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Enhanced Fingerprint Recognition Techniques

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ABSTRACT

Fingerprints have been used for over a century and are the most widely used form of biometric identification. Fingerprint image enhancement is required to make the image clearer for subsequent operations The quality of fingerprint images is not completely perfect. Images may be corrupted and damaged due to some skin conditions so there is a need to improve the quality of images. In this paper a new technique is proposed which is based on various existing techniques. The proposed work is based on CLAHE, curve gabor filter and fourier filtering.. This paper presents a methodology and new implementation techniques for fingerprint image enhancement.

Keywords: Fingerprint ridges, minutia, CLAHE, FFT(fast fourier transformation), curved gabor filter.

1. INTRODUCTION

A fingerprint is the feature pattern of a finger and it is believed with the strong evidences that each fingerprint is unique. Each person has his own fingerprints pattern with permanent uniqueness. So fingerprints have being used for a long time in identification and forensic investigation. A fingerprint is consisting of many ridges and furrows. These ridges and furrows present perfect similarities in each small local area, like parallelism and average width [2].

A fingerprint is formed by an impression of the ridges pattern on a finger. A ridge is defined as a curved area, and a valley is the area between two adjacent ridges. The minutiae, which are the local irregularities in the ridge flow pattern, provide the features that are used for authentication [6].

Figure-1.1) Example of a ridge ending and a bifurcation.

Fingerprint is one of the famous methods used for personal recognition or identification, a fatal fingerprint ridges are formed during the third to fourth month of its development. The ridges begin to develop on the skin of the thumbs and fingers. The objective of these ridges is to give the fingers a strong grasp and to avoid slippage over anything. thus allow the us to grasp and pick up the objects.

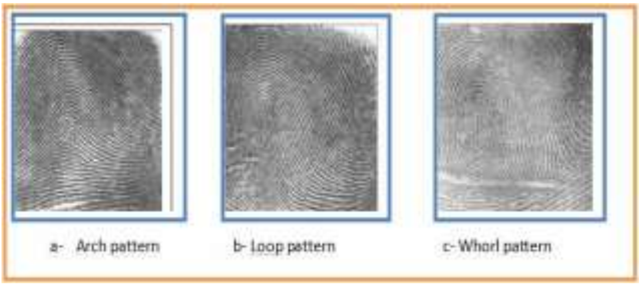


Figure1.2: Types of fingerprint patterns.

The three most basic patterns of fingerprint ridges are the arch, loop, and whorl as shown in figure (1.2).

i) Arch Pattern:- The ridges enter from one side of the finger, rise in the center forming an arc, and then exit the other side of the finger.

ii) Loop Pattern:- The ridges enter from one side of a finger, form a curve, and then exit on that same side.

iii) Whorl Pattern:- Ridges form circularly around a central point on the finger.

About 65 percent of people in the total population has loops, 30 percent have whorls, and 5 percent have arches [1].

The fingerprint recognition problem can be grouped into two sub-domains: one is fingerprint verification and the other is fingerprint identification. In addition, different from the manual approach for fingerprint recognition by experts, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint Recognition System), which is program-based.

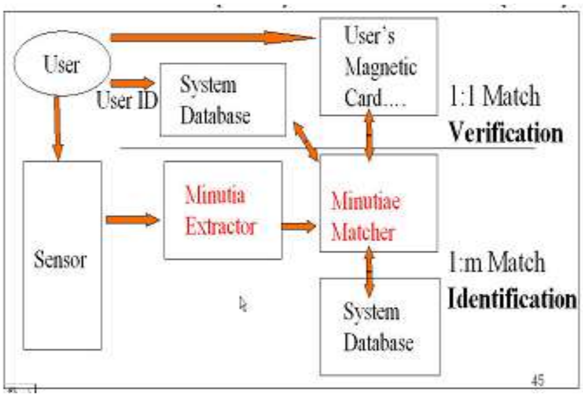


Figure-1.3) Automatic Finger Recognition System

Fingerprint verification is to verify the authenticity of one person by his fingerprint. The user provides his fingerprint together with his identity information like his ID number. The fingerprint verification system retrieves the fingerprint template according to the ID number and matches the template with the real-time acquired fingerprint from the user. Usually it is the underlying design principle of AFAS (Automatic Fingerprint Authentication System) [2].

The most common approach to implement a minutia extractor is a three-stage approach. The preprocessing, minutia extraction and post processing stage as shown in figure (1.4).

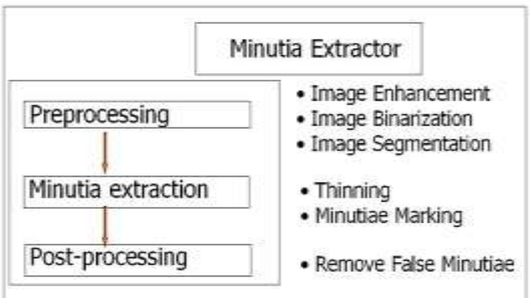


Figure 1.4: Minutia Extractor

Fingerprint images are rarely of good quality. They may be damaged and corrupted with elements of noise due to many factors including variations in skin and impression conditions. This damage or degradation can result in a significant number of spurious minutiae being created and genuine minutiae being ignored. A critical step in studying the statistics of fingerprint minutiae is to reliably extract minutiae from fingerprint images. Thus, it is necessary to use image enhancement techniques prior to minutiae extraction to obtain a more reliable estimate of minutiae locations [2].

