Fingerprint Recognition Using Improved Gabor Filtering

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Abstract: **Fingerprint recognition defines the automated method of identifying or confirming the identity of an individual based on the evaluation of two fingerprints. Fingerprint recognition is one of the most well-known biometrics, and it is by far the mainly used biometric solution for authentication on computerized systems. The reasons for fingerprint recognition being so admired are the ease of acquisition, established use and acceptance when compared to other biometrics, and the fact that there are plentiful (ten) sources of this biometric on each individual. Uni-modal biometric system performs person recognition relayed on a single source of biometric information. Such systems are often affected by the following problems: Noisy sensor data, on- universality, Lack of individuality, Lack of invariant representation, Susceptibility to circumvention. To design an approach for removing the false minutiae generated during the fingerprint processing. A method to reduce the false minutiae to increase the efficacy of identification system. An improved Gabor filtering for fingerprint image enhancement technology using orientation selection and frequency selection characteristics of Gabor filtering.**

Keywords: Fingerprint, Fingerprint Recognition, System Level Design, Algorithm Level Design

I. INTRODUCTION

1.1 What is A Fingerprint?

A fingerprint is the characteristic pattern of one finger (Figure 1.1). It is supposed with strong evidences that each fingerprint is distinctive. Each person has his own fingerprints with the permanent uniqueness. So fingerprints have being applied for gratitude and forensic inquest for a long time. A fingerprint is collected of many ridges and furrows. These ridges and furrows present fine similarities in each small local gap, like parallelism and average width.

Figure1.1A fingerprint image acquired by an Optical Sensor

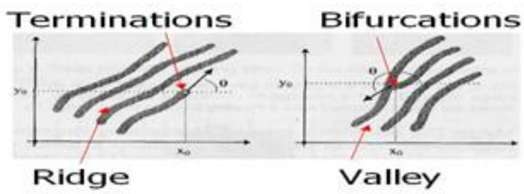

Figure 1.2 Minutias. (Valley is also referred as Furrow; Termination is also called Ending sand Bifurcation is also called Branch

However, shown by severe research on fingerprint identification, fingerprints are not illustrious by their ridges and furrows, but by Minutia, which are some irregular points on the ridges (Figure 1.2). Along with the variety of minutia types reported in literatures, two are mostly extensive and in heavy usage: one is called termination, which is the immediate ending of a ridge; the other is called bifurcation, which is the position on the ridge from which two branches derive [3].

The American National Standards Institute has planned a minutiae classification based on four classes: terminations, bifurcations, trifurcations (or crossover) and undetermined. The various kinds of minutiae are shown in Fig. 1.3.

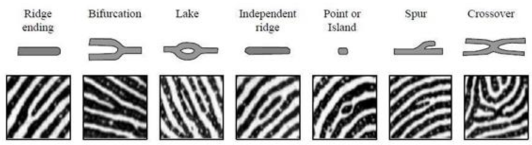

Figure 1.3 Various Types of Minutiae [3]

1.2 What is Fingerprint Recognition?

The fingerprint recognition problem can be grouped into two sub-domains: one is fingerprint confirmation and the other is fingerprint recognition (Figure 1.4). In addition, different from the manual approach for fingerprint identification by experts, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint identification System), which is program-based [6].

1.3 System Level Design

A fingerprint identification system contains of fingerprint acquiring device, minutia extractor and minutia matcher [Figure 1.5].

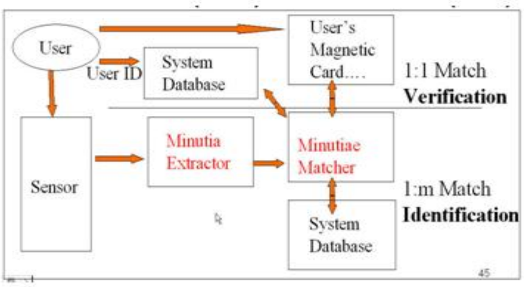

Figure 1.4 Verification vs. Identification

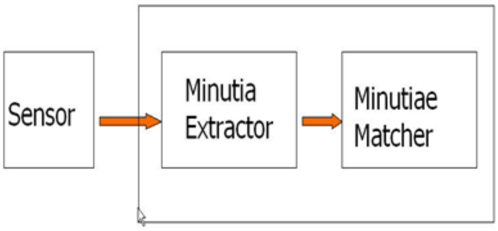

Figure 1.5 Simplified Fingerprint Recognition Systems

1.4 Algorithm Level Design

To execute a minutia extractor, a three-phase approach is widely used by researchers. They are preprocessing, minutia removal and post processing stage [Figure 1.6].For the fingerprint image preprocessing phase, Histogram Equalization and Fourier Transform to do image improvement [9]. And then the fingerprint image is binaries using the nearby adaptive threshold method [10]. The image segmentation task is accompli by a three-step in the direction of: block direction estimation, segmentation by direction intensity [4] and Region of Interest mining by Morphological operations.

