A Case Study Of Recognition Technology with special Reference To Fingerprint

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Abstract: *The Case study of fingerprint with reference to recognition technology based on the Minutiae matching used in various fingerprint algorithms. Humans fingerprint are the rich in details called the "minutiae", which can be used as the identification marks for the fingerprint verification. The goal of the paper is to describe the technology used for the fingerprint verification through the extracting and matching minutiae. To achieved good minutiae extraction on the fingerprints with varying the quality, pre-processing in the form of image enhancement, image Binarization and the image segmentation is first applied on the fingerprints before they are evaluated. The histogram equalization & Fourier Transform have been used for the image enhancement. Then fingerprint image is binarize using local adaptive thresholds method .The Minutia Extraction is done by the thinning and the minutia marking technique. A simple algorithm technique is use for the minutia matching. By using this match score method, we can differentiate the two fingerprints weather they are same or not.*

Key Words: *Minutiae, Segmentation, Ridge, Histogram Equalization, Fast Fourier Transformation and Image Binarization.*

1. INTRODUCTION:

1.1 Introduction

Fingerprint recognition refers to the automated method of verifying a match between human fingerprints . The fingerprints are one of many forms of the biometrics used to identify an individual and his identity. Because of the Uniqueness and consistency over time; fingerprints have been used for over a century and more recently becoming automated or "biometric" due to advancement in computing capability.

1.2 What is a fingerprint?

Skin on human fingertips contain ridges and valleys and they forms some distinctive
patterns. This patterns are fully developed under pregnancy and permanent for the whole lifetime. The prints of those patterns are called fingerprints. Some Injuries like
burns, cuts and bruises can temporarily damage quality of fingerprints but when fully healed the patterns will be restored. Through various studies, it has been observed that no any persons have the same fingerprints, hence they are unique for the every individual.

Figure 1.1: Human Fingerprint Image

However, shown by intensive research on the fingerprint recognition, the fingerprints are not Distinguished by their furrows and ridges but by the features called Minutia, which are some abnormal points on the ridges (Figure 1.2)

Among the variety of the minutia types reported in literatures, the two are mostly significant and in heavy usage:

- Ridge ending- the abrupt end of the ridge
- Ridge bifurcation- the single ridge that divides into two ridges

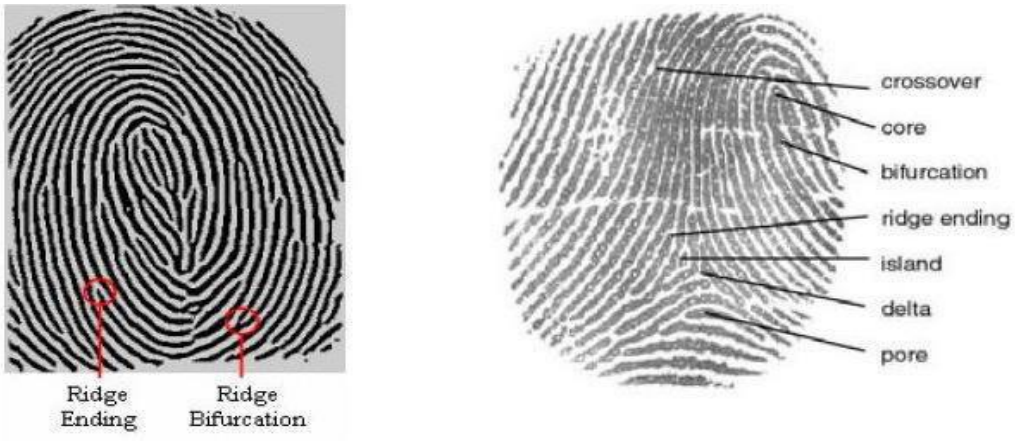


Figure 1.2: Two Minutia Features of human finger

2. FINGERPRINT IMAGE ENHANCEMENT TECHNIQUES

The first step, the minutiae extraction stage is Fingerprint Image enhancement. It is mainly done to improve the image quality and to make it clearer for the further operations. Often fingerprint images comes from the various sources of lack sufficient contrast and clarity. Hence the image enhancement is necessary. A major challenge for all fingerprint techniques to improve the accuracy of matching criteria. It increases the contrast between the ridges, the furrows and connects the some of the false broken points of ridges due to the insufficient amount of ink or poor quality of sensor inputs.

In our case study, we have implemented three techniques they are as follows: Histogram Equalization , Fast Fourier Transformation, and Image Binarization.

