A Review of Advanced Techniques and Technology to Detecting Fingerprint

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Abstract— the human fingerprint have been key biometric technology providing authentication and security for last decades. Currently fingerprint detection technology used in almost every Smartphone and laptop manufacturing company also considering implementing fingerprints detection technology in laptop. It is preferred by the most of people due to its accuracy, reliability, distinctiveness, feasibility and acceptability. There is several technologies available in the market for scanning the image which works on different principle viz. optical unique fingers impression in which Optical fingers impression sensor works by catching a high definition image of the fingertip through light source. This sort of sensor has a specific kind of high resolution advanced camera. The upper layer of the sensor, where the finger is put, is known as the touch surface. After this layer is a light-producing phosphor layer which illuminates the surface of the finger. The light reflected from the edges and valleys of the finger and goes through that layer which catches a picture of the fingertip. Semiconductor likewise called capacitance unique mark sensors, this sensor additionally produces a picture of the edges and valleys of fingertip yet as opposed to detecting the example utilizing light, and it utilizes electrical current. Ultrasonic unique mark sensors, this sensor influences utilization of the standards of ultrasonography keeping in mind the end goal to make visual picture of the unique mark. Ultrasonic sensor utilizes high recurrence sound waves to create the example of fingertip. Here it measures the reflected sound wave to generate pattern.

Keywords— Minutiae point, Fingerprint patterns, Imaging Technology, Techniques for extraction, Binarization, Thinning, Crossing Number Algorithm.

I. INTRODUCTION

The big term Biometrics is short for biological measurable characteristics. There are many physical human traits like eyes, face, figure, palm, hand, are measurable can be termed as a biometrics. To detect, identify and classify the one to one or one to many class one can use three mention trait. These traits are unique for every individual. Biometric authentication is simply authentication driven by biometrics. The application of biometrics are criminal examination, Security and Educational regions, and many more. Iris, palm-print, voice and unique finger impression acknowledgment are generally utilized biometric strategies. Among these systems, unique mark acknowledgment is the outstanding and exact technique. To perceive a man character it is important to coordinate his unique finger impression with the layouts put away in the database. Coordinating depends on the data incorporated into the unique mark picture. The unique finger impression picture contains details focuses, center focuses, edges and valleys, foundation region, forefront zones, neighborhood highlights and worldwide highlights. Details focuses are the little lines in unique mark

picture. Center point is the focal zone of unique finger impression picture. It is the most upper purpose of the deepest territory. Edges are the dark lines of unique mark picture and valleys are the white lines of finger impression picture.
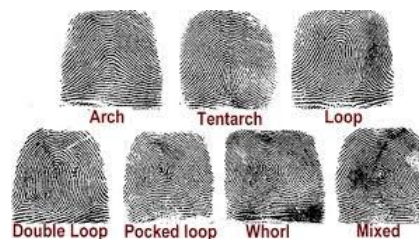
Figure 1 Fingertip Patterns

Biometrics is the growing region of bioengineering; it is robotized system of distinguishing individual in view of a physiology. There are a few biometric frameworks currently used, for example, fingerprints, voice, iris, retina, hand geometry, ear geometry, and face. Fingerprint is one forms of biometrics used to provide authenticity and security. Because of their uniqueness and consistency over other technology it has been used for over century. Fingerprint mark is the

example of edges and valleys on fingertip. For any fingerprint, ridge characteristic and their relationship are unique. Ridge make different pattern on fingertip called arches, loops, whorls, double loop, pocked loop, tent arch etc. Which are shown in below figure: 1. when an individual first uses a biometric system, their fingerprint pattern's features are stored as a reference for comparison. The main objective of the project is to develop a scanner which provides higher accuracy with low cost. These are the different fingerprint patterns.

II. RELATED WORK

Dr. S. Karthikeya and J.Nithya, proposed document on discontinue spot fingerprint pattern, lake independent ridges pattern, dots island crossover. Consequently picture enhancement ways are utilizes preceding details extraction to capture a more solid particulars area. The calculation is propose to make an associated the limits utilizing the nearby point (highlight) of the details point in the unique finger impression picture protest picture draw the guide interface the all point so work will have the capacity to unique finger impression picture finding the guide of the part by limits calculation[1]. Harshada Jadhav, Ruksar Khan, Anusha Gugale and Bhushan Thakare, proposed document on fingerprint detection and rectification of distorted fingerprints by using canny edge algorithm which was used to detect and sharpen edges. With respect to the angular direction, color is assigned to each edge. From the obtained image core point is found out using K means [2].K.D.Mahajan, Sharvari Tatwadi, proposed archive on unique finger impression acknowledgment utilizing minutia score coordinating strategy. The channel checks the picture at the fringe to keep up the nature of the picture and concentrate the details from the diminished picture. The false coordinating proportion is better contrasted with the leaving calculation [3]. L.Arunkumar and A.Arun Raja proposed document on Biometrics Authentication Using Raspberry Pi in they have used special image processing algorithm called flann_index_kdtree with cv2.FlannBasedMatcher [4].A. Aditya Shankar, P.R.K.Sastry , A. L.Vishnu Ram and A.Vamsidhar proposed document on Finger Print Based Door Locking System where they have tried some traditional security aspect like lock & key system, password authentication, Authentication by RFID card but they find fingerprint more secure than them [5]. Manisha Redhu and Dr.Balkrishna proposed a unique finger impression acknowledgment strategy and framework, more in detail, the layered finger impression acknowledgment technique and framework which think about the particulars or solitary point, as well as look at the pictures of nitty-gritty zone for making precise correlation of unique finger impression. The consequence of the unique finger impression database test contrast with the when calculation we can see change [6]. Pallavi Verma and Namit Gupta proposed report on Fingerprint Based Student participation System Using GSM

