RESEARCH ARTICLE OPEN ACCESS

Implementation of Fingerprint Matching Algorithm

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Abstract:

This paper introduces the implementation of fingerprint matching Minutiae Algorithm for Fingerprint Matching. These algorithm increases the reliability accuracy of the fingerprint matching. The proposed method was evaluated by means of experiment conducted on the FVC2002, FVC2004 database. Experimental results confirm that the taking time of the fingerprint image matching is very less than the other methods. This algorithm is very effective algorithm for the identification of fingerprint image.

Keywords — **FVC2002 DB1_B, Minutiae, Fingerprint Matching.**

1. INTRODUCTION:

Biometric system is automatic identification system by using different recognition system such as iris recognition, face recognition, retina recognition; palm print recognition etc. Fingerprint recognition system is one of the best known and most widely biometric technologies. Fingerprint identification systems, that match a query print against a large database of prints (which can consist of millions of prints), rely on the pattern of ridges in the query image to narrow their search in the database (fingerprint indexing), and on the minutiae points to determine an exact match (fingerprint matching). The ridge flow pattern itself is rarely used for matching fingerprints.

Pattern recognition is the first application of machine in biometric technology. Pattern recognition method is compared to the basic template fingerprint pattern. The pattern which are aggregate characteristics of ridges and minutiae points which are unique features found the within the patterns. Arch, Whole and Loop are the features of the pattern based method. Arch is defined as one line is start from the left side of finger and end from the right side of the finger. In arch, core point and delta points are not present in arch pattern based method. In Whorl, it consists of one or more re curving ridges. Two core point and two delta points are present in the center. In Loop, it consist of one or more free circular ridges access from one directional then back from the same direction after a rotation round. Twinned loop, left loop, right loop are the type of the loop. Minutiae based method is another application of the machine in fingerprint recognition system. Minutiae based system determining the minutiae point present in the first fingerprint image and template fingerprint image. Minutiae based system generally rely on finding the corresponding between the minutiae point present in First and copy of first fingerprint images.. Ride ending, bifurcation and short ridge are the features of the minutiae based system. Ridge ending method is the ending is the point at which a ridge terminates. Bifurcation methods are points are which a single ridge splits in to two ridges. Short ridge method or dot methods are ridge which are shorter than average ridge length on the fingerprint images.

2. LITERATURE SURVEY:

Heeseung Choi et al. introduce a novel fingerprint matching algorithm using both ridge feature and the

conventional minutiae features to increase the recognition performance against non linear deformation in fingerprints. [1]. Anil Jain introduces filter bank based algorithm uses a gabor filters to compute both global and local details in fingerprint as compact to fix length finger code. This method observed that ridge features are invariant to conventional alignment free features in the fingerprint identification [2]. Lin Wang et al. this paper evaluated the performance of the image enhancement algorithm using the index of the extracted minutiae and accuracy of an online verification system [3]. Andrew S describes a method for achieving any level of accuracy required of the system by sacrificing the efficiency of the classifier [4]. Weiguo Sheng et al. describes develop MFMA which aims to identify the optimal or near optimal global matching between two minutiae sets [5]. Ying Hao et al. proposed an effective fingerprint matching algorithm based on error propagation. Firstly, Ridge information and Hough transformation are adopted to find several pairs of matching minutiae [6]. Jens Bornemann introduces a fast and efficient radial mode-matching technique (RMMT) is applied to the analysis and design of components in circular ridge waveguide technology [7]. Arun Ross developed deformation model for estimating the distortion effects in fingerprint impressions based on ridge curve correspondence. The nonlinear distortion represented using the thin-plate spline (TPS) function [8]. Paridhi Munshi introduces a rough-set based approach for binarization of fingerprint image is presented. Maximization of rough entropy and minimization of roughness of the image lead to an optimum threshold for binarization [9].

