A Survey of Fingerprint Analysis using Artificial Neural Networks

Kavitha S N
Assistant Professor
Department of Information Science & Engg.
R.V.College of Engineering
Bengaluru, India

Dr. S C Prasanna Kumar
Professor,
Department of Electronics and Instrumentation Engg.
R V College of Engineering
Bengaluru, India

***Abstract*—Fingerprint Analysis is one of the efficient biometric tool which is highly used to verify the identity of the user. Artificial neural networks consist of various sets of neurons which resembles the neurons in the human brains. ANN is most widely used in the fingerprint analysis because of quick learning Techniques. Usually the ANN is trained to determine the characteristics that will be occurring in the fingerprint and extraction of those characteristics. In the training phase the extracted characterizations are compared with the templates that will be present in the stored database. A wavelet is used to divide a continuous signal into a scalable component, this technique of wavelets help to determine and differentiate the mordant characteristics of the fingerprint.**

***Keywords*- Artificial neural networks, Discrete wavelet transform, Minutiae, Ridges, Fingercode, Feed Forward ANN.**

I. INTRODUCTION

[1].A fingerprint mainly consists of several characteristics of a finger, it includes ridges, minutiae, ridge ending, etc. Nowadays fingerprints are mostly used for crime detection ,user authentication, application login etc. Fingerprint recognition refers to authenticating a user by comparing a fingerprint with a stored fingerprint.

A fingerprint device mainly uses several characteristics of a finger which includes the characteristics of the ridges and minutia points. There are different types of patterns present on a fingerprint which includes arch, loop, whorl. An arch is one of the characteristics where it starts from one point on the finger and forms an arc at center and end at the other point of the finger. Loop starts from one point on the finger and forms a curve and ends at the other point of the finger. Ridges will run circularly at the central point of the finger.

A minutia mainly consists of Ridge ending, Bifurcation. Ridge ending refers to the point where ridges terminate and birufiaction is the point where the ridge s spilled into two. These are two important characteristics which are highly useful in determining uniqueness in the fingerprints.

There exist different types of fingerprint sensors. Some of the sensors will perform the live scan of the finger and store the template n the database. Different types of technologies are used to capture the fingerprint of a human and storing the template.

Some of the different types of fingerprint scanners are Optical, ultrasonic, capacitance etc. Optical fingerprint sensor mainly makes use of visible light or emitted light to capture the image. It may make use of any of the digital camera which is capable to take low light images. A ray of light is passed on finger and visual image of the finger is captured. This sensor fails when the fingers contain some dirt components or there is some scratch on the glass.

Capacitance fingerprint scanner makes use of capacitor in which one plate will be parallel plate capacitor and other will be epidermal layer. It mainly consists of passive capacitance and active capacitance. In passive capacitance pixel value of the sensor will be used to measure the capacitance. In the active capacitance a voltage will be applied below the skin and measurement is done.

In this paper, Section 2 describes the Fingerprint recognition for the low quality images, Section 3 describe a system for fingerprint minutiae classification and recognition , Section 4 describes Efficient features extraction for fingerprint classification with multilayer perception neural network, Section 5 describes Recognition of finger prints enhanced by curve let transform with artificial neural networks, Section 6 describes a new fingerprint recognition approach using artificial neural network.

II. FINGERPRINT RECOGNITION FOR THE LOW QUALITY IMAGES

[2].Minutiae based algorithms and methods are more popular in fingerprint recognition but they fail when there are low quality images to be detected. This method uses the mean value of correlation to have correlation based system. The various features of minutiae in the fingerprint can be used match the fingerprint of other one. For poor quality images which contains the fingerprints a correlation based image matching approach is used.

Preprocessing: In this process the contrast of the image is increased so that any discontinuity that exists in the images i.e. in between the broken points of ridges and furrows can be eliminated. For the better distribution of the pixel values the histogram equalization method can be used to enhance the perceptional information. Ridge orientation: The core point in the fingerprint can be determined with the help of ridge orientation , the local ridge orientations in the images can be calculated. Filtering: A gobar filter with the frequency sensitive , frequency selective and orientation selective with optimal joint resolutions will have spatial and frequency domains . Core point detection: The orientation is used to get the corepoint so that we can perform alignment of the two fingerprints. The corepoint can also be detected with the help of point core index in orientation field .

