International Journal of Engineering Research And Advanced Technology (IJERAT)
ISSN:2454-6135 [Volume. 03 Issue.6, June – 2017]
www.ijerat.com

Fingerprint Recognition Based on Coalition of Multi-Features

Kawther ThabtSaleh

Mustansiriyah University – College of Education

Iraq

ABSTRACT

This paper is representative to create a system of authentication depended on biometric confirmation. Different biometric methods are Face Recognition; Palm Recognition; Fingerprint Recognition; Face Recognition; voice Signature; Iris; User-Ids and Passwords. Our authentic system use fingerprint factor in its work. Because fingerprint is one of the most common biometric methods and ID of fingerprint recognition has been performed by in view of its unique features like: delta points, core point, and bifurcation points. Moreover, fingerprint is one of the greatest instances insecurity of biometric because it can recognize personal information and it is more protected than any other biometric ID system. The purpose of this paper is to achieve fingerprint recognition system based on Crossing Number (CN) method was utilized for minutiae extraction and coalition of 2D Wavelet Transform and 2D Gabor features extraction. The experiment the system based on coalition of 2D Wavelet filter and 2D Gabor wavelet transform feature the recognition rate of fingerprint recognition is 95.9 %. In matching process, we used Bhattacharyya distance.

In this work four types of feature extraction techniques was performed and tested then compare between their results to get the most efficient method for used in the proposed system.

Keywords: Biometric, fingerprint recognition, Ridge Thinning,Minutiae,2D Wavelet Transform,2D Gabor, Bhattacharyya distance.

1. INTRODUCTION

Where we need to recognition an individual in environments, Biometrics can be employed here. Different applications range from logical admission to a personal computer, to physical admission of a secure building or office. They can be employed in a diversity of set environments for example identification systems. Moreover, Biometrics is employed for accountability systems, for instance, signing for a part of equipment ,recording the chain of indication, or recording the biometric personalities of persons boarding an aircraft. Obviously, biometrics achieves more reliably in controlled world, for instance, laboratories and offices, than in uncontrolled world, for example, outdoors [1].

Fingerprint is an imprint formed done deposit of minute valleys and ridges when a finger senses an exterior. Facts are that the valleys and ridges do not modify throughout life anyc ase what occurs and in a matter of mutilation or injury, they come back within a short time. The five normally created fingerprint ridge patterns which show in Figure 1 are arch, tented arch, left loop, right loop and whorl consecutively [2].

Fig -1: Types of Fingerprints Patterns

Digital image handling is a method of handling images in a digital computer. This processing can be implementation by advance of a computer depended on algorithm in order to handles these images. This is a technology commonly employed for digital image processes such asmorphology, segmentation, feature extraction and pattern recognition[3].

2. Related Works

There are many techniques in the related workdepended ondifferent feature extraction technicality and matching in fingerprint recognition system is presented currently.

Supriti Ghosh and Mohammad Abu Yousuf(2016) offered novelway is identification of fingerprint employing Minutiae identical in security of biometric system[4].

Vandana and AlankritaAggrawal(2016) are employing gabor filtering a bit advantage is got but Log – Gaboris execution better. By employing Log- Gabor they are gained95 % accuracy in expressions of Euclidean Distance Metric.[5].

Guanghua Zhang and et al.(2016) are suggested in their paper has achieved the last fingerprint segmentation image by using aim for high-frequency coefficient next Contour let transform, using modulus maxima detection to again highlighting the fingerprint ridge line and finally employing a value filter in direction to joining the fragmented fingerprint line. It can achieve wealthier direction information and make the placing of features more accurate than the method depend on Gabor and wavelet transform function [6].

Rakesh Verma (2016)is presented the diverse fingerprint recognition techniques sideways with the algorithms. The benefits and weaknesses of each technique are studied in detail. The wavelet transformed established system response time and decreases the cost of fingerprint systems as they removes any pre-processing and post-processing of images. Thus, Wavelet Transform has a significant role to advance the recognition experiments rate of any recognition system as well as fingerprint. The fingerprint recognition system performance increases due to multi-scale demonstration of fingerprint image by using wavelets. Recognition rates can be increased by the utilization of wavelet transform directional resolving power. The recognition rate rises bythis local texture information. The employ of multi resolution, de noising and density property of wavelets creates it is valuable in fingerprint recognition system. [7].

