A Fingerprint Identification Approach using Neural Networks

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Abstract

Today, because of the vulnerability of standard authentication system, law-breaking has accumulated within the past few years. Identity authentication that relies on biometric feature like face, iris, voice, hand pure mathematics, handwriting, retina, fingerprints will considerably decrease the fraud, so that they square measure being replaced by identity verification mechanisms. Among bioscience, fingerprint systems are one amongst most generally researched and used. itś fashionable due to their easy accessibility. Moreover in this work the system modified to an adaptive system i.e intelligent by using neural networks.

Index terms— AFPR, biometric security, gabor filter, neural networks, etc.

1 Introduction

umans have used body characteristics such as face, voce, finger prints, Iris, etc. to recognize each other. Automatic recognition of these characteristics called a biometrics; now days it has become an active research area in pattern recognition. Over a decade's fingerprint is one of the oldest forms of biometric identification because of their uniqueness, consistency, the intrinsic ease in acquisition, distinctiveness, persistence and high matching accuracy rate. As we know, No two people have the same set of fingerprints even identical twins fingerprints. Finger ridge patterns do not change throughout the life of an individual. This property makes fingerprint an excellent biometric identifier and also can be used as forensic evidence. It has received more and more attention during the last period due to the need for society in a wide range of applications. Among the biometric features, the fingerprint is considered one of the most practical ones. Fingerprint recognition requires a minimal effort from the user and provides relatively good performance. Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity.

2 Figure 1.1 : Sample Finger Prints

Author : Research Scholar JJT University, India. e-mail : moorthypsm@gmail.com Basically Skin of human fingertips consists of ridges and valleys and they mixing together form the distinctive patterns. A fingerprint is the composition of many ridges and furrows. Fingerprints mostly are not distinguished by their ridges and furrows but are distinguished by Minutia which are some abnormal points on the ridges. Minutia is divided in to two parts such as: termination and bifurcation. Termination is also called ending and bifurcation is also called branch. Again minutia consists of ridges and furrows valley is also referred as follows.. Fingerprint recognition system has been successful for many application areas such as computer login, bank account recovery and cheque processing. But the fingerprint recognition system still faces with defect in accuracy rate. The primary objectives of the proposed system will perform more accuracy rate.

3 II.

4 Literature Survey

Dayashanka Singh et al. (2010) projected a completely unique technique of fingerprint matching supported embedded Hidden Andrei Markov Model (HMM) that\'s used for modeling the fingerprint's orientation field.

This HMM primarily based fingerprint matching approach exploitation solely orientation angle parameters. It includes 2 kinds of random finite method. One may be a Mark off process of finite state that describes the transfer from one state to another; the opposite describes the chances between states and observation knowledge. what\'s necessary to statistically characterize a HMM may be a state transition likelihood matrix, Associate in Nursing initial state likelihood distribution, and a group of likelihood density functions related to the observations for every state. Usually a HMM may be a 1-D structure appropriate for analyzing 1-D random signals. The embedded HMM includes 3 super states that represent 3 elements of a finger print from the highest to bottom. Every super state consists of 5 sub states (embedded states) horizontally. The performance is nice and strong. it\'s less sensitive to the noise and distortions of a fingerprint image than the traditional approaches during which the dependent parameters embody a lot of fingerprint details. Still this approach skipped the processes of cutting the ridge image and choosing trivia which can facilitate any noise reduction.

Qijun Zhao et al. (2009) projected pore matching technique that with success avoids the dependency of pore matching on point matching. Such dependency limits the pore matching performance and impairs the effectiveness of the fusion of point and pore match scores, so as to match the pores on 2 fingerprint pictures,{they square measure| they\'re} 1st pair-wise compared and initial correspondences between them are established supported their native options. The initial pore correspondences square measure then refined by exploitation the RANSAC (Random Sample Consensus) algorithmic program to convey the ultimate pore matching results. A pore match score is finally calculated for the 2 fingerprint pictures supported each the initial and final pore correspondences. Thus, the fusion of the point and pore match scores more practical in raising the fingerprint recognition accuracy. However this technique is its complexness in describing the pores.

5 Min et al. (2008) developed a brand new technique during which they used Fingerprint

Recognition System which mixes each the options extraction by applying a applied mathematics and pure mathematics approach system illustrates the process by considering elementary geometric terms, applied mathematics computation and conjointly it checks all of the options for input fingerprint image to attain higher accuracy share and to provide the connected info of input image properly from info. This technique takes less time for recognition of input image but by exploitation non-minutiae primarily based algorithmic program this technique will any be improved with a lot of authentications and fewer area memory usage.