2. RELATED WORK

Muzhir Shaban Al-Ani .al[1] proposed fingerprint algorithm to develop an efficient novel system. The proposed fingerprint algorithm is concentrated on the improvement of the thinning process. Fingerprint enhancement and minutiae extraction based on optimal thinning. The output results indicate a significant improvement of the fingerprint recognition pattern. Various human fingerprints patterns are collected using traditional and electronic devices then these patterns are converted to digital forms to be processed via the designed algorithm. Many modifications are introduced to the implemented algorithm to generate an optimal result. The implemented algorithm gives adequate results related to the other system.

Pankaj Deshmukh .al[6] proposed a new method in fingerprint enhancement with application of wavelet transform which is more efficient than existing methods. At present the methods that are in use are the ones involving the use of Gabor filtering and Fourier filtering. But the accuracy of these techniques is far from satisfactory. A new technique is being proposed that incorporates wavelet transform and Gabor filtering.

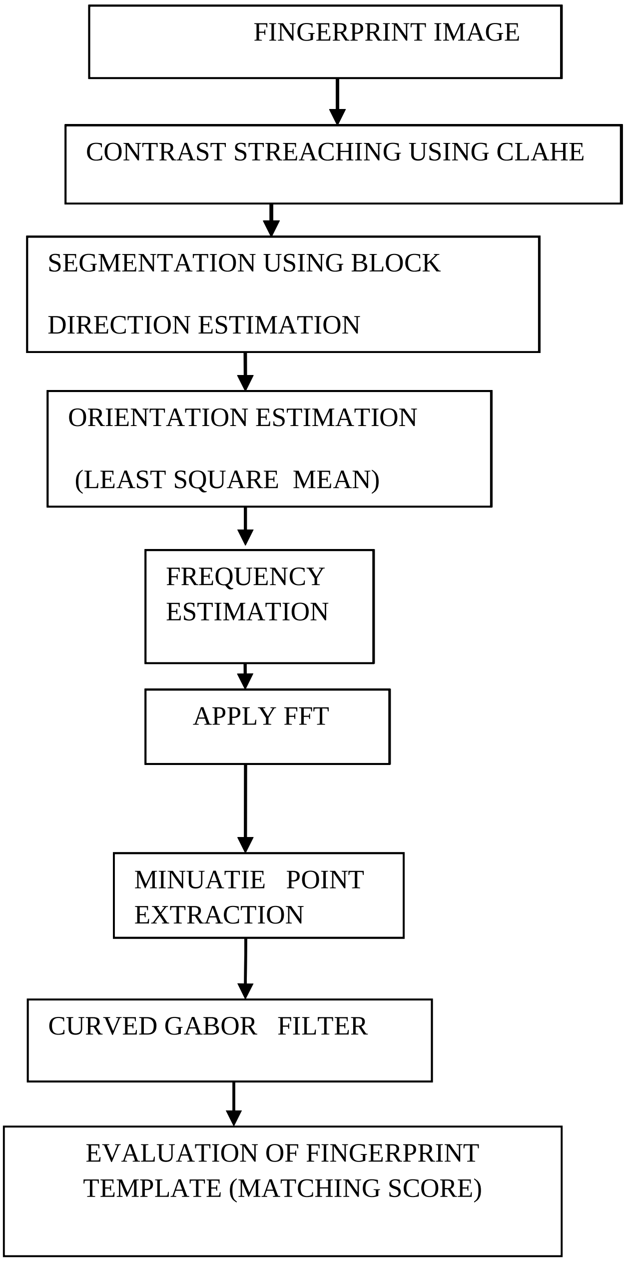
Sandhya Tarar .al[8] proposed an algorithm of fingerprint image enhancement by using Iterative Fast Fourier Transform (IFFT). Iterative image reconstruction algorithms play an important role in fingerprint identification systems in order to achieve higher degree of efficiency. With the fast increase of the sizes of the fingerprint data, design of the reconstruction algorithms is of great importance in order to improve the performance. Fourier-based frequency orientation methods have the potential to considerably reduce the computation time in iterative reconstruction. They also have 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. They have used fingerprint Verification Competition 2006 (FVC

2006) as a database for implementation of proposed algorithm to verify the degree of efficiency of proposed algorithm. Experimental result shows that the proposed enhancement algorithm is better than existing Fast Fourier Transform algorithm.

