



# PROJECT FILE

## TOPIC:- SCIENCE BEHIND FINGER-PRINT RECOGNITION

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# # ABSTRACT

- Human fingerprints are rich in details which is known as minutiae, which can be used as identification marks for fingerprint recognition or verification. Our team project is to study on fingerprint recognition system based on minutia based matching which is quite frequently used in various fingerprint algorithms and techniques.
- The Approach of this project involves how the minutia points are extracted from the fingerprint images and after that between two fingerprints we are performing the fingerprints matching. Image enhancement, image segmentation, minutia extraction and minutia matching these stages are the main themes of our project.
- This project is coded in MATLAB. Some of the technologies that have been investigated are fingerprinting, iris scanning, facial scanning, voice detection and palm scanning. Biometric authorization's strengths are that it requires the user to be present and that it eliminate

# # INTRODUCTION

- Basically skin of human fingertips consists of ridges and valleys and they mixing together form the distinctive patterns. At the time of pregnancy these distinctive patterns are fully developed and are permanent throughout the whole lifespan. Those patterns are called fingerprints, so they are unique for each individual. because of the above mentioned characteristics, fingerprints are very popular for biometric applications. Finger print matching is a very complex pattern recognition problem so Manual finger print matching is not only time taking but experts also takes long time for education and training.
- Fingerprints have remarkable permanency and uniqueness through out the time. From observation we conclude that the fingerprints offer more secure and reliable personal identification than passwords, id-cards or key can provide. Examples such as computers and mobile phones equipped with fingerprint sensing devices for finger print based password protection are being implemented to replace ordinary password protection method. Fingerprints records normally contain impression from the pad on the last joint of fingers and thumbs.

# \* FINGERPRINT

- A finger print are the most important part of human finger. It is experienced from the research that all have their different finger print and these finger prints are permanent for whole life. So fingerprints have been used for the forensic applications and identification for a long time.
- A fingerprint is the composition of many ridges and furrows. Finger prints can't distinguished by their ridges, Minutia, which are some abnormal points on the ridges.
- Minutia is divided into two parts such as : Termination and bifurcation. Termination is also called ending and bi-furcation is also called branch. Again minutia consists of ridges and furrows. valley is also referred as furrow.