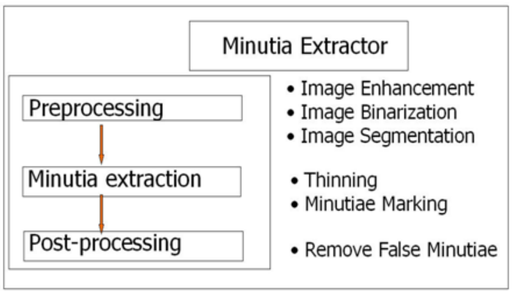

Figure 1.6: Minutia Extractor

Morphological thinning operation is lastly bid out with high effectiveness and striking good thinning quality. The minutia marking is easy task as most literatures reported but one special case is found throughout my implementation and an additional check mechanism is enforced to evade such kind of supervision. For the post processing phase, a more rigorous algorithm is developed to eradicate false minutia based on [10, 1].

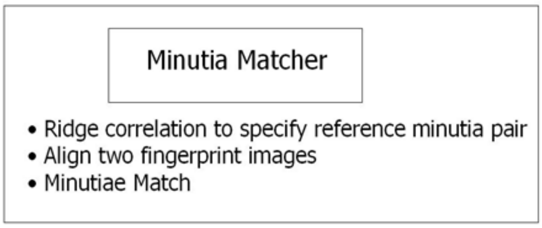

Figure1.7 Minutia Matcher

The minutia matcher chooses any two minutia's as a reference minutia pair and then matches their associated ridges earliest. If the ridges equivalent well [1], two fingerprint images are aligned and matching is conducted for all remaining minutia shown in Figure 1.7.

II. RELATED WORK

The research work performed in this area by different researchers is presented as follows:

[1] Cappelli R. et al., (2006) this paper is concerned with the performance estimation of fingerprint authentication systems. After an initial classification of biometric testing initiatives, we discover both the theoretical and practical issues linked to performance evaluation by presenting the outcome of the recent Fingerprint Verification Competition (FVC2004). FVC2004 was prepared by the authors of this work for the purpose of assessing the state-of-the-art in this challenging pattern detection application and making available a new common level for an unambiguous evaluation of fingerprint-based biometric systems.FVC2004 is an autonomous, strongly supervised estimation performed the evaluators' site on evaluators' hardware. This permitted the test to be completely controlled and the computation times different algorithms to be quite compared. The experience and feedback received from previous, similar competitions (FVC2000 and FVC2002) permitted us to improve the association and methodology of FVC2004 and to capture the attention of a significantly higher number of educational and commercial organizations (67 algorithms were submitted for FVC2004). A new, "Light" opposition category was included to guess the loss of matching performance caused by imposing computational constraints. This paper discusses facts collection and testing protocols, and comprises a detailed analysis of the results. We introduce easy but effectual method for comparing algorithms at the score level, allowing us to isolate difficult cases (images) and to study fault correlations and algorithm “fusion.” The huge amount of information obtained, including a structured categorization of the submitted algorithms on the basis of their features, makes it possible to better understand how current fingerprint recognition systems work and to delineate useful investigate directions for the future.

[2] Gotsschlich Carsten(2011) Gabor filters play an essential role in many application areas for the enhancement of various types of images and the extraction of Gabor features. For the intention of enhancing curved structures in noisy images, we introduce curved Gabor filters which locally adapt their shape to the route of flow. These curved Gabor filters enable the choice of filter parameters which enhance the smoothing power without creating artifacts in the enhanced image. In this paper, curved Gabor filters are applied to the curved ridge and valley formation of low-quality fingerprint images. First, we combine two orientation field estimation methods in order to attain a more robust estimation for very noisy images. Next, curved regions are constructed by following the respective narrow orientation and they are used for estimating the local ridge incidence. Finally, curved Gabor filters are defined based on curved regions and they are applied for the enhancement of low-quality fingerprint imagery. Experimental effect on theFVC2004 databases show improvements of this approach in comparison to state-of-the-art enhancement methods.

