International Journal of Advance Study and Research Work (2581-5997)/ Volume 2/Issue 3/March 2019

A Cost-Effective Method for Blood Group Detection Using Fingerprints

[1]Dr.D.Siva Sundhara Raja and [2]J.Abinaya
[1]Associate Professor and Head, [2]Student
Electronics and Communication Engineering,
SACS MAVMM Engineering College, India.
Email Id: [1] ssrrvs@gmail.com, [2]gkmabinaya@gmail.com

DOI: 10.5281/zenodo.2591955

Abstract

In this latest automated world, it has become more and more essential to keep people in a protected way. This paper proposes an important scheme of blood group detection using a fingerprint. There are five feature extraction used in the fingerprint images and represented using a mathematical model. In this paper, we have increased the efficiency of fingerprint matching by combining GLCM based feature extraction, wavelet feature extraction, laws of texture feature extraction and minutiae feature extraction with Back Propagation Neural Network based matching. Once the feature extraction is collected, a database containing other fingerprints are built the extracted features are compared with the Neural Network Classification with the previously available set of fingerprint images. So Depending on the similarities close that is whichever fingerprint gets the highest match with the given input image, we declare the result of the fingerprint blood group it actually belongs to.

Keywords: Blood group, fingerprint, features, match, classifications.

Introduction

The majority of the diseases in the human body are detected and diagnosed through blood tests. Blood plays an important role in regulating the human body's system and life. A person's physical and behavioral characteristics are called Biometrics and it is used for identification and authentication purposes in computer security. With the advancement of technology, computers are used in a lot of places like identification, authentication, and other security purposes. When we estimate to the inconsistent biometric techniques because of many reasons such as ease of obtaining, difference and durability, also the fingerprint sensors are little in size and economical when we compare with other biometric sensors. A person can be uniquely identified by the process of Biometric verification. Examples of Biometrics include face recognition, fingerprints, palm prints, DNA etc. Among this fingerprint recognition is one of the important and widely used Biometric systems and it is used in a lot of places like banks, organization's and even in forensic departments to track the criminals.

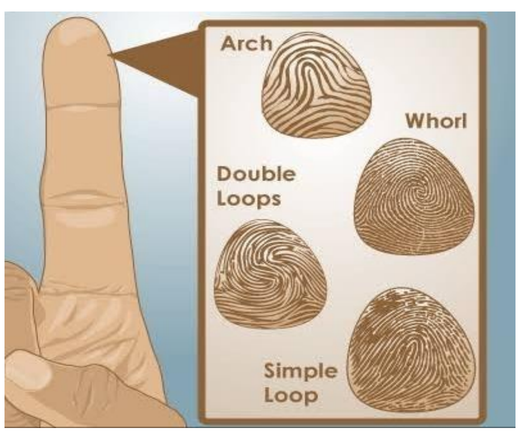


Figure 1 Fingerprint

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

Human fingerprints can be divided into three main categories as loops, whorls, arches, as depicted in Fig.1. In loops, it occupies approximately 65% in our fingerprint. Whorls occupy approximately 30% in our fingerprint. Arches are the simple pattern, but rarely occupy 5% in our fingerprint. The initial step to do fingerprint recognition is the process for entering the biometric data to the database as an arrangement, then the fingerprint will go under the identification or verification process. The person's fingerprint will be verified with the database for the verification process.

Literature Survey

Bajaj et al. (2016) developed a technique for Fingerprint recognition in order to determine gender. The authors used the Feature extraction technique to recognize the fingerprint. The authors obtained 98.55 %of recognition rate of their proposed method. Manidipa Saha (2013) established an efficient scheme of fingerprint recognition using texture features for biometric identification of individuals. The authors used three statistical features to extract from fingerprint images. Lavanya (2011) progressed a Performance Evaluation of Fingerprint Identification Based on DCT and DWT using Multiple Matching Techniques. The authors used FDDMM algorithm for the Fingerprint verification. Mousmi (2013) developed a technique for Fingerprint Identification Using Minutiae Matching. The authors used the Minutiae extraction algorithm to recognize the fingerprint. Neha Jaiswal (2014) improved the Image Compression Using Back Propagation Neural Network. The authors used Backpropagation neural network algorithm. Backpropagation neural network algorithm helps to increase the performance of the system and it will reduce the training time of the neural network.