where they indicated how attractive card is simple lost and harm and furthermore guardians don't know whether the kids are missing from class. In any case, in this task they feat that issue likewise turn out to more secure because of unique finger impression [7]. In table 1, we present some relevant fingerprint detection technology and techniques are used to detect the figure print match with dataset to classify are compared.

Table 1 Comparison of fingerprint detection technology, techniques and limitation

Research Paper(s)	Year	Technology Used	Technique used	Limitation	Overcome Limitation
Secured Electronic Voting Machine Using Biometric[1]	2017	Image Acquisition Through Optical Sensor	Ridge Based Image processing	Less accurate compare to minutiae based technique.	Minutiae Based Image Processing
Detection and Rectification of Distorted Fingerprints[2]	2017	Image Acquisition Through Optical Sensor	Canny Edge Detection	Difficult to implement to reach real time response. Time consuming.	Sobel Edge Detection
Biometrics Based Security System For Bank Lockers With OTP Support[3]	2017	Image Acquisition Through Optical Sensor	Minutiae Based Image Processing	Inaccurate result because it missed some minutiae point of some part.	Neural Network Based Approach
Biometrics Authentication Using Raspberry Pi[4]	2015	Image Acquisition Through Optical Sensor	Ridge Based Image processing	Less accurate compare to minutiae based technique.	Minutiae Based Image Processing
Finger Print Based Door Locking System[5]	2015	Image Acquisition Through Optical Sensor	Ridge Based Image processing	Less accurate compare to minutiae based technique.	Minutiae Based Image Processing
Fingerprint Recognition Using Minutiae Extractor[6]	2013	Image Acquisition Through Optical	Minutiae Based Image Processing	Inaccurate result because it missed some minutiae point of some part.	Neural Network Based Approach
Fingerprint Based Student attendance System Using GSM[7]	2013	Image Acquisition Through Optical	Ridge Based Image processing	Less accurate compare to minutiae based technique.	Minutiae Based Image Processing

III. EXISTING TECHNOLOGY AND TECHNIQUES

Imaging Technology

1) OPTICAL: Optical fingerprint imaging works by catching an advanced image of the fingertip through light source. This type of sensor is a particular kind of computerized camera. There is a light-transmitting phosphor layer which illuminates the surface of the finger. The light reflected from the edges and valleys of the finger goes through the phosphor layer to a variety of state pixels which catches a picture of the unique finger impression sensors [9].

2) CAPACITANCE: Capacitive detecting additionally called capacitance detecting is an innovation in light of capacitive coupling that can recognize and measure anything that is conductive or has a dielectric not quite the same as air [9].

3) ULTRASONIC: Ultrasonic sensor is a gadget that can measure the separation to an object through sound waves. It calculates distance by sending a sound wave at a particular frequency and tuning in for that sound wave's reflection [9].

4) THERMAL: The thermal imaging sensor is a one sort of sensor used to decide a picture in light of the temperature of the protest. The picture is framed in light of the finger's warmth signature. Picture processing techniques: a) Edge based: the edges of a smooth capacity of two factors are an arrangement of bends whose focuses are, in at least one approaches to be made exact beneath, nearby maxima of the capacity in no less than one dimension. b) Relationship based: This technique depends on the pivot and scale invariant standardized cross-connection. Both the size and the introduction of the connection windows are resolved by the trademark scale and the predominant interest point. c) Particulars based: these technique utilize non-trifling subtle elements as distinguishing proof imprints to confirm the fingerprints. Unique mark picture is improved utilizing Fast Fourier Transform and changed over to twofold picture for additionally handling [10].

Feature Extraction Techniques:

A. **Minutiae Extraction:** *Most of the particulars extraction strategies follow the unique finger impression skeleton to discover diverse sorts of details focuses.*
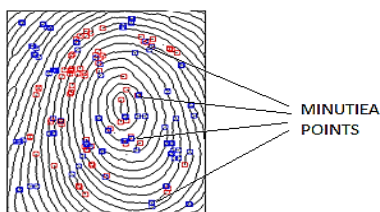

Figure 2 Minutiae Point

B. **Ridge Detection:** Main property of the edges in a unique finger impression picture is that the dark level esteems on

edges accomplish their neighborhood maxima along a course typical to the nearby edge introduction. The subsequent edge guide may contain false edges as openings and dots.

