

# Review on Fingerprint Identification

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**Abstract:** For over a hundred years, fingerprints were the gold standard for personal identification within the forensic community. Fingerprints and fingerprints are used to provide police and courts with the most effective means of personal identification. The basic fingerprint patterns are loops, whorls and arches which can be found in fingerprints. The basic technique used by fingerprint experts is ACE-V for analysis, comparison, assessment and verification. Which are the four essential phases of this cycle? To verify or determine identity, the recovered prints can be manually compared with existing antemortem records or searched through an automated fingerprint system (AFIS). Fingerprint authentication is the most advanced approach of all biometric methods and has been extensively tested through a variety of applications. Also characteristics such as the face or signature of an individual can change over time and can be created or imitated. But for a person a fingerprint exists uniquely and remains unchanged for life. This paper describes the different aspects and approaches to be used in the identification system based on fingerprints.

**Keywords:** Biometric, Fingerprint identification, Histogram, Minutiae, Accuracy.

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## INTRODUCTION

Fingerprint is biometric's oldest and simplest available traits; it shows an infallible personal means Identification [1]. Using fingerprinting technique, accuracy matches. Compared with other existing biometric traits it has been shown to be very high. Fingerprints are persistent with age as opposed to face and voice patterns, and cannot be easily changed. We may claim that fingerprinting is one of biometric authentication's most researched and matured fields. The first example of biometrics is its being used in China as a method of fingerprinting. Fingerprints are incomparably the surest and most unchanging type of all other signature types.

A fingerprint is defined by a set of ridge lines that run parallel to each other and sometimes end and sometimes intersect. The points are referred to as Minutiae, where the ridge lines are ended. Whereas according to Galton, each ridge is distinguished by various minute peculiarities called Minutiae, which can separate and reunite almost immediately, encompassing a small circular or elliptical area, or sometimes the independent start or end of ridges. The ridges are dark in a fingerprint picture, while the valleys are light. Ridges and valleys sometimes run alongside each other; sometimes they bifurcate and sometimes they finish off. Minutiae-based fingerprint

identification method correctly approaches the elimination of ridge patterns.

A good quality fingerprint contains 25-80 minutiae numbers depending on the sensor resolution and finger location. Nevertheless, there are fewer minutiae points in the fingerprint picture produced by bad scanners. So ensure that the minute extraction process is mages as data, this gives the fingerprint images a cause for change.

## LITERATURE REVIEW

Different types of research have been performed so far in the area of fingerprint identification[2]. In this section, we had gone through various research articles, the work done until today and the methods used in each work are shown:

### *1. Fast Fourier Transform and Gabor Filters:*

Quick Fourier Transform[3] and Gabor Filters have been used in this work to identify fingerprint. It is used for improving and reconstructing fingerprint image information, two specific categories of minutiae, endpoints and bifurcations are identified as well. Finally, the derived functions are used for the identification of fingerprints.

## International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 5, Issue 2, February 2018

### 2. Fusion and Context Switching Frameworks:

In forensic science application the principle of fusion and context mixing is applied in order to match two latent fingerprints. Unlike inked or live fingerprints suit latent in this definition, proper analysis and attention is paid.

### 3. Segmentation Algorithm:

Segmentation[4] is one of the first and most important pre-processing measures for any authentication of fingerprints and it decides the outcome of examination and identification of fingerprints. Various segmentation algorithms were used which are defined as follows:

#### 3.1 Gauss Filtering In this process of collecting the Fingerprints:

For many reasons such as inhaling dust and spots on the sensor surface, noises are usually drawn into the fingerprint picture. The Gaussian filter is therefore used to mitigate the effect and increase the image quality.

#### 3.2 Histogram Processing:

Manipulation of histograms[5] can be used effectively to improve fingerprint images. Histograms are simple to calculate in software and also lend themselves to implementations of economic hardware, making them a common resource for real-time image processing.

#### 3.3 Histogram Equalization:

We consider a continuous function here, and let the variable represent the gray image levels to be enhanced. They assume that  $r$  has been normalized to the interval  $[0, 1]$ , with  $r=0$  representing black and  $r=1$  representing white. The transformation can be written as:

$$s = T(r) \quad 0 < r < 1$$

This produces a level  $s$  for every pixel value  $r$  in the original image. The transformation Function  $T(r)$  satisfies the following conditions:  $T(r)$  is a single-valued and monotonically increasing in the interval,  $0 < r < 1$  and  $0 < T(r) < 1$  for  $0 < r < 1$

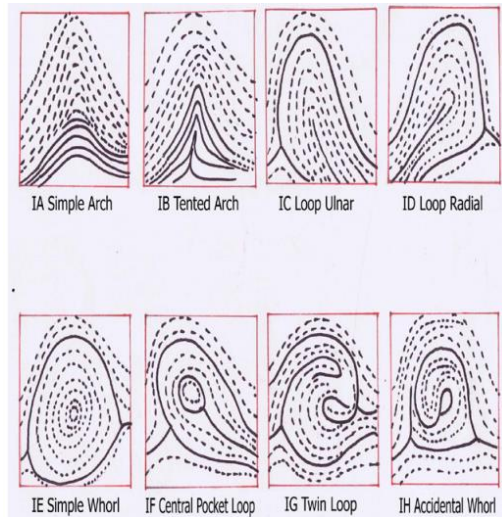
### PATTERN RECOGNITION AND FEATURE EXTRACTION

