An Analytical Study of Fingerprinting Detection using Artificial Neural Network

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Abstract - **The use of biometric identification is widely used in our daily life as growth of Information technology as well as computer science. This is the authentication system. The uniqueness of fingerprint for every human we need for faultless identification. However, at the time of fingerprint scanning process, image generated by scanner is marginally different during each scan. In this paper we studied of Artificial Neural Network which is used to matching algorithm for fingerprint authentication. Using Back-Propagation technique, the algorithm works to match twelve fingerprint parameters and relate them a unique number provide to the authorize user. Using matching algorithm it gives best match of fingerprint.**

Keywords: Fingerprint, Biometric, Artificial Neural Network, Back-Propagation, edge detection.

I. Introduction

Fingerprint detection is Physiological feature and may be observed as grain design formed by crinkle skin sense on the exterior of various substances and the paper deals with execution of a pattern matching algorithm for match and verify fingerprints. This matching algorithm uses Artificial Neural Network concept to execute constructive pattern matching to detect fingerprint. Artificial Neural Network is nothing but the computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the Artificial Neural Network because a neural network changes in a sense based on that input and output.

The concept of image processing detects twelve fingerprint trait using fingerprint survey by a very brief period of time. Fingerprint processing must return match of this each trait. Through the any set of correlate traits values may be the similar for the two individuals. But the mixture of all twelve values may not be the same. Hence distinctive and effectual identification parameter is found for each individual.

In this paper we also followed the concept of fingerprint ridges. Fingerprint is nothing but the graphical grain of ridges. Due to the distinctiveness of fingerprint this is the most reliable human characteristic which is used for private identification. The presentation of an automatic fingerprint identification system depends steadily on the fingerprint image standard which can be over flown by many parts as like existence of mark. In that time of acquisition process, a change of the pressure between fingerprint and acquisition sensor, worn relic and environmental condition. To buildup the attractive fingerprint detection to use fingerprint enhancement algorithm is necessary.

Directional bearing is a special characteristic in a fingerprint image trigger by the continues flow of fingerprint ridges. Where the orientation goes slowly to get change in fingerprint grain. Ridges and valleys are close to each other to form a sinusoidal wave, which gives a proper frequency and orientation. Both are maintain in small area.

There is the step to detected fingerprint; first we detect the orientation of ridges. Secondly we go to smoothing operation of fingerprint along with to removing noise errors. Ridges orientation may be directly move with gray scale image using gradient method. Other requires binary operation and smoothing operation may be done with various filters.

II. Elementary Step of Fingerprint Detection

2.1 Fingerprint icon

Fingerprint is nothing but attribute of one finger. Everyone have own fingerprints with its own constant singularity. Due to this specialty of each fingerprint it may reliable human guts that can be used for private identification.

2.2 Fingerprint Acquisition

There is the more method that used to acquire the fingerprints. Among them, one of the inked impression method which most of the time used and another is the inkless method which is done by the scanner. It is used as the digitization process. The quality of the fingerprint is most valuable because it directly affected to the tiny extraction of fingerprint algorithm. Approximately size of the scan fingerprint in research is 188 X 240 pixels. Another approach

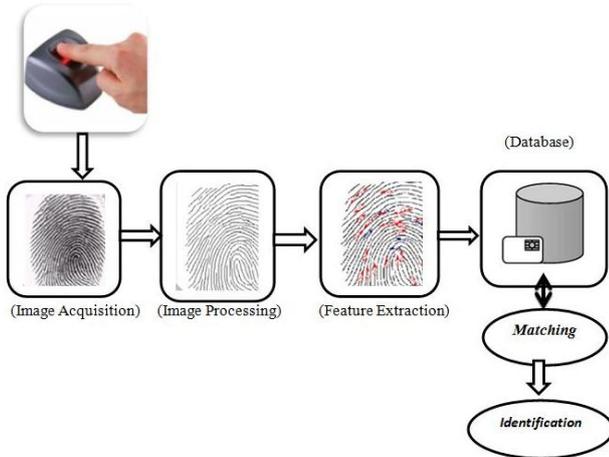is that we have directly taken fingerprint using Bio-metric hi scanner.

Figure 1: Steps for fingerprint detection

This is correlating with the software. We have collecting image from the publicly available database.

2.3 Fingerprint Image processing

Fingerprint processing is necessary for the quality of image. First it gives clarity of fingerprint ridges. And second to improve the integrity. Also maintain fingerprint normalization, Binarization, enhancement. Fingerprint processing image first we have to go with capture fingerprint image and convert with digital performance of 256 gray scale. Image should be clear. The binary image is further enhancing by thinning algorithm which reduces the image ridges to a skeleton structure. After obtaining the binary form the image cased skin fold, spreading ink.