Proposed Methods

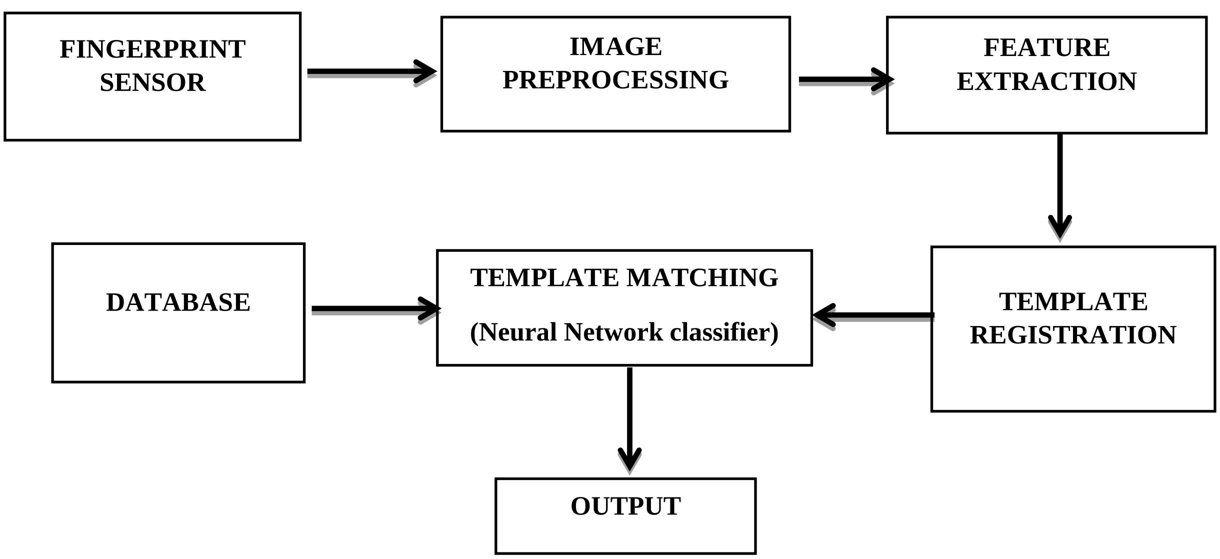


Figure 2 Proposed method for blood group detection using fingerprint

3.1 Fingerprint Sensor

There are so many sensors among that biometric fingerprint sensor (R305) is used to capture the fingerprints and then captured image is factored by the following image processing techniques. When the light clashes the circumference between two clear media at a great enough angle, all the light is repeated, rather than propagated. This is called Total Internal Reflection.

Biometric fingerprint sensor (R305) operates on the principle of (FTIR) Frustrated Total Internal Reflection.

3.2 Image Preprocessing

The proposed work consists of the following stages as preprocessing, feature extraction and classification, as depicted in Fig.2. Image Preprocessing is the technique to perform some operations for enhancing images prior to computational processing. It is a technique which is used to cover up the information that is not pertinent to the image for further processing. The preprocessing steps include the following: image enhancement, image resizing process and thinning process. Image enhancement process rectifies

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

the clarity of ridges and valley structure in the fingerprint image. In this proposed work, histogram equalization method is used. We have taken two types of blood group. Table 1 shows the output of the original image.

Table 1: Output of the original image

B +ve Image	O +ve Image
	

Image resizing is used to enlarge or compress the total number of pixels. So that it has the specified number of rows and columns.

$$\boldsymbol{Resized\ image\ I} = \boldsymbol{imresize}\ (\boldsymbol{I}) \qquad \text{------- (4.1)}$$

The lens distortion is done when we zoom the lens, it will turn into curved shape instead of the sharper shape. Table 2 shows the output of resizing image.

