

# A SURVEY ON FINGERPRINT RECOGNITION TECHNIQUES

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Abstract-Fingerprint Recognition is the automated method of verifying a match between two human fingerprints. It is the most sophisticated method of all biometric techniques and it has been thoroughly verified by various applications. Fingerprints remain unchanged for lifetime and are unique for each person. This paper involves how Fingerprint recognition is carried out and architecture of the Fingerprint Recognition paper.

Keywords-Fingerprint, Enhancement, Extraction.

## I.INTRODUCTION

The popular Biometric used to authenticate a person is fingerprint. It is unique and permanent throughout the person's life. There are two types of biometric characteristics. First one is physiological characteristics whereas second is behavioural characteristics. Physiological characteristics are unique characteristics which are physically present in human body. Examples of physiological biometric characteristics include face, fingerprint, iris, ear etc. Behavioural characteristics are related to behaviour of a person. Examples of behavioural biometrics include signature, voice etc. The advantage of biometrics is that biometric identity is always carried by a person. So there is less chance of losing or forgetting it. Also, it is impossible to forget or steal biometric identity. Fingerprint technique is one of the best biometric techniques used for identifying a person[1].

### A. Fingerprint

A fingerprint pattern feature is shown in Figure 1. It is an impression of the friction ridges and furrows on all the parts of a finger and these furrows and ridges present good matching in every small local window.



Figure1.Fingerprint

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Fingerprints are not distinguished by their ridges and furrows. Fingerprints are distinguished using a method called Minutia, which are some abnormal points on the ridges which are shown on Figure 2[2]. Among the variety of minutia types reported in literatures, two are mostly significant and widely used:

- 1) Ridge ending - the abrupt end of a ridge
- 2) Ridge bifurcation - a single ridge that divides into two ridges

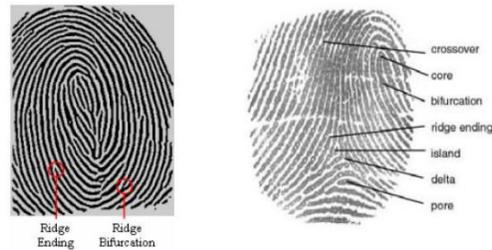


Figure 2.(a) Two important minutia features 2. (b) Other Minutiae features.

### B.Fingerprint Recognition

Fingerprint recognition is the process of comparing fingerprint against another fingerprint to determine if the impressions are from the same finger or palm. It includes two sub-domains: one is fingerprint verification and the other is fingerprint identification Figure 3. In addition, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint Recognition System)[2].

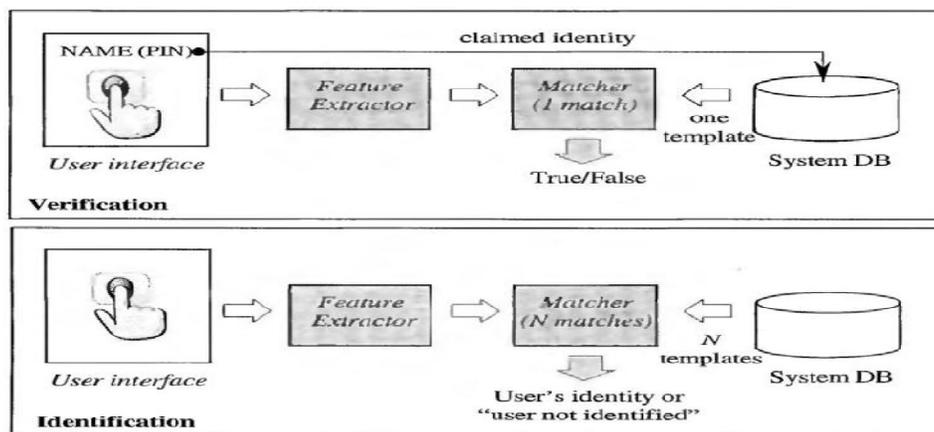


Figure3.Verification v/s Identification

## II.LITERATURE SURVEY

Madhuri and Richa Mishr (2012) [1] have proposed a paper on “Fingerprint Recognition using Robust Local Features”, they say that there are many existing human recognition techniques which are based on fingerprints. Most of these techniques use minutiae points for fingerprint representation and matching. These techniques are not rotation invariant and fail when enrolled image of a person is matched with a rotated test image and such techniques fail when partial fingerprint images are matched. This paper proposes a fingerprint recognition technique which uses local robust features for fingerprint representation and matching.