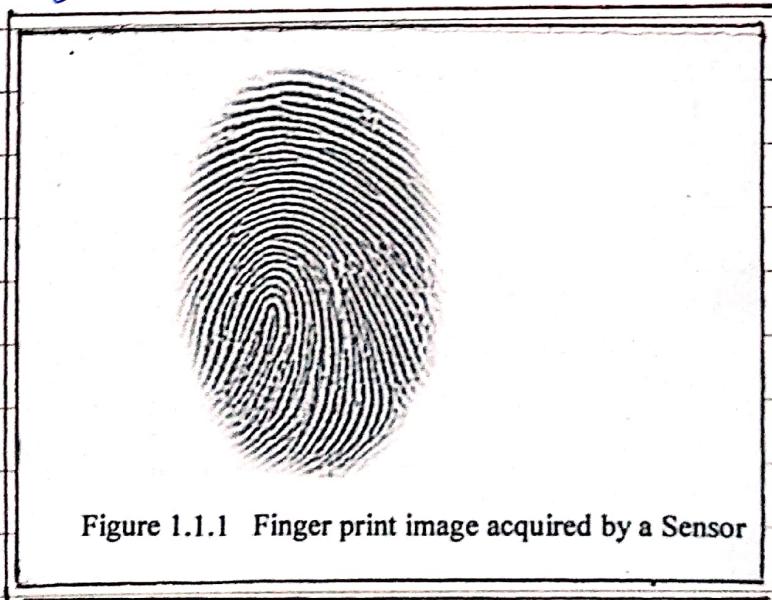


Figure 1.1.1 Finger print image acquired by a Sensor

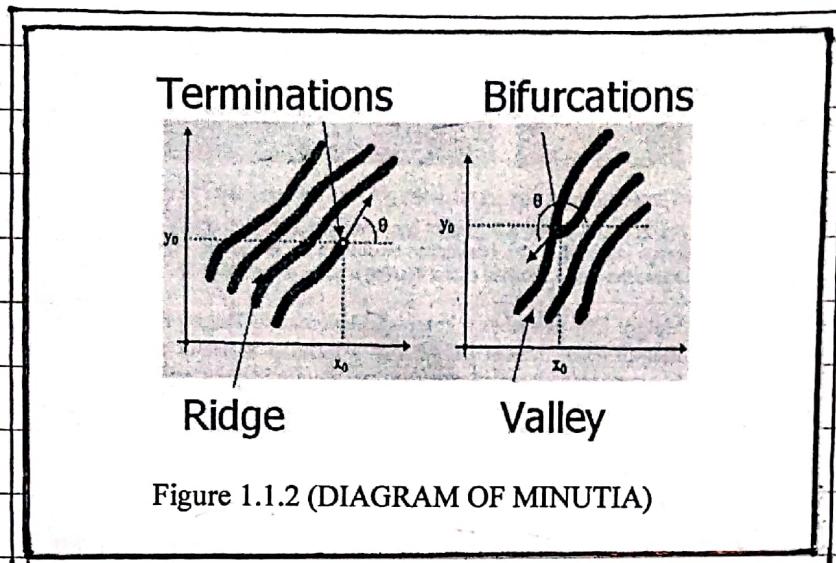
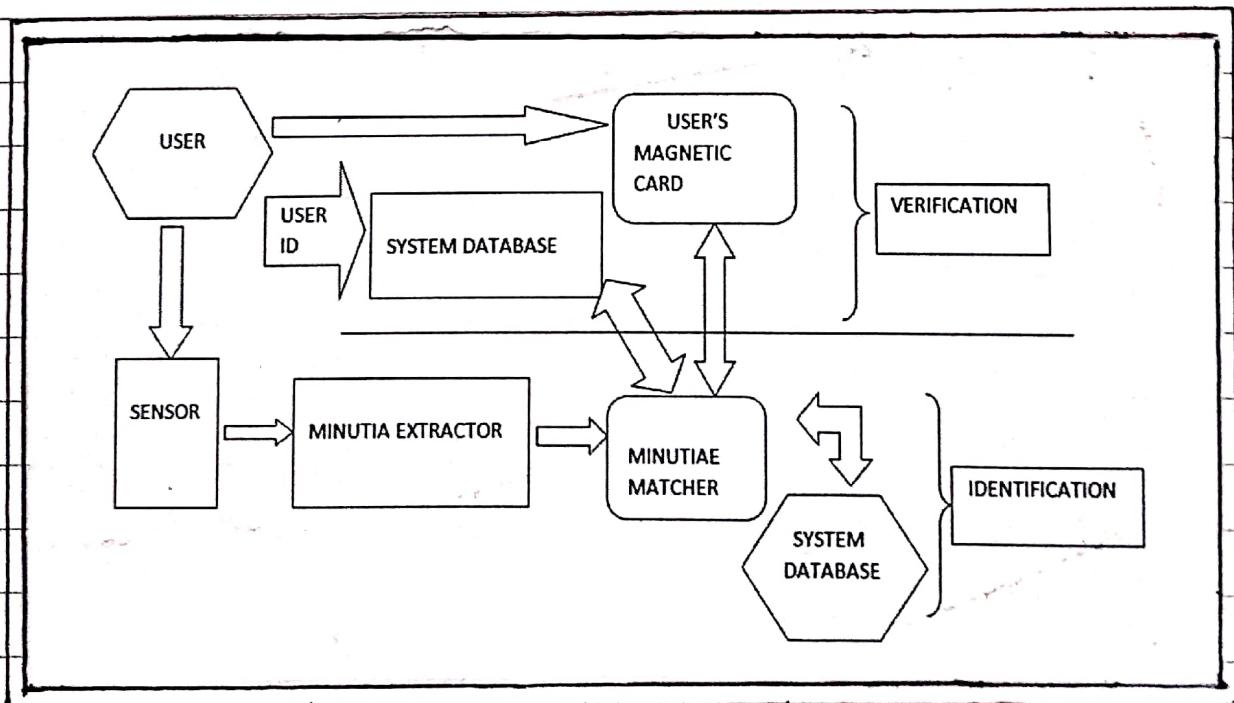


Figure 1.1.2 (DIAGRAM OF MINUTIA)

# # FINGER PRINT - RECOGNITION

→ The fingerprint recognition problem can be grouped into two sub-domains such as :-

- ① Fingerprint Verification
- ② Fingerprint identification





- **Fingerprint Verification** => It is the method where we compare a claimant fingerprint with an enrollee fingerprint, where our aim is to match both the fingerprints. This method is mainly used to verify a person's authenticity. For Verification a person needs to put his or her fingerprint in to the fingerprint verification system. Then it is represented in some compressed format with person's identity and his or her name. Then it is applied to the fingerprint verification system so that the person's identity can be easily verified. Fingerprint verification is also called one-to-one matching.
- **Fingerprint Identification** => It is mainly used to specify any person's identity by his fingerprint. Identification has been used for criminal fingerprint matching. Here the system matches the fingerprint of unknown ownership against the other fingerprint present in the database to associate a crime with identity. This process is also called one-to-many matching. Identification is traditionally used for solve crime and catch thieves.

