

Development of Image Enhancement and the Feature Extraction Techniques on Rural Fingerprint Images to Improve the Recognition and the Authentication Rate.

Babasaheb V. Bhalerao, Ramesh R. Manza.

Department of Computer Science and Information Technology,

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS) India.

Abstract: Fingerprint recognition is one of the most popular and successful methods used for person identification which takes advantage of the fact that the fingerprint has some unique characteristics called minutiae which are points where a ridge crosses another ridge or bifurcates. A critical step in studying the statistics of fingerprint minutiae is to reliably extract minutiae from the fingerprint images. However fingerprint images are rarely of perfect quality. Fingerprint image enhancement techniques are employed prior to minutiae extraction to obtain a more reliable estimation of minutiae locations. Fingerprint matching is often affected by the presence of intrinsically low quality fingerprints and various distortions introduced during the acquisition process. In this paper we have used the rural fingerprints database which is collected from IIT Delhi research lab which consists of 1634 fingerprint images. Out of which we have preprocessed 600 sample preprocessing extracts the ridges and bifurcation from a fingerprint image and tried to improve the quality of images. The resultant images quality is verified by using different quality measures.

Keywords: minutiae extraction, extracts the ridges and bifurcation, rural fingerprint authentication.

I. Introduction

Fingerprint matching is among the most widely used biometric technologies with a broad range of both government and civilian applications such as a UIDAI, passport control, ATM/credit card, The key challenge in fingerprint matching is getting a match decision between a pair of fingerprints from the same finger under various within-class variations. Our implementation mainly noisy rural fingerprint images enhancement, image segmentation, minutiae extraction.

Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify an individual and verify their identity. Because of their uniqueness and consistency over time, fingerprints have been used for over a century.

The word "Biometrics" comes from the Greek language and is derived from the words "Biomeans life and „metric" means to be measure, so biometrics is a field of science and technology used to be measure life characteristics. Biometrics System uses physical and behavioral parameters for person identification. Biometric data are unique for each individual person, even two identical twins. Basically we can use physical parameters than behavioral because behavioral parameters are changed with age and environment whereas physical parameters never changed during whole life. Fingerprint matching techniques are divided into three main types:

- *Correlation based matching
- * Minutiae based matching
- * Pattern based matching.

Minutiae based matching is the most popular and most widely used technique for fingerprint matching. This technique refers the analysis of some unique point's exhibit on fingerprint called minutiae points. The detection and representation of these points are also known as minutiae set. There are two basic minutiae points are majorly used for matching in minutiae based technique, that is Ridge-end, which means the end of the ridges and Bifurcation points, which means one single ridge divided into two ridges.

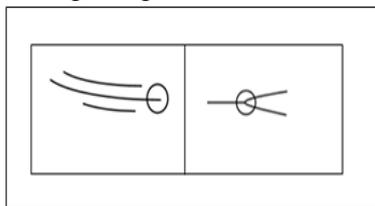


Figure 1. Ridge-end point, Bifurcation point

II. Fingerprint Recognition:

Fingerprint recognition system can be used to analyze two fingerprint images one is original image and another one is template image stored in the database. Fingerprint recognition is mainly divided in two sub-parts: one is verification system and other is identification system. Fingerprint verification is used to verify the authenticity of one person with one to one matching of the database, while fingerprint identification is used to specify the person identification with one to n matching, fingerprint verification is rapid execution method than fingerprint identification. Fingerprint identification is especially serviceable for criminal investigation cases.

MATLAB software provides the best image processing toolbox. Digital fingerprint images can analyze easily using MATLAB. In this paper we present the result of implementation of algorithm on MATLAB.

III. Methodology

The complete algorithm is as follows: Input: Introduce fingerprint Image. Output: Matching score or total number of both ridges-end and bifurcation points.



Figure 2. Rural Fingerprint Original Images

Step1: Acquisition of fingerprint image. **Step2:** Convert image into binary form.

Step3: Apply thinning process on the binary image.

Step4: Find total numbers of ridges-end points and bifurcation points.

Step5: Match both minutiae points for fingerprint verification.

