Volume 4, Issue 7, July 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Steps In Fingerprint Enhancement Techniques

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Abstract—In this paper we study that fingerprints are the oldest and most widely used form of biometric identification. The widespread use of fingerprints, there is little statistical theory on uniqueness of fingerprint minutiae. A critical step in study statistics of fingerprint minutiae is to reliably extract minutiae from the fingerprint images. Automatic and reliable extraction of minutiae from the fingerprint images is crucial step in fingerprint matching However, fingerprint images are rarely of the perfect quality. They are degraded and corrupted due to variations in skin and the impression conditions. The quality of input fingerprint images plays important role in the performance of automatic identification and the verification algorithms .Thus, image enhancement techniques are employed prior to minutiae extraction to obtain a more reliable estimation of minutiae locations.

Keywords— Automatic Fingerprint Identification System (AFIS), Fingerprint Image Enhancement (FIM), Histogram Equalization (HE), Fourier Transform (FT), Automatic Fingerprint Recognition System (AFRS)

I. INTRODUCTION

Biometrics refers to the quantifiable data related to human characteristics and traits. Biometric identification (or biometric authentication) is used in the computer science as form of identification and access control.

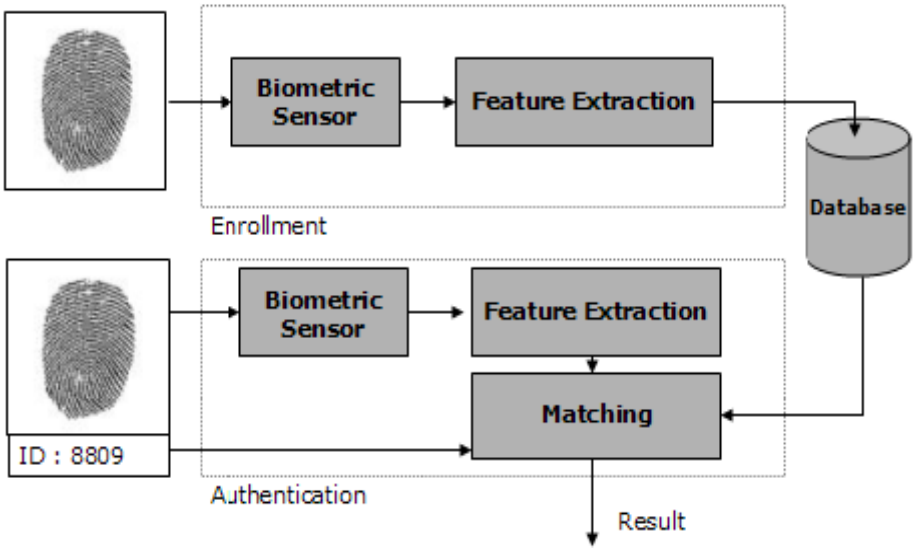


Figure1: Biometrics System

The block diagram illustrates the two basic modes of a biometric system. First, in verification (or authentication) mode, system performs a one-to-one comparison of the captured biometric with specific template stored in the biometric database in order to verify individual is the person they claim to be. Three steps are involved in verification of a person. In first step, reference models for all the users are generated and stored in the model database. In second step, some samples are matched with the reference models to generate genuine and impostor scores and calculate threshold. Third step is testing step. This process may use a smart card, username or ID number (e.g. PIN) to indicate which template should be used for the comparison.

Second, in identification mode system performs a one-to-many comparison against the biometric database in order to establish identity of an unknown individual.

The most and widely used bio-identification system is fingerprint recognition system popular because of the fact that fingerprints of human are unique and the persistent. The fingerprints of the even identical twins are different [3]. Fingerprints have been used for over century and are the most widely used form of biometric identification. The fingerprint of individual is unique and remains unchanged over lifetime [1]. A fingerprint can be seen as smoothly varying pattern formed by alternating crest (ridges) and troughs (valleys) on the surface of the finger as shown in Fig.2.A ridge is defined as the single curved segment, and valley is a region between the two adjacent ridges.