Mehran Yazdi and Kazem Gheysari(2008)have offered a novel method for the fingerprint classification depends on the co-occurrence matrix. The co-occurrence matrices features extraction can well distinguish the fingerprint regular texture images [8].

ShwetaWarade and Rajesh Patil (2015)are suggested recognition of touch-less fingerprint method camera of opt digital as the device to gain the fingerprint images and it contains of three main phases: Pre-processing, Feature

extraction and Authentication. Current work offerings a comparative performance estimation of two commonly employed classifiers: Gaussian Mixture Model (GMM) and Support Vector Machine (SVM). Experimental results demonstrate that GMM displays slightly best accuracy than SVM [9].

In this paper, we suggest a feature-level coalition, consisting of two types of features: Crossing Number (CN) method was utilized for minutiae extraction and coalition of 2D Wavelet Transform and 2D Gabor features extraction. Also, in matching process employed Bhattacharyya distance.

3. Research Methodology

The proposed automatic fingerprint methodology to scheme a proficient fingerprint detection and recognition system is described as follows: Acquisition the input fingerprint image dataset by using an optical sensor and CASIA fingerprint image of version 5.0. The aim of analyses is to increase the fingerprint recognition system achievement, the original fingerprint image requirements to pre-processing in two steps: first step, using Histogram to remove the noise and to increase the clarity of image. Second step, Binarization the fingerprint is done for fingerprint digital image. One of the most significant stages is a segmentation which is separate the current fingerprint portion of digital image in requirement to remove each irrelevant portion. Also, ridge thinning is done to reduce the abundant ridge pixels. Furthermore, the fingerprint feature extraction performed to extract Fingerprint code based on Crossing Number (CN) method was utilized for minutiae extraction and coalition of2D Wavelet Transform and 2D Gabor wavelet transform feature. Finally, matching operation employs Bhattacharyya distance. Our proposed automatic fingerprint methodology steps are showed in Figure-2.

