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School of Computer Science and Engineering

BIOMETRICS

PROJECT COMPONENT

ATM Terminal Security using Fingerprint Recognition

Submitted to-PROF.Usha

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- INTRODUCTION

Biometrics is a technology that helps to make your data tremendously secure, distinguishing all the users by way of their personal physical characteristics. Biometric information can be used to accurately identify people by using their fingerprint, voice, face, iris, handwriting, or hand geometry and so on. Using biometric identifiers offers several advantages over traditional and current methods. Tokens such as magnetic stripe cards, smart cards and physical keys, can be stolen, lost, duplicated, or left behind; passwords can be shared, forgotten, hacked or unintentionally observed by a third party .There are two key functions offered by a biometric system. One method is identification and the other is verification.

- Problem Definition

We propose a simple and effective approach for Biometric fingerprint image enhancement and minutiae extraction based on the frequency and orientation of the local ridges and thereby extracting correct minutiae points.

Automatic and reliable extraction of minutiae from fingerprint images is a critical step in fingerprint matching. The quality of input fingerprint images plays an important role in the performance of automatic identification and verification algorithms. In this project we presents a fast fingerprint enhancement and minutiae extraction algorithm which improves the clarity of the ridge and valley structures of the input fingerprint images based on the frequency and orientation of the local ridges and thereby extracting correct minutiae.

Fingerprint based identification has been one of the most successful biometric techniques used for personal identification. Each individual has unique fingerprints. A fingerprint is the pattern of ridges and valleys

on the finger tip. A fingerprint is thus defined by the uniqueness of the local ridge characteristics and their relationships. Minutiae points are these local ridge characteristics that occur either at a ridge ending or a ridge bifurcation. A ridge ending is defined as the point where the ridge ends abruptly and the ridge bifurcation is the point where the ridge splits into two or more branches. Automatic minutiae detection becomes a difficult task in low quality fingerprint images where noise and contrast deficiency result in pixel configurations similar to that of minutiae. This is an important aspect that has been taken into consideration in this presentation for extraction of the minutiae with a minimum error in a particular location. A complete minutiae extraction scheme for automatic fingerprint recognition systems is presented. The proposed method uses improving alternatives for the image enhancement process, leading consequently to an increase of the reliability in the minutiae extraction task.

- Objective

To create an ATM machine that uses fingerprint scanning rather than the old fashioned card to make transactions and to ease the life of people in both urban and rural areas.

- Literature Survey

Algorithms	Pros	Cons
Minutiae Based Algorithm	It is the most widely used technique of fingerprint representation and its configuration is highly distinctive. It is more accurate compared to other correlation based systems and the template size is smaller in minutiae-based fingerprint representation.	Not suitable for low quality template .
Threshold Cryptography Technique	This system has less than 0.2% of False Acceptance Rate and False Rejection Rate and is proved to be efficient than the existing biometric based authentication systems. This system is secure against biometric template attack done at the server side.	Compression is required for reconstruction of fingerprint image
Fingerprint Matching using Gabor Filter	At 1% FAR, the Gabor filter based fingerprint matcher gives a GAR of 91% while the	More number gabor filter used.

	minutiae based matcher gives a GAR of 73%.	
Ratio of Relational Distance Matching	Requires no explicit alignment of the two to-be compared fingerprint images and also tolerates distortions caused by spurious minutiae points.	Dependency of an efficient feature extraction scheme.
K-Nearest Neighbor Minutiae Clustering	Helps to identify the fingerprint it reads each fingerprint clustered graph templates from database	This technique increase the processing time .

- Proposed system

System Level Design

A fingerprint recognition system constitutes of fingerprint acquiring device, minutia extractor and minutia matcher.

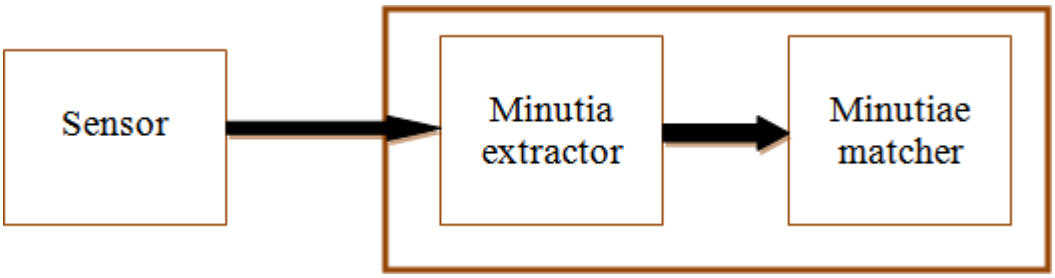

Figure 2.1.1 Simplified Fingerprint Recognition System

For fingerprint acquisition, optical or semi-conduct sensors are widely used. They have high efficiency and acceptable accuracy except for some cases that the users finger is too dirty or dry. However, the testing database for my project consists of scanned fingerprints using the ink and paper technique because this method introduces a high level of noise to the image and the goal of designing a recognition system is to work with the worst conditions to get the best results.

