



## Review on fingerprint System

Anu Lohat, Rishabh Parashar

Computer Science and Engineering,  
Shri Krishan Institute of Engineering and Technology, Kurukshetra  
Kurukshetra University,  
India

**Abstract:** fingerprint identification is also known as dactyloscopy. It is a process to find that whether two friction ridge skin impression from the human finger or toes even the palm are the same or not. Friction ridge skin uses the minutiae for matching. There are recently advancement in fingerprint sensing technology has done in accuracy and in speed of matching algorithm. AFIA is an attractive automatic fingerprint identification and authentication method for the fingerprint identification and authentication process. This paper is regarding the human fingerprint identification. A fingerprint is the most biometric system mostly used in various authentication system. For Example: Login system, Schools, Govt. Offices and EVM machine etc. There are some issues regarding the better performance, cost and reliability.

**Keywords:** fingerprint, authentication, biometric, segmentation, extraction

### I. INTRODUCTION

Biometric verification system is a process in which individual identity is identified by checking a physiological trait. For Example:- Retina, Face or Signature etc. Biometric are defined as anatomical (Fingerprint, face) and behavioral (ridges) characteristics that are used in FBI. Intelligence Bureau for identification of an particular person. Common biometric include DNA, Thumb impression, Face Pattern etc. The AFIA system combine the algorithm of image processing with impression of fingerprint and then map that in the result to an particular base of fingerprint. [2]

- The AFIA include the following:-
- Fingerprint segmentation
- Fingerprint image enhancement
- Feature Extraction
- Minutiae matching
- Fingerprint classification [1]

### II. MINUTIAE

The ridge ending and ridge junction are termed as the minutiae which provide the details of ridge's valley structure. [17, 18]

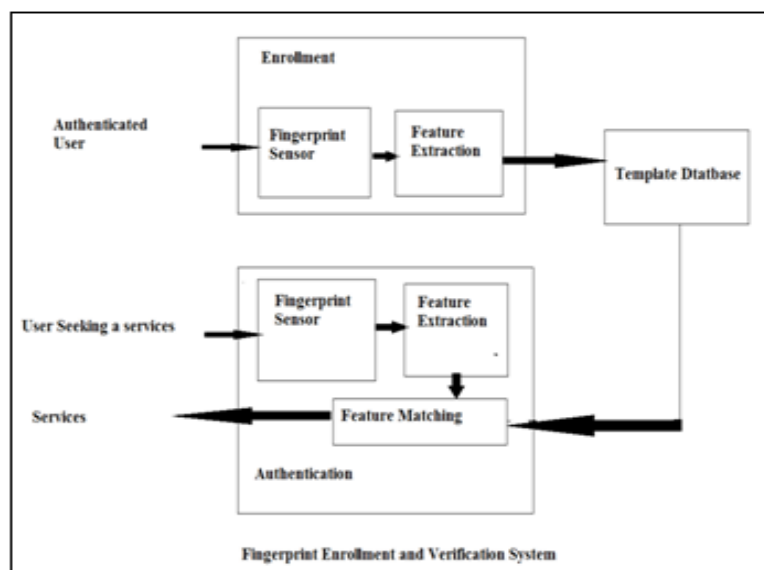


Fig. 1: Personal Authentication and Verification [3]

### III. CLASSES OF FINGERPRINT

The classes of fingerprint include Image Arch, Tented, left, right. These classes are rarely used in biometric authentication system. Many kind of details exist, consist of dots, islands(ridges that slightly longer than dots), taking a middle space between two provisionally different ridges, Ponds(Empty place between two different ridges), Bridges(A small ridge combine two longer adjacent ridges) and crossover(Where two ridges cross each other). [1]

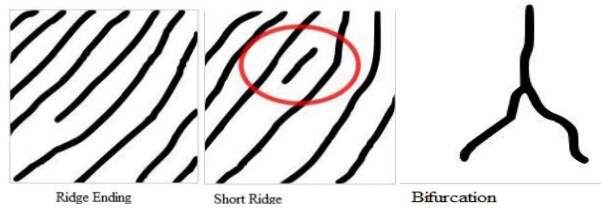


Fig. 2: Ridge end, Short Ridge, Bifurcation [2]