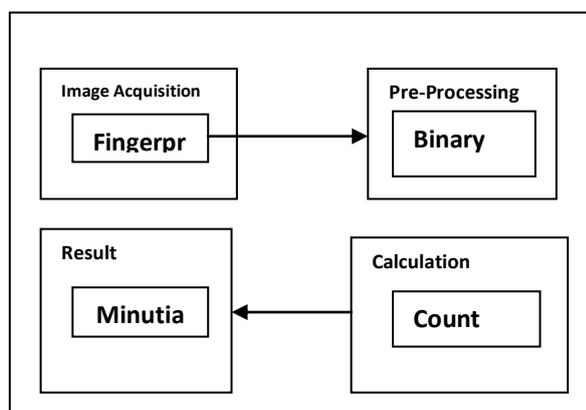


Figure 3. Flow

Pre-Processing:

Pre-processing is the process of alter a gray scale image to a black and white image. In MATLAB, a value of one represents that the pixel is white and value of zero represents that the pixel is black. This modification of gray scale image to binary image is executed by using threshold process to the image. When a threshold process is applied to an image, each pixel values are analyzed to the input threshold. Those pixel values which are smaller than the threshold value is place to zero and those pixel value which are greater than the threshold value is place to one. At the end of this process each pixel values within the image are either zero or one, and the image has been modifying to binary form. After this conversion the ridges in the fingerprint are highlighted with black color while valleys are highlighted with white color.

Minutiae Extraction:

In fingerprint extraction have an accurate representation of the fingerprint image is critical to automatic fingerprint identification systems, because most deployed commercial & non commercial large-scale systems are dependent on feature-based matching. Among all the fingerprint features, minutia point features with corresponding orientation maps are unique enough to difference amongst fingerprints robustly; the minutiae feature representation reduces the complex fingerprint recognition problem to a point pattern matching problem. In order to achieve high-accuracy minutiae with varied quality fingerprint images, segmentation algorithm needs to separate foreground from noisy background which includes all ridge-valley regions and not the background.

Image enhancement and Feature Extraction Techniques algorithm needs to keep the original ridge flow pattern without altering the singularity, join broken ridges, clean artifacts between pseudo-parallel ridges, and not introduce false information. Finally minutiae detection algorithm needs to locate efficiently and accurately the minutiae points



Figure 4. Input Image after Bifurcations

Thinning:

After binarization, next leading pre-processing technique used for matching process is thinning. Image thinning is the process of decrease the thickness of all ridges lines into single pixel width. Thinning process does not convert the original x, y location and angle of direction of the minutiae points of the image, which assure the true calculation of minutiae points. It is also known as Block Filtering. Ridges thinning are used to destruct the extra pixel of ridges till the ridges are just one pixel broad this is done using MATLAB.

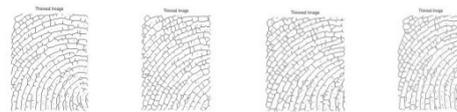


Figure 5 Input images after thinning Minutiae

Input images after thinning Minutiae extraction:

Rural Fingerprint analysis using minutiae extraction process with the combination of several techniques for image pre-processing and post-processing steps to improve the input image until it is suitable for minutiae extraction. Preprocessing steps are crucial for further minutiae extraction. The Minutiae Extraction is done by

Points Searching:

The proposed algorithm detects the Minutiae Points on the basis of Ridges are disconnected at arbitrary point: Ridge-end Point and Ridges are associated with bifurcations: Bifurcation Point.

The classification of ridge-end or bifurcation points is done in MATLAB by creating matrix. If the central pixel is one, has only one neighbor pixel that is ridge-end point. Whereas, if the central pixel is one, has two neighbor pixel that is bifurcation point.

Minutiae Matching:

Image Acquisition

Fingerprint image.BMP = Input Image acquisition from reader.

Timage BMP = Template Image retrieve from database.

Computation of Value:

This step is a very important part of fingerprint matching. After the detection of minutiae points, matching algorithm require to calculate total number of available points in the fingerprint image separately. To perform this computation two counter variables are used to count both ridge-end and bifurcation points.