The minutia extractor and minutia matcher modules are explained in detail later on in this paper.

Algorithm Level Design

To implement a minutia extractor, a three-stage approach is widely used by researchers. They are preprocessing, minutia extraction and post-processing stage.

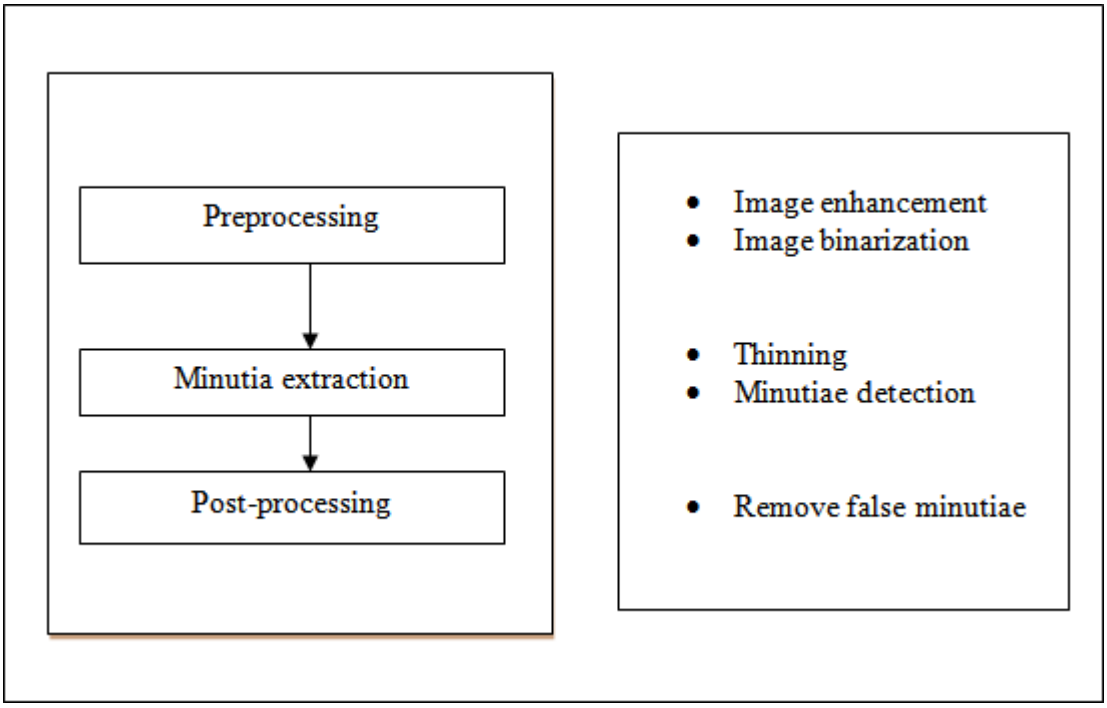

Figure 2.2.1 Minutia Extractor

For the fingerprint image preprocessing stage, Histogram Equalization and Fourier Transform are used to do image enhancement. And then the fingerprint image is binarized using the locally adaptive threshold method. The image segmentation task is fulfilled by a three-step approach: block direction

estimation, segmentation by direction intensity and Region of Interest extraction by Morphological operations.

For minutia extraction stage, iterative parallel thinning algorithm is used. The minutia marking is a relatively simple task. For the post-processing stage, a more rigorous algorithm is developed to remove false minutia.

The minutia matcher chooses any two minutiae as a reference minutia pair and then matches their associated ridges first. If the ridges match well, the two fingerprint images are aligned and matching is conducted for all the remaining minutiae.

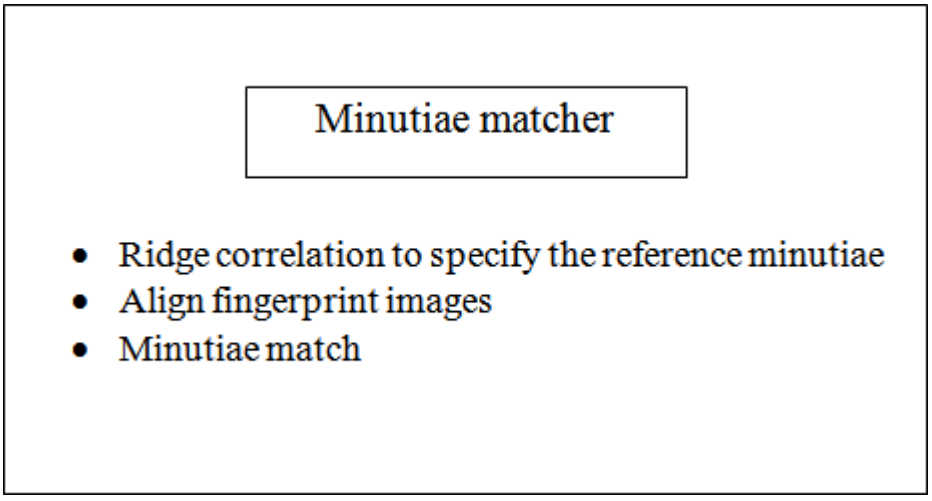

Figure2.2.2 Minutia Matcher

- Evaluation

As we can see in the graph shown below, when eliminating a step from the whole process or changing some of the parameters, the matching process is affected.