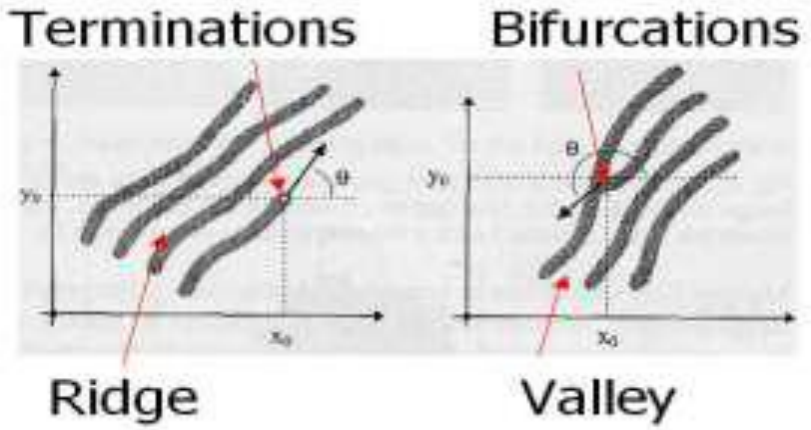


Figure2:Example of a ridge ending and a bifurcation[1].

Most of the automatic fingerprint identification systems (AFIS) are based on the minutiae matching. Fingerprint acquisition can be classified into two major techniques: First, Automatic Fingerprint Recognition System (AFRS) with the help of online sensors or other devices. Second technique based on latent prints which are obtained by various medias such as ink, powder and paper etc they are by crime sections [4].

Fingerprint Image Enhancement
Fingerprint Image enhancement (FIM) is used to make the image clearer for easy further operations.
Two Methods are: first is Histogram Equalization [3]; the next is Fourier Transform [3].

1. Histogram Equalization (HE):
HE attempts to improve the contrast of an input image by stretching the peaks of the histogram and compressing the troughs .Histogram equalization is to expand the pixel value distribution of an image so as to increase the perception information.

2. Fourier Transform (FT):
In method this, we divide the image into small processing blocks (32 by 32 pixels) and perform Fourier transform.

II. RELATED STUDY

Benazir.K.K.al [1] presents a fast fingerprint enhancement methodology and new implementation of techniques for the fingerprint image enhancement. Experimental results show the incorporating enhancement algorithm improves the verification accuracy.
CarstenGottschlich [2] for the purpose of enhancing curved structures in noisy images, he introduce curved Gabor filters which locally adapt their shape to flow of direction. These Gabor filters enable choice of filter parameters which increase the smoothing power without creating artefacts in enhanced image. They are applied to curved ridge and valley structure of the low-quality fingerprint images. First, he combines the two orientation end estimation methods in order to obtain a more robust estimation for noisy images. Second, the curved regions are constructed by the following respective local orientation and they are used for estimating the local ridge frequency. Lastly, curved Gabor filters are denied based on curved regions and they are applied for the enhancement of low-quality fingerprint images. The experimental results on FVC2004 databases show improvements of this approach in comparison to state-of-the-art enhancement methods.
VipanKakkar.al [3.]proposed a enhancement method based on Gabor filtering in the wavelet domain. This filter is chosen because it has both frequency-selective and orientation-selective properties and has optimal resolution in both spatial and the frequency domain. This filtering is done on the images results from wavelet decomposition and then finally, image is reconstructed to get the enhanced image. The experiments are conducted on 500dpi resolution fingerprint images commercially available from FVC2002 fingerprint database.
R.DharmendraKumar.al [4] discuss about the enhancement of fingerprint image for the fingerprint recognition. This target can decompose into the image pre-processing, feature extraction and feature match. For the each sub-task, some classical and the up-to-date methods in literatures analysed. Based on the analysis, integrated solution for the fingerprint recognition is developed for the demonstration. MATLAB (matrix laboratory) is used in this project. For the program, optimization at coding level and algorithm level are proposed to improve the performance of this fingerprint recognition system. The performance enhancements are shown by experiments conducted upon a variety of fingerprint images. The experiments illustrate some key issues of fingerprint recognition that are consistent with what the available literatures say.
Dr.S.Pannirselvam.al [5] he used the high boost filter and Gaussian filter for efficient finger print image quality. In the proposed methodology, original is filtered using High Pass filter and the Gaussian filter for the noise removal. Finally, the High Boost filter is apply for better enhancement and the performance of the image quality is measured using Mean Squared Error (MSE) and Peak Signal Noise Ratio (PSNR). It is proved that our methodology provides better result in improving the image quality and better enhancement.

HongchangKe.al[6] proposed an improved Gabor filtering for fingerprint image enhancement technology is proposed by using orientation selection and the frequency selection characteristics of Gabor filtering, the local orientation of fingerprint image and ridge line frequency are the parameter of the Gabor filtering function, two-dimensional Gabor filter is divided into a one-dimensional band-pass filtering and one-dimensional low-pass filtering. The algorithm has increased the computing speed and efficiency and has a good robustness.

SandhyaTarar.al [7] has proposed an algorithm of fingerprint image enhancement by using Iterative Fast Fourier Transform (IFFT). Iterative image reconstruction algorithms play an important role in fingerprint identification systems in order to achieve higher degree of the efficiency. With fast increase of sizes of the fingerprint data and design of reconstruction algorithm is of great importance in order to improve performance. The Fourier-based frequency orientation methods have the potential to considerably reduce the computation time in iterative reconstruction. We also designed an approach for removing the false minutia generated during the fingerprint processing and a method to reduce the false minutia to increase the efficacy of identification system.

PankajDeshmukh.al.[8] propose a new method in fingerprint enhancement with application of wavelet transform which is more efficient than the other methods. At the present, methods that are used are the ones involving the use of Gabor filtering and Fourier transform. But accuracy of these techniques is far away from the satisfactory. A new technique is also being proposed that incorporates wavelet transform and the Gabor filtering.

III. PROPOSED WORK

To remove the noise and dust between the images I proposed some steps in fingerprint enhancement. For the purpose of enhancing in noisy images, curved Gabor filters locally adapt their shape to direction of flow. These curved filters enables choice of filter parameters which increase the smoothing power without creating artefacts in the enhanced image. Gabor filters are applied to the curved ridge and valley structure of low-quality fingerprint images. First, combine two orientation estimation methods in order to obtain a more robust estimation for the noisy images. Second, the curved regions are constructed by following the respective local orientation and they are used for estimating the local ridge frequency. Lastly, curved Gabor filters are based on curved regions and they are applied for the enhancement of low-quality fingerprint images.

IV. RESULTS AND DISCUSSION

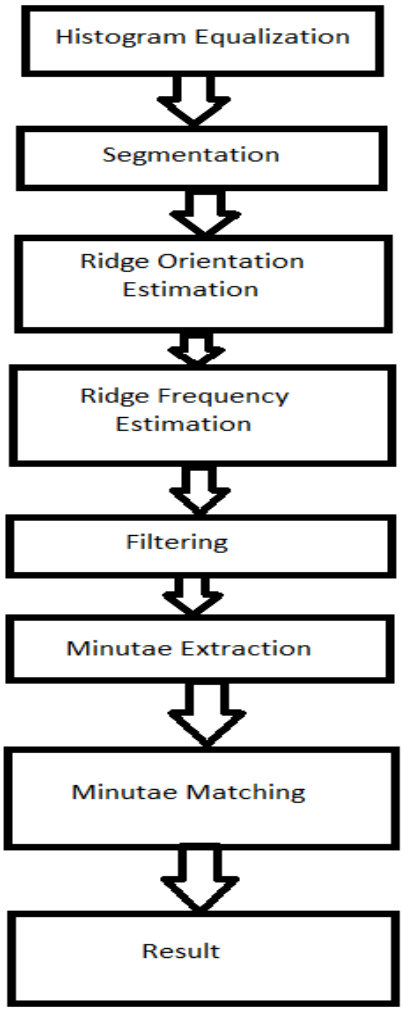


Figure3: Steps in Image Enhancement

1. Histogram equalization

The first step of fingerprint image enhancement process is histogram equalization which is applied to enhance the image's contrast by transforming the intensity values of the image (the values in the colour map of an indexed image).

2. Segmentation

This step is done to separate the actual fingerprint area from the image background. The image is divided into many blocks and the std deviation is calculated from the local neighbourhood. A threshold is set to exclude the background from the fingerprint area.

3. Ridge orientation estimation

This step is done to estimate the orientation of the image. The process is carried out by placing an image window at a point in the raw image. The window is rotated in 16 equally spaced directions and the projections are calculated along the y direction. The projection with maximum variance is fixed as the orientation of the pixel. This is continuously done to obtain the values for all the pixels.

4. Ridge frequency estimation

This estimates the approximate ridge frequency for the fingerprint image by dividing it into blocks of 8 x 8 pixels. For the local neighbourhood which does not have the singularities, gray-levels of the pixels form a sinusoidal shape along the direction orthogonal to the ridge orientation for that local neighbourhood. An oriented window (oriented in the direction orthogonal to the local ridge orientation) is used to approximate this sinusoid. The inverse of the average distance between the numbers of peaks encountered is the local frequency of that block.

