IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 9, September 2016

A Novel Method of Fingerprint Recognition Based on Neural Network

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Abstract: Fingerprints are the great way to identify individuals. Biometric identification through fingerprint is one of the oldest methods. To get a good fingerprint is not always easy because of injury on an individual's finger and noisy image. So pre-processed of the fingerprint image is necessary before matching. The main aim of this work is to get better and enhanced fingerprint image**.** We have analysed the components to obtaining high-performance feature point's detection algorithm, such as quality of image, separation, enhancement of image and feature detection. It is necessary to accurate Separation of noisy background from fingerprint ridges**.** The simulations are completed in the MATLAB2014 environment to evaluate the performance of the applied algorithms.

Keywords: Biometric, Fingerprints, Neural Network, Feedforward network, MATLAB2014.

1. INTRODUCTION

The uniqueness and permanence of the fingerprints are well-known. Assyrians and Chinese were using fingerprints for identification of the person in ancient time. Nowadays fingerprint recognition is the basic task of identification of the person is also famous for police agencies.

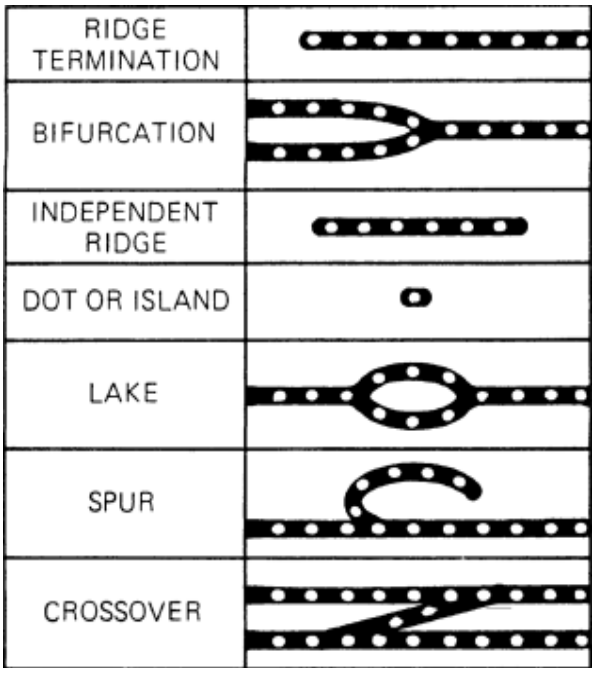
Identification of fingerprint is the method of recognition using impressions which made by the minute ridge formations on the fingertips.

Two persons can't have the same ridge patterns arrangement. The ridge patterns of any one individual remain unchanged throughout life.
[1] Personal characteristics may change but ridge pattern of fingers do not change throughout life. [2] Nowadays for the person of importance and person of inclination to the security of information in internet and network. The old tools liked password cannot reply this request for individuals.

In this paper work identification of the person by using altered fingerprints, the system should identify a person by the bifurcation and termination.

2. FINGERPRINT DETAILS

The fingerprint will have recognized the pattern of projections and depressions on the surface of the finger. [3]The fixing similar of two samples of the fingerprint are difficulty based on images. A fingerprint is the pattern of ridges and valleys on the fingertip surface. The endpoints and crossing points of ridges are called minutiae. It is a widely known assumption that the minutiae pattern of each finger is unique and not change throughout one's life. The Minutiae details are below



3. OBJECTIVE OF THE WORK

The objective is to implement fingerprint recognition algorithm. The Region of Interest (ROI) for each fingerprint image is extracted after enhancing its quality. The concept of Crossing Number is used to extract the minutia, followed by false minutiae elimination. An alignment based matching algorithm is then used for minutia matching. Here we use threshold value for matching injured fingerprint with normal fingerprints. In this case, we used two kinds of ridge of special points in the automatic fingerprint identified system like termination and bifurcation.

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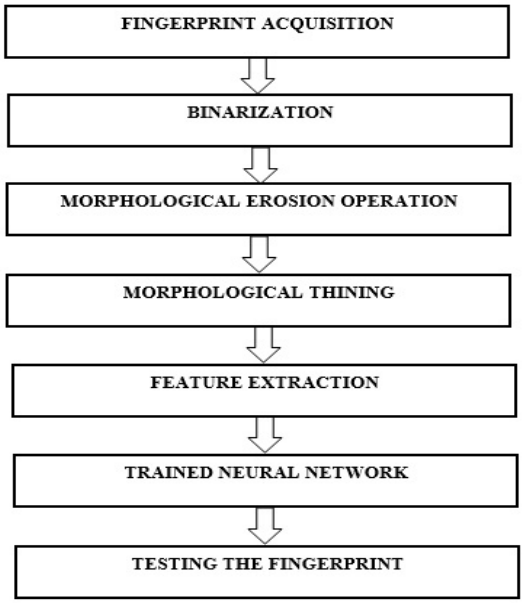
4. PROPOSED ALGORITHM

In this work, we present the algorithm of fingerprint recognition system. Image enhancement and feature extraction is the essential part to fingerprint recognition system image enhancement and features extraction are required. The suggested algorithm is separated into main three stages: Preprocessing, post processing and final matching stage of minutia matching. Preprocessing stage elaborate enhancement of the image by using binarization and morphological operations after applying this enhancement algorithm a binarized thinned image has been obtained. In second stage minutiae are pull out from the enhanced fingerprint by using the optimization technique. The final stage is the recognition of the fingerprint which has been done with the help of the neural network. [4] In this case, we used two kinds of ridge of special points in the automatic fingerprint identified system like termination and bifurcation



4.1 Fingerprint acquisition

There is more than one method to acquire fingerprints. Here we use biometric

4.2 Image enhancement

Binarization is the operation that converts the gray scale image into the binary image with 0 value for ridges and 1 value for furrows.

Morphological erosion technique is used for filtering and thinning.

Morphological Thinning is final enhancement method prior the minutiae extraction in thinning. Thinning is a morphological operation that erodes the pixels. Thinned images help minutiae extraction.

4.3 Feature extraction

Feature extraction is a type of reduction of dimension. This is used for efficiently represents interesting parts of an image. This is useful when image sizes are large .A reduced images feature representation is required to quickly complete tasks such as image matching and retrieval.

4.4 Training of neural network

"[5] A neural network is a massively parallel distributed processor made up of simple processing units, which has a natural propensity for storing experiential knowledge and making it available for use. It resembles the brain in two respects:

1. Knowledge is acquired by the network from its environment through a learning process.
2. Interneuron connection strengths, known as synaptic weight are used to store the acquired knowledge "

Feedforward neural network:

In this work, we use multilayer feedforward neural network for training purpose.

This is the second class of feedforward neural network having more than one hidden layer, whose computation nodes are correspondingly called hidden neurons.

The function of hidden neurons is to intervene between the external input and the network output in some useful manner.

The source nodes are the input layer of the network supply respective elements of the activation, which constitute the input signal applied to neurons in the second layer (the first hidden layer).

The output signals of the second layer have used a inputs to the third layer, and so on for the rest of the network.

4.5 Testing the fingerprint

This is the last step of proposed algorithm. In this step first take any fingerprint image from the dataset and fed this image to trained network. After that given result by showing whether it matches to right or wrong person. If the sample matches another person instead of that person is also false.

5. DATABASE

The performance of the SIFT-based fingerprint recognition was evaluated on **FS88H FIPS201/PIV Compliant USB2.0 Fingerprint Scanner** DB1a [26]. The database contains images of 100 different fingers with 8 versions for each finger – totally 800 images. The fingerprint image is named with the format 101_1. 101 and -1represent the person ID and the fingerprint impression respectively.

Table 1 Description of FVC 2002 DB1a

	Sensor type	Image size	Number of images	Resolution
DB1	CMOS SENSOR	320X480 PIXELS	14X14	500 DPI

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6. RESULT AND DISCUSSION

Fingerprint Image Processing Steps

This is the first step to taking as input in the proposed algorithm for fingerprint recognition.

We binaries the image. Ridges in the fingerprint are highlighted after the operation with black color while furrow is white.

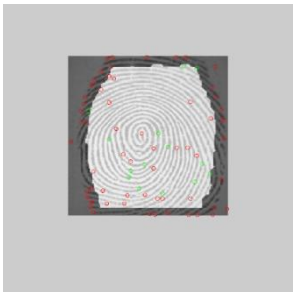
Ridge thinning is to remove the redundant pixels of ridges till the ridges are just one pixel wide.

We select the termination point in the fingerprint image which is shown as the red circle in the below fingerprint image.

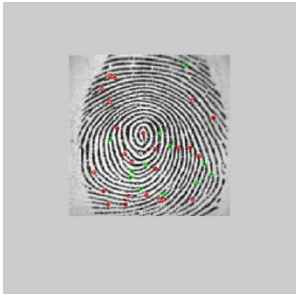
We select the bifurcation point in the fingerprint image which is shown as the green circle in the below fingerprint image.

We have a lot of spurious minutiae. We choose a variable D as a distance which is 6(D=6).We are going to process them. Step 1: if the distance between termination and bifurcation is smaller than D, we remove this minutiae, Step 2: if the distance between two bifurcations is lesser than D, we remove this minutia Step 3: if the distance between two terminations is smaller than D, we remove this minutia

We have to determine an ROI (region of interest). For that, we consider the binary image, and we apply and closing on this image and an erosion.



Once we defined the ROI, we can suppress minutiae external to this ROI



DOI 10.17148/IJARCCE.2016.5996

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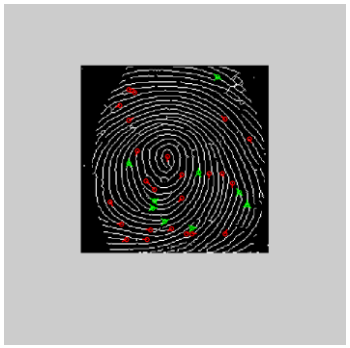
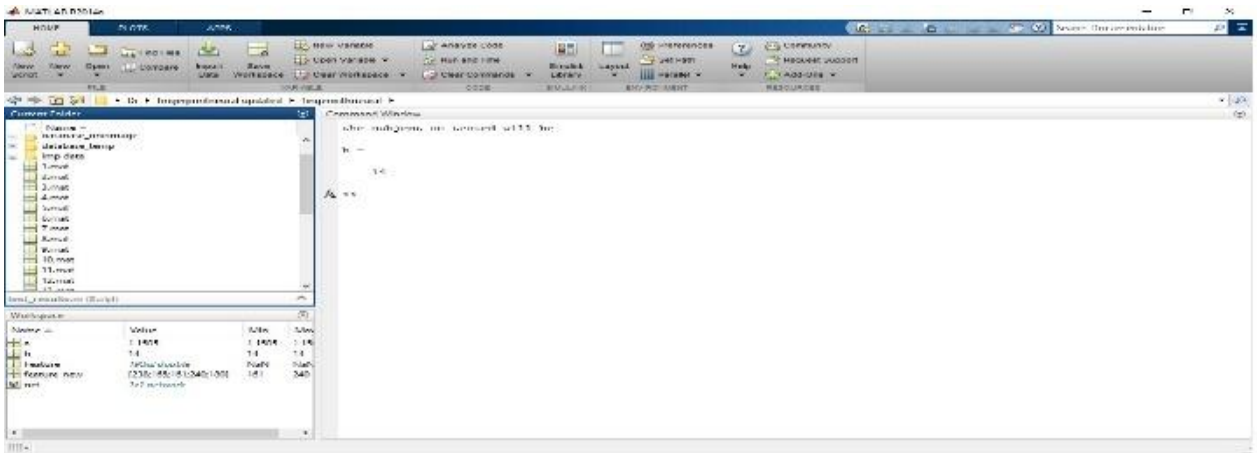
We have to find the orientation of the termination. For finding that, we evaluate the locus of the pixel on the edge of a 5 x 5 bounding box of the termination.

We have to find the orientation of the bifurcation. For finding that, we evaluate the locus of the pixel on the edge of a 5 x 5 bounding box of the bifurcation.



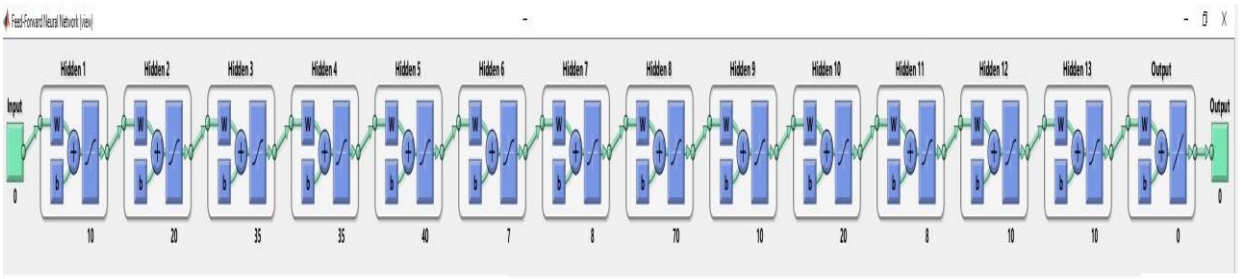
We devised an algorithm to match the X and Y coordinates of both the Termination points as well as the bifurcations. We also match their orientations to ensure a perfect match if found.