Manisha Redhu and Dr.Balkishan (2013) [2] have proposed a paper on "Fingerprint Recognition Using Minutiae Extractor", they say that the popular biometrics are used to authenticate a person's fingerprint which is unique and permanent throughout the person's life. Fingerprint Recognition refers to the automated methods of verifying a match between two human fingerprints. Fingerprints are widely used in daily life for more than 100 years due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability. In this paper they projected Fingerprint Recognition using Minutia Score matching method.

Sangram Bana and Dr.Davinder Kaur [3] have proposed a paper on "Fingerprint Recognition using Image Segmentation", which specifies a study and implementation of a fingerprint recognition system based on Minutiae based matching techniques. This approach mainly involves extraction of minutiae points from the sample fingerprint images and then performing fingerprint matching based on the number of minutiae pairings among two fingerprints in question.

Ritu and Matish Garg (2014) [4] have proposed a paper on "A Review on Fingerprint-Based Identification System", this paper says that biometric fingerprints are the personal identification tool because of their individuality, uniqueness and reliability. A fingerprint image consists of valleys & ridges on human fingertips. Fingerprint authentication is possibly the most sophisticated method of all biometric techniques. Fingerprint authentication has been thoroughly verified through various applications. All human recognition techniques using fingerprints are based on one of the following three methods: Minutiae-based, correlation-based, and hybrid. This paper provides a review of various fingerprint recognition techniques and then discusses a general minutiae-based fingerprint identification system.

Priyanka rani, Pinki Sharma (2014) [5] have proposed a paper on "Fingerprint Identification System", they say that the Fingerprint authentication is the most sophisticated method of all biometric techniques and has been thoroughly verified through various applications. Even features such as person's face or signature can change with changing in time and may be fabricated or imitated. But a fingerprint occurs uniquely to an individual and remains unchanged for lifetime. This paper defines the various aspects and methods to be used for the fingerprint-based identification system.

Gurpreet Singh and Vinod Kumar (2014) [6] have proposed a paper on "Fingerprint Recognition: Minutiae Extraction and Matching Technique", they say that the recent advancement in fingerprint identification and authentication has encouraged many people to conduct researches in Fingerprint Identification and Authentication (AFIA). The fingerprint identification system is becoming a new domain for user authentication. Fingerprint classification plays an important role in large organizations where fingerprint identification systems are deployed. Fingerprint identification is very helpful in authentication when two fingerprints do not match and also it reduces the time used for identification. This paper presents a thorough review on the existing classification approaches that have applied to fingerprint recognition problems. The explanation in this paper covers the various evaluation parameters used by AFIS classification approaches.

## II. FINGERPRINT RECOGNITION SYSTEM

The architecture of Fingerprint recognition system can be divided into four phases [4]: Image acquisition, Image enhancement process, Feature extraction from the enhanced image and Pattern matching process (Figure 4).

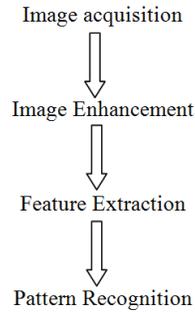


Figure 4. Steps to identify fingerprint image

### A. Image acquisition

In this phase, image of Fingerprint is first acquired with the help of sensors. Captured images may be blurred or may contain noises, which Detroit the quality of an image and affect the performance of Fingerprint recognition system. The fingerprint image acquired may vary by location of finger placed, direction and stretching degree [5].

