STUDY OF EXISTING PREPROCESSING TECHNIQUES FOR FINGERPRINT ANALYSIS

* **Ms. Almas m. N. Siddiqui**
Research student,
Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad. India

* **Ms. Rupali Telgad**
Research student,
Dr. Banasaheb Ambedkar Marathwada University,
Aurangabad. India

* **Prof. Prapti d. Deshmukh**
Principal,
MGM's G. Y. Pathrikar College,
Aurangabad, India.

ABSTRACT

Biometrics is an advanced technology in order to allow only an authorized user by using a specific biometric feature of a human such as fingerprints, irises, face and veins. As the importance of security increases, biometrics becomes a critical technology. Among biometrics, the most matured and accepted biometric system is the fingerprint recognition system. In this paper we discuss about pre-processing techniques for Fingerprint recognition system. Fingerprint is human characteristics used for person identification. When a fingerprint image is captured it is made to pass through all the algorithms arranged in a particular order. We found that if we process a fingerprint in this particular order, the final output is good enough for minute detection and feature extraction. We used fingerprint image pre-processing techniques to reducing noise, enhancing the quality of the captured fingerprint image, facilitating the subsequent processing steps. Experimental results show that our enhancement Methods improves the performance of the fingerprint Images and make it more robust with respect to the quality of input. In this paper we discussed about some preprocessing techniques for removing noise of fingerprint image.

Index Terms- Image Processing, fingerprint, pre-processing, image, and filter.

INTRODUCTION

Image processing is any form of information processing, in which the input is an image. A biometric system is essentially a pattern recognition system that operates by acquiring biometric data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set in the database. Fingerprint recognition continues to be one of the most widely used biometric systems.

Finger prints are the most important part of human finger. It is experienced from the research that all have their different finger prints and these finger prints are permanent for whole life. Fingerprints are the patterns present on a finger. Fingerprint contains complex patterns of stripes, called ridges. In a fingerprint, the dark lines of the image are called the ridges and the white area between the ridges is called valleys, thus exists some gap between the ridges and the white area.

Fig 1. Fingerprint Image.

A ridge can spread further in two ways, either it ends or bifurcates into two ridges. The place where ridge ends is called termination or ridge end and where it bifurcates is called bifurcation.

FINGERPRINT IMAGE PRE-PROCESSING

Pre-processing is an important step for Fingerprint Recognition System. It enhances the quality and produces an image. The image enhancement is a preprocessing technique to make the image clearer than the original image, for further operations. Since the fingerprint images, acquired from sensors or other media are not always assured with perfect quality,the captured fingerprint image in RGB format is first converted to gray scale [0-255] followed by the normalization process. We determine the probable fingerprint region. The adaptive thresholding followed by the morphological processing are performed on the determined probable fingerprint region in order to create the fingerprint binary mask. The normalized image is then multiplied with the fingerprint binary mask.

SOME OF THE EXISTING PRE-PROCESSING TECHNIQUES FOR FINGERPRINTS:

The captured fingerprint image may contain various noises, thus cause poor matching result. In this work, we propose several preprocessing techniques to remove noise.

- Frequency Domain Filter.
- Low pass Filter.
- Band Pass Filter.

The Major Techniques are:

1. Directional Median Filter (DMF).
2. Directional Weighted Median Filter (DWMF).
3. Wiener Filtering.
4. Anisotropic Filter.
5. Fourier transformation Filter.
6. Gaussian Filter.
7. Median Filter.
8. Gabor Filter.

1. FREQUENCY DOMAIN FILTER: -

Frequency domain is the domain for analysis o mathematical functions or signals with respect t frequency, rather than time.[1] A frequency-domai representation can include information on the phas shift that must be applied to each sinusoid in orde to be able to recombine the frequency components t recover the original time signal.

2. LOW PASS FILTER: -

Low pass filtering involves the elimination of th high frequency components in the image. It results i blurring of the image (and thus a reduction in shar transitions associated with noise). Low pass filte would retain all the low frequency components, an eliminate all the high frequency components.

3. BAND PASS FILTER: -

A band-pass filter is a device that passes frequencie within a certain range and rejects frequencies outside tha range. A band pass filter is an electronic device or circu that allows signals between two specific frequencie to pass, but that discriminates against signals at othe frequencies.Some band pass filters require an externa

source of power and employ active components such as transistors and integrated circuits; these are known as active band pass filters.

4. DIRECTIONAL MEDIAN FILTER (DMF) : -

Directional Filter is one of the enhancement techniques which are familiar in multi-resolution enhancement method. The Multi-resolution analysis has been proposed to remove noise from fingerprint image by decomposing the image into different frequency bands (or sub-images). This allows compensating for different noise. [9]

5. DIRECTIONAL WEIGHTED MEDIANFILTER (DWMF) : -

Directional weighted median (DWM) filter performs much better than the other median-based filters in removing random-valued impulse noise, especially when the noise level is as high as 60%. [5]

6. WIENER FILTERING: -

Wiener filter is to filter out noise that has corrupted a signal. It is based on a statistical approach. Typical filters are designed for a desired frequency response. However, the design of the Wiener filter takes a different approach. One is assumed to have knowledge of the spectral properties of the original signal and the noise, and one seeks the linear time-invariant filter whose output would come as close to the original signal as possible.

7. ANISOTROPIC FILTER: -

Anisotropic filtering is a method of enhancing the image quality of textures on surfaces of computer graphics that are at oblique viewing angles with respect to the camera where the projection of the texture appears to be non-orthogonal.

8. FAST FOURIER TRANSFORMATION FILTER: -

Fourier transform comes from the study of Fourier series. The Fourier transform is an extension of the Fourier series that results when the period of the represented function is lengthened and allowed to approach infinity.

9. GAUSSIAN FILTER: -

Gaussian filter is a filter whose impulse response is a Gaussian function. Gaussian filters are designed to give no overshoot to a step function input while minimizing the rise and fall time. This behavior is closely connected to the fact that the Gaussian filter has the minimum possible group delay. Mathematically, a Gaussian filter modifies the input signal by convolution with a Gaussian function; this transformation is also known as the Weierstrass transform. [9]

10. MEDIAN FILTERS: -

The median filter is a nonlinear digital filtering technique, often used to remove noise. Median filtering is very widely used in digital image processing because it preserves edges while removing noise.

11. GABOR FILTER: -

A Gabor filter is a linear filter whose impulse response is a defined by harmonic function multiplied by a Gaussian function. In image processing a Gabor filter, is a linear filter used for edge detection. Gabor filters, simulated visual vertex cells have the properties of

spatial localization, orientation selectivity and spatial frequency selectivity. Gabor filter can remove noise and preserve the true ridge and valley structures thus showing good performance.

Fig: 2. Original Image.

Here we have discussed about some existing preprocessing techniques, now we will discuss about the proposed approach which will include explaination of algorithm used to produce a better quality image and show only the results of Gabor filter.

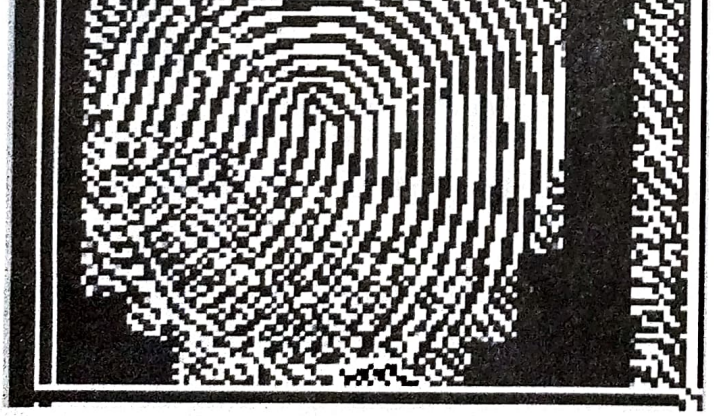

Fig: 3. Apply Gabor filter.

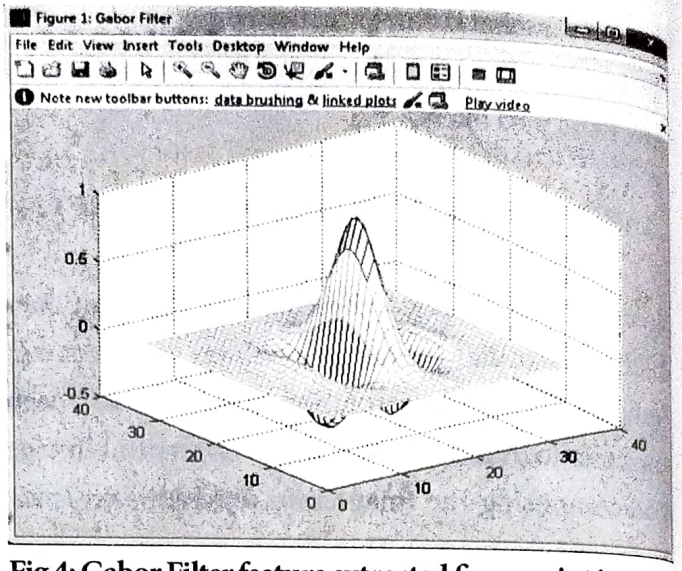

Fig 4: Gabor Filter feature extracted fingerprint image

FINGERPRINT IMAGE PRE-PROCESSING:

The captured fingerprint image in RGB format i first converted to gray scale [0-255] followed by th normalization process. We determine the probabl fingerprint region. The adaptive thresholding followe by the morphological processing are performed on th determined probable fingerprint region in order to creat the fingerprint binary mask. The normalized image i then multiplied with the fingerprint binary mask.

IMAGE ENHANCEMENT TECHNIQUE:

The aim of image enhancement is to improve th interpretability or perception of information in image for human viewers, or to provide better input for othe automated image processing techniques. To process a image is needed so that the result is more suitable tha the original image for a specific application.