## # SYSTEM LEVEL DESIGN

- Here a fingerprint recognition system contains a sensor, minutiae extractor and minutiae matcher.



=)

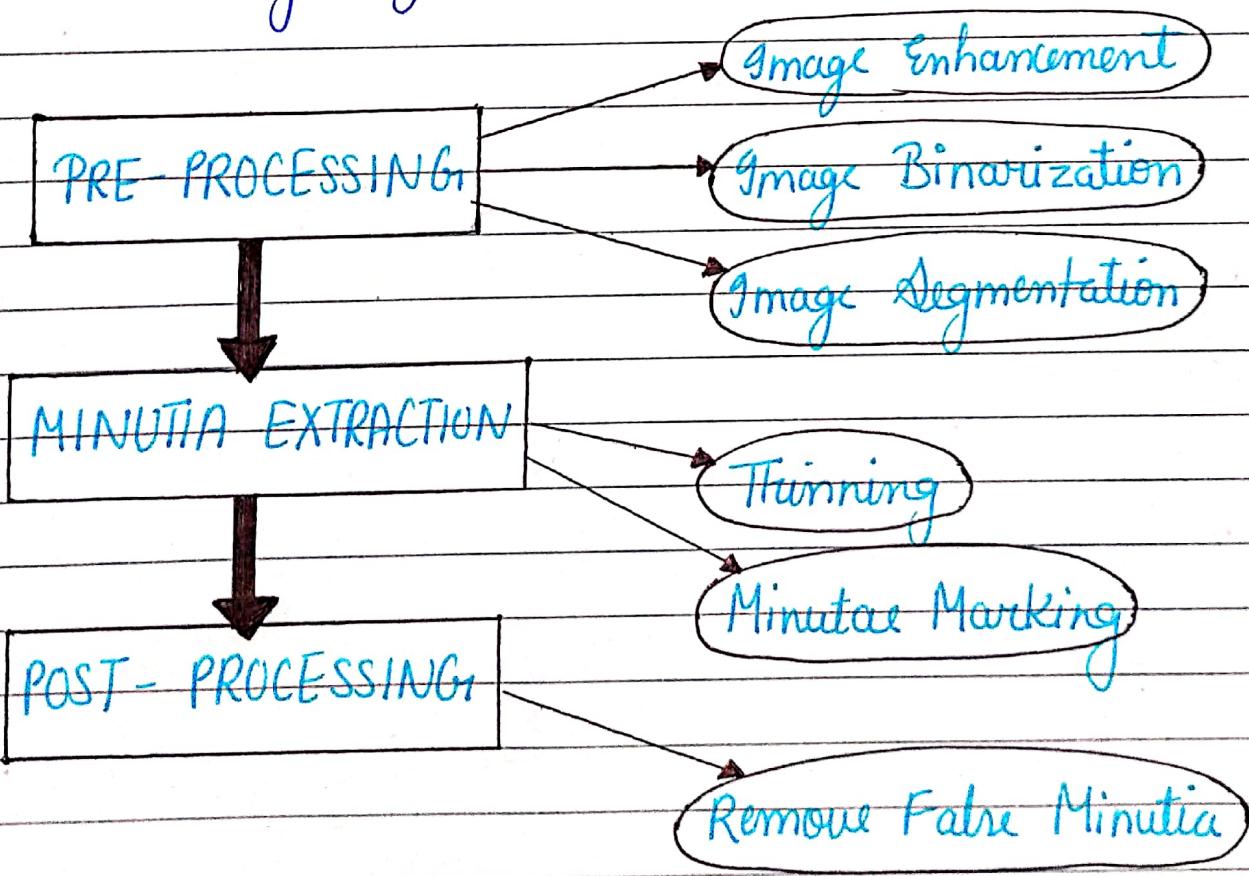


=) Optical and semi-conduct sensors are mainly used in finger print acquisition system. These sensors are of highly acceptable accuracy and high efficiency except for some cases like if the user's finger is too dirty or dry.



=) To extract a minutia a three step approach is used :-

- (i) Pre- Processing stage.
- (ii) Minutia Extraction stage.
- (iii) Post- Processing stage.



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## 1. PRE - PROCESSING STAGE =>

→ Again pre-processing stage is divided in to three sub stages such as :-

- (i) Image enhancement
- (ii) Image binarization
- (iii) Image Segmentation

→ For image enhancement we used two methods such as :-  
Histogram equalization and Fourier transform. After enhancing the image we need to binarize the image for that we used the locally adaptive threshold method.