Table 2: Output of resizing image

B +ve Image	O +ve Image
	

Thinning is a morphological operation that is used to get rid of choosing front picture elements from binary images. Table 3 shows the output of thinning image.

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

Table 3: Output of thinning image

B +ve Image	O +ve Image
	

Feature Extraction

Further, feature extraction is a method of capturing the visual content of images for indexing and healing. The approaches are based on

- GLCM
- Wavelet Features
- Laws of texture features
- Minutiae Extraction

4.1 GLCM

GLCM Matrix at 45degree

1	5	3	4
2	2	4	1
3	4	5	5
4	2	1	2

GLCM	1	2	3	4	5
1	0	1	0	0	0
2	0	0	0	1	1
3	1	1	0	0	0
4	1	0	0	0	1
5	0	1	0	1	0

Figure 3 GLCM diagram

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

Table 4: GLCM features for different blood group fingerprint

B +ve image	Image
Contrast	0.5835
Correlation	0.8308
Energy	0.3041
Homogeneity	0.8364

O +ve image	Image
Contrast	0.3425
Correlation	0.7545
Energy	0.2545
Homogeneity	0.8585

4.1.1 Contrast

$$f1 = \sum_{i,j} |i-j|^2 \mathrm{p}(i,j) \quad \text{-------- (4.2)}$$

Where i is the number of rows and j is the number of columns.

4.1.2 Correlation

$$f2 = \sum_{i,j} \frac{(i-\mu_i)(j-\mu_j)p(i,j)}{\sigma_i \, \sigma_j} \quad \text{------- (4.3)}$$

Where μ is the means and σ is the standard deviations.

4.1.3 Energy

$$f3 = \sum_{i,j} p(i,j)^2 \quad \text{----- (4.4)}$$

Where i is the number of rows and j is the number of columns.

4.1.4 Homogeneity

$$f4 = \sum_{i,j} \frac{p(i,j)}{1+|i-j|} \quad \text{---------- (4.5)}$$

Where i is the number of rows and j is the number of columns

4.2 Wavelet Transform Approach

4.2.1 2D-Discrete Wavelet Transform (2D-DWT)

The Wavelet Transform is used to decompose the signal that is, it will slice by its layer. Generally, decomposition levels are 4 bands in the Wavelet transform. There are approximation band, horizontal band, vertical band, and diagonal band. The approximation band consists of two things that are a low-frequency signal and noise. The other three bands consist of high-frequency signal in order to reduce the noise from the low-frequency signal we apply the wavelet Transform again. This time the noise is completely separated from the low-frequency signal.

$$f \rightarrow \left(a^D \middle| d^D\right) \quad \text{--------- (4.6)}$$

$$b^D = \left(b_1, b_2, \dots, b_{N/2}\right) \quad \text{------------ (4.7)}$$

$$c^D = \left(c_1, c_2, \dots, c_{N/2}\right) \quad \text{----------- (4.8)}$$

Where D is the decomposition level, b is the approximation sub-band and c is the detail sub-band.

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

LL	HL
LH	HH

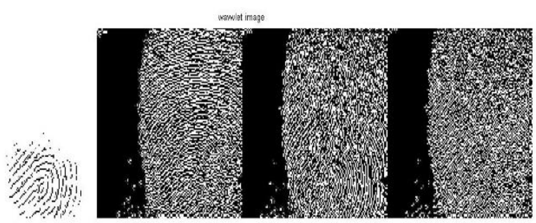
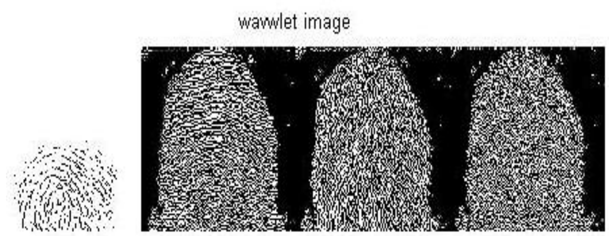
(*a) Decomposition Level 1*