[3] He Y. et al., (2002) Fingerprint image enhancement and minutiae matching are two key steps in an automatic fingerprint recognition system. In this paper, we build up a fingerprint image enhancement algorithm based on orientation fields; According to the ideology of Jain et al., s matching algorithm, we also introduce ideas beside the following three aspects: introduction of ridge in sequence into the minutiae matching process in a simple but efficient way, which solves the problem of reference point pair collection with low computational cost; use of a variable sized bounding box to create our algorithm more robust to non-linear deformation involving fingerprint images; use of a simpler organization method in our algorithm. Experiments using the Fingerprint proof Competition 2000 (FVC2000) databases with the FVC2000 performance estimation show that these ideas are effective.

[4] Ke H. et al., (2012) The effect of image improvement has an impact on features extraction and the fingerprint identification of detection rate, according to the research of conventional fingerprint image enhancement technology, an enhanced Gabor filtering for fingerprint image enhancement technology is proposed, using direction collection and frequency selection characteristics of Gabor filtering, narrow orientation of fingerprint image and ridge line frequency are the constraint of Gabor filtering function, the two-dimensional Gabor filter is separated into a one-dimensional band-pass filtering and a 1-dimensional low-pass filtering. The algorithm has increased computing pace and efficiency and has a good robustness.

[5]Sepasian M.et al.,(2008) The intention of this paper is to investigate the performance of a three-phase procedure for the fingerprint identification and improvement, using CLAHE (contrast limited adaptive histogram equalization) together with 'Clip edge, standard deviation and sliding neighborhood as stages through processing of the fingerprint image. Initially, CLAHE with clip limit is applied to improve the disparity of the small tiles existing in the fingerprint image and to combine the adjoining tiles using a bilinear interpolation in order to eradicate the artificially induced limitations. In a second step, the image is decomposed into an array of diverse blocks and the unfairness of the blocks is obtained by computing the standard deviation of the matrix elements to eradicate the image background and obtain the boundaries for the region of interest. Lastly, by using a slide neighborhood processing, and development of the image is obtained by clarifying the Minutiae (endpoints and bifurcations) in every specific pixel, process known as thinning. The paper presents the inspiration for developing this method, its phases, and its probable advantages through a simulated investigation.

[6] Mishra P. et al., (2013) this paper is the conclusion of fingerprint recognition system in which the matching is made using the Minutiae points. The methodology is the generating & applying matching procedure on the Minutiae point slinking the sample fingerprint & fingerprint under question. The major functional blocks of this system directs steps of Image Thinning, Image Segmentation, Minutiae (quality) point Extraction, &Minutiae point Matching. The procedure of improved Thinning included for the intention of decreasing the size of the memory space used by the fingerprint image database.

[7]Tarar S.et al., (2013) Fingerprint Identification System performance largely depends on the feature of input fingerprint images. Lofty quality input fingerprint images are prerequisite for high performance systems. In this paper, we have projected an algorithm of fingerprint image enrichment by using Iterative Fast Fourier Transform (IFFT). Iterative image reconstruction algorithms play an important part in fingerprint identification systems in order to achieve higher extent of efficiency. With the quick increase of the sizes of the fingerprint data, design of the reconstruction algorithms is of great importance in order to progress the performance. Fourier-based frequency orientation methods have the potential to considerably lessen the computation time in iterative modernization.

We also have designed an approach for removing the forged minutia generated during the fingerprint processing and a method to reduce the false minutia to increase the worth of identification system. We have used fingerprint authentication Competition 2006 (FVC 2006) as a database for implementation of projected algorithm to verify the degree of efficiency of projected algorithm. Experimental result shows that the projected enhancement algorithm is better than presented Fast Fourier Transform algorithm.

[8] Al- Ani M (2013) Years ago, many algorithms are published for fingerprint detection and these algorithms has different accuracy rate. This paper deals with the learn of the existing fingerprint detection algorithms in order to improve the performance of the projected fingerprint algorithm to develop an proficient novel system. The proposed fingerprint algorithm is concentrated on the development of the thinning process. Fingerprint development and minutiae extraction based on optimal thinning. The output outcome indicate a noteworthy improvement of the fingerprint recognition pattern

III. PROPOSED WORK

1.1 Problem Formulation

For the intention of enhancing curved structures in noisy images, curved Gabor filters locally adapt their shape to the flow of direction. These Gabor filters permit the choice of filter parameters which increase the smoothing power without creating artifacts in the enhanced image. These filters are applied to the curved ridge and valley structure of low-quality fingerprint images. First, combines two orientation end estimation methods in order to obtain a more robust estimation for the noisy images. Second, bowed regions are constructed by following the respective local orientation and they are used for estimating the local ridge occurrence. Lastly, curved Gabor filters are applied on curved regions and they are applied for the development of low-quality fingerprint images.