2.4 Fingerprint Image enhancement

There is need of the concept of fingerprint image enhancement because activity depends on the quality of image. Degradation types – ridges are not continuous, equal ridge. And not well separated, cut and inks problem. Fingerprint enhancement goes with various steps like:

1. Image segmentation
2. Local Normalization
3. Image filtering
   - Orientation Estimation
   - Ridge frequency
   - Gabor filtering
   - Image Binary/thinning

Local ridge expansion it is a property of fingerprint image. To view the fingerprint texture, there is a more method

are available to oriented the image. Previous observation we use as local orientation filter based on Gabor filter based. Gabor filter is move to the particular range and orientation values. This filter is enhancing the ridge moment of local orientation to presence ridge structure.

"It plays as a local band-pass filter with surely optimal joint localization specification in both spatial domain and frequency domain". Gabor filter termed used for detect the corrupt image.

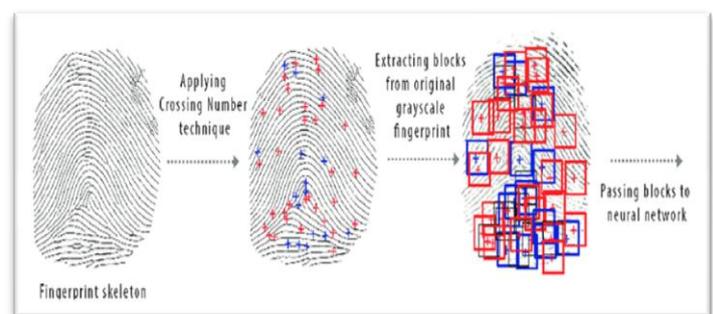## III. Extraction using Neural Network

Figure 2: Detection of fingerprint skeleton and extraction of small block on fingerprint using artificial neural network

We use as a new method known as extraction method. This method used with artificial neural network. Once the process of fingerprint enhancement was completed. After that fingerprint pattern assign to the acquisition section. Because, we detect most difficult blocks of the fingerprint. Blocks are present is some possible place. Crossing method is most of the time used in simple fingerprint detection.

Pixels are present into the blocks in a original image. We passed the input layer of neural network extraction. 11X11 blocks of the fingerprint image. In an extraction of neural network uses input layer which contains 121 input elements. Which contains 200 neurons which same as the neural network of acquisition feature? The 11X11 block of image fingerprint extract only ridges. Bifurcation and termination which work as solution of other methods.

3.1 Matching

After the organization of all image blocks in the original fingerprint. A last one attribute is vector and every step of extraction is represented by its p and q coordinate. The vector is passed to the BOZORTH3 algorithm for matching. This algorithm is open source so we can use as matching algorithm. This algorithm compare two fingerprint which varies a range 0-999 where o is no similarity and 999 is possibility of similarity.

3.2 Database

Database indicates that the vector form of the database with a very top similarity score and exceeding decision threshold is resulting identity of the unknown fingerprint.

IV. Fingerprint Edge Detection

Our fingerprint required lots of edges which gives the uniqueness of fingerprint image. Edges having its own specialty known as object boundaries. Accurate edges helps to identify feature and object edge symbol and location can be seen the attractive representation of instance.

We can extract the polygonal shape from boundary of object. We have three types of detection: points, lines and edges. We use the gradient operator, sobel operator. Both operators performs 2-d spatial gradient on image. These operator related with frequency correspond to edges.

HX=   HY=

-1	-2	-1
0	0	0
1	2	1

-1	0	1
-2	0	2
1	0	1

V. Fingerprint Normalization Algorithm

Normalization means the process to recognize data in a database. So we can meet two requirements that is redundancy of data and data dependencies. A proper fingerprint image having a quality, ridges and valleys.

Let's take example we want fingerprint on card so we have clear image of fingerprint. When you put the finger skin on card. It take the impression of your skin finger, after that we remove the finger from card take the impression of ridges as continues flow of white color. But as per the truth condition, it scans the fingerprint by using scanning device. Even the National Institute of Standard and technology fingerprint scanned by the ink impression on scan card but it is not perfect, arise minute extraction. And the uneven distribution pixel arise the problem of ridge orientation. To solve this algorithm used, it used to decrease the gray scale between ridges and valleys of fingerprint image without changing structure.

We take I(p,q) and the gray scale value. Pixel(p,q) M and VAR denote the estimate mean and variance as respectively G(i,j) denote the uneven normalized gray scale level value at pixel(p,q).

$$N(i,j) = \begin{cases} M_0 + \sqrt{\dfrac{V_0(I(i,j) - M)^2}{V}} & if\ I(i,j) > M \\[2ex] M_0 - \sqrt{\dfrac{V_0(I(i,j) - M)^2}{V}} & otherwise \end{cases}$$

Figure 3: formula of fingerprint Normalization

Where Mo and VAR is nothing but the desirable mean and variance of fingerprint image. This algorithm performs pixel wise operation it does not affect on the structure of fingerprint and clarity of ridge and valleys. Normalization algorithm used for to highlight the ridges.