2.1 Histogram Equalization

Histogram equalization is a technique for improving the global contrast of an image by Adjusting of the intensity distribution on a histogram . This allows areas of the lower local contrast to gain the higher contrast without affecting of the global contrast. The histogram equalization accomplishes this by effectively spreading out the most frequent intensity values of an image. The original histogram of the fingerprint image has the bimodal type shown in Figure 2.1(a), which shows the histogram and after histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced as shown in Figure 2.1(b).

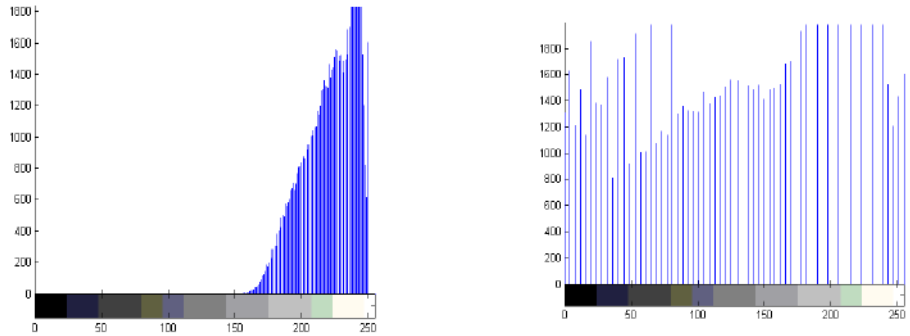


Figure 2.1: (a) Histogram of an image**,** (b) Histogram equalization of an image

(a) (b)

Figure 2.1: (a) Original image, (b) Enhanced Image after Equalization

2.2 POST PROCESSING STAGE

2.2.1 Minutia Extraction

The Ridge Thinning is to eliminate the redundant pixels of the ridges till the ridges are just one pixel wide. An iterative; parallel thinning algorithm is used. In each scan of the full fingerprint image; the algorithm mark down the redundant pixels in each small image window3x3 and finally it removes all those marked pixels after several scans. The thinned ridge map is then filtered by the other three Morphological operations to remove some H breaks isolated points and spikes.

2.2.2 Minutia Marking

After the fingerprint ridge thinning; marking minutia points are relatively easy. The concept of the Crossing Number (CN) is widely used for extracting the minutiae . In general, for each 3x3 window, if central pixel is 1 and has exactly 3 one value neighbor of the central pixel of ridge branch and if a central pixel is 1 and has only 1 one value for neighbors then the central pixel is a ridge ending ,for example if the Cn(P) = =1 it's a ridge end and if the Cn(P) = = 3 it's a ridge bifurcation point for a pixel P.

2.3 Minutia Matching

Let us consider two set of minutia of two fingerprint images, the minutia match algorithm determines whether the two minutia sets are from same finger or not. For this an alignment based match algorithm is use. It includes two consecutive stages 'one is alignment stage' and the second is 'match stage'.

1. In the Alignment stage, two fingerprint images is to be matched if any one minutia from each image is chosen and similarity of two ridges associated with the two referenced minutia points are calculated. If the similarity is larger than a threshold, each set of minutia is transformed to a new co-ordination system whose origin is at the referenced point and whose x axis is coincident with the direction of referenced point.

2. Match stage: After obtaining two set of the transformed minutia points then the elastic match algorithm is used to count the matched minutia pairs by assuming two minutia having nearly the same position and direction which are identical.

2.3.1 Alignment Stage

The ridges are associated with each minutia which represented as a series of x-coordinates (x1,x2…xn) of the points on the ridge. A point is sampled as per ridge length L starting from the minutia point where L is the average inter-ridge length and n is set to 10 unless the total ridge length is less than the10*L.

3. MATCH STAGE:

The matching algorithm is used for the aligned minutia patterns needs to be elastic. Since the strict match requiring that all parameters *x*, *y*,z……. are the same for two identical minutiae, Which is impossible due to slight deformations and the inexact quantization of minutia . The elastic matching of the minutia is achieved by placing a bounding box around each template minutia. If the minutia be matched within the rectangle box and the direction discrepancy between them are very small then the two minutiae are regarded as the matched minutia pair. Each minutia in the template image either has no matched minutia or only one corresponding minutia.

Final match ratio for two human fingerprints is the number of total matched pair over the number of minutia of the template fingerprints. The score is 100*ratio and its ranges from 0 to 100. If the score is larger than pre-specified threshold then the two fingerprints are taken from the same finger. However the elastic match algorithm has the large computation complexity and is vulnerable to the spurious minutia.