A pattern is a descriptor system[6]. It is defined not by the intrinsic nature of those elements, but by the order of the elements of which it is formed. Recognition of trends is divided into two main areas: Theoretical and Structural Decisions. The theoretical decision deals with patterns which are represented using quantitative descriptors such as duration, area and texture. Structural category deals with trends best described by qualitative descriptors, such as descriptors of the relation. A pattern class is a family of patterns that share some common properties. Pattern classes are denoted by  $w_1, w_2, \dots, w_W$ , where  $W$  is the number of classes. Computer pattern recognition requires techniques for automatically assigning patterns to their respective classes, and with as little human intervention as possible. Vectors, strings, and trees are three common pattern patterns used in practice. The pattern vectors are defined as follows:

$$x = [x_1, x_2, \dots, x_n]$$

Where each variable,  $x_i$  represents the  $i$ th descriptor and  $n$  is the total number associated with the pattern of such descriptors. The existence of a pattern vector  $x$ 's components depends upon the method used to characterize the object itself.

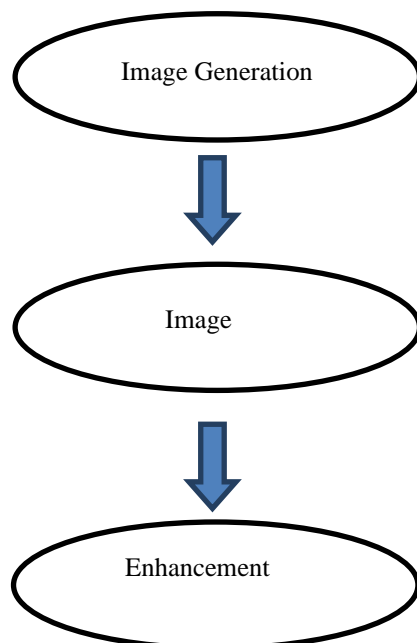
The key concept to keep in mind is that selecting the descriptors on which to base each component of a pattern vector has a profound influence on the eventual performance of object recognition based on the pattern vector approach. Finally fingerprint recognition[7] is based on the interrelationships of print features called minutiae. This arrangement is shown in a figure 1 given below.



**Figure 1: Types of Finger Patterns: Systematic Drawings with Boldly Traced Type Lines**

### METHODOLOGY

The Biometric Identification System (BIS)[8] block diagram is clearly referenced in figure 2 below. This consists of three components which are shown to classify the fingerprint image using a flowchart.



**Figure 2: Flowchart to Identify Fingerprint Image**

Each of the component mentioned in the flowchart are described as follows:

#### 1. Image Generation:

The image sensor acquires digital images by relation to question domain. First is a physical system sensible to the object's radiated energy. The second one, called a Digitizer, is a device that translates the physical sensing unit output into the form of digits. Specialized hardware for image processing consists of the digitizer and hardware which perform other primitive operations. The Computer is a system for image processing that ranges from PC to Supercomputer. The image processing software consists of specialized modules which perform specific tasks. The mass storage capability is a must in applications for image processing. A 1024x1024 pixel size image, in which each pixel's strength is an 8-bit quantity, requires one megabyte (MB) of storage space if the image is not compressed. In use, image displays are primarily TV monitors in color. Monitors are powered by image outputs and display graphics cards, which are an integral part of the computer system.

#### 2. Image Enhancement:

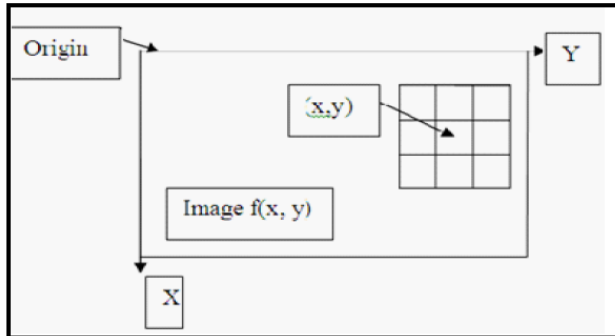
The approaches to image enhancement are broadly classified into two broad categories, which are discussed here.

##### 2.1 Spatial Domain Methods:

Spatial domain refers to the aggregate of pixels composing an image. Spatial domain[9] methods are procedures that operate directly on these pixels. It can be denoted by the expression:

$$g(x, y) = T[f(x, y)]$$

Where  $f(x, y)$  is the input image  $(x, y)$  is the processed image and  $T$  is an operator of  $f$ , defined over some neighborhood of  $(x, y)$ .



**Figure 3: A 3\*3 Neighborhood About a Point (x,y) in an Image**

### 3. Matching Of Fingerprint Image:

Matching-based recognition techniques represent each class by a vector of a template pattern[10]. The class to which it is equivalent in terms of a predefined metric is given an undefined sequence. The simplest approach is the minimum-distance classifier, which measures the distance between the unknown and each of the prototype vectors, as its name implies.