6 III.

7 Methodology

A Number of different techniques are used for automatic classification of fingerprint. These classifications based on:? Singular Point ? Syntactic or Grammar Based ? Mathematical Model

The most natural topology for analysing fingerprint images is the topology of curves created by the ridge and valley structures. This necessitates the use of the analysis of properties of the curves or curve features. The approach presented in this paper is combination of biometric and Gabor filter.

8 Fingerprint sensing

There are two primary methods of capturing a fingerprint image:

1. Inked (off-line) and

9 Live scan

The most popular technology to obtain a livescan fingerprint image is based on optical frustrated total internal reflection (FTIR) concept. The ridges are in contact with the platen, while the valleys of the finger are not in contact with the platen.The laser light source illuminates the glass at a certain angle and the camera is placed such that it can capture the laser light reflected from the glass. The light touched by the ridges is randomly scattered while the light corresponding to valleys suffers total internal reflection. Consequently, the image formed on the plane of the CCD corresponding to ridges is dark and those corresponding to valleys are bright. More recently, capacitance-based solid state live-scan fingerprint sensors are gaining popularity since they are very small in size and inexpensive in the near future.

10 a) Capacitance-based fingerprint sensor

Essentially consists of an array of electrodes. The fingerprint skin acts as the other electrode, forming a miniature capacitor. The capacitance due to the ridges is higher than those formed by valleys. This differential capacitance is the basis of operation of a capacitancebased solid state sensor.

11 b) Feature Extraction:

A feature extractor finds the ridge endings and ridge bifurcations from the input the overall flowchart of a typical process is depicted in Figure ??. It mainly consists of three components. In any vision system the first stage is the image acquisition stage which is hardware dependent. A number of methods are used to acquire fingerprints. Among them, the inked impression method remains the most popular one. Inkless fingerprint scanners are also present eliminating the intermediate digitization process. In this process we generally use minutiae extraction algorithm achieved by Binarization method.

12 ii. Edge Detection

An edge is the boundary between two regions with relatively distinct gray level properties. The set of pixels obtained from the edge detection algorithm seldom characterizes a boundary completely because of noise, breaks in the boundary and other effects that introduce spurious intensity discontinuities. Thus, edge detection algorithms typically are followed by linking and other boundary detection procedures designed to assemble edge pixels into meaningful boundaries.

13 a. Histogram equalization

Histogram equalization is a technique for adjusting image intensities to enhance contrast. Let f be a given image represented as a mr by mc matrix of integer pixel intensities ranging from 0 to L ? 1. L is the number of possible intensity values, often 256. Let p denote the normalized histogram of f with a bin for each possible intensity. So pixels of number total n ensty with pixels of numberP n ______int ______= n=0,1,........L-1

The histogram equalized image g will be defined by( ) ? ? ? ? ? ? ? ? ? ? = ? = j i f n n j i p L floor g , 0 , 1

Where floor () rounds down to the nearest integer. This is equivalent to transforming the pixel intensities, k, of f by the function( ) ( ) ? ? ? ? ? ? ? ? = ? = k n n P L floor k T 0 1 b. Image Segmentation

There are two regions that describe any fingerprint image; namely the foreground region and the background region. The foreground regions are the regions containing the ridges and valleys. As shown in Fig. **??**, the ridges are the raised and dark regions of a fingerprint image while the valleys are the low and white regions between the ridges. The foreground regions ( ) ( ) ( )2 1 1 2 , 1) (?? ? = ? = W i W j k M j i I W k V ( ) ( ) ?? = = = W a W b b a J W k M 1 1 2 , 1

The background region possess very low greylevel variance value while the for ground region possess very high grey-level variance values. A block processing approach is adopted in this research for obtained the grey-level variance values .the approach in this research for obtaining the grey-level variance values. The approach firstly divides the imaged into block of size W*W and the varianceV(k) for each of the pixel in block K in obtained for I(i,j) and J(a,b) are the grey-level value for pixel i,jabd (a,b) respect in block k.

14 c. Binarization

The image obtained for the Gabor filters stage is binarised and thinned to make it more suitable for feature extraction. the method of image binarization sets the threshold (T) for making each cluster in the image as tight as possible, thereby minimizing their overlap to determine the actuial value of T.