Minutiae extraction Bifurcations value

Table 1: Minutiae extraction Bifurcations value

Sr.No	Name of Fingerprint Image	Bifurcation (Value)
1	BB\rural fingerprint01_1bmp	522
2	BB\rural fingerprint01_2bmp	699
3	BB\rural fingerprint01_3bmp	578
4	BB\rural fingerprint01_4bmp	701
5	BB\rural fingerprint01_5bmp	380
6	BB\rural fingerprint01_6bmp	488
7	BB\rural fingerprint01_7bmp	623
8	BB\rural fingerprint01_8bmp	690
9	BB\rural fingerprint01_9bmp	362

10	BB\rural fingerprint\01_10bmp	296
11	BB\rural fingerprint\2_1bmp	830
12	BB\rural fingerprint\2_2bmp	760
13	BB\rural fingerprint\2_3bmp	857
14	BB\rural fingerprint\2_4bmp	773
15	BB\rural fingerprint\2_5bmp	811
16	BB\rural fingerprint\2_6bmp	651
17	BB\rural fingerprint\2_7bmp	664
18	BB\rural fingerprint\2_8bmp	752
19	BB\rural fingerprint\2_9bmp	675
20	BB\rural fingerprint\2_10bmp	775
21	BB\rural fingerprint\3_1bmp	788
22	BB\rural fingerprint\3_2bmp	685
23	BB\rural fingerprint\3_3bmp	786
24	BB\rural fingerprint\3_4bmp	942
25	BB\rural fingerprint\3_5bmp	957
26	BB\rural fingerprint\3_6bmp	823
27	BB\rural fingerprint\3_7bmp	709
28	BB\rural fingerprint\3_8bmp	515
29	BB\rural fingerprint\3_9bmp	645
30	BB\rural fingerprint\3_10bmp	579
31	BB\rural fingerprint\4_1bmp	1224
32	BB\rural fingerprint\4_2bmp	488
33	BB\rural fingerprint\4_3bmp	794
34	BB\rural fingerprint\4_4bmp	745
35	BB\rural fingerprint\4_5bmp	507
36	BB\rural fingerprint\4_6bmp	690
37	BB\rural fingerprint\4_7bmp	696
38	BB\rural fingerprint\4_8bmp	420
39	BB\rural fingerprint\4_9bmp	672
40	BB\rural fingerprint\4_10bmp	594

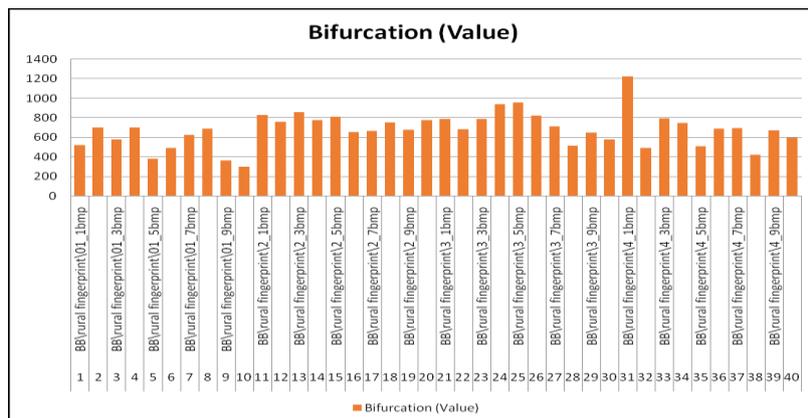


Fig 6 Bifurcations valueGraph

Each minutiae point in the fingerprint image has a specific location. This location information of particular point is significant to store for further matching of fingerprints. The location of every point in the digital image is given by pixel position, so that it can be taken and stored separately for both ridge-end and bifurcation points.

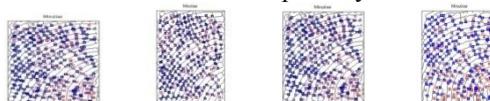


Figure 7 Minutiae point extracted in input images

IV. Conclusion:

In large scale deployment of fingerprint recognition systems, especially in rural fingerprints database, there are some challenges involved. Along with the sensor noise and poor image quality, presence of scars and

warts, and deteriorating ridge/minutiae patterns in fingerprints from rural population affect the data distribution. Since there is no research that evaluates the performance of automatic fingerprint verification/identification in rural fingerprints databases. We will studied the performance using standard fingerprint recognition systems and fingerprint databases collected from the rural fingerprints databases, Indian population now a day's it has been work on unique identification where but when there is enhancement with such noisy fingerprints hence our research work concentrated on same. In this paper we have perform minutiae extraction fingerprint images of rural fingerprint image database. We have selected 600 images out of 1632. In this paper sample result of first forty images out of six hundred given. Fingerprint image enhancement techniques are employed prior to minutiae extraction to obtain a more reliable estimation of minutiae locations very much useful to enhance the quality of rural fingerprint image database.

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