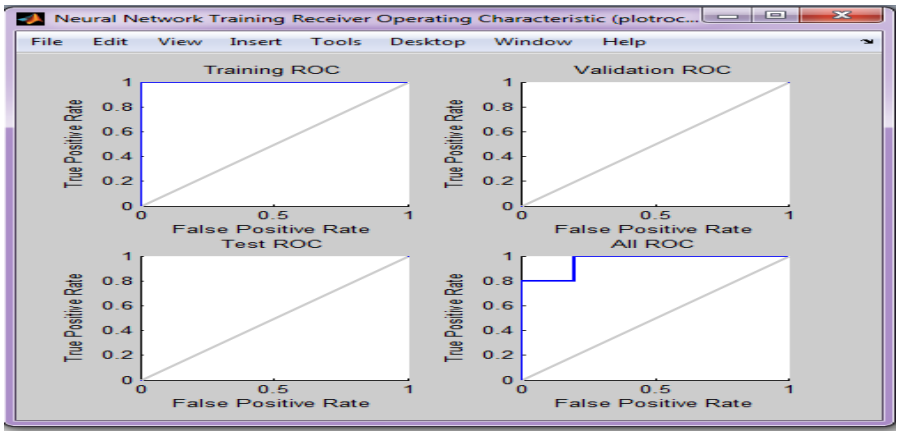


Figure 4: Neural network training Receiver Operating Characteristic for fingerprint recognition system.

Following table shows the accuracy rate of fingerprint recognition system using termination and bifurcation as a minutiae.

Trait	Algorithm	Accuracy	FAR (%)	FRR (%)

Fingerprint	Minutiae extraction (termination & bifurcation) and Neural Network	96%	1.24	6.09

IV. Conclusion

In this paper we have used termination and bifurcation as minutiae for fingerprint recognition system. This system gives the highest recognition rate due to neural network. The ROC curve is a plot of the true positive rate (sensitivity) versus the false positive rate (1 - specificity) as the threshold is varied. A perfect test would show points in the upper-left corner, with 100% sensitivity and 100% specificity. The recognition rate of this proposed method of fingerprint recognition system using neural network is **90.06%.** The system is giving an overall accuracy of **90.06 %** with FAR and FRR of 1.24% and 6.09%. In future study we can use this fingerprint trait in multimodal biometric system to enhance the accuracy rate.

Acknowledgement

We are thankful to our Guide Dr. P. D. Deshmukh Principal of Dr. G.Y.P.C.C.S and I.T .for providing valuable guidance and technical support.

References

[1]. Anil K. Jain, Arun Ross and Salil Prabhakar, "An Introduction to Biometrics", IEEE Transactions on Circuits and Systems for Video Technology, Special Issue on Image- and Video-Based Biometrics, Vol. 14, No. 1, January 2004.
[2]. A. Ross and A. Jain, "Information Fusion in Biometrics," Journal of Pattern Recognition Letters, vol. 24, 2003 pp. 15-21.
[3]. Anil Jain, Sharath Pankanti, 1988, "Automated Fingerprint Identification and Imaging Systems". Technical Report 500-89, National Bureau of Standards.
[4]. Md. Mamunur Rashid and Aktar Hossain, A. K. M., 2006, "Fingerprint Verification System Using Artificial Neural Network". (ISSIN 1812-5638)Information Technology Journal 5(6):1063-1067.haur-Chin Chen and Yaw-Yi Wang, 2003, An AFIS Using Fingerprint Classification (Palmerston North, November 2003).
[5]. Jain, A.K., and et al, 2004, "An Introduction to Biometric Recognition", IEEE Tran. On Circuits and Systems for Video Technology, vol.14 No.1, PP. 4-20.
[6]. R. L. Telgad, Almas Siddiqui,"Computer Aided Ttechnique for Finger Print Image Enhancement by Using DFT and Binarisation"I.J.C.S.I.E. Vol. 4, No. 1, June 2013, pp. 17-23
[7]. R.L. Telgad,Dr. P.D.Deshmukh,"Computer Aided Technique for Finger Print Image Enhancement and Minutiae Extraction "I.J.C.A. Volume 75, Number 17, August 2013.
[8]. Prabhakar, S, Jain, A.K, Jianguo Wang, Pankanti S, Bolle, "Minutia Verification and Classification for Fingerprint Matching", International Conference on Pattern Recognition vol. 1, pp. 25-29, (2002).
[9]. J. S. Bartunek, M. Nilsson, J. Nordberg and I. Claesson, "Neural Network based Minutiae Extraction from Skeletonized Fingerprints," IEEE Region 10 Conference on TENCON, pp. 1-4, 2006.
[10]. Anil K. Jain,Arun Ross,Salil Prabhakar,"An Introduction to Biometric Recognition",IEEE transaction for circuits and systems for video Technology,VOL.14,No.1,January 2004.
[11]. W. Chang, S. H. Soliman and H. A. Sung, "Fingerprint image compression by a neural network clustering neural network," Proceedings IEEE International Conference on Image Processing, vol. 02, pp. 341-345, 1994.
[12]. K. Nandakumar, A. Ross, and A. K. Jain, "Incorporating ancillary information in multibiometric systems," Handbook of Biometrics.New York: Springer-Verlag, pp. 335–355, 2007.
[13]. W. F. Leung, H. S. Leung, W. H. Lau and A. Luk, "Fingerprint recognition using neural network," Proceedings of the IEEE Workshop on Neural Networks for Signal Processing, pp. 226-235, 1991.
[14]. S. Sjogaard, "Discrete neural networks and fingerprint identification," Proceedings of the IEEE-SP Workshop on Neural Networks for Signal Processing II," pp. 316-322, 1992.

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