5. Filtering

The next step is filtering which is used to finally remove noise and preserve the ridge structures.

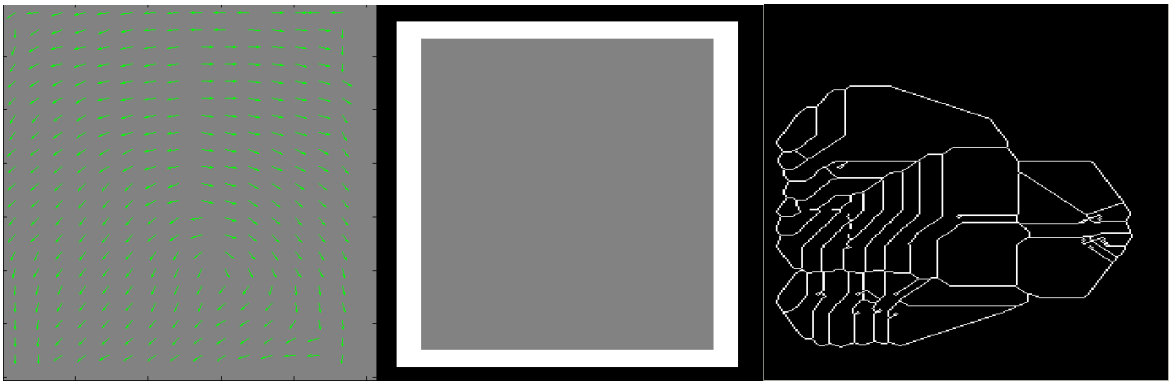
6. Minutiae extraction

Among all the fingerprint features, minutiae point features with the corresponding orientation maps are unique enough to discriminate amongst fingerprints robustly; the minutiae feature representation reduces the complex fingerprint recognition problem to a point pattern matching problem. Minutiae points are detected by locating the end points and bifurcation points on the thinned ridge skeleton based on the number of neighbouring pixels.

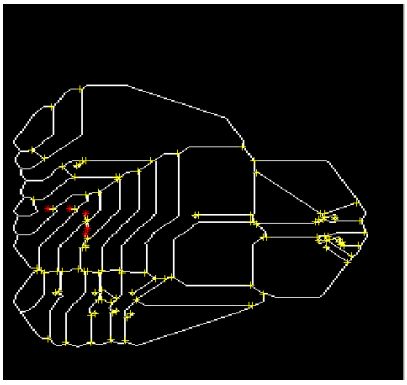
7. Minutiae matching

At the matching stage, approach is to elastically match minutiae. Given two set of minutiae of the two fingerprint images, minutiae match algorithm determines whether the two minutiae sets are from the same finger or not.

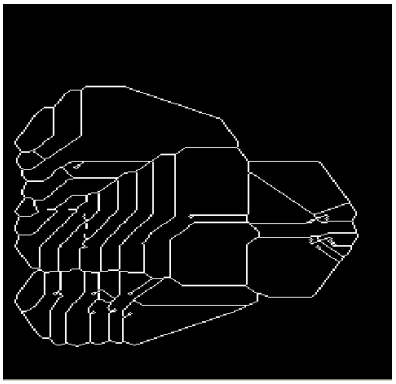
Load Image | Histogram Equalization | Enhanced by FFT



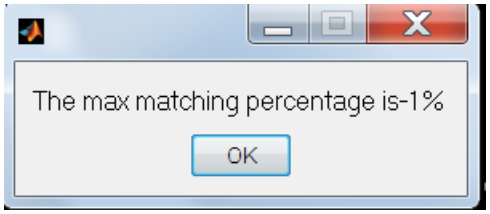
Direction | ROI area | Thinning



Extract



Real Minutiae



Match

V. CONCLUSION

In this, I proposed some steps in image enhancement to remove the noise and dust between the image. The first step is load which is used to load the image. The next step is histogram which is used to increase the contrast and clarity between the images. The segmentation step is done to separate the actual fingerprint area from the image background. The image is divided into many blocks. Filtering is performed finally to remove noise and preserve the ridge structures. The minutiae feature representation reduces the complex fingerprint recognition problem to a point pattern matching problem. At the matching stage, approach is to elastically match minutiae.

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