3. FINGERPRINT PRE-PROCESSING:

3.1 Fingerprint Image Enhancement:

Fingerprint image is used to make image clear for operation. Since the fingerprint image received from the fingerprint machine or any other fingerprint equipment, the quality of this fingerprint image is not accurate. Fingerprint image enhancement method is using for solving this problem. Fingerprint image enhancement method increasing the brightness level of the ridge and valleys. It also connects the not working ridges. There are two methods used in fingerprint image enhancement such as Fingerprint Histogram Equalization and second is Fourier method.

Figure: Fingerprint Image Enhancement

3.1.1 Histogram Equalization:

A chart of the histogram equalization image shows the distribution of different intensity in the fingerprint image. Histogram defines as convert one gray scale fingerprint image into another gray scale fingerprint image. Sometimes all the useful information in an image is not correct only in a small area of color; hence it is generally difficult to extract the useful information from the image. Histogram Equalization is used to increase the value of pixels of fingerprint image so as to increase the perceptional information of fingerprint image. Histogram Equalization is used to increase the brightness level of the fingerprint image. It is also used to keep the constant brightness level of the fingerprint image. A histogram may be viewed with the 'imhist ()' command. The range of gray scale level of the fingerprint image in the histogram equalization is 0 to L-1. It is a discrete function is defined as,

$$p(rk) = \frac{nk}{n}$$

Where, rk: kth gray level of the fingerprint image.

nk: number of the pixels.

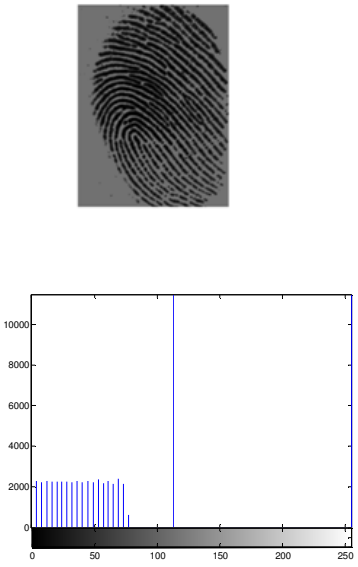

Figure: Fingerprint Image Equalization

3.1.2 Fingerprint Enhancement using Fourier Transform:

The Fourier transform is done to determine the frequency of the pixel value of the fingerprint image. So the out would be fingerprint image in the frequency domain. In the Fourier transform, the fingerprint image is divided into blocks in order to enhance a specific block by its dominant frequencies. So the process is to multiply the Fourier transform of the block by its magnitude a set of times.

3.2 Fingerprint image Binarization:

The fingerprint image binarization is the process of gray scale fingerprint image is converted into the binary fingerprint image. The binarization step which is the accurate information of the equalized image is binary image. Ridge extracting is most important process in the image binarization. The images present or given as a grayscale image. Image binarization converts the image that gives accurate information of fingerprint image. Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0." Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's label (black for 0, white for 1)

Figure: Fingerprint Image Binarization

4. MINUTIAE EXTRACTION OF FINGERPRINT IMAGE:

4.1 Ridge Thinning of Fingerprint Image:

Ridge thinning is to eliminate the redundant pixel of ridges till the ridges are just one pixel wide. In ridge thinning, reduce the complexity in the binaries fingerprint image then ridge thinning of fingerprint image is performed. It is the process of reducing the width of the ridge in the image i.e. skeleton image by morphological thinning operation. By using some thinning, we can generate a one pixel image. The thinning is then filtered by other thinning operation to remove some noise and point. In image processing elements in a binary pattern may have either value 1 or value 0 as shown in figure.

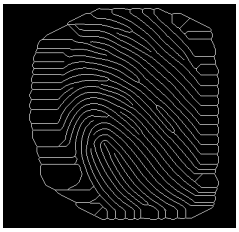

Figure: Fingerprint Image Ridge Thinning

4.2 Minutiae Marking:

After the ridge thinning, marking minutiae point is relatively easy. The concept of cross number (C.N) is widely used for extracting the minutiae. In general, for each 3x3 window, if the central pixel is 1 (one) and has exactly 3 (Three) one value neighbors, then the central pixel is a ridge branch as shown in figure 6.2. If the central pixel is 1 (one) and has only 1 one value neighbors, then the central pixels is a ridge ending as shown in figure 6.3. That is, for a pixel P,