1.2 Proposed Work

Proposed some steps in image enhancement to remove the noise from the image. The first step is load which is used to load the image. The next step is contrast stretching which is used to increase the contrast and clarity between of the image. The segmentation step is done to break up the actual fingerprint area from the image background. The image is divided into many blocks. Gabor filtering is performed finally to remove noise and preserve the ridge structures. The minutiae feature representation reduces the intricate fingerprint recognition problem to a point pattern matching problem. At the matching stage, approach is to elastically match minutiae.

IV. RESULTS AND ANALYSIS

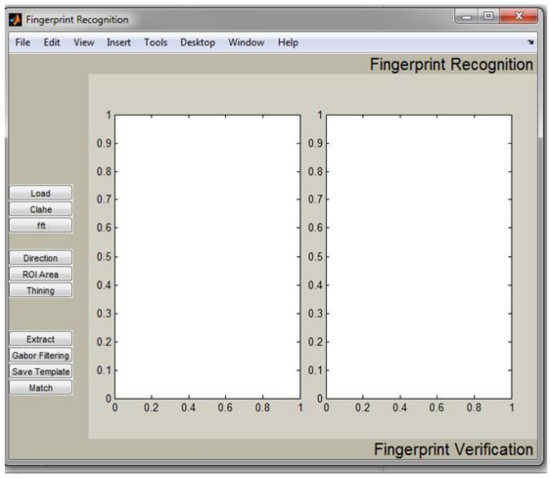

Figure 4.0Main GUI

The fingerprint samples are saved in a folder for feature extraction and the feature extraction is done in the fingerprint recognition systems. Subsequent are some figures.

4.1.1 Load Click the Load button to pack the fingerprint sample in the Fingerprint recognition system.
4.1.2 CLAHE Click on the CLAHE to get the Contrast Stretching.
4.1.3 FFT Enter any FFT value between 0 and 1 and then we get the enhanced image according to that value.