→ For image segmentation we preferred a three-step approach such as :-

- (i) Block direction estimation
- (ii) Segmentation by direction intensity
- (iii) Region of Interest (ROI) extraction by Morphological operations

## 2. MINUTIA EXTRACTION =>

→ Minutia extraction stage is divided in to two stages such

- (i) Fingerprint Ridge thinning.
- (ii) Minutia Marking.

We used iterative parallel thinning algorithm for minutia extraction stage. Ridge thinning is

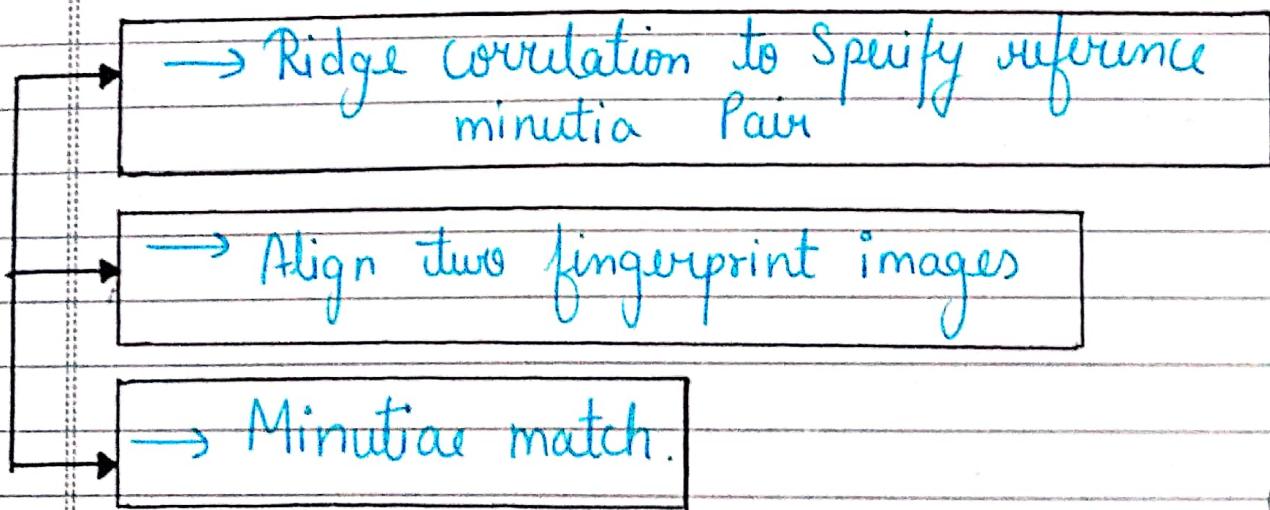


used to eliminate the redundant pixels of the ridges till the ridges are of one pixel wide. The minutia marking is quite simple task. Here croning number (CN) concept is used.

### 3.4 POST- PROCESSING STAGE =

- For the post processing stage, it has only one sub step that is :- removal of false minutia. Also a novel representation for bifurcations is proposed to unify terminations and bifurcation.
- The minutia matcher determines whether the two minutia sets are from the same finger or not. If the ridges are match well, then the two fingerprint images are aligned and matching is conducted for all remaining minutia.

#### MINUTIA MATCHER





★ One by One Steps Involved in fingerprint Algorithm =

①

Load Image

↓  
Histogram Equalization

↓  
Enhancement Using FFT

↓  
Binarization

Ridge Direction

Preprocessing Stage

②

Thinning

↓  
Minutia Marking

Minutia Extraction stage

③

Remove False Minutiae

↓  
Unify Termination & Bifurcations

Postprocessing stage

④

Save Template

↓  
Align and Match

Template

Minutia Matching stage

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# # HISTOGRAM EQUALIZATION

→ Histogram equalization is mainly used to increase the pixel value of an image so that the perceptual information also increases. Histogram represent the relative frequency of various types of gray levels in an image.