The following operations are performed on set of presume treshold values:

1. The pixel is separated into two clusters according to the threshold. 2. The mean of each cluster are determined. 3. The difference of the means is squared. 4. The product of the number of pixels in one cluster and the number in the other is determined. The success of these operations depends on the difference between the means of the clusters. The optimal threshold is the one that minimizes the within-class variance. the within-class variance of each of the cluster is then calculated as the weighted sum of the variance for p(i) is the pixel value at location I, N is the intensity level and [0,N-1] is the range of intensity levels, the between class variance ,which is the difference between the within class variance and the total variance of the combine distribution is then denoted from ( ) ( ) ( ) ( ) ( ) ( ) ( ) T T n T T n T B B withinT T within between 2 2 2 ? ? ? ? = ( )[ ] ( )[ ] B T n A T n B 0 + = ( ) ( ) 2 µ µ ? = T A B ( ) ( )**2**) ( ) ( ) ( ) ( ) [ ] 2 0 0 2 T T T n T n T B B µ µ ? µ ? = = in ( )[ ] ( )[ ] B T n A T n B 0 + ( ) ( ) ( ) ( ) ( ) [ ] 2 . 0 0 2 T T T n T n T B B between µ µ ? ? = ( ) ( ) p T n T n B B + = + 1 ( ) ( ) p T n T n ? = + 0 0 1 ( ) ( ) ( ) ( ) 1 1 0 + + = + T n p T n T T B T B B µ µ ( ) ( ) ( ) ( ) 1 1 0 0 0 0 + ? = + T n p T n T T T µ µ iii. Thinning

Thinning algorithms can be divided into two broad classes namely iterative and non-iterative. Although non -iterative algorithms can be faster than iterative algorithms they do not always produce accurate results. Like other morphological operators, the behavior of the thinning operation is determined by a structuring element. The binary structuring elements used for thinning are of the extended type described under the hit-and-miss transform (i.e. they can contain both ones and zeros). The thinning operation is related to the hitand-miss transform and can be expressed quite simply in terms of it. The thinning of an image I by a structuring element J is:( ) ( ) J I miss and hit I J I thin , , ? ? ? =

Where the subtraction is a logical subtraction defined byNOT X Y X ? = ? Y iv. Feature Extraction

Extraction of appropriate features is one of the most important tasks for a recognition system. We are using back propagation algorithm to do this feature extraction. Feature Extraction can be performed by following techniques.

1. Gauss Network Method.
2. Gradient Method.
3. Numerical Method.

15 Directive Adaptive methods.

Feature extraction is concerned with the quantification of texture characteristics in terms of a collection of descriptors or quantitative feature measurements often referred to as a feature vector. It is desirable to obtain representations for fingerprints which are scale, translation, and rotation invariant. Scale invariance is not a significant problem since most fingerprint images could be scaled as per the dpi specification of the sensors. The present implementation of feature extraction assumes that the fingerprints are vertically oriented. In reality, the fingerprints in our database are not exactly vertically oriented; the fingerprints may be oriented up to away from the assumed vertical orientation. This image rotation is partially handled by a cyclic rotation of the feature values in the Finger Code in the matching stage. The feature data can be extracted from thinned fingerprint image, which generally includes the type (endpoint or bifurcation), absolute coordinates and direction of the feature point. Using the template shown in Figure 1, and the value of Cn and Sn are calculated (Cn is the cross number and Sn is the sum of 8 neighborhood pixels): If

16 P S

Estimate the block direction for each block of the fingerprint image with WxW in size (W is 16 pixels by default). The algorithm is:

1. Calculate the gradient values along x-direction (gx) and y-direction (gy) for each pixel of the block. Two Sobel filters are used to fulfill the task. 2. For each block, use following formula to get the Least Square approximation of the block direction.

After finished with the estimation of each block direction, those blocks without significant information on ridges and furrows are discarded based on the following formulas: 80(gx2+gy2) 3. For each block, if its certainty level E is below a threshold, then the block is regarded as a background block tg2ß = 2 ??(g x *g y)/??(g x 2 -g y 2) for all the pixels in each block. The formula is easy to understand by regarding gradient values along x-direction and ydirection as cosine value and sine value. So the tangent valueof the block direction is estimated nearly the same as the way illustrated by the following formula.

tg2?= 2sin?cos?/(cos 2 ? -sin 2 ?) v. Classification RBF Neural Network classifier has an ability to learn from their experience is the key element in the problem solving strategy of a pattern recognition task. A neural networks system can be seen as an information processing system composed of a large number of interconnected processing elements. Each processing element also called node, neuron calculates its activity locally on the basis of the activities of the cells to which it is connected. The strengths of its connections are changed according to some transfer function that explicitly determines the cell's output, given its input. The learning algorithm determines the performance of the neural networks system. It should be noted that this network configuration is designed to accept the weight values that are obtained by projecting a test images into image-space.