<table>
<tr><td>LL</td><td>HL</td><td rowspan="2">HL</td></tr>
<tr><td>LH</td><td>HH</td></tr>
<tr><td colspan="2">LH</td><td>HH</td></tr>
</table>

(b) Decomposition Level 2

Figure 4 Decomposition level using discrete Wavelet transform

Table 5: Wavelet features for different blood group fingerprint

B +ve Image	O +ve Image
	

4.3 Laws of Texture Features

In this paper, the methods of the Fingerprint Recognition are discussed. As datasets of the fingerprints are black & white images, so here I extract the features of texture. Here I use texture features like Entropy, Energy & Correlation.

4.3.1 Entropy

$$En = -\sum_{j=1}^{k} p_j log_2 p_j \quad \text{--------- (4.9)}$$

Where, p_j is the probability that the difference between two adjacent pixels is equal to j an log_2 is the base 2 algorithm.

4.3.2 Correlation

$$c_{t=\frac{A}{B}} \quad \text{-------- (4.10)}$$

Where, $A = \sum m \sum n(imn - i)(jmn - j)$ **--------- (4.11)**

$$B = \sqrt{\{\sum m \sum n(imn - i)^2\}\{\sum m \sum n(jmn - j)^2\}} \quad \text{---------- (4.12)}$$

Table 6: Texture features for different blood group fingerprint

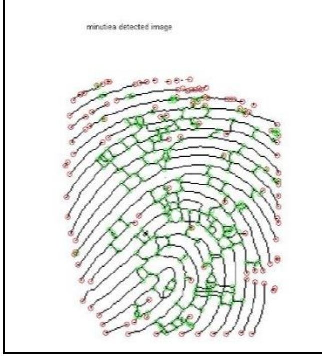
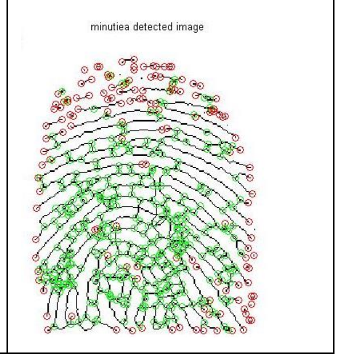
S.NO	FEATURES	B+	O+
1.	Energy 1	6.698	5.744
2.	Energy 2	1.203	1.676

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

4.4 Minutiae based approach

The Major features of the fingerprints like ridge endings, ridge bifurcations are called Minutiae. Minutiae states the difference between one fingerprint from another fingerprint. A ridge ending is where the ridge abruptly terminates whereas ridge bifurcation is where the ridge divides into two or more branches. The extraction of minutiae becomes more challenging because of the noise present and deficiency of contrast in the image. Table 7 shows the output of Minutiae Extraction.

Table 7: Minutiae feature for different blood group fingerprint

B +ve Image	O +ve Image
	

Classifier

5.1 Existing Method

In this existing system, SVM classifier is used for blood group detection using a fingerprint. It works really well with a clear margin of separation. It is effective in high dimensional spaces. It produces less accuracy.

$$K(Y, Y') =< \Phi(Y), \Phi(Y') > \qquad \text{-------- (5.1)}$$

Where K is the kernel function and Y→H is the dot product.

5.2 Proposed Method

On the Template Registration stage, feed forward Back Propagation Neural Network classifier (BPNN) is used. Neural Network is a system or hardware that is designed to operate as a human brain. It is used for applications like translating the text, identifying faces, recognizing the speech and controlling robots etc. Neural networks are inspired by the brain. The neuron is defined as the thing that holds a number specifically a number between 0 and 1 really not more than that. There are 3 different layers in the neural network input layer, hidden layer, and the output layer. The first layer is the Input layer it picks up the input signal and passes them to the next layer. A couple of layers between the input layer and the output layer is the hidden layer. The second layer is the hidden layer and it does all the calculations and feature extraction. The last layer is the output layer it delivers the actual output and from the output received, we will backpropagate the error to the input layer. It means if you feed image lighting up all the neurons in the input layer according to the brightness of the image. That pattern of activations passes some specific pattern in the next layer which passes to another layer and finally gives some pattern in the output layer.