If CN (P) == 1 …… Ridge Ending Point

If CN (P) == 3 …….Ridge Bifurcation Point

0	0	0
0	1	0
0	0	0

Table 1: Ridge Ending Point

1	0	1
0	1	0
0	1	0

Table 2: Ridge Bifurcation Point

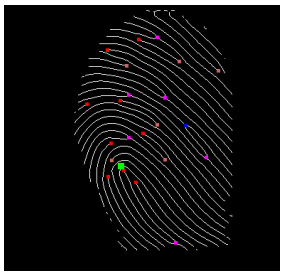

Figure: Minutiae Marking

5. FINGERPRINT IMAGE POST-PROCESSING:

5.1 Removal False Minutiae Point:

There are seven methods to removing the false minutiae points.

a. If the distance between one bifurcation and one termination is less than average distance between two parallel neighbor ridge (D) and two minutiae are in the same ridges, remove both of one bifurcation and one termination.

b. If the distance between two bifurcations is less than average distance between two parallel neighboring ridges and they are in the same ridge, remove the two bifurcations.

c. If the two terminations are within a distance D and their directions are coincident with a small angle variation. And they suffice the condition that no any other information is located between the two terminations. Then the two terminations are regarded false minutiae derived from a broken ridge and are removed.

d. If two terminations are located in a short ridge with length less than average distance between two parallel neighboring ridges, remove the two terminations.

6. FINGERPRINT MATCHING:

Given two set of minutiae of two fingerprint images, the minutiae match algorithm determines whether the two minutiae sets are from the same finger or not. An alignment

base match algorithm is used. In alignment stage, two fingerprint images to be matched, select any one minutia from each image; calculate the similarity score of the two ridges. If the similarity score is greater than the threshold, transform each set of minutiae to a new coordination system whose origin at the reference point. If the similarity score is less than the threshold then input image is successfully matched with the output image. If the similarity score is greater than the threshold, transform each set of minutiae to a new coordination system whose origin at the reference point.

7. EXPERIMENTAL RESULTS:

Result for the Taking time of the Fingerprint Matching

Dataset	FVC 2002	FVC 2002
	Time (S) (Proposed Method)	I.G. Gabriel Babatuned Method (Ref 2)
DB1_B	46.56 Sec	129.10 Sec

Table 1

Result of the False Match Rate and False Not Match Rate of the DB1_B

Dataset	FVC 2002 (Proposed Method)		FVC 2002 (Gabriel B. Method)	
	FMR	FNMR	FMR	FNMR
DB1_B	14.71	12.11	15.33	14.65

Table 2

For the project, we used the database FVC 2002 DB1_B. In Table 1 shows that, taking time of the fingerprint matching in FVC 2002 DB1_B is 46.56 Sec and I.G. Gabriel Babatuned Method fingerprint matching time is 129.10 Sec. In table 2 shows that, in proposed method, False Match Rate (FMR) of the databae_1 is 14.71 % and existing method False Match Rate is 15.33 %. Also False Not Match Rate of the DB1_B is 12.11 % and exiting method, FNMR is 14.65 % as shown in table 2. The proposed method provides less time for fingerprint matching and better accurate results than the existing methods. And also gives the better False Match Rate and False Not Match Rate than the previous method.

8. CONCLUSION:

In this paper, proposed work is divided into the three steps, such as Pre-Processing, Minutiae Extraction and Post-Processing. In the Pre-Processing step, input fingerprint image is converted into the grayscale image and after that this fingerprint image is converted into the binary image, this process is done by using Histogram Equalization and Binarization respectively. In Minutiae Extraction Step, ridge thinning is the redundant pixels of ridges till the ridges are just one pixel wide. Thinning is removing the redundant pixels of ridge. In ridge thinning, to reduce the complexity in processing the binarized image, thinning is performed. After the ridge thinning, marking minutiae point is relatively easy. The concept of cross number (C.N) is widely used for extracting the minutiae. In Post-Processing Step, some mechanism of removing false minutiae is essential to keep the fingerprint verification system effective.

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