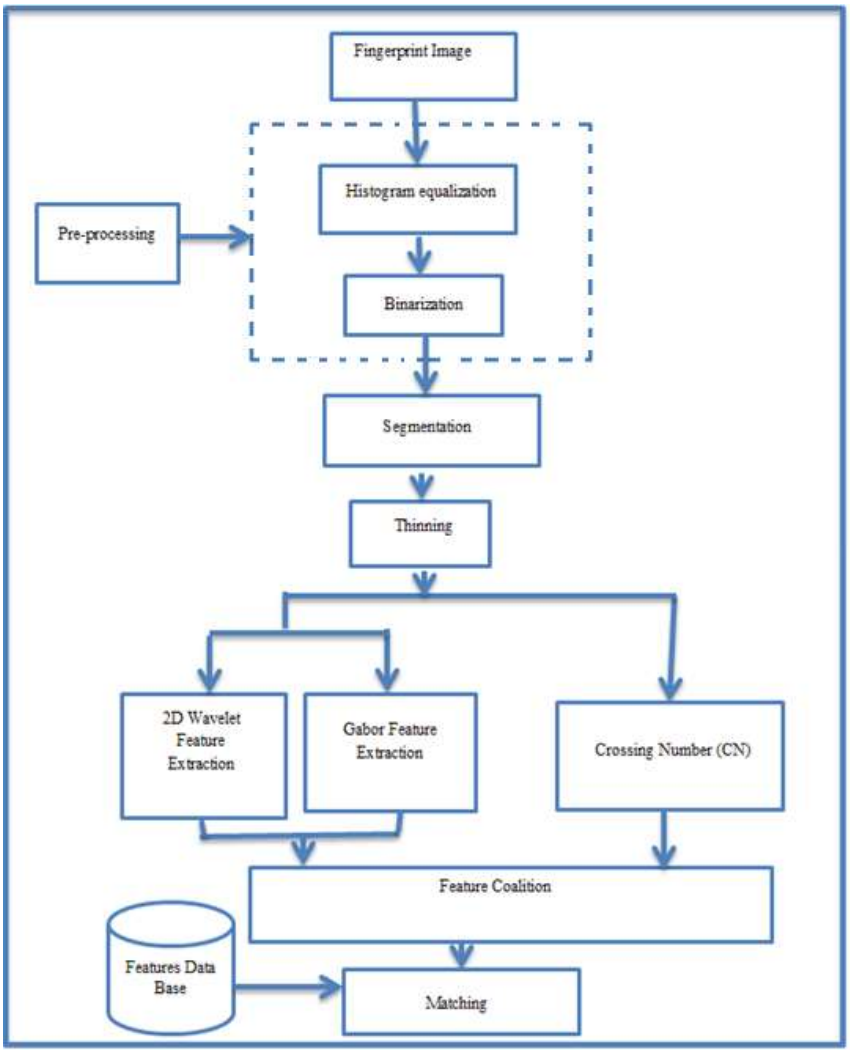

Fig -2: Purposed methodology steps

3.1. Image Acquisition

To gain the biometric data in a finger print digital design image which is essential to process winning a clear and good image with the assistance of a sensor. In this paper, there is employed an optical sensor creative with digital biometrics. Optical sensor can get electronic signals from modification light emissions and also we used the CASIA fingerprint image dataset of version 5.0. Figure-3 shows a sample of original image.

Fig -3: Sample of original image

3.2.Preprocessing

The performance of feature extraction algorithms for fingerprint recognition requires higher quality of the input fingerprint images. Actually, the gain fingerprint images from optical sensors or other media are not guaranteed with perfect feature. We pre-processing the input image by using two steps: Histogram equalization and Binarization.

3.2. 1.Histogram equalization

In fact, device noise, unfitting finger pressure, and also some manual workers and elderly people have naturally poor quality fingers, the dry or wet, bruises and cuts may be in skin, an important proportion of fingerprint images is of lowly quality. The significance of fingerprint improvement algorithm is to enhance the clearness of the ridge constructions in the improvable section and mark the unenhanced section for additional processing. At this time, Histogram equalization was used. to enhance contrast. It is not essential that contrast will constantly be rise in this. There are some cases can be worse were histogram equalization. In that case is decreased in the contrast.

3.2.1. Image Binarization

Binarization process is to transform the fingerprint Image with 8-bit Gray-scale to image with a 1-bit also ridges have 0-value and valleys have 1-value (binary). After Binarization, valleys are seemed white color but ridges are seemed highlight with black show in figure-4.

Fig -4: Binarize image

3.3. Segmentation

Only a Region of Interest (ROI) is suitable to be segmented for every fingerprint image. The image region without association valleys and ridges is first omitted which it only contains information of background. Thus process the remaining working area is drafted out then the minutiae in the working region are mystifying with those fake minutiae that are created when the ridges are out of the optical sensor. ROI is an important phase that can affect the accuracy of matching. The Complex filters technique is used.

3.4. Ridge Thinning

Ridge Thinning is removed the abundant ridge pixels until each ridge has single pixel wide. In this step, parallel thinning technique was used. And also in every scan of the fingerprint image, the method marks down abundant pixels. In the end, eliminates all those marked pixels after some scans.Figure-5 presents ridge thinning image.

Fig -5: Ridge thinning image

3.5. Feature Extraction

The fingerprint feature extraction operation targets to extract Fingerprint code from ridge thinning image. In our proposed system, use two techniques. The first technique is marking minutia points were recognized; Crossing Number (CN) method was employed here for minutiae extraction show in figure-6 that could be characterized as vector of feature, these feature vectors are employed in the pattern matching process.

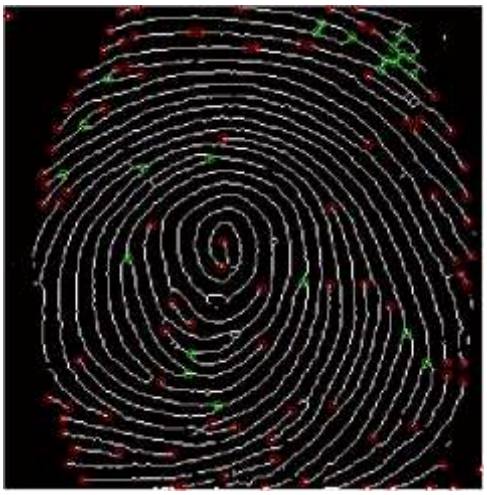

Fig -6: Marking minutia points

The second technique, the coalition of (2D Wavelet Transform and 2D Gabor wavelet transform feature)is proposed. The suggested algorithm for fingerprint feature extraction involves of five stages: firstly; construct 2D Wavelet Transform. Secondly, extract the feature from 2D Wavelet Transform. The vector features have been resulted. Thirdly, Gabor filters are employed for extract the characteristic fingerprint ridge thinning images. 2D Gabor functions were

proposed from Daugmann [10] to model the spatial collecting properties of simple cells in the minutia points. Fourthly, extract the feature from 2D Gabor filter. The vector features have been resulted. So, the last step will gathering two vectors of features of the 2D Wavelet Transform vector and 2D Gabor vector to represent patterns to use it in matching process.

3.5.1. Wavelet Transform

The two-dimensional discrete wavelet transform (2D-DWT) [11–12] achieves a sub band coding of an image in spectral terms frequency/spatial components, employing are cursive and iterative process. Figure-7shows the example of decomposition of two-level. The image is first denoted by HH, HL, and LH sub bands that encode the details of image in three directions and an LL sub band which offers an estimate of it. The gained estimate or detail images can be decomposed again to get second-level estimate and detail images, and the operation can be frequent for better analysis as every repetition pairs the image scale [13].

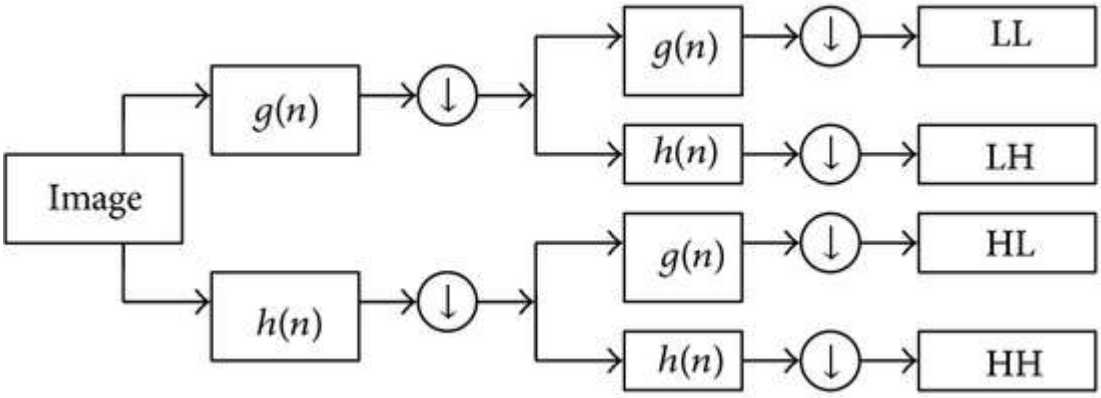

Fig -7: 2D-DWT decomposition of an image

3.5.2. Gabor wavelet transform feature

Gabor filters are working for extract the characteristic of fingerprint images. 2D Gabor functions were proposed through Daugmann[10] to model the spatial collecting characteristics (of the receptive area) of natural cells in the observable skin. They are hugely employed in image processing, computer vision, neuroscience, and psychophysics. Envision Gabor functions, apply a Gabor filter for edge detection of texture features and extraction, simple cells (observable skin) and emulate complex, emulate non-classical receptive are a border inhibition or suppression and operate it for object contour presentation, and exemplify convinced visible imagination effects. The fingerprint feature extraction employed 2D Gabor function is exemplifying equation[14]:

$$g(x,y) = -\frac{k^2}{\sigma^2}\exp\left(-\frac{kx^2}{2\sigma^2}\right)[\exp(ik.x) - \exp\left(-\frac{\sigma^2}{2}\right)] \ldots\ldots\ldots (1)$$

Where (x, y) is the spatial domain variables, k is the wave-factor that describes the direction and range of Gabor function, $\frac{k^2}{\sigma^2}$ factor covers all spatial frequency bands bydescribes of equal energy, $\frac{\sigma^2}{2}$ subtract the DC constituents of Gabor filter [14].

The value of σ is π for the image of resolution 256 X 256. Eighteen diverse Gabor filter denotes excellent texture information of image with three spatial frequencies (k= π /4, π/8, π/16) and six directions from 00 to 1800. In this test the value of σ = π and k= π / 4, π/8, π /16 and the middle frequency is at the basis[14].