The workflow of the neural network consists of seven steps. In the first step, the data are collected that is, it is loaded to the database. The neural network is created after the data is collected in the database. Then Network is configured (selection of network architecture) and then the weights and biases are initialized. In the next step the network is trained and validated (testing and performance evaluation) and finally it displays the result of the neural network classifier.

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

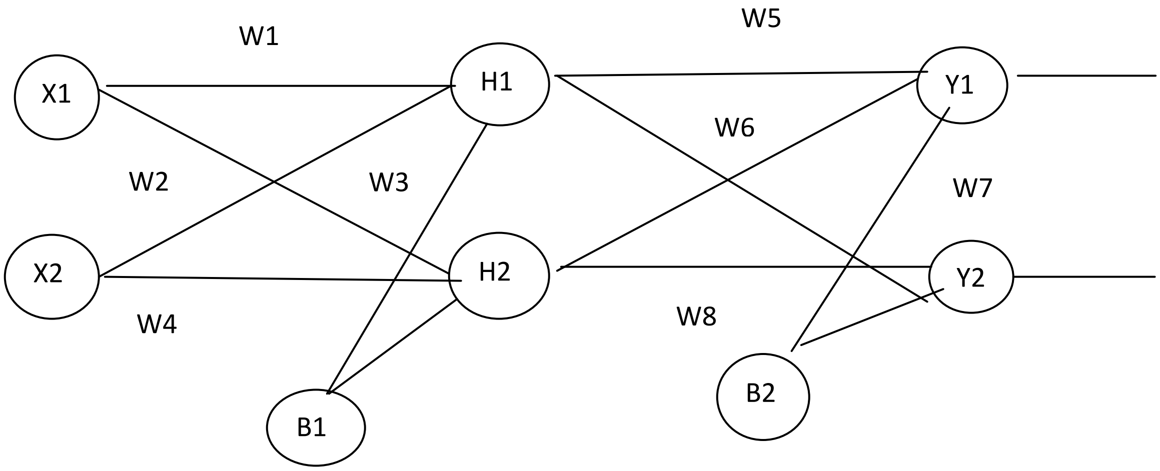


Figure 5 Back Propagation Neural Network of the Proposed Method

5.2.1 Forward Pass:

The Back Propagation Neural Network diagram is depicted in Fig.5The formula for calculating the output of the hidden layer of the input layer is

$$H_1 = X_1 * w_1 + X_2 * W_2 + b_1 \qquad \text{------- (5.2)}$$

Where H is the number of hidden layers, X is the number of input layers, W is the number of weights and b1 is the bias. We apply an activation function to get the output from the hidden layer or output layer at every node in the middle of the network.

$$\text{The activation function is } sigmoid = \frac{1}{1+e^{-H}} \qquad \text{------ (5.3)}$$

$$out\ H_1 = \frac{1}{1+e^{-H_1}} \qquad \text{------- (5.4)}$$

$$out\ H_2 = \frac{1}{1+e^{-H_2}} \qquad \text{-------- (5.5)}$$

Where H_1 and H_2 are the hidden layers.

For calculating the output layer

$$Y_1 = outH_1 * W_5 + outH_2 * W_6 + b_2 \qquad \text{------- (5.6)}$$

Where out H is the number of outputs of the hidden layers, X is the number of input layers, W is the number of weights and b1 is the bias.

$$\text{The activation function is } sigmoid = \frac{1}{1+e^{-Y}} \qquad \text{-------- (5.7)}$$

$$out\ Y_1 = \frac{1}{1+e^{-Y_1}} \qquad \text{-------- (5.8)}$$

$$out\ Y_2 = \frac{1}{1+e^{-Y_2}} \qquad \text{--------- (5.9)}$$

Where Y_1 and Y_2 are the output layers.