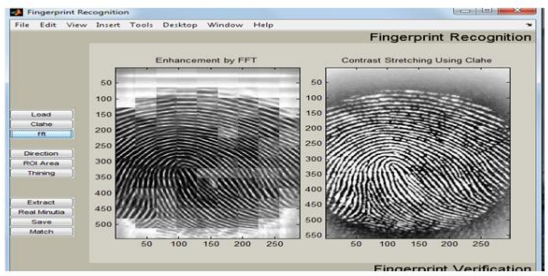

Figure 4.1Enhancements by FFT& CLAHE

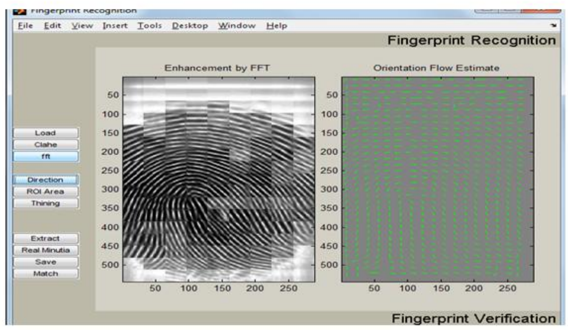

Figure 4.2 Direction

4.1.5 ROI Area

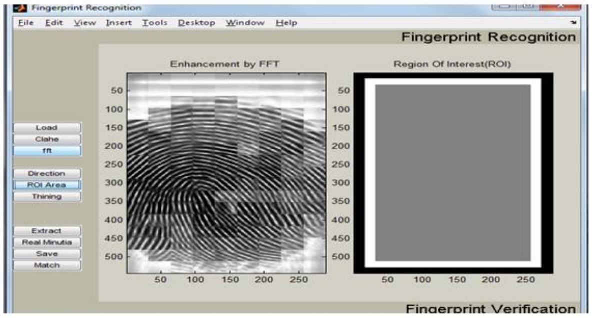

Figure 4.3 Region of Interest

4.1.6 Thinning

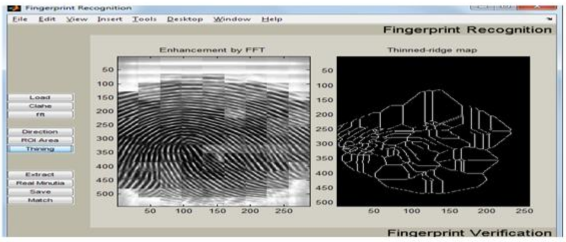

Figure 4.4 Thinned-ridge maps

4.1.7 Extract

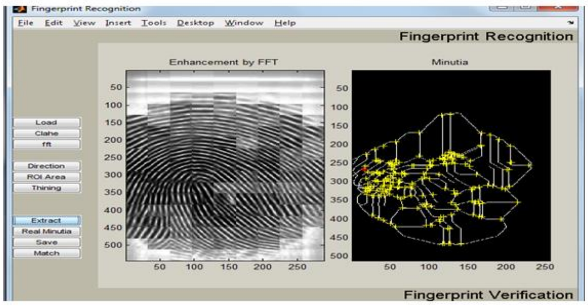

Figure 4.5 Extract

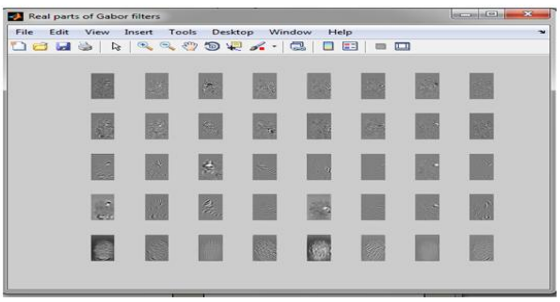

Figure 4.5.1 valid parts of Gabor filters

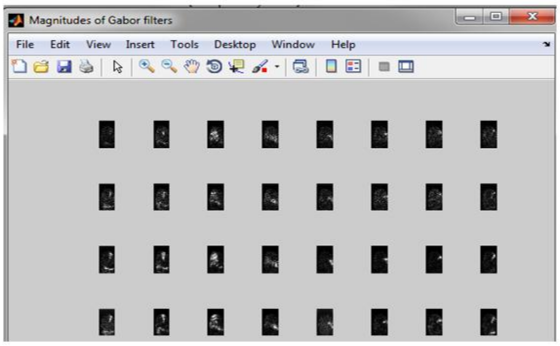

Figure 4.5.2Magnitudes of Gabor filters

4.1.8Real Minutia by clicking real minutia we will get the factual image of the minutia to which we have to match the fingerprint

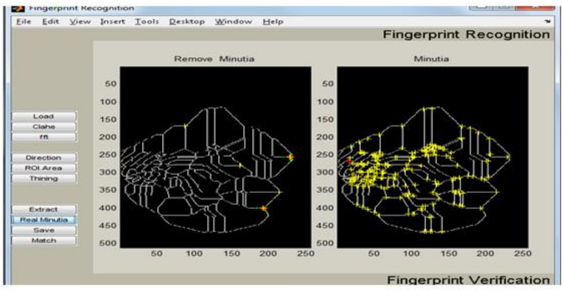

Figure 4.6 Real Minutia

4.1.9 Save Click on the save button to save the extracted image.

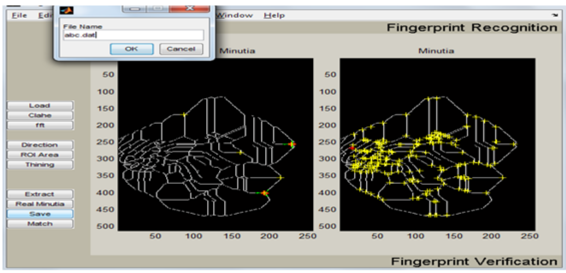

Figure 4.7 Save

4.1.10 MatchThe saved image and the previous image is then matched to get the 100% result. Here we will find whether the person is genuine or fraud.

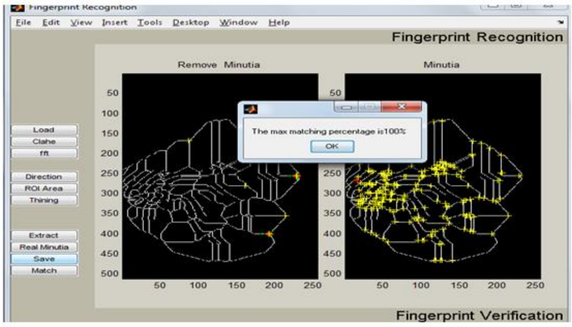

Figure 4.8 Match score

V. CONCLUSION

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

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