17 a. Parameter Estimation of RBF Neural Networks

Two important parameters are associated with each RBF unit, the center Ci and the width ?i

18 b. Center estimation

Each center should well represent each subclass because the classification is actually based on the distances between the input samples and the centers of each subclass. In our experiment, the mean value of the training samples in every subclass is chosen as the RBF center as follows? = = 1 1 1 n j i j i i P n C

Where i j P is the j th sample in the i th subclass and ni is the number of training samples in the i th subclass.

c. Width estimation The width of an RBF unit describes the properties of a subclass because the widt of a Gaussian function represents the standard deviation of the function controlling the amount of overlap of Gaussian function. Our goal is to select the width that minimizes the overlaps between different classes so as to preserve local properties as well as maximize the generalization ability of the network. In our experiment, the following method for width estimation is applied( ) ( ) { }, , i j d med i d med = i,j=1,2,.............u, j i ? k, l=1,2,.......s, l k ? ( ) k i l j C C j i d ? = ,

Where k Ci is the center of the i th cluster belonging to the k th class and dmed (i) is the median distance from the i th cluster to the centers belonging to other classes. The width ?i of the i th cluster is estimated as follows( ) ? ? ln i d med i =

Where ? is a factor that controls the overlap of this cluster with other clusters belonging to different classes. By selecting the proper factor ?, a suitable overlaps between different classes can be guaranteed. [1] [2]

12

Figure 1: Figure 1 . 2 :

13

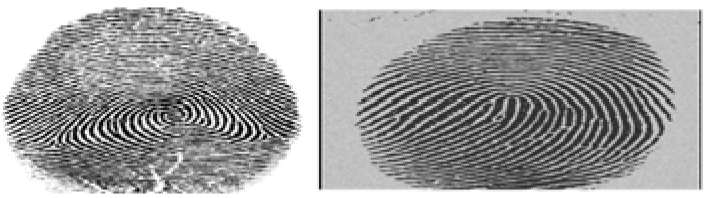


Figure 2: Figure 1 . 3 :

114

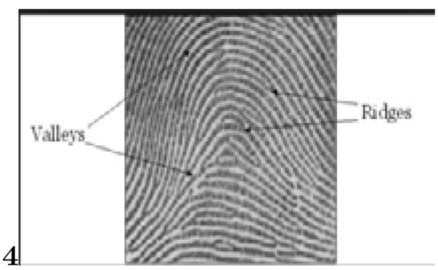


Figure 3: 1 .FFigure 1 . 4 :

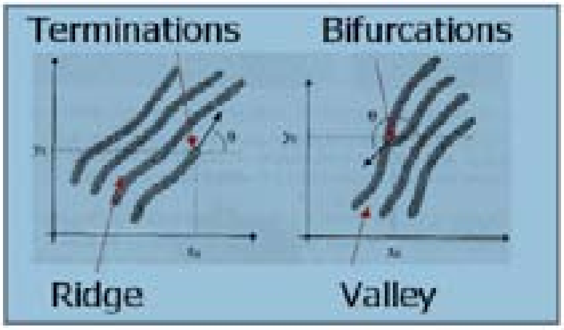
2 

Figure 4: 2 ?

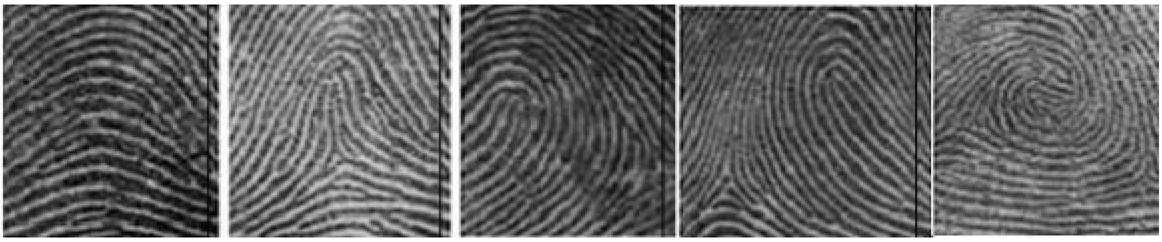
2 

Figure 5: 2 ?

Figure 6: (

Figure 7: SF

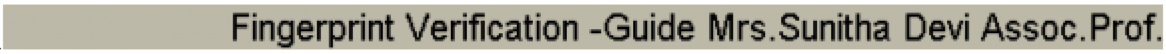
1 

Figure 8: t 1 ,FR

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