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MINUTIAE AND CORE POINT EXTRACTION OF FINGERPRINT FOR IDENTIFICATION

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Abstract: Fingerprint is the most important biometric trait which is considered to be unique for each person. It is more popular when compared to other identities because of ease of capture, permanence and distinctiveness. In this research, we have formulated a technique for fingerprint recognition which uses pre-processing, ROI cropping, classification, minutiae extraction, post processing and verification techniques. In pre-processing, we have used enhancement techniques for noise removal and edge detection. First it passes through classification phase to match with fingerprint template. If it success, it extracts minutiae points. Before feature extraction, ROI is cropped from fingerprint based on locating reference point. For feature extraction, crossing number method of 3x3 template is applied. Post processing is done which removes the false minutiae points from the fingerprint. Our technique is reliable in terms of number of minutiae points.

Keywords: Fingerprint Image; Identification; Feature extraction; Binarization; Thinning, Local Features; Global Features.

I. INTRODUCTION

Biometric technology helps in identifying a person by his physiological or behaviour characteristics. Physiological characteristics include face, palm, fingerprint, iris, and retina. Behavioural characteristics include signature, the way you walk, the way you speak and keystroke [1]. All characteristics should be unique in nature.

Fingerprint is most important biometric trait as compared to other biometric techniques because of its some characteristics such as:

- Universality
- Ease of capture.
- Highly distinctiveness.
- Permanence over time.
- Fingerprint sensors are smaller and cheaper [2].

Fingerprints are the patterns presents on a finger. It contains a complex patterns called ridges and valleys. In this image, black lines are ridges and there exists some gap between ridges, called valleys.

Fingerprint features are classified in to two categories:

Global features: singular points (ex. core, delta).

Local features: minutiae points (ex. bifurcation, ridge ending) [1].

Figure 1 Minutiae points in fingerprint [3]

Fingerprint systems are widely used in applications like:

- Commercial applications: building access, computer system, ATM.
- Government applications: driver license, passport.
- Forensic applications: criminal investigation.

II. PROPOSED METHODOLOGY

In this process, we have used a technique for fingerprint recognition which uses pre-processing, ROI cropping, classification, minutiae extraction and post processing techniques. In pre-processing, we have used enhancement techniques for noise removal and edge detection. First it passes through classification phase to match with fingerprint template. If it success, it extracts minutiae points. Before feature extraction, ROI is cropped from fingerprint based on locating reference point. For feature extraction, crossing number method of 3x3 template is applied. Post processing is done which removes the false minutiae points from the fingerprint.

1) Image Enhancement

Median filtering is used for image enhancement. Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise [4].

For every pixel, a 3x3 neighbourhood with the pixel as centre is considered. In median filtering, the value of the pixel is replaced by the median of the pixel values in the 3x3 neighbourhood [4].

2) Binarization

The Binarization process is carried out using an adaptive thresholding, where each pixel

- The image is divided into blocks with size 16 * 16.
- Mean intensity value for each block is calculated.
- For each pixel the following rule is applied.

1, if Pi(x, y) > Mean value for block P(x, y) = {0, if Pi(x, y) < Mean value for block