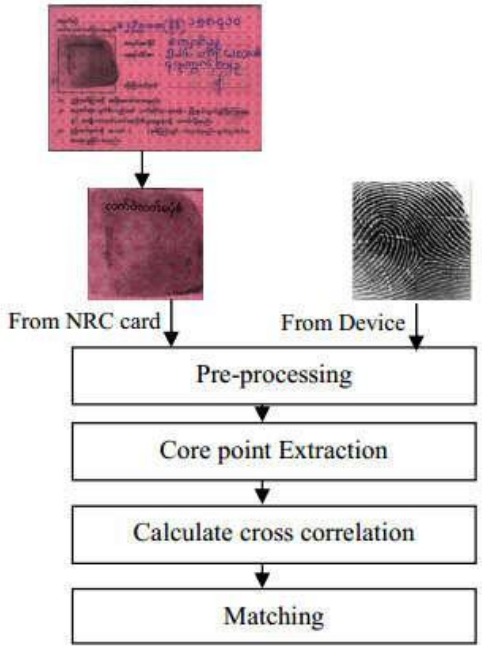

Figure 1.System for recognizing low quality images

Correlation matching: The similarity between the images can be obtained with the help of cross correlation. We can get the best points in the meeting of alignment of narrow area under reference point. This process will reduce the cost dramatically and price for processing.

III. A SYSTEM FOR FINGERPRINT MINUTIAE CLASSIFICATION AND RECOGNITION

[3].This method makes use of automated fingerprint recognition based on minutiae Artificial neural networks are used to extract minutiae .minutiae is one of the features that is used to classify a fingerprint The method follows a complex and parallel ANN

Minutiae classification and recognition system

It includes image acquisition, preprocessing, minutiae extractor, minutiae recognition

1) Image acquisition – it takes the input as the image

2) Preprocessing – it includes original image -> shading ->binarazation ->thinning

In this step a very good minutia contained image is presented

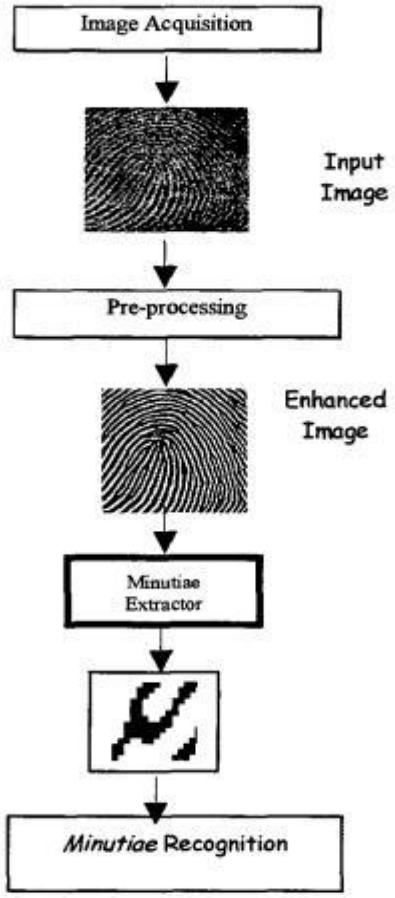

Figure 2.Minutia classification and recognition system

3) Minutiae extractor -- In this step a Neocognitron is trained with different types of 8 minutiae .

4) minutiae Recognition :

A) Control network: It mainly performs edge detection, line detection and end point detection. Control network is trained with different techniques so that it can detect lines and edges efficiently.

B) Recognition network: It is mainly composed of 3 layers, threshold value is set as 0.6 for edges and ridges.

There are mainly 8 classes and each classes are capable of detecting 20 samples of features. A high quality fingerprint may be able to provide different 35 classes.

IV. EFFICENT FEATURES EXTRACTION FOR FINGERPRINT CLASSIFICATION WITH MIULTILAYER PERCEPTION NEURAL NETWORK

[4].The back propagation method is used to train the ANN on a set of fingerprint algorithm. For the feature vector Pseudo zernize moments will be used for all the images.

The training set will be used to train the ANN and will be used to test on test set. The recognition rate is 100%

Figure 3. Sub images created using different values

Initially shape information with a new definition for the distance measure threshold called fingerprint candidate threshold is used for fingerprint localization. The fingerprint candidate threshold is used to differentiate fingerprint image and non fingerprint image

There may be irreverent data in the fingerprint image and that can be eliminated with the help of axis correlation , and it is also helpful for feature extraction.

The classifier used here is multilayer perception

Fingerprint Localization: The main aim of this method is used to find a object as fingerprint candidate whose shape resembles most of the fingerprint.

The edge information, print image or the region over which image is located are the information used by localization algorithm. This helps the system to be robust in presence of noise and changes occurring in the images. To find fingerprint region an ellipse model with five parameters are considered.

V. RECOGNITION OF FINGER PRINTS ENHANCED BY CURVELET TRANSFORM WITH ARTIFICIAL NEURAL NETWORKS

[5].The fingerprint of an image needs to be enhanced for better fingerprint matching.

There are 2 procedures which are proposed for finger print quality improvements.

Noise reduction filters and local histogram equalization are used in first procedure. Curverlet transform and wavelet transform is used in second procedure

1) Fingercode : Artificial neural network is used to develop this method for recognizing the fingerprint. Texture based matching is more suited for this procedure. Initially a reference point in fingerprint and circular region at the reference point is determined. The region of interest is circular region.

Fingercode is a feature vector which is collection of all the features of every sector in each image which is filtered

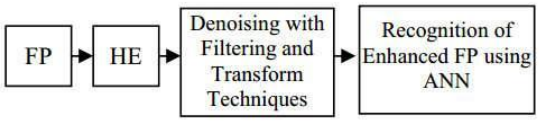

Figure 4. Different stages enhancement methods

2) *Fingerprint enhancement:* the clarity of ridges is important and it is enhanced by this method . In the received image a set of intermediate steps are applied which includes the combination of filters and the noise reduction techniques for preprocessing of images and post processing f the images.

3) Contrast enhancement: the contrast of the image can be enhanced by histogram equivalization. Once this technique is applied we will get 153 contrast values.

4) Filtering for fingerprint image denoising: The corrupted, individual pixels can be identified with the help of median filters, and these missing pixels are filled with the help of median of the neighboring valued pixels.

5) Fingerprint image denoising using wavelet transform: The elementary 2 channel filter bank which is 2 dimensions is used by wavelet transform for fingerprints, this will decompose the image into low pas and highpass subbands in each of the following vertical and horizontal directions .

6) Curverlet Transform for fingerprint image denoising : curverlet provides multi scanning and directional filters and it is extensions to wavelet transform . it is mainly used to captures smooth counters that occurs in natural images and are dominant features of the images .

Wavelets have the capability to capture only upto point discontinues where as curverlet have capabilities to extend up to linear segments and it uses very less number of confidents to repost the smooth contour.

ARTIFICIAL NEURAL NETWORK FOR FINGERPRINT RECOGNITION

It is “Decision by Learning “.

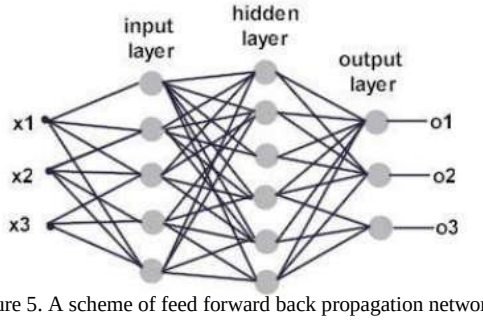

Figure 5. A scheme of feed forward back propagation network

Input layer- it is responsible for taking the input and providing the input to hidden layer

Hidden Layer – multiplexing the input signals by the weights of the neurons . a transfer function is used where value of neuron is calculated by passing sum of neurons

The local information in each sub image extracted and enumerated and a feature vector is created .The global relationship between local patterns are captured by Tessellations

VI A NEW FINGERPRINT RECOGNITION APPROACH USING ARTIFICIAL NEURAL NETWORK

[6]Recognition System: It mainly consists of two phases which includes a training phase and the testing phase.

In the training phase all the unnecessary information are stripped out leaving out the features which are necessary to useful. Only characteristics information will be leaved in the training.

In the testing phase, the obtained images with characteristics obtained from feature extraction are compared with the image models present in the database, which allows unknown characteristics to be identified.

The feature vectors are obtained from the conversion of digital IO signal into a sequence of numerical descriptor with the help of feature extractor. Linear predictor coefficients, linear predictive analysis are some of the examples of the feature extraction technique.

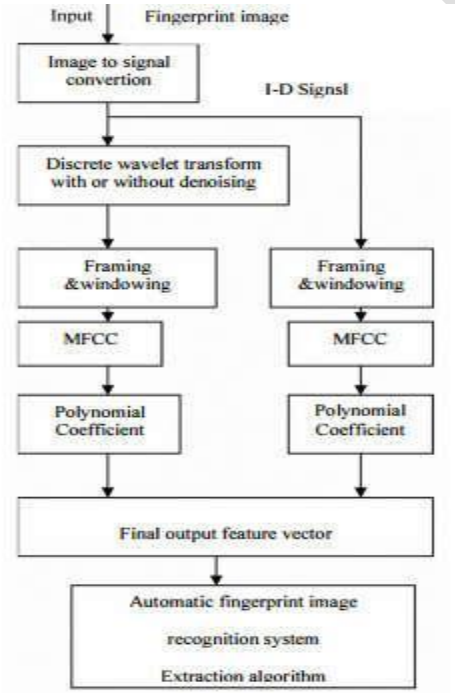

Figure 6.Wavelet Denoising

Classification of edges can be done using modeling and pattern matching. With the help of set of samples each image is modeled in the training mode resulting into set of recognition of set of feature vectors and served in the database

Windows and framing

The signal will be broken down into small sections of each of size N samples so that feature extraction must occur. These sections are called as frames. Depending on sampling data no of samples per frame are presented.

This windowing helps to increase the connectivity between the lines.

Pattern matching will be performed using artificial neural network . Multilayer perceptions are popular types of neural networks consisting of various layers .

The information in specific band pas channel are captured by Gabor filters, all the obtained feature vectors are found and compared with the finger code.

VI. CONCLUSION

The conclusion is that an image needs to be preprocessed for removing noise and surplus components, in which gabor filters can be used for preprocessing. ANN can be used to classify and match the fingerprint. For this training and testing the ANN is required. Wavelet can be used to identify important characteristics of an image. An obtained fingerprint is matched with a template stored in the database.

REFERENCES

[1] https://en.wikipedia.org/wiki/Fingerprint_recognition
[2] Z. M. Win,“ Fingerprint recognition for the low quality images” , SICE Annual Conference (SICE), 2011 Proceedings , Tokyo , 2011, p. 1133 - 1137.
[3] M. Arantes,“ a system for fingerprint minutiae classification and recognition” , Neural Information Processing, ICONIP '02. Proceedings of the 9th International Conference Proceedings , 2002,Vol 5, p. 1133 - 1137.
[4] I. El-Feghi,“ Efficient features extraction for fingerprint classification with multi layer perceptron neural network” , Signals, Circuits and Systems (ISSCS), 2011 10th International Symposium on) , lasi , 2011, p. 1 - 4.
[5] A. A. Altun,“ Recognition of finger prints enhanced by curvelet transform with artificial neural networks” Systems, Signals and Image Processing, 2013. IWSSIP 2013. 15th International Conference on, Bratislava , 2013, p.421 - 424.
[6] Zou Lihua.” a new fingerprint recognition approach using artificial neural network” , SICE E-Health Networking, Digital Ecosystems and Technologies (EDT), 2010 International Conference on, Shenzhen , 2010, p 295 - 298.