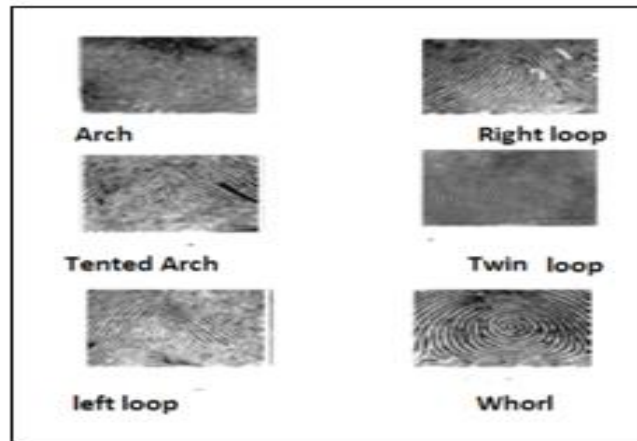


Fig. 3: Modules of fingerprint [1]

### IV. DIRECTIONAL MAP

The ridge line flow can be efficiently explained by formation called directional map. [1]



Figure 4: Directional Map [1]

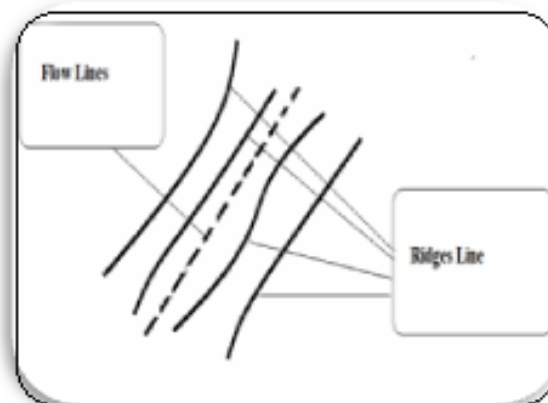


Figure 5: Ridge Line, Flow Line [1]

The fingerprint details can be obtained from the fingerprint impression. An acquired impression of fingerprint may be a latent fingerprint or identified fingerprint or plastic fingerprint impression.

A latent fingerprint impression is a two dimensional duplicate of ridges produced when a finger touch a plane and fingerprint is formed by purification. For Example: oil, hot, ill etc. This kind of fingerprint impression is able to seen by using some scientific method or powders.

When Latent fingerprint impressions are noticeable without using the scientific technologies then it is known as patent fingerprint. The second kind of fingerprint is known fingerprint, where the impression acquired by planned replica of the ridge. The fingerprint can be acquired by printer's ink or by chemical technique or by other biometric identification system.

The Plastic fingerprint is that in which ridge detail are acquired by impression. This impression is made on some flexible substrate for Example: Wax, Putty.

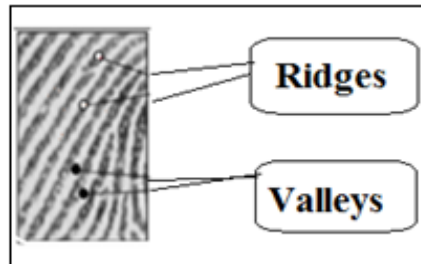


Fig. 6: The Structure of Fingerprint [1]

The Fingerprint includes the pattern of ridges on the human's Finger.

#### V. A PROCESS OF FINGERPRINT USER INTERFACE

The flow fingerprint user interface works on with the sensor and obtained the image of the fingerprint when user pushes the sensor. After this the fingerprint system execute the identification process by matching the fingerprint to the stored fingerprint in the database. [3]

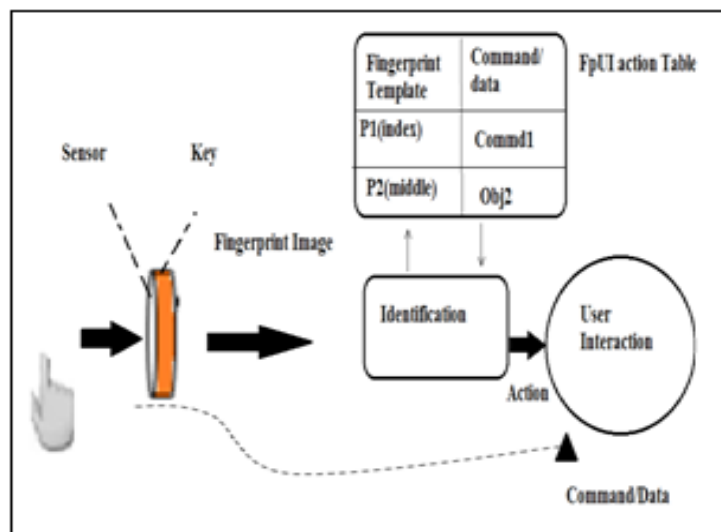


Fig. 7: Fingerprint User Interface [3]

#### 5.1 Fingertip Memo

For example, a user browse the website by keeping the URL in each finger. By using the memory. Then get sequence dynamically and user could copy and paste.