Figure 3 Ridges of Fingertip

C. **Minutiae Detection:** The minutia focuses are then separated from the diminished edge outline looking at the area of each edge skeleton pixel. The edge finishing, Ridge bowing bearing and width, edge breaks, edge bifurcation are the data removed yet this may contain fake details.

D. **Orientation Estimation:** A unique mark picture is a situated surface example and an edge introduction at a pixel is the point that the edges inside a little neighbourhood focused at shape with the even pivot.

SYSTEM ARCHITECTURE

The basic flow of the figure print detection process is present in mention figure-4. There are total 6 modules are define in architecture mainly fingerprint sensor, image processor.

Fingerprint Sensor: These modules are ordinarily used to gain unique mark design with the assistance of powerful DSP chip that does the picture handling, count, include finding and seeking. This sensor filters the example on fingertip and creates the yield in picture arrangement of gathered information. You can also add new fingerprint pattern directly.

Image Reprocessing: The pre-handling steps attempt to make up for the varieties in lighting, differentiate and different irregularities which are presented by the sensor amid obtaining process.
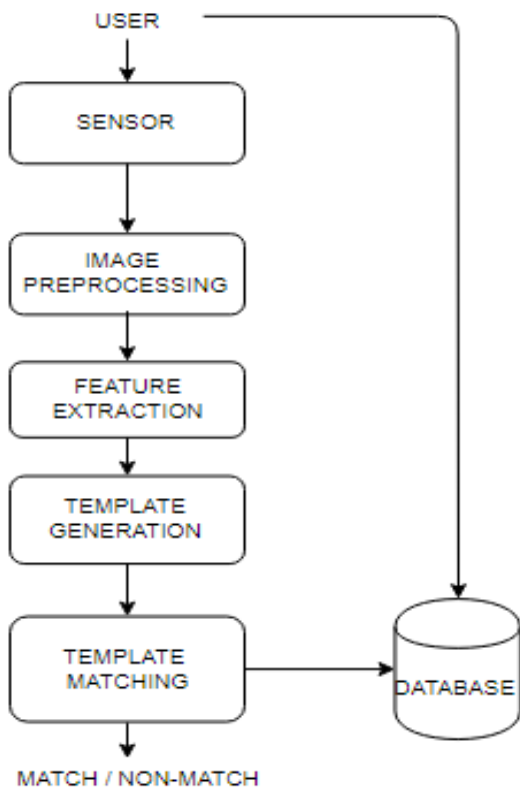
Figure 4 Basic Framework

Binarization: Here unique mark picture is changed over into dim scale picture and after that change over it into twofold information. In this progression the picture introduction is adjusted, as it can have an alternate introduction from the layout fingerprints, which will be utilized as a part of the coordinating advance [8]. See the figure 5.

Block Filter (Thinning): This binarized image is then thinned to reduce the thickness of all ridge lines to one pixel wide. The use of the thinning algorithm is to preserves the connectivity of the ridge structures while forming a skeletonised version of the binary image. This skeleton image is then used in the extraction of minutiae [8]. Follow the figure 5.



Figure 5 (a) Binarised image   (b) Thinned Image

Feature (Minutiea) Extraction: The details are removed by filtering the nearby neighborhood of each edge pixel in the picture. The most ordinarily utilized technique for particulars extraction is the Crossing Number (Cn) idea. Ending of

ridge, Cn=1; (b) Normal ridge, Cn=2; (c) Bifurcation of ridge, Cn=3;
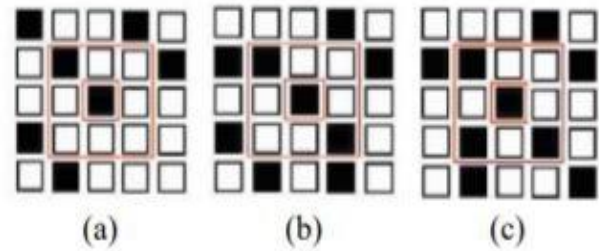
Figure 6 Crossing Number Algorithm

Feature (Minutia) Matching: Most fingerprint matching systems are based on matching. Fingerprint based authentication systems have speedily started recognition due to their advantages over the access badge. Biometrics such as fingerprints cannot be stolen or misplaced like an access badge can be. It is very difficult, if not impossible, to forge a fingerprint. In this move collected data matched with the template data which was stored during first time registration.
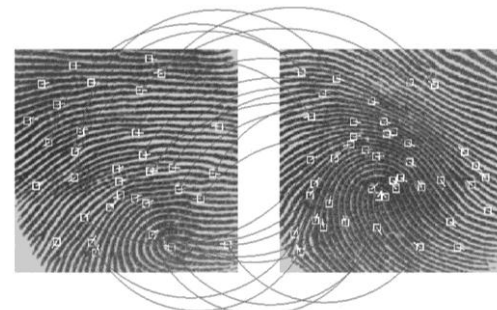
Figure 7 Minