A SURVEY ON FINGERPRINT IMAGE QUALITY IMPROVEMENT USING HYBRID APPROACH

[1]Bhavin Patel, [2]Miss Shivangi Malli
[1]ME Research Scholar, [2]Assistant Professor
Department of Computer Engineering,
SOCET, Ahmedabad.

ABSTRACT

In recent world Biometric used to authenticate a person is fingerprint which is unique and permanent throughout the person life. Fingerprints are widely used in daily life due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability. A large number of approaches to fingerprint matching and various algorithm and methods are behind their matching different types of procedures correlation matching, Minutiae Based matching and pattern based matching.

Fingerprint recognition system strongly dependent of quality of fingerprint image. If input fingerprint image quality poor then get it result also poor so its enhancement needed. In this paper discuss different parameter and methods for fingerprint image enhancement.

Keywords: Fingerprint, Segmentation, Normalization, Sharpening, Curvelet, Wavelet , DWT, Gabor Filter

I. INTRODUCTION

The most popular and widely used bio-identification system is fingerprint recognition system because of the fact that fingerprints of human are unique and persistent. Fingerprints of even identical twins are different. A fingerprint can be seen as smoothly varying pattern formed by alternating crest (ridges) and troughs (valleys) on the surface of the finger.

It plays a very important role in forensic and civilian applications. The matching performance of a fingerprint recognition system depends heavily on the image quality A fingerprint recognition system can be used for both verification and identification.

Here, In these papers, Researchers have been used different algorithm and methods for enhancing the fingerprint image quality. In generally Wavelet Transform, DWT, and Curvet Transform algorithms have been used. Firstly, applying normalization to normalize fingerprint image then after segmentation to divide background and foreground. Secondly, applying wavelet transform to classify the fingerprint image. Then after gabor filter has been applied to remove unwanted noise.

In this paper discuss about the various approach to enhance quality of fingerprint image.

II. RELATED WORK

In the paper [1] Jing-Wein Wang and his team have been proposed a novel algorithm for improve the clarity and continuity of ridge structures of fingerprint image. The process flow is decomposing the input fingerprint image into four sub bands by applying two-dimensional discrete wavelet transform. And then adaptively obtaining the compensation coefficient for each sub band. based on the referred Gaussian template. So achieve higher fingerprint classification rates but time delay has been occurred. In the paper [2] Vishal Krishna Singh and his

team have been proposed method its three phases pre-processing, local features and otsu thresholding and also filtering technique used by it. So, optimized filtering enhances the performance of the segmentation algorithm for low quality fingerprint images. M. F. Fahmy and M. A. Thabet [3] had been introduced novel enhancement algorithm.Main purpose of that algorithm fingerprint image enhancement and joining broken ridges. Therefore result was improve the performance of fingerprint but most of time take more time to classify and enhancing the fingerprint image. Amna Saeed, Anam Tariq and Usman Jawaid[4] had been proposed Segmentation, Sharpening and Gabor filtering technique for accurate feature extraction and enhancement of the fingerprint image. so result got to enhancing the fingerprint image quality. Naeim Karimimehr,Ali Asghar Beheshti Shirazi, Mehdi Keshavars Ba haghighat[5] have been proposed to Gabor wavelet and Gabor filter technique. Main goal was fingerprint image quality improvement and result got better but time delay had been occurred. Keokanlaya Sihalath, Somsak Choomchuay, Shatoshi Wada and Kazuhiko Hamamoto[6] have proposed Directional wavelet transform and second derivative of a Gaussian filter. Main purpose was enhancing the quality of fingerprint images and result was noise in the image could be reduced. With less computational complexity . The images could also be improved but not as good as that involves the DWT.

III. GENERIC FINGERPRINT ENHANCEMENT PROCESS

1. Segmentation

In segmentation method is obtained for extracting image from its background. Segmentation use for divide background and foreground. The foreground is the component that originates from the contact of a fingertip with the sensor, whereas noisy area of the borders of the image is known as the background. The foreground area in the fingerprint represent the information and is sometimes called the Region of Interest (ROI).[7]

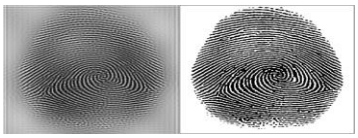

Fig.1 (a) Original image (b) Segmented Image

[Cited: https://danelovell.wordpress.com/]

2. Normalization

An input fingerprint image is normalized. Normalization[4] is a method that changes the range of pixel intensity values. In order to remove the effects of sensor noise and finger pressure differences. Example, fingerprint image with poor contrast because of light.

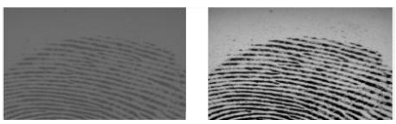

Fig.2 (a) Original image (b) Normalized Image

[cited http://answers.opencv.org/answers/6370/revisions]

3. Wavelet decomposition

Decompose the input image into sub bands at any level. However, too low resolution is not suitable because an excessive down sampling of the signal can vanish the orientation characteristic of the ridge structure. Generally, only one or two decomposition levels are selected.[8]

$f(t) = \sum_{k=0}^{2^j-1} S_{j,k}\, \varphi_{j,k} \quad (t) \epsilon\, V_j$, where function f(x)

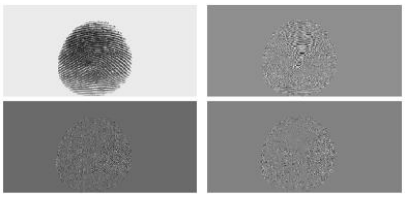

Figure 3: Wavelet transforms decomposition one level.[6]

4. Sharpening

Sharpening help in enhancing the boundaries of objects and further harmonize the contrast and the shade feature of the image. Sharpening highlights fine detail in an image and work on enhancing feature.

$L_{sharp}(x) = [\ L(x) - (k_{sharp}/2) * (L(x-V) + L(x+V))\ ] / (1- k_{sharp})$

L(x) is the input pixel level and $L_{sharp}(x)$ is the sharpened pixel level. k_{sharp} is the sharpening constant (related to the slider setting scanning or editing program). V is the shift used for sharpening.[9]

Fig.4 (a) Original image (b) Sharpened Image[4]

5. Gabor filtering

The aim of the filtering stage is to enhance the clarity of the ridge structures while reducing noise in the image. Gabor filters have both frequency-selective and orientation-selective properties and have optimal joint resolution in both spatial and frequency domains. Therefore, it is appropriate to use Gabor filters as bandpass filters to remove the noise and preserve true ridge-valley structures[10]. The Gabor filter is applied to the fingerprint image by spatially convolving the image with the filter. Gabor filter has the general form:

$$g(x, y: \omega, f) = \exp - \frac{1}{2}\left(\frac{x_\omega^2}{\sigma_x^2} + \frac{y_\omega^2}{\sigma_y^2}\right)\cos(2\pi f x_\omega)$$

Where ω is the orientation of the Gabor filter, f is the frequency of sinusoidal plane wave and σ_x and σ_y are the space constants of the Gaussian envelope in the x and y directions.

IV.GENERIC FINGERPRINT ENHANCEMENT PROCESS FLOW

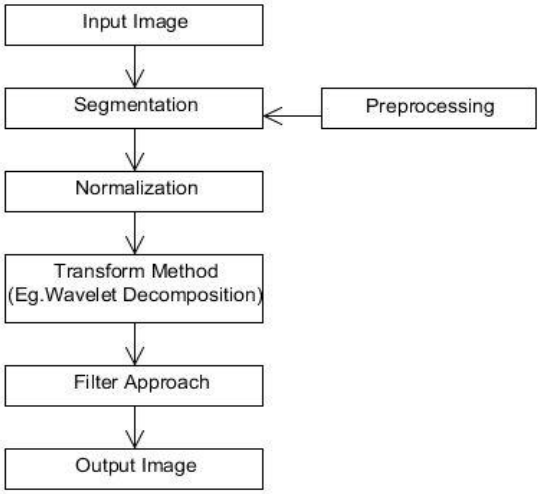

Fig.4 Generic Fingerprint Enhancement Process Flow

V.FINGERPRINT ENHANCEMENT ALGORITHM

1. DISCRETE WAVELET TRANSFORM (DWT)

The fingerprint image is decomposed into multi resolution representation using DWT[11]. The three level Daubechies wavelet is applied and features are extracted from LL, LH, HL and HH sub bands for the verification of fingerprint. LL sub band gives over all information of the original fingerprint image, LH sub band represents vertical information of the fingerprint image, HL gives horizontal characteristics of the fingerprint image and HH gives diagonal details of the fingerprint image.

LL1	**HL1**
LH1	**HH1**

Fig.2 One Level of DWT[11]

2. CURVET TRANSFORM

Curvelet Transform [12] is very effective modal those not only consider a multi scale Time – Frequency local portion but also make use of the direction of features. There are two types of Curvelet transform is unequally spaced Fast Fourier Transform and wrapping based fast Curve let Transform, in curvelet transform the width and length are related by the relation Width~ Length 2 that is known as parabolic or anisotropic scaling . This transform can we used for both continuous and digital domain.

Fast Discrete Curvelet Transform (FDCT) is the second generation curvelet transform is meant to be simpler to understand and use . DCT can be implemented by wrapping based fast discrete curvelet at a given scale. At a given scale and orientation both the image and the curve let are transformed into Fourier domain. The product of curve let and the image are obtained in the fourier domain.

3. WAVELET VS CURVELET TRANSFORM

In fingerprint images are generally 8 bit i.e. they have 256 gray levels. In such images two very close regions that have conflicting pixel values will give rise to edges; and these edges are typically curved for fingerprint. As curvelets are good at approximating curved singularities, they are fit for extracting crucial edge-based features from fingerprint images more efficiently than that compared to wavelet transform. We will now describe different fingerprint recognition algorithms that employ curvelet transform for feature extraction .Typically, a fingerprint recognition system is divided into two stages a training stage and a classification stage. In the training stage, a set of known fingerprint (labeled data) are used to create a representative feature-set or template. In the classification stage, a unknown fingerprint image is matched against the previously seen fingerprint by comparing the features. Curvelet based feature extraction takes the raw or the preprocessed fingerprint images as input. The images are then decomposed into curvelet subbands in different scales and orientations. Feature extraction algorithm is based on extracting spatial variations precisely from high-informative local zones of the fingerprint image instead of utilizing the entire image.

VI. CONCLUSION

According to literature review number of method and technique available for fingerprint recognition using matlab , still some limitation phase and see like time for recognition ,false alarm rate, accuracy using proposed method/plane try to improve quality of fingerprint recognition using matlab also reduce time for same. In future work design proposed method using matlab for increase the clarity of finger print images.

VII.REFERENCES

[1] Jing-Wein Wang, Ngoc Tuyen Le, Chou-Chen Wang, and Jiann-Shu Lee ,"*Enhanced Ridge Structure for Improving Fingerprint Image Quality Based on a Wavelet Domain*.",IEEE VOL..22,no.4, April 2015 pp.390-394

[2] Vishal Krishna Singh, K. J. Mathai, Shailendra Singh*,"Fingerprint Segmentation: Optimization of a filtering technique with Gabor Filter"*, IEEE, 2014 ICCSNT,pp. 823-827

[3] M. F. Fahmy,M. A. Thabet ,"*A Novel Scheme for Fingerprint Enhancement*",IEEE, 2014 NRSC pp.142-146

[4] Amna Saeed, Anam Tariq,Usman Jawaid,"*Automated System For Fingerprint Image Enhancement Using Improved Segmentation And Gabor Wavelets"*, IEEE, 2014

[5] Naeim Karimimehr,Ali Asghar Beheshti Shirazi, Mehdi Keshavars Ba haghighat*,"Fingerprint Image Enhancement Using Gabor Wavelet Transform"*IEEE, 2010

[6] Keokanlaya Sihalath, Somsak Choomchuay, Shatoshi Wada, Kazuhiko Hamamoto"*Fingerprint Image Enhancement with Second Derivative Gaussian Filter and Directional Wavelet Transform*",IEEE, 2010,ICCEA.

[7] Vipan Kakkar, Abhishek Sharma, T.K. Mangalam, Pallavi Kar" Fingerprint Image Enhancement Using Wavelet Transform And Gabor Filtering." ATN,Volume 52, Number 4, 2011 Pp.17-25.

[8] Wei-Peng, Zhang, Qing-Ren. Wang, YYTang, "A wavelet-based method for fingerprint image enhancement". Proceeding of the First International Conference on Machine Learning and Cybernetics, Beijing, 4-5 November 2002

[9] Sharpening formula concept, website: http://www.imatest.com/docs/sharpening

[10] Jain, A. K., and Farrokhnia, F. "Unsupervised texture segmentation using Gabor filters". Pattern Recognition 24, 12 (1991), 167–186.

[11] Mrs. Kavita Tewari Mrs. Renu L. Kalakoti,"*Fingerprint Recognition and Feature Extraction Using Transform Domain Techniques"*,IEEE 2014,ICACACT

[12]Arvind Kourav,Dr. Prashant Singh ," *Analysis of Recognition Accuracy Using Curvelet Tranform*",IJARCSSE,pp.343-346.