3.6. Fingerprint Matching Techniques

After a thinned ridge map is presented, and features extraction and saved. Matching operation is an insignificant mission. Two forms of representation for fingerprints distinct the two recognition methods for fingerprint. The first method, which employs image-based techniques[15-16], attempts to do matching depend on the global features of an entire fingerprint image. The second method, which is minutiae- depend on the local features of terminations and bifurcations fingerprint. This method has been good studied, moreover is the backbone of the fingerprint recognition system. Using two minutiae set of two fingerprint images; the match algorithm of minutiae determines whether the two sets minutiae are from the identical finger or not [3].

In our proposed system, when perform a pattern recognition challenge, the eventual objective is to build a recognition system which is qualified for classify strange patterns with the highest potential accuracy. A quantity of diverse feature calculation measures have been proposed in the literatures. One of these measures is depend on probabilistic distance criteria. Consequently, it is easy to display that the suggested system employs Bhattacharyya distance as presented in the following equation [17]:

$$B = \frac{1}{4}(\mu_1 - \mu_2)^T[\Sigma_1 + \Sigma_2]^{-1}(\mu_1 - \mu_2) + \frac{1}{2} ln \left[\frac{\frac{1}{2}(\Sigma_1 + \Sigma_2)}{\sqrt{|\Sigma_1||\Sigma_2|}}\right] \quad \ldots\ldots\ldots (2)$$

Where$\mu_i$is the mean vector and $\sum_i$is the mean covariance matrix of the class distribution.

(V_i) forever feature vector, the factor pair $\{\boldsymbol{\mu_i}, \boldsymbol{\sigma^2_i}\}$ is separate of the other pairs of factor of the feature vector *V*. Therefore, $\boldsymbol{V_k}$ and $\boldsymbol{V_l}$ arethe distance between two feature vectors which is calculated on a factor-pair base, that is, the distance is reflected as a sum of distances relative to every of these factor pairs. When one employs the Bhattacharyya distance, $\boldsymbol{D_i}$ the distance between ***i*** the factor pairs of $\boldsymbol{V_k}$ and $\boldsymbol{V_l}$ the two feature vectors as presented in the following equation [17]:

$$D_i(v_k, v_l) = \frac{1}{4}\frac{(\mu_{ik} - \mu_{il})^2}{(\sigma^2_{ik} + \sigma^2_{il})} + \frac{1}{2}\ln\left[\frac{\frac{1}{2}(\sigma^2_{ik} + \sigma^2_{il})}{\sqrt{\sigma^2_{ik}\sigma^2_{il}}}\right] \ldots\ldots\ldots (3)$$

For *i* = 0,1,2,…,24. As a result, the consequential distance between $\boldsymbol{V_k}$ and $\boldsymbol{V_l}$ two feature vectors can be selected as[17]:

$$D(v_k, v_l) = \sum_{i=0}^{24} D_i(v_k, v_l) \quad \ldots\ldots\ldots (4)$$

Consequently, it confirms that every image may be categorized into the accurate class if it has minimum distance with that class.

4. Experiment results:

The experiments have been performed using MATLAB 7. To covers all state of activities of fingerprint recognition system, the experimental results have been done on a fingerprint digital image dataset acquired by assistance of (an optical sensor) and also we used the dataset CASIA fingerprint image of version 5.0.

The recognition rate of fingerprint recognition employing Crossing Number (CN) method which was utilized for minutiae extraction88.4%. On the other hand, we experiment the system by wavelet transform feature the recognition rate of fingerprint recognition is 91.4 % also when we experiment the system by Gabor wavelet transform feature the recognition rate of fingerprint recognition is 93.7 %. While experiment the system base on coalition of 2D Wavelet filter and 2D Gabor wavelet transform feature the recognition rate of fingerprint recognitions 95.9 %.Comparison of this method has been made for four methods of feature extraction in fingerprints recognition system. Table-1 shows the comparison of recognition rate of various techniques.

Table 1. Recognition rate of by Discrete Crossing Number, Wavelet transform Gabor and Wavelet transform feature with Coalition of multi-features

Technique	Recognition rate (in percentage)
Crossing Number	88.4
Wavelet transform	91.4
Gabor wavelet transform	93.7
coalition of 2D Wavelet transform and 2D Gabor wavelet transform feature	95.9

5. CONCLUSIONS

In this paper, we suggested to employ improvement technique coalition of (2D Wavelet transform and 2D Gabor wavelet transform feature) as the feature extracted for fingerprint recognition. The obtained coalition feature vectors are fed up into Bhattacharyya distances a fingerprint matching techniques. Experiments carried out on (a clear and good fingerprint digital image with the assistance of an optical sensor) and CASIA fingerprint image dataset of version 5.0. The application has been done exclusively employing Matlab and its image processing toolbox. The experimental results show this approach of coalition multi-feature (2D Wavelet transform and 2D Gabor wavelet transform feature) can be used to automatically recognize the fingerprint more efficient than used one feature individually. The maximum success of 95.9% recognition has been achieved.