Calculating the total error

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

$$E_{Total} = \sum \frac{1}{2}(Target - Output)^2 \qquad \text{-------- (5.10)}$$

$$E1 = \frac{1}{2}(T_1 - outY_1)^2 \qquad \text{---------- (5.11)}$$

$$E2 = \frac{1}{2}(T_2 - outY_2)^2 \qquad \text{-------- (5.12)}$$

Where E1 and E2 are the numbers of error rates.

It produces more accurate when we compare with the existing method.

Results

We are taking 2 types of blood group one is so positive and another is B positive images. The approach is tested over a dataset of 4 images in each blood group and is seen to provide accurate recognition results. Table 8 shows the training set of o positive fingerprints. Table 9 shows the training set of B positive fingerprints. Table 10 shows the training set of both o positive and B positive fingerprints.

Table 8: Output of Training set

O +ve Image			
			

Table 9: Output of Training Set

B +ve Image			
			

Table 10: Output of Testing Set

B +ve Image	**O +ve Image**	**B +ve Image**	**O +ve Image**
			

© 2019, IJASRW, All right reserved
http://www.ijasrw.com

After testing the fingerprint images with the training set of fingerprint images and the approximate result of 80% of matching is achieved.

Conclusions

This paper has proposed a quick and efficient technique of blood group detection using a set of features of the fingerprints. The features are derived from GLCM, wavelet transform, laws of texture feature and minutiae detection. Once we obtained the feature extraction it is sent to the Neural Network Classifier, where we match by comparing images with the pre-existing database. Increase the clarity of the images further for better results.

References

[1]. Mouad.M.H.Ali, Vivek H. Mahale, "Fingerprint Recognition for Person Identification and Verification Based on Minutiae Matching," *IEEE 6th International Conference on Advanced Computing*, 2016, pp. 332-339.

[2]. Rakesh Verma, "Wavelet-Based Fingerprint Authentication System: A Review," *An International Journal (ELELIJ)*, Vol 5, No 1, 2016, pp.61-72.

[3]. Neha Jaiswal and Shivdan Singh, "Image Compression Using Back Propagation Neural Network," *International Journal of Scientific Engineering and Research (IJSER)*, 2014, pp.61-64.

[4]. Manidipa Saha, Jyotismita Chaki, Ranjan Parekh, "Fingerprint Recognition using Texture Features, " *International Journal of Science and Research (IJSR)*, 2013, pp.265-270.

[5]. Lavanya B N and Raja K B, "Performance Evaluation of Fingerprint Identification Based on DCT and DWT Using Multiple Matching Techniques," IJCSI *International Journal of Computer Science* Issues, 2011, pp.275-283.

[6]. S.Mousmi and Dr. T. *Meyappan, "*Fingerprint Identification Using Minutiae Matching," *International Journal of Engineering Trends and Technology (IJETT)*, Volume 4, Issue 6,2013, pp.2746-2750.

[7]. Jin Fei Lim, Renee Ka Yin Chin, "Enhancing Fingerprint Recognition Using Minutiae-Based and Image-Based Matching Techniques," First *International Conference on Artificial Intelligence, Modelling & Simulation, 2013*, pp, 226-231.

[8]. Manu Garg, Er. Harish Bansal, "Fingerprint Recognition System using Minutiae Estimation," *International Journal of Application or Innovation in Engineering & Management (IJAIEM)*, Volume 2, Issue 5,2013, pp.31-36.

[9]. Mohanaiah, P. *Sathyanarayana, "* Image Texture Feature Extraction Using GLCM Approach,*" International Journal of Scientific and Research Publications*, Volume 3, Issue 5,2013, pp. 1-5.

[10]. Benazir K.K, Vijayakumar , " Fingerprint Matching by Extracting GLCM Features," *International Journal of Computer Applications (IJCA)*,2012, pp.30-34.

© 2019, IJASRW, All right reserved
http://www.ijasrw.com