### B. Image Enhancement

After Image acquisition Image Enhancement will takes place. Sometimes image may becorrputed by various kind of noise such as creases, smudges and holes. Which is impossible to recover the true ridge/valley structures in the unrecoverable regions; any effort to improve the quality of the fingerprint image in these regions is pointless. Therefore, the reasonable enhancement algorithm is used to improve the clarity of ridges/valley structures of fingerprint images in recoverable regions and to mask out the unrecoverable regions.noise and missing minutiae etc. During process, noise can be removed with the help of filters utilized in processing/enhancement. Theaim of thisImage Enhancementphase is to provide the image of high quality. A high quality fingerprint image has the high contrast between the ridges and the valleys. A poor quality fingerprint image is low in contrast, noisy, broken, blur, missing minutiae. Techniques such as Grey-level smoothing, contrast stretching, histogram equalization, and Wiener filtering can be used as pre-processing steps before a sophisticated fingerprint enhancement algorithm is applied [6] (Figure 5).

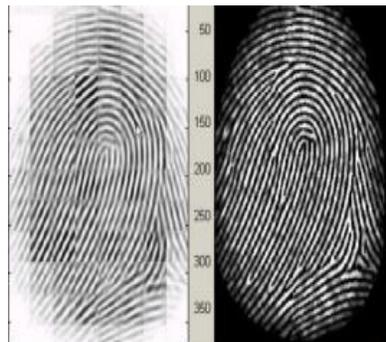


Figure 5.(a) Enhanced Image after FFT, (b) Image before FFT

### C. Feature Extraction:

Fingerprint pattern exhibits different types of fingerprint features [1]:

*i.* Level 1 (Global Level): When the ridges are parallel. They are classified as delta, loop and whorl which are representing in Figure 6.

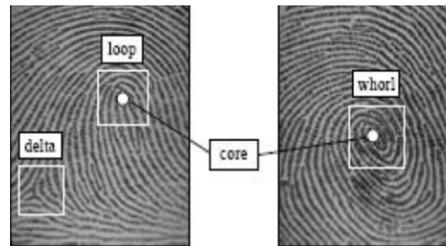


Figure 6.Delta,Loop,Whorl

*ii.* Level 2 (Local Level): This is based on minutiae in which the ridges are not in order. They are classified as ridge ending, ridge bifurcation, lake, independent ridge, point or island, spur, crossover are shown in Figure 7.

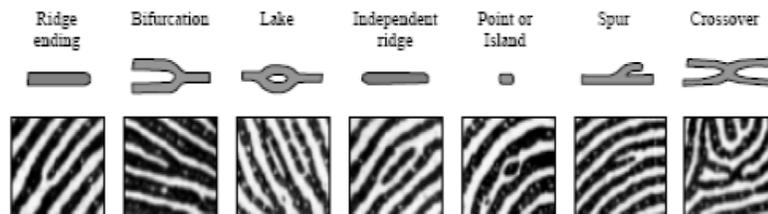


Figure 7.Ridge ending, Bifurcation, Lake,Independent ridge, Point or Island, Spur, Crossover

*iii.* Level 3 (Very Fine Level): Intra ridge details are detected. Sweat pores are showed at this level is shown in Figure 8.



Figure 8.White pores are Sweat Pores.

### D. Pattern Recognition

A pattern is an arrangement of descriptors. It is characterized by the order of the elements of which it is made, rather than by the intrinsic nature of these elements. Pattern recognition is divided into two parts: first one is Decision theoretic and second is Structural. The Decision theoretic deals with patterns described using quantitative descriptors, such as length, area, and texture. Structural category deals with patterns described by qualitative descriptors that are relational descriptors. Pattern recognition phase compare basic fingerprint patterns like

arch, whorl and loop between a candidate fingerprint and previously stored template. This requires that the images be aligned in the same orientation. In pattern recognition, the template has the type, size, and orientation of patterns within the fingerprint image [3, 6].

### E. Fingerprint Matching

The large number of approaches to fingerprint matching can be coarsely classified into three families.

#### i. Correlation-based matching:

Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments.

#### ii. Minutiae-based matching:

This is the one of the best technique. Minutiae are extracted from the two fingerprints and they can store as group of points in the two-dimensional manner. A minutiae based matching consists of finding the alignment between the template and the input minutiae sets which results in maximum number of minutiae pairings.