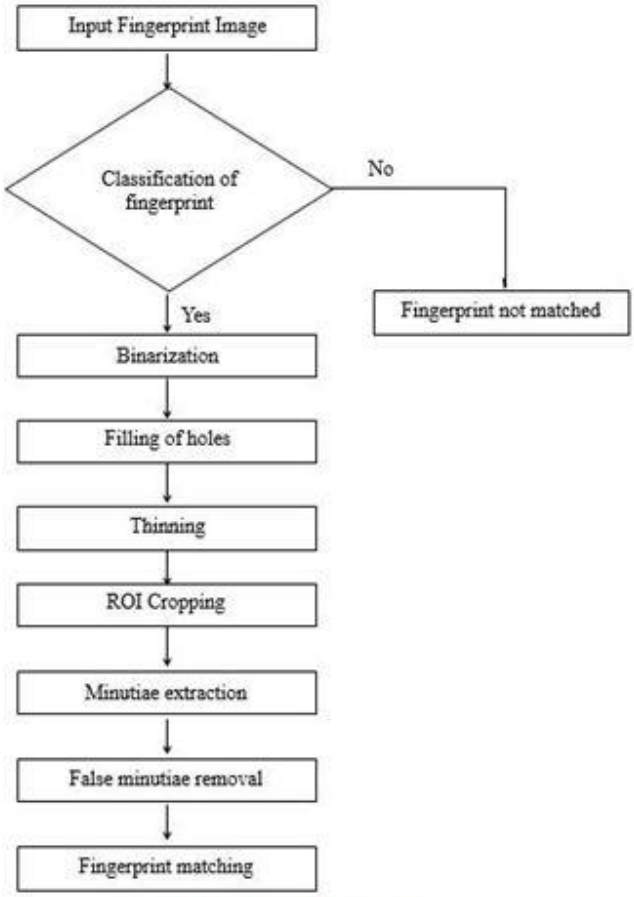


Figure 2 Proposed algorithm

3) Filling of holes

It is used to fill all the holes that are present in the ridges. So any white portion which is surrounded by black color from all sides will be filled with black color. For that Imfill method is used.

4) Thinning

Morphological thinning algorithm is used for thinning process which is faster in compare to zhang suen thinning algorithm.

5) ROI cropping

Reliably cropping ROI is a critical step from the input fingerprint image. However poor quality of the input fingerprint image seriously affects the performance of the cropping. To ensure the performance of cropping ROI and recognition, enhancing algorithm is necessary in a fingerprint recognition system.

Before cropping ROI, the reference point will first be determined. The reference point of a fingerprint is defined as the point of maximum curvature of the concave ridges in fingerprint image. In this work, the complex filter is used to determine the reference point.

6) Classification of Fingerprint

Fingerprints can be categorized based on their global pattern of ridges and valleys. According to Henry there are eight categories are known as

"Henry's Classification" [6].

- It classify that in which class fingerprint exist.
- If class is same of both fingerprint then only match.

7) Minutiae extraction

Crossing Number Method on point P of 3

3 window.

$$CN = \frac{1}{2}\sum_{1}^{8} |Pi - Pi{-}1|$$

8) False Minutiae removal

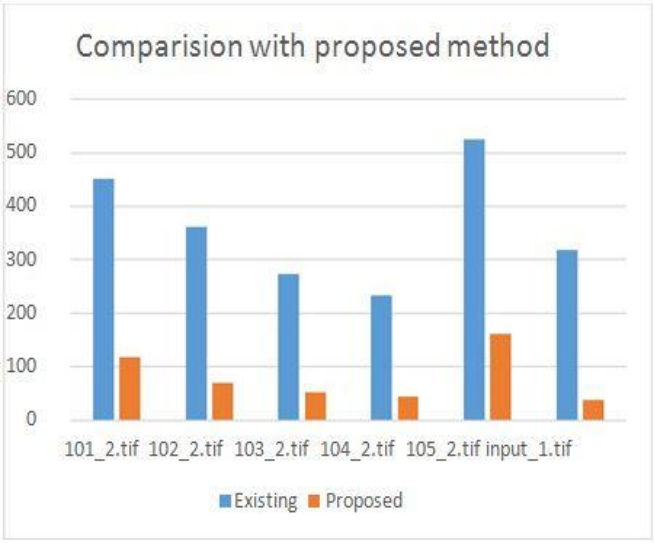
Remove false minutiae by calculating inter ridge width distance D.

$$D = \frac{\text{Sum of all pixels with value 1}}{\text{row length}}$$

III. RESULT ANALYSIS

The proposed technique is implemented using the MATLAB Tool.

Sr. No.	Number of Minutiae Points Found		
	Image	Existing Method	Proposed Method
1	101_2.tif	451	118
2	102_2.tif	361	70
3	103_2.tif	273	52
4	104_2.tif	233	45
5	105_2.tif	525	161
6	input_1.tif	318	37



IV. CONCLUSION

In this research, we designed a technique for identification of fingerprint by using minutiae points. Proposed methodology uses pre-processing, ROI cropping, classification, minutiae extraction, post processing and verification techniques. Proposed methodology provides more accuracy as in the sense that it first classify fingerprint type with template. If it matches then only it finds minutiae point. So it reduces time as well it provides minutiae points near real number.

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