Vipan KAKKAR .al[10] proposed a enhancement method based on gabor filtering in wavelet domain. Gabor filter is so chosen because it has both frequency-selective and orientation-selective properties and has optimal resolution in both spatial and frequency domain. Filtering is done on the images results from wavelet decomposition and finally, the image is reconstructed to get the enhanced image. Wavelet analysis can be considered to be a time-scale method embedded with the characteristic of frequency. It gives its best performance when it is applied to the detection of short time phenomena, discontinuities, or abrupt changes in signal. The decomposition of the input signal into approximation and detail space is called multi-resolution approximation, which can be realized by using a pair of finite impulse response (FIR) filters h and g, which are lowpass and high-pass filters, respectively Experiments are conducted on 500dpi resolution fingerprint images commercially available from FVC2002 fingerprint database.

3. PROPOSED WORK

By considering the inefficiency of the existing image enhancement method there is a need to propose a new methodology for finger print image enhancement leads to image quality.



1) LOAD IMAGE FROM DATABASE

Images are store in to the database. Load image from database is the first step.

2) CONTRAST STREACHING USING CLAHE

CLAHE with clip limit is applied to improve the contrast of the small tiles existing in the fingerprint image.

3) SEGMENTATION

Estimate the block direction for each block of the fingerprint image with W x W in size (W is 16 pixels by default). After finished with the estimation of each block direction and blocks without significant information on ridges and furrows are removed.

4) ORIENTATION ESTIMATION

Orientation estimation is the first of the prerequisites for fingerprint image filtering. In every image, the ridges form patterns that flow in different directions.

5) FFT (Fast Fourier Transformation)

FFT are used to enhance the intensity of pixels of the fingerprint images with maintaining its frequency and orientation selective properties.

6) MINUATIAE POINT EXTRACTION

An important step in automatic fingerprint matching is to reliably extract minutiae from the input fingerprint images.

7) CURVED GABOR FILTER

Curve Gabor filters gives the choice of filter parameters which increase the smoothing power without creating artifacts in the enhanced image.

4. RESULTS

a) **b)**

c) **d)**

Figure-4.1 Images of fingerprint

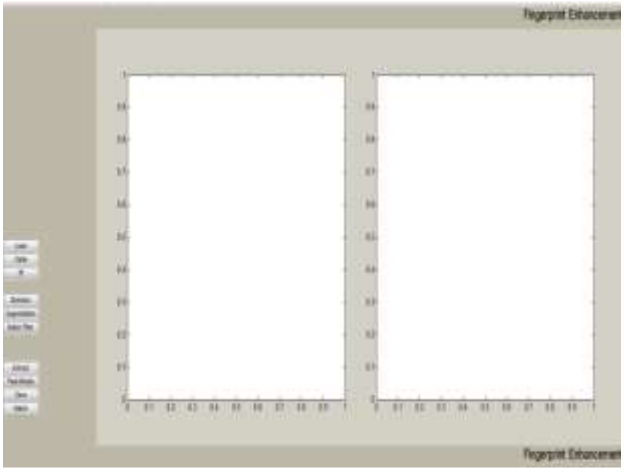


Figure-4.2 User Interface

Figure-4.3(a) Before Clahe

Figure-4.3(b) After Clahe

Figure-4.4 Apply FFT Operation

Figure-4.5 Apply Segmentation

Figure-4.6 Apply curved Gabor filter

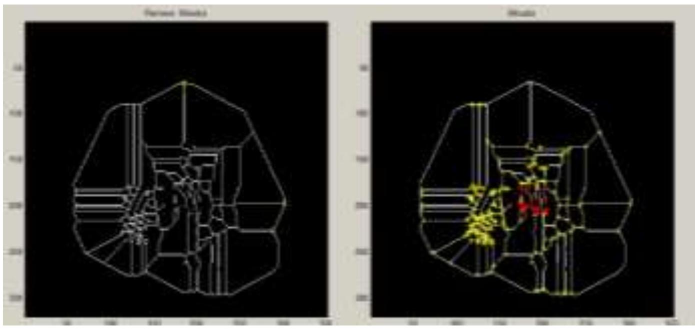


Figure-4.7 Remove false Minutia

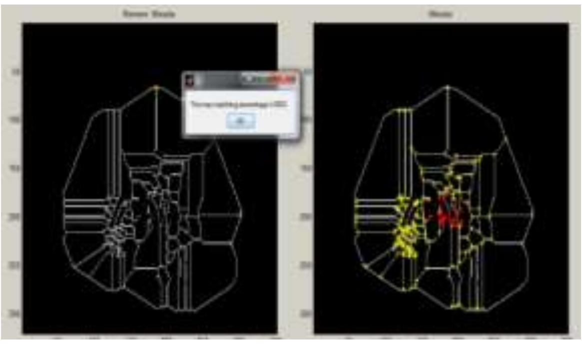


Figure-4.8 Matching Percentage

4. CONCLUSION

We have developed a fingerprint enhancement algorithm which can adaptively improve the clarity of ridge and valley structures based on the CLAHE, curved gabor filtering from the loaded image. In this we also identify the false minutiae points and then remove all the false minutia points. All work are successfully implemented and evaluation is done on matching scores.

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