#### iii. Pattern-based (or image-based) matching:

Pattern based matching compares two fingerprints. This requires that the images be aligned in the same orientation. In order to do this, the Pattern-based finds a middle point in the fingerprint image. In the image-based matching, the template contains the size, type and pattern orientation within the fingerprint image. The person fingerprint image is compared with the template to recognize the degree. Which focuses on implementation of minutiae based matching technique [6]. The full procedure is represented in Figure 9.

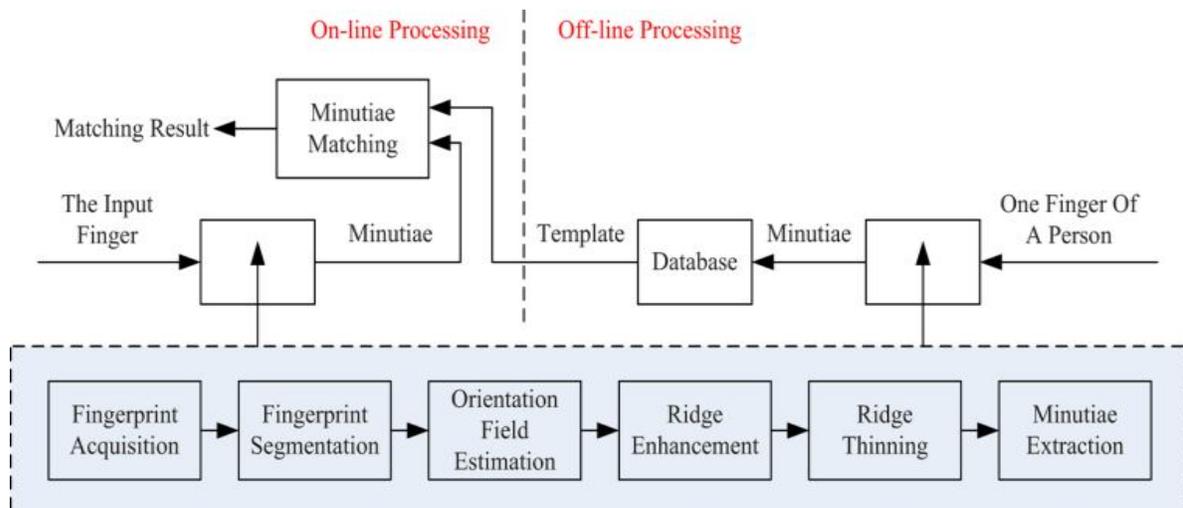


Figure 9. Implementation Procedure

## III. CONCLUSION

Fingerprint recognition is very reliable recognition system. The above implementation was an effort to understand how Fingerprint Recognition is used as a form of biometric to recognize

identities of human beings. It includes all the stages from minutiae extraction from fingerprints to minutiae matching which generates a match score. Various standard techniques are used in the intermediate stages of processing.

## REFERENCES

- [1] Madhuri and Richa Mishr, "Fingerprint Recognition using Robust Local Features", IJARSSE, Volume 2, Issue 6, June 2012, INDIA.,
- [2] Manisha Redhu and Dr. Balkishan, Department, "Fingerprint Recognition Using Minutiae Extractor", Applications (IJERA), Vol. 3, Issue 4, pp. 2488-2497, Jul-Aug 2013, Maharshi Dayanand University, Rohtak, India
- [3] Sangram Banal and Dr. Davinder Kaur, "Fingerprint Recognition using Image Segmentation", IJAEST, Vol No. 5, IIT Roorkee, Roorkee
- [4] Ritu and Matish Garg, "A Review on Fingerprint-Based Identification System", Student, SBIET College, Pundri, Kaithal, India, Assistant Professor, SBIET College, Pundri, Kaithal, IJARCCCE, Vol. 3, Issue 3, March 2014, India.
- [5] 1Priyanka rani, 2Pinki Sharma, "A Review Paper on Fingerprint Identification System", IJARCSST, Vol. 2, Issue 3 (July - Sept. 2014) Kaithal, Haryana, India
- [6] Gurpreet Singh and Vinod Kumar, "Review On Fingerprint Recognition: Minutiae Extraction and Matching Technique", IJISR, Vol. 10 No. 1, pp. 64-70, Oct. 2014, Punjab, India