This application also used on the network object virtually copied to finger on PC and placed on another by touching. This shows saving and carrying data the object in his finger. [3]

#### 5.2 Fingertip command

By using the fingertip command the interface designer can reduce the number of keys, to avoid the use of control key. This often thing that confuse the computer novice. [3]

#### 5.3 Fingertip Saver

The Login used not only fingerprint verification but also used for system's security etc. In addition to static setup the dynamic status can applied to pending session might be saved and later restored so that user can continue their work easily.[3]

## VI. FINGERPRINT ENROLLMENT, VERIFICATION AND IDENTIFICATION

### 6.1 False Error Rate

The rate at which the System reject the registered user after comparing to the total number of trials. [2]

### 6.2 False Acceptance rate

The rate at which falsely system take non registered user as registered user. One compare with the Total. [2]

### 6.3 Equal Error Rate

This is the where both FAR and FRR are keep as low possible at the same time. This shows the High accuracy when FAR and FRR will be equal. [2]

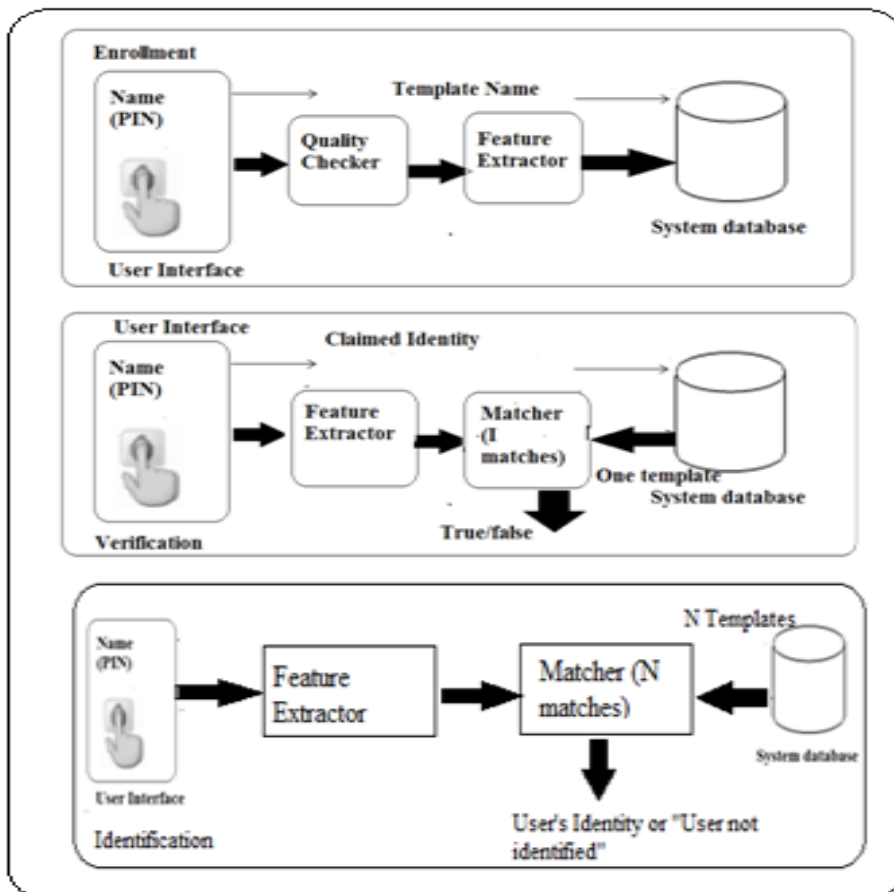


Fig. 8: Fingerprint Enrollment, Verification and Identification [2]

## VII. TEMPLATE DATABASE

It is used to store the fingerprint images. The database should also be encrypted and protected against the writing by unauthorized person. [3]

The enrollment and Identification module involve the database for storage of the fingerprint and after processing the input image compare with the fingerprint image from the database. [5]