RESULT OF MATCHED FINGERPRINTS



Architecture of proposed Neural Network
Network type – FeedForward back propagation
Number of layer = 2
Number of hidden layer = 13
Training function = Trainlm (Levenberg-Marquardt)
Performance = MSE (mean square error)
Number of epoch = 3500
Iteration= 3500
Gradient =1.00e-07

Training performance
Feedforward neural network there is 13 hidden layers with different neurons and one input and out layer



Proposed neural network

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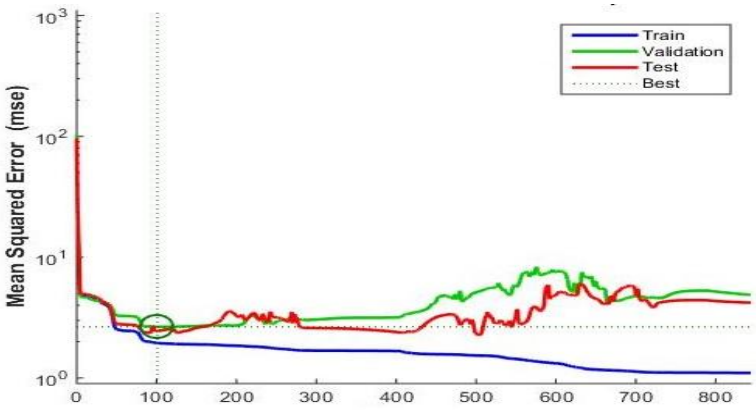
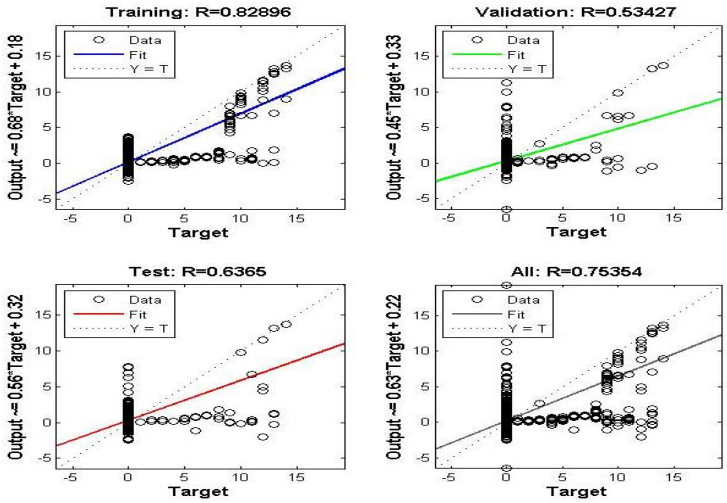
Training of neural network

Error performance

The error pattern represents that the error between the network input to target. The error is called Mean square error i.e. the graph shown in the figure represents that when we trained the simulated data with BP algorithm, best validation performance is 2.6539 at epoch 101.1



Error performance



Regression status

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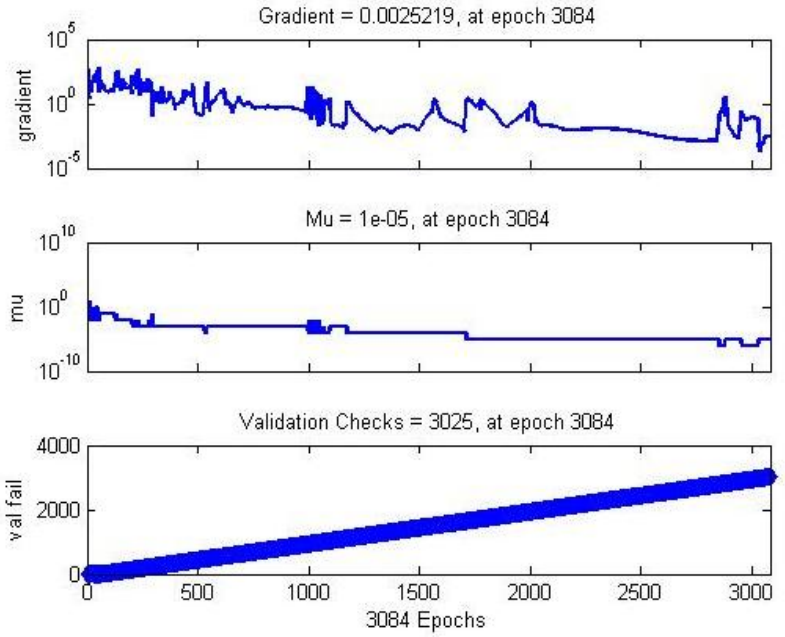

Neural Network Training Result

7. CONCLUSION

A new approach to fingerprint recognition based on neural network is presented. Features of the fingerprint are extracted after enhancing the fingerprint images. Enhancing of fingerprints includes banalization, morphology operations, it made a great improvement of recognition accuracy for recognition method. The result obtained show that combination of both image processing and neural network technique provides \the better and efficient method for fingerprints reorganization. We can recognize image accuracy. We can recognize fingerprint image easily with accuracy when the image is noisy image, injured image.

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