### CONCLUSION

We have shown various methods and techniques in this paper which can be used to identify a person via his fingerprint. Such methods suggest that the fingerprint is quick and accurate for a more robust and safe device. The method of filtering Gabor is a very useful method that is used to remove features. The biometric identification system technique is represented with the aid of diagrams and flow charts that can be used to improve the image quality and to verify a person's identity. Through enhancing the image enhancement technique and creating a better matching technique, future research work can be done to improve the quality of the image. Identification of fingerprints is the oldest forensic science known to humans. Over time, fingerprints have proven to be the fastest, most reliable and most cost-effective means of identifying unknown deceased individuals, particularly in a mass-disaster setting. To verify or determine identity, the recovered prints can be manually compared with established antemortem records or searched through an automated fingerprint system (AFIS). The identification of remains by fingerprints fulfills the most important and difficult function of a forensic identification operation: the prompt and precise notification of the fate of their loved one to the families.

### REFERENCES

- [1] J. A. Unar, W. C. Seng, and A. Abbasi, "A review of biometric technology along with trends and prospects," *Pattern Recognit.*, 2014, doi: 10.1016/j.patcog.2014.01.016.
- [2] K. Krishan, T. Kanchan, and G. S. Bumrah, "The Fingerprint Sourcebook," *J. Forensic Leg. Med.*, 2012, doi: 10.1016/j.jflm.2011.12.018.
- [3] G. Plonka, D. Potts, G. Steidl, and M. Tasche, "Fourier transforms," in *Applied and Numerical Harmonic Analysis*, 2018.
- [4] N. H. Patel and P. Z. Liu, "Segmentation," in *Encyclopedia of Insects*, 2009.
- [5] D. W. Scott, "Histogram," *Wiley Interdiscip. Rev. Comput. Stat.*, 2010, doi: 10.1002/wics.59.
- [6] G. Van Rossum, "Descriptor HowTo Guide," *Python*, 2017.
- [7] F. Alonso-Fernandez, J. Bigun, J. Fierrez, H. Fronthaler, K. Kollreider, and J. Ortega-Garcia, "Fingerprint recognition," in *Guide to Biometric Reference Systems and Performance Evaluation*, 2009.
- [8] V. I. Syryamkim, D. N. Kuznetsov, and A. S. Kuznetsova, "Biometric identification," in *IOP Conference Series: Materials Science and Engineering*, 2018, doi: 10.1088/1757-899X/363/1/012005.
- [9] L. Estes *et al.*, "The spatial and temporal domains of modern ecology," *Nat. Ecol. Evol.*, 2018, doi: 10.1038/s41559-018-0524-4.
- [10] R. K. Colwell, "III.1 Biodiversity: Concepts, Patterns, and Measurement," in *The Princeton Guide to Ecology*, 2014.
- [11] S. Balamurugan, RP. Shermy, Gokul Kruba Shanker, VS. Kumar, VM. Prabhakaran, "An Object Oriented Perspective of Context-Aware Monitoring Strategies for Cloud based Healthcare Systems", *Asian Journal of Research in Social Sciences and Humanities*, Volume : 6, Issue : 8, 2016.
- [12] S. Balamurugan, P. Anushree, S. Adhiyaman, Gokul Kruba Shanker, VS. Kumar, "RAIN

**International Journal of Engineering Research in Computer Science and Engineering  
(IJERCSE)****Vol 5, Issue 2, February 2018**

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- Computing: Reliable and Adaptable Iot Network (RAIN) Computing”, Asian Journal of Research in Social Sciences and Humanities, Volume : 6, Issue : 8, 2016
- [13] M. Prabhakaran, Prof S.Balamurgan ,A.Brindha ,S.Gayathri  
,Dr.GokulKrubaShanker,Duruvakkumar V.S,  
“NGCC: Certain Investigations on Next Generation 2020 Cloud Computing-Issues, Challenges and Open Problems,” Australian Journal of Basic and Applied Sciences (2015)
- [14] Usha Yadav, Gagandeep Singh Narula, Neelam Duhan, Vishal Jain, “Ontology Engineering and Development Aspects: A Survey”, International Journal of Education and Management Engineering (IJEME), Hongkong, Vol. 6, No. 3, May 2016, page no. 9 – 19 having ISSN No. 2305-3623.
- [15] Vishal Assija, Anupam Baliyan and Vishal Jain, “Effective & Efficient Digital Advertisement Algorithms”, CSI-2015; 50th Golden Jubilee Annual Convention on “Digital Life”, held on 02nd to 05th December, 2015 at New Delhi, published by the Springer under ICT Based Innovations, Advances in Intelligent Systems and Computing having ISBN 978-981-10-6602-3 from page no. 83 to 91.
- [16] Vishal Jain and Dr. S. V. A. V. Prasad, “Analysis of RDBMS and Semantic Web Search in University System”, International Journal of Engineering Sciences & Emerging Technologies (IJESSET), Volume 7, Issue 2, October 2014, page no. 604-621 having ISSN No. 2231-6604.