Observations:

1. When altering in such an important step such as the image enhancement part, the performance quality of the system drops rapidly as the noise in the image is increased. Because when working with a biometric identification system, obtaining clear and noise free images is a really hard thing, so this step is usually needed.

2. For the binarization step, as explained earlier, using global thresholding may introduce a few problems and may lead to the elimination of significant details by mistake. Here, I tried using global thresholding, with 2 different thresholds, once using an intensity threshold of 120 and the second time using a value of 80. As we can see from the graph, setting the threshold at the average (value for a gray-scale image) affected the system performance a lot and led to false non-match results, while setting a fixed threshold as low as 80 gave better results. Still, it remains better to use the adaptive threshold method because, although it consumes more processing time, it still guarantees the quality of the results.

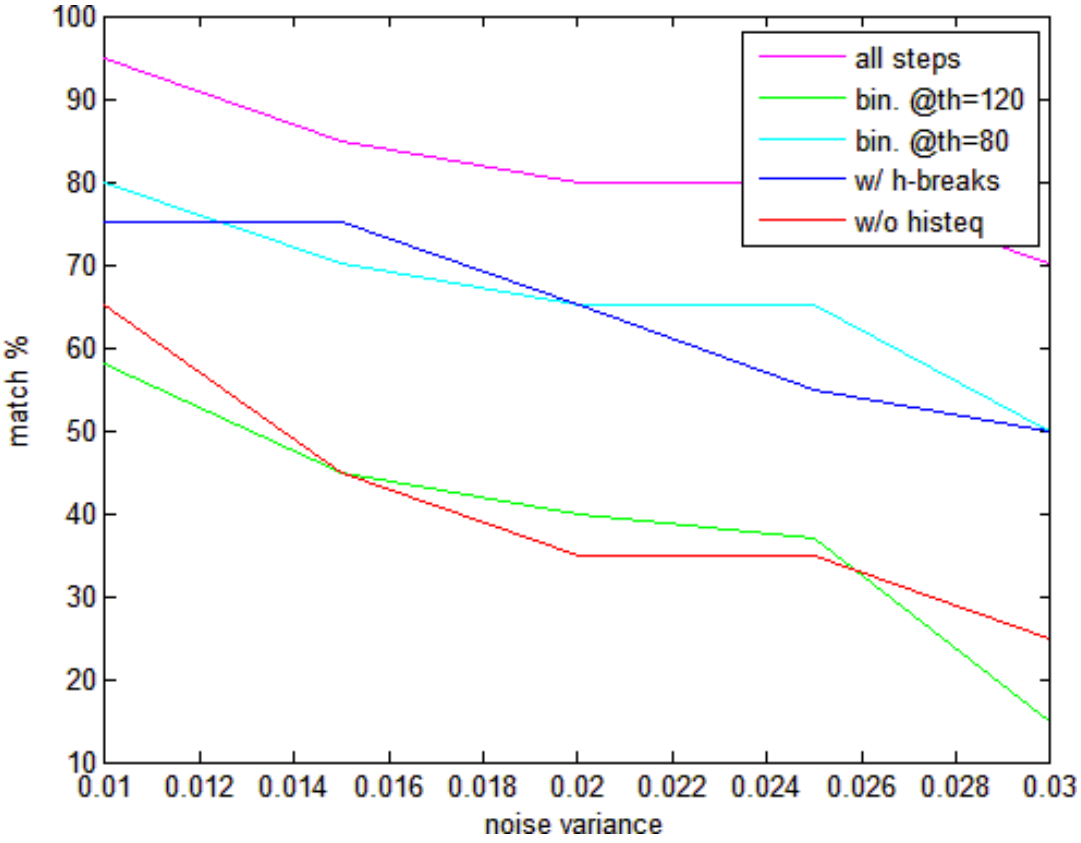

Figure 8.1.1 match percentage vs. noise variance

- Conclusion

The reliability of any automatic fingerprint system strongly relies on the precision obtained in the minutia extraction process. A number of factors damage the correct location of minutia. Among them, poor image quality is the one with most influence.

The proposed alignment-based elastic matching algorithm is capable of finding the correspondences between minutiae without resorting to exhaustive research.

There is a scope of further improvement in terms of efficiency and accuracy which can be achieved by improving the hardware to capture the image or by improving the image enhancement techniques. So that

the input image to the thinning stage could be made better, this could improve the future stages and the final outcome.