VI. Fingerprint Binarization

Binarization is the process of to converting gray scale image into binary image is called Binarization. Binary means the value 0 & 1 forms global threshold algorithm is used for performing the Binarization process.

We move to the each pixel on the fingerprint image and deciding. Where it should be black or white. That is

"1 for gray scale to black and white image of each pixel value compared with threshold level then pixel value zero. Otherwise is set to 255".

Figure 4: Example of fingerprint Binarization

VII. Fingerprint Feature Extraction with Moments

Moments invariants are important shape in computer vision. There are two shape descriptors: 1. Contour based shape descriptor 2.region based shape descriptor Regular moment invariants are one of the most popular and used contour shaped by Hu A computer vision system recognize object to capture image using geometric moment.GM inherited from algebraic moment. It extract feature of image using Rotation scale translation.

7.1 Why use Neural Network

Neural network used for to solve the problem where algorithmic method are too computational intensive or not

exit. The problem of feature extraction to be suitable application for neural nuts. They provide significant speed advantage over conventional techniques.

7.2 Overview of Neural Network

Neural network is computational structure which is used for biological neural processing. Neural Network is providing the mechanism known as learning algorithm. The neural network helps to the system which understands all things as human do. In this we use the graph node as neurons connected by weighted edges (synapse).

There are the different types of neural network. Nothing but simple to complex. There are the many theories based on neural network process. Neural network has various type of layered. This layer is work as on element more dependent on data it receives and passes to the result. This process is repeated again as computational data pass to next layer as result. As first layer, and middle layer between first and last layer has hidden.

The each element of processing unit is some as neurons of human brain. Hence it refers to the artificial neurons. Threshold function used for to qualify the output from output layer.

Following steps are possible in neural network.

- Start with one set of weight and run the network.
- Start with set weights, run network and modify some and network with new weight repeat this step until output step.
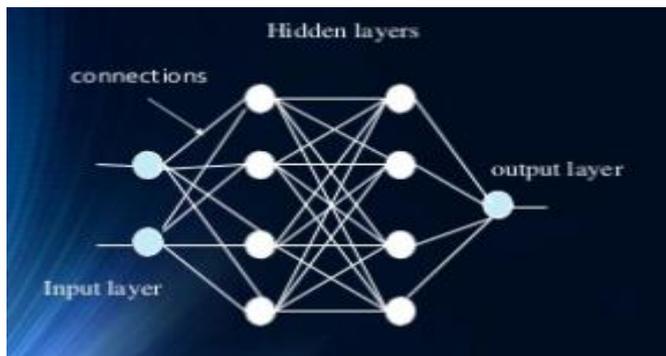

Figure 5: Artificial neural network

VIII. Fingerprint Classifier

Classification is the last stage of image processing system where each unknown pattern is assigned category. The degree of difficult classification problem depends variability feature value. In this we study the MLP as pattern classifier used as pattern.

MLP has termed a universal approximate and can provide an optimal solution to an arbitrary classification problem. Pairing of two finger and assign the numerical value to the patterns.

8.1 Training

When output is not be expected then weight need to be altered. There are some rules to determine how to alter the weight. The process using to change weights or update known as training.

The training follows ladder with an element of training:

- The first input pattern is present the network.
- The connection will adjust to recognize pattern.
- The second pattern is passing and step second is repeated.
- All process will run 1000 of time.

IX. Back-Propagation

The back-propagation algorithm used in layered feed-forward artificial network. Back-propagation is a multilayer feed forward, supervised learning network based on gradient descent learning rule. We provide the algorithm with examples of the input and output. We want to the network to compute, and them error is compute.

The idea of the back propagation algorithm is to reduce this error until the artificial neural network learns training data. In an input layer the input pattern which is presented on the net and the net is run normally, that we see what actual output produce.

Compare the actual output for that input pattern. We have to compute the error for the output layer. We use the following formula and apply it. For every nod of I in the output layer.

$Ei = 1/2\sum(Yi-Di)2$

Back-Propagation Formula as,

Where,

Ei is the error for node i in output layer
Yi is the activation node i in output layer
Di desired output in output layer

X. Conclusion and Future work

The overall paper described that the verification and authentication term. For some previous year fingerprint has been one of the most useful method for the human recognition. In that century biometric used for verification.

Fingerprint has a board acceptance with general public, law and forensic scientist. Here we described a fingerprint based biometric identification system using artificial neural network of a critical decision. To specialty of configured properly it can calculate the variations in the fingerprint t image and that way provide it require input for the verification and authentication.

The future work have a lots of work to identified the fingerprint using artificial network as increasing the growth of lots of technology using internet of things, artificial intelligence . As per the advancement of technology have led to next generation of fingerprint which rapidly and accurate. Advancement is that fingerprint can capture by its shadow of fingerprint.

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