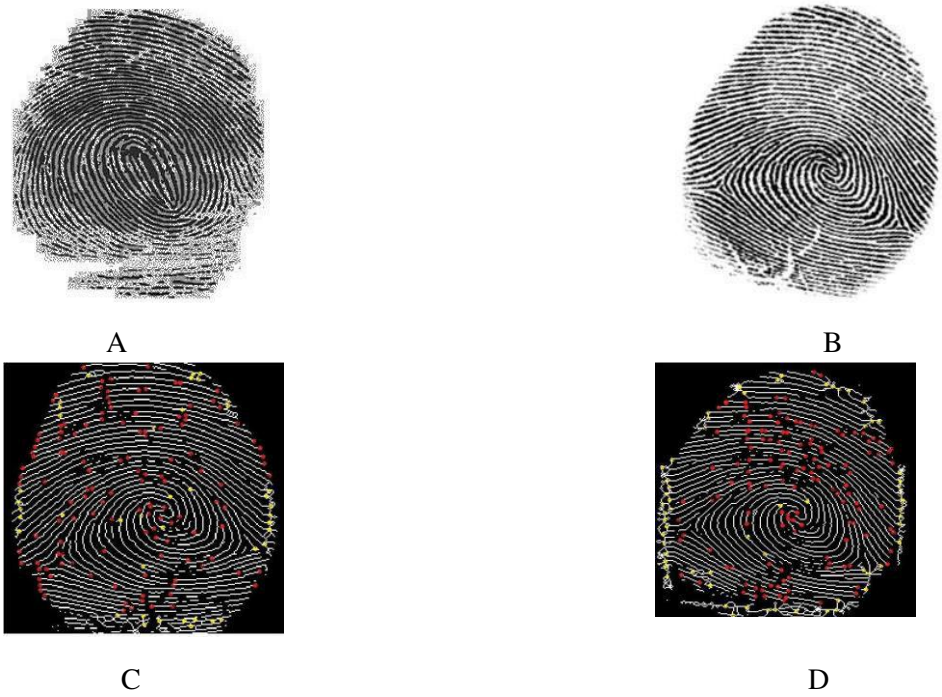
3.1 Results for Minutiae Extraction algorithm:

STEP1: At first we take the original fingerprint image and performing image enhancement by using Histogram equalization. Figure 3.1a. shows the original fingerprint image.

Figure 3.1: (a) Original Image

3.2. Two Fingerprint of a same person with a Little Difference

Figure3.1 (a), Figure 3.1(b) shows two different fingerprint, here Figure 3.1(b) shows the little modify of Figure 3.11(a). Figure 3.1(c), Figure 3.1(d) shows the corresponding Minutiae marked images. Here the match score value between the two images is 0.68. Therefore this value is Greater than the threshold value. Now we can conclude that these two fingerprints are of the same person.



A B

C D

Figure 3.1: (a) First Fingerprint; (b) Second Fingerprint; (c) Minutiae extraction of First Fingerprint;, (d) Minutiae extraction of Second Fingerprint.

4. CONCLUSION:

Above implementation has an effort to understand how the Fingerprint Recognition is used as a form of biometric to the recognize identities of different person. Its include all the stages from the enhancement to minutiae extraction of the fingerprints. Therefore various standard techniques are used in the intermediate stages of the processing.

The relatively low percentage of the verification rate as compared to the other forms of the Biometrics, which indicates that the algorithm used is not very robust and it is vulnerable to the effects like scaling and elastic deformations. There are various new techniques and algorithm have been found out which give better results. Also a major challenge in the Fingerprint recognition lies in the pre-processing of the bad quality of fingerprint images, which also add to low verification rate.

The reliability of automatic fingerprint system strongly relies on the precision obtained in a minutia extraction process. Number of factors are detrimental to the correct location of minutia. Apart them, poor image quality is the most serious one of the others fingerprints. In this case study, we have combined many methods to build the minutia extractor and the minutia matcher. The following concepts have been used in segmentation using the Morphological operations, minutia marking by the specially considering the triple branch counting, minutia unification by the decomposing a branch into the three terminations. There is a scope of the further improvement in the terms of the efficiency and the accuracy, which can be achieved by the improving the hardware to capture the image or by the improving a image enhancement technique. So that the input image to thinning stage could be made better this could improve for future stages and the final outcome.

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