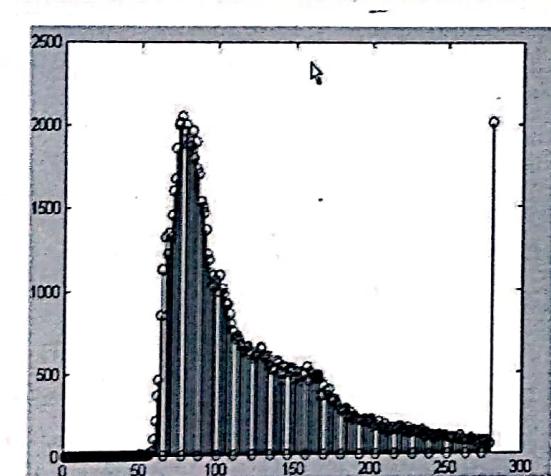


Figure 3.1.1.1  
Histogram of a fingerprint image

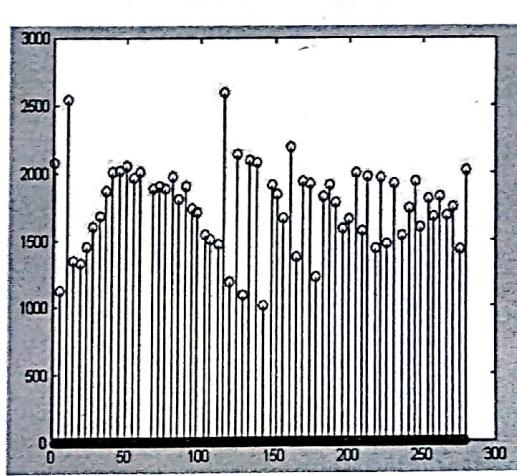


Figure 3.1.1.2  
Histogram after histogram  
equalization

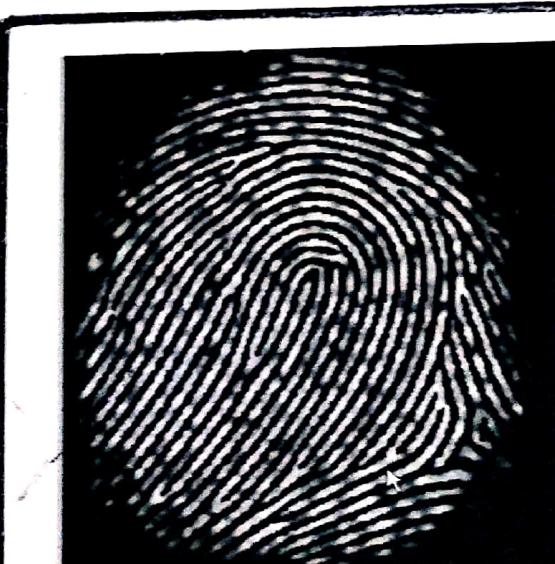


Figure 3.1.1.3 Original Image



Figure 3.1.1.4 Enhanced Image after  
Histogram Equalization



# # ADVANTAGES =>

- Security => Security were, it is a vast improvement on passwords and identity cards. Fingerprints are much harder to fake.
- Ease of use => For the user they are simple and easy to use. No more struggling to remember your last password or being locked out due to leaving your photo ID at home. Your fingerprints are always with you.
- Non-Transferable => Fingerprints are non-transferable, ruling out the sharing of passwords or 'Clocking-in' on behalf of another colleague.
- Accountability => using fingerprint recognition also provides a higher level of accountability at work.
- Cost effective => from a technology management perspective fingerprint recognition is now a cost-effective security solution. Small hand-held scanners are easy to set up & benefit from a high level of accuracy.

# # DISADVANTAGES =>

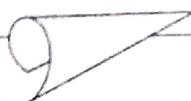
- Using the fingerprints scanner can lead to false rejections.
- Using the fingerprint scanner does not take into consideration when a person physically changes.



- One of the biggest disadvantages of biometrics is the highly technical and complex system that makes up the whole process.
- Some biometric devices take more than the accepted time and a long queue of workers form waiting to be enrolled in large companies.
- Using the fingerprints scanner can lead to false acceptance.

## # APPLICATIONS →

- ① Security Systems
- ② Banking and Finance.
- ③ Law Enforcement
- ④ Health-Care
- ⑤ Time and Attendance
- ⑥ Border Control
- ⑦ Biometric measurements
- ⑧ Solving crime investigation





# # CONCLUSION

- The above implementation was really an effort to understand how the fingerprint Recognition is used in many applications like biometric measurements, solving crime investigation and also in security system. From minutiae extraction to minutiae matching all stages are included in this implementation which generates a match score. Various standard techniques are used in the intermediate stages of processing.
- We have completed our job of preparing a report file on "study of fingerprint recognition system" we don't know how far we have been able to perform the job accurately. However, we are sure we have always tried to avoid any fault or mistake that may tell on our endeavour. The project emphasizes both the theoretical concept as well as gives insight into the practical application program.
- A focus on fighting insurgents and terrorism has led to the military deployment of biometric tools to enable recognition of individuals as friend or foe.