REFERENCES

[1] R. S. Prasad, M. Sh. Al-Ani, and S. M.Nejres, "An Efficient Approach for Fingerprint Recognition", International Journal of Engineering Innovation & Research, Volume 4, Issue 2, 2015.

[2] I. G.Babatunde, "Fingerprint Matching Using Minutiae-Singular Points Network", International Journal of Signal Processing, Image Processing and Pattern Recognition, Vol. 8, pp. 375-388, 2015.

[3] A.Tukur, "Fingerprint Recognition and Matching using Matlab", The International Journal Of Engineering And Science (IJES), Volume 4, PP. 01-06, 2015.

[4] S.Ghosh and M. A.Yousuf,"Novel Method of Identifying Fingerprint UsingMinutiae Matching in Biometric Security System", International Journal of Advanced Engineering, Management and Science (IJAEMS),Vol-2, Issue-7, July- 2016.

[5]Vandana andA. Aggrawal, "Fingerprint Authentication System using Log-Gabor Filter",International Journal of Computer Applications, Volume 145, July 2016

[6]Guanghua Zhang, ZhongyangXiong, Shuyin Xia,YueguoLuo, Changyuan Xing, "Fingerprint Image Segmentation Algorithm Based on Contour let Transform Technology",*INT. J. BIOAUTOMATION*, 20(3),339-350,2016.

[7] Rakesh Verma, "WAVELET BASED FINGERPRINT AUTHENTICATIONSYSTEM: A REVIEW ",Electrical and Electronics Engineering: An International Journal (ELELIJ) Vol 5, No 1, February 2016.

[8] M. Yazdi and K. Gheysari, "A New Approach for the FingerprintClassification Based on Gray-Level Co-Occurrence Matrix ", World Academy of Science, engineering and TechnologyInternational Journal of Computer, Electrical, Automation, Control and Information Engineering Vol:2, No:11, 2008.

[9] Sh.Warade, R.Patil, " Touch-less Fingerprint Recognition UsingSVM and GMM: A Comparative Study", International Journal of Innovative Research in Computerand Communication Engineering ,Vol. 3, Issue 5, May 2015.

[10] J.G. Daugman,"Uncertainty relations for resolution in space, spatial fre-quency, and orientation optimized by two-dimensional visual cortical filters", Journal of the Optical Society of America A, vol. 2, pp. 1160-1169, 1985.

[11] B. Li and M. Q. H. Meng, “Texture analysis for ulcer detection in capsule endoscopy images,” Image and Vision Computing, vol. 27, no. 9, pp. 1336–1342, 2009. View at Publisher · View at Google Scholar · View at Scopus

[12] M. Vetterli and C. Herley, “Wavelets and filter banks: theory and design,” IEEE Transactions on Signal Processing, vol. 40, no. 9, pp. 2207–2232, 1992. View at Publisher · View at Google Scholar · View at Scopus

[13]S.Lahmiri and M.Boukadoum, "Hybrid Discrete Wavelet Transform and Gabor Filter Banks Processing for Features Extraction from Biomedical Images", Journal of Medical Engineering, 27 March 2013.

[14]Rafid. E. Haleot,Kawther .T. Saleh, Rania Ali Mustafa, Haitham S. Chyad, " Iris Recognition Based on fusion of Multi-features",The twenty - third Conferenceof Mathematics and ComputersatMustansiriyah University,April 2017.

[15] Leung, W.F., Leung, S.H., Lau, W.H. and Luk, A, Fingerprint Recognition Using Neural Network, proc. of the IEEE workshopNeural Network for Signal Processing. pp. 226-235,2000.

[16] Lee, C.J., and Wang, S.D. Fingerprint feature extraction using Gabor filter, Electroni. Lett.35, (4), pp.288-290,1999.

[17] Abdul-Wahab Sami Ibrahim,"Face RecognitionUsingSkin Color and Texture Features", thesis, University of Technology, October 2005.