1. PROPOSED APPROACH :

The steps used in pre-processing are as follows:

1- Binarization

2- Central line thinning of the image.

3- Dilation of the thinned image

4- Thinning of the dilated image

5- Refining.

6- Producing dual image.

All of the above steps are explained in detail below. The above steps when performed sequentially, they produce image of very good quality which helps in identifying true minute points accurately.

1. BINARIZATION:

In binarization, the grey scale image is converted into binary image. Binary images are easy to process. The basic principle of converting an image into binary is to decide a threshold value, and then the pixels whose value are more than the threshold are converted to white pixels, and the pixels whose value are below or equal to the threshold value are converted to black pixels. In this way the entire image is converted to binary. We have seen experimentally that this method produces a better result. This is popularly known as Recursive Otsu method.

2. CENTRAL LINE THINNING OF THE IMAGE:

In central line thinning, after we get the binary image, the next task is to thin the image. Central line thinning algorithm produces better result than other thinning algorithm because the basic structure and alignment of the ridges remain same after thinning as were in the original image. By referring to some templates the algorithm decides which black pixels to be converted to white or which black pixels to be kept as such. This results a thinned image.

3. DILATION OF THINNNED IMAGE:

Dilation is process to make the given images smoother. All the holes are filled and the edges are smoothed in dilation. A structuring element has been used for dilation which is given below.

4. THINNING OF DILATED IMAGE:

In this step we simply thin the dilated image. The thinning technique is exactly same as the step-2 explained above.

5. REMOVING THE UNWANTED PORTIONS:

There are many small unwanted portions that are unnecessary for further processing, but these portions if exist may lead to incorrect minutiae detection.

6. PRODUCING DUAL IMAGE:

Fingerprints show a typical characteristics called duality. It means ridges and valleys are dual of each other. If there is ridge end (considering the ridge), then there must be a bifurcation (considering the valley) near to it.

5. CONCLUSION AND FUTURE WORK:

From all the steps explained above, we can see that it produces better images which are clearer and identifying minutiae points from different preprocessing techniques are easy. From some preprocessing techniques I have shown the result of Gabor.

filter. The experiment results shown that the biometric system had much higher recognition accuracy and Gabor filter gives a better result for feature extraction for matching

of a fingerprint. In future work we would improve performance of fingerprint recognition system by using more enhancement techniques.

ACKNOWLEDGEMENT:

We are thankful to our Guide Dr. P.D. Deshmukh Principal of Dr. G.Y.P.C.C.S and I.T. for providing valuable guidance and technical support.

REFERENCES:

[1] Chaohong Wu, Zhixin Shi and Venu Govindaraju. "Fingerprint Image Enhancement Method Using Directional Median Filter".

[2] Yiqiu Dong and Shufang Xu. "A New Directional Weighted Median Filter for Removal of Random-Valued Impulse Noise".

[3] Raju Sonavane, Dr. B.S. Sawant. Noisy Fingerprint Image Enhancement Technique for Image Analysis: A Structure Similarity Measure. Approach. IJCSNS International Journal of Computer Science and Network Security, VOL.7 No.9, September 2007.

[4] Lin Hong, Yifei Wan, Anil Jain. Fingerprint Image Enhancement: Algorithm and Performance Evaluation. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 20, NO. 8, AUGUST 1998.

[5] Sharat Chikkerur, Alexander N. Cartwright, Venu Govindaraju. Fingerprint enhancement using STFT analysis. Elsevier, 25th May 2006.Page: 198-211

[6] Sangram Bana and Dr. Davinder Kaur. Fingerprint Recognition using Image Segmentation. (IJAEST). International journal of advanced engineering sciences and technologies Vol No. 5, Issue No. 1, 012 – 023

[7] Graig T. Diefenderfer, June 2006. Thesis on Fingerprint Recognition at Naval Postgraduate School, Monterey, California.

[8] M. Cheriet, J. N. Said, and C. Y. Suen. A Recursive Thresholding Technique for Image Segmentation IEEE RANSACTIONS ON IMAGE PROCESSING, VOL. 7, NO. 6, JUNE 1998.

[9] HUANG Xian-wu; SU Peng-cheng; BAI Pei-quan. Algorithms for an Automatic Fingerprint Identification System Based on Oriented Filtering and Segmentation. Journal of Image and Graphics[J] 2002,PP: 829-834.

[10] Vesa Onnia,Marius Tico.Adaptive Binarization Mathod For Fingerprint Images. Acoustics, Speech and Signal Processing, 2002. ICASSP-2002., 2002 IEEE International Conference.

[11] N. Ikeda; M. Nakanishi; K. Fujii; T. Hatano; S. Shigematsu; T. Adachi,Y; Okazaki; H. Kyuragi Fingerprint image enhancement by pixel-parallel processing, 16th International Conference on Pattern Recognition, 2002,pp. 752–755.

[12] Eun-Kyung Yun, Sung-Bae Cho Adaptive fingerprint image enhancement with fingerprint image quality analysis Image and Vision Computing (2005) 1–10.