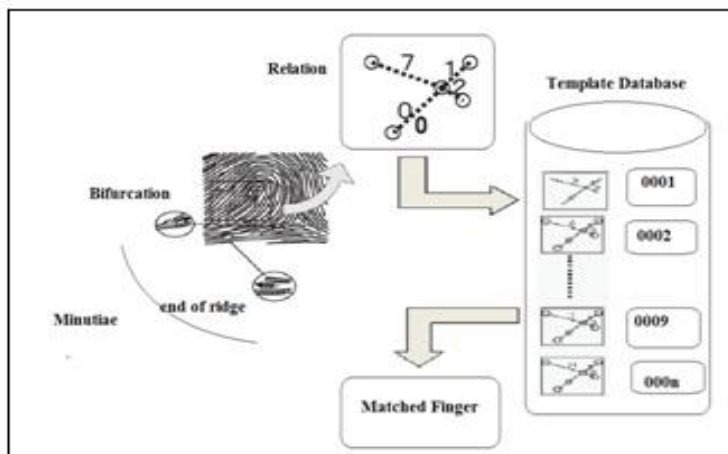


Fig. 9: Search in a template database [3]

### 7.1 Pre-Processing Stage

The input fingerprint image made appropriate for processing by Image enhancement Method. [19]

### 7.2 Post- Processing

It includes an analysis of local image or other indicators of non fingerprint structure. The image can be reversed into Gray scale, Conversion of black to white or vice versa. [17]

### 7.3 DCT

Fingerprint recognition is done using DCT(Discrete Cosine Transform).AOI (Area of interest) will be transformed into DCT. [8]

### 7.4 Variance

It is the each pixel's variation in the given block with respect to the other. [8]

### 7.5 Major and Minor Block

The image is depend on the pressurethe corresponding DCT coefficient differ, at different instant. But the variation remains constant between the DCT coefficient. This variation considered as features and extract by the segmenting the DCT into the non-overlap blocks. [8]

### 7.6 Feature Vector

The Variance Computed for Major and Minor Block are act as feature Vector for matching. [8]

### 7.7 AOI (Area of interest)

Where more information related to ridge distance, orientation and helpful is needed for the computation, there is an error computed as shown in the given Block diagram of FRIRV. [8]

### 7.8 RR (Recognition rate)

The recognition process will compare the shape perspective training and testing data set. The RR is the number of images that will truly match with testing set. [8]

### 7.9 Success rate

The rate at which successful verification is done by comparison[2]. The variance of each block is compared with the threshold value, the block with minimum variance are eliminated. AOI obtained is resized, which contain more information. [8]

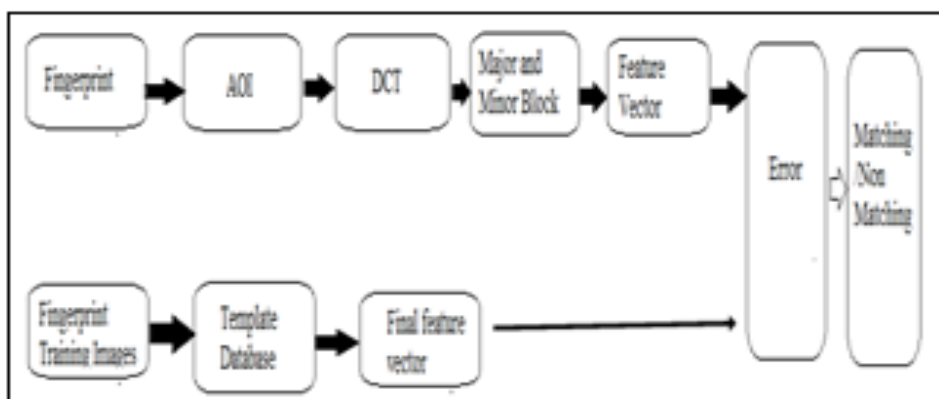
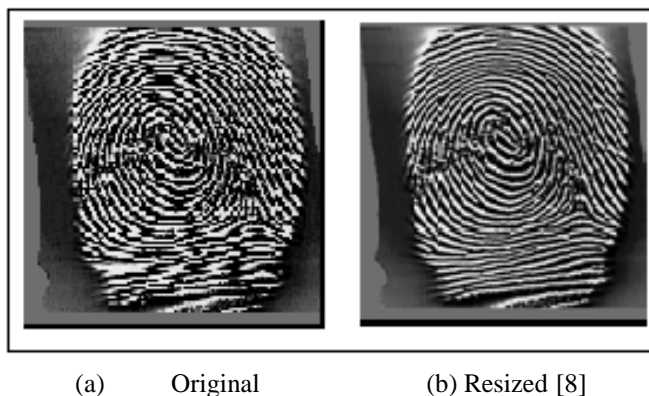


Fig. 10: Block Diagram of Fingerprint recognition Using Inter-Ridge Variation (FRIRV) [8]

### VIII. MATCHING

It can be defined as the process to find the similarity or difference of given fingerprint by using the clearness of the one can trace the minutiae point which will be the universal in the both print. There can be a number of universal minutiae and close to fit. It is feasible to access the similarity. [17]

The strong fingerprint Algorithm must be capable to handle all these difference in the various impression of same finger. Example displacement, rotation, Partial overlap etc. The alignment algorithm should be able to properly align the two fingerprint set of minutiae after alignment.

Some algorithm use the Core and Delta point extract and some uses the Pattern-Matching algorithm Hough transform. Other use the thinned ridge matching field matching to get there an alignment.

When the alignment will recognized, the minutiae from the two fingerprints not exactly overlies each other because of the small left over error in the algorithm and the nonlinear alteration. [17]

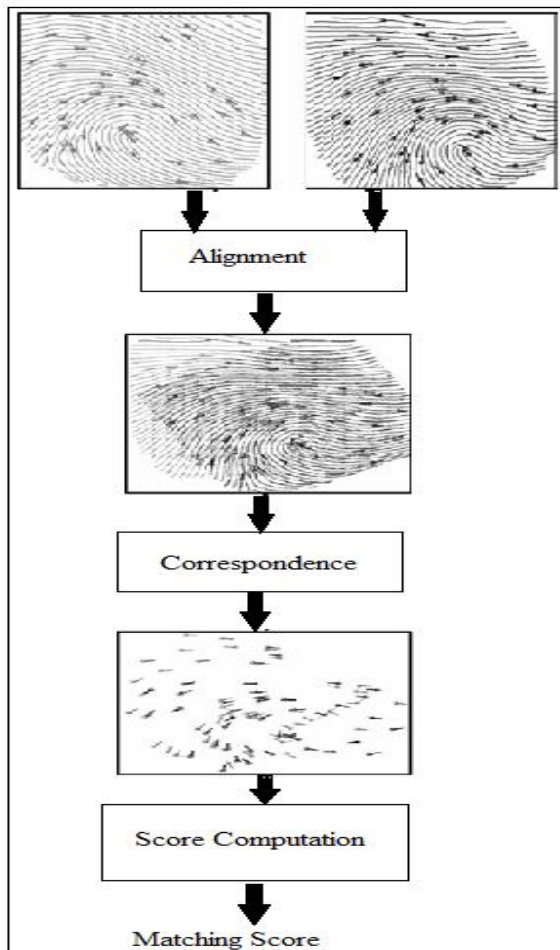


Fig. 11: The steps in a typical Fingerprint matching algorithm [17]

### IX. THE BIOMETRIC ENCRYPTION

Because of the security issue the encryption process is required. Biometric data are only one of its kind and stable characteristic of individual, the privacy protection of biometric scheme has become common.

The key is created rather than to directly compare the data. The goal of this is for the security of biometric template to the enrolled person and only that person can decrypt. Biometrically encryption raised in Central database. [2]

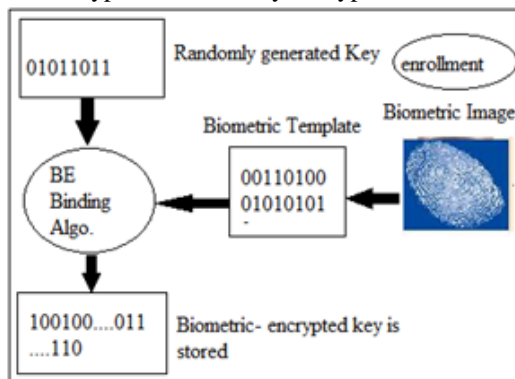


Fig. 12: Biometric Encryption use biometric as encryption key [2]



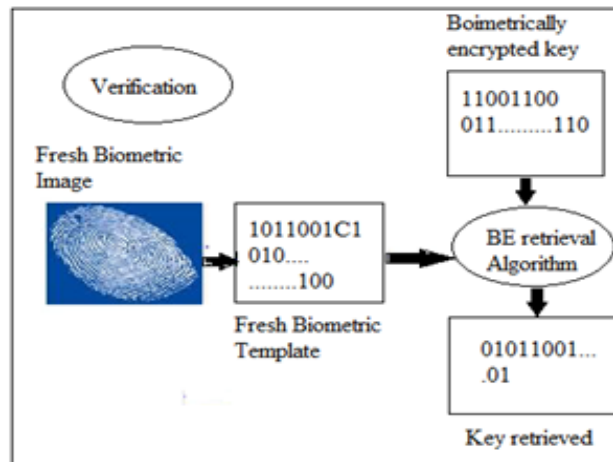


Fig. 13: Biometric Encryption (BE) decrypt with same Biometric [2]

- Biometric is a lifetime stable identifier than a right to use control.
- Prohibited secondary use of Biometric data.
- Random collection of data invites the misuse. [2]

### X. SENSING TECHNOLOGIES

A pattern of finger prints have fine ridges and valleys and the sensor of fingerprint machine makes computerize image of the fingerprint. The sensing resolution 569dpi (dot per inches) or 560\*400, 569 dpi. We can compare the both images. The image size 300\*300 and 512\*512 pixels makes the area cover between 15 to 25mm/millimeter square. [4]



Fig. 14: Fingerprint Image with different dpi [4]

- 1) Conventional prism type optical sensor
- 2) Solid state sensor[4]

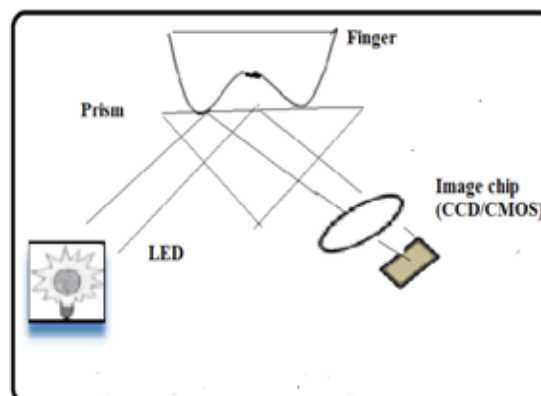


Fig. 15: Optical Fingerprint using prism[3]

### XI. CLASSIFICATIONS ALGORITHM

The classification of fingerprint is based on information in the global ridge in pattern. Classification of finger print remove the requirement to match an input fingerprint with the whole fingerprint database. So that it decrease the time complexity of the system. The motive of the fingerprint system is that it should be constant to rotate, translation flexible misinterpretation of the frictional skin. The Algorithm named classification Algorithm will introduce the index for fingerprint and perform the fingerprint match with the database [1].

Table 1: Classification of algorithms

Author	Tarjoman&Zarei(2008)	Kant&Nath	Suralkar.et.al(2009)	Bhuyan et.al.(2010)
Feature	Segmented region directional ridge lines	Singular Point(Delta)	Singular point and maximum variation in local orientation field	Numeric code sequence based on ridge flow pattern
Technique Used	Relative super graph classifier	Henry Classification with single print	Rule Based classification	K means clustering and apriority classifier
Classes	9 Classes	4C	5Cb	5Ca
Database Used	Own database	Madhuban Forensic Laboratory, Karnal	FVC2000	FVC2000, FVC2002, FVC2004
Area that can be improved	Should find acceptable range between two parameter of classification accuracy and number of classes	Only a single point of a person in used and time complexity	Left loop and Right loop are more often confused with architecture.	Improvement of search method for large clustered fingerprint database

## XII. CONCLUSION

Mostly there are five classes of fingerprint arch, tented, whorl, left and right loop. Recently the machine learning classifier has been proposed FVC2000. Based on several research following results are made:

1. Describe about the Inter Ridge Variation technique, which is based on the variation in the ridges. This technique was good in PRR (percentage Recognition Rate) of DCT as compared with other algorithm.[8]
2. Mostly all the fingerprint technologies based on Biometric system. This technology is used in every field except Chemical industries because of fingerprint of the working people are affected. So multimodal biometric can be used. The fingerprint biometric system is one of the efficient, secure, cost-effective and ease to use.[2]
3. In The fingerprint Identification described the process of fingerprint user interface. The advantage of this technology is to broaden in the real world application.[3]
4. Classification of fingerprint is usually based on ridges, minutiae and global features.[1]
5. There are model based and structured based method. The model based method is based on global feature of fingerprint and the structured method is based on the estimated observation in the fingerprint image, can be found capable to the one image into one from the five classes.[1]

After study about the whole research on fingerprint, observed that future work can be done to create the matching algorithm for faster running and more accurate result then preexisting software. Also create a technique for independent specific requirement, with less preprocessing which made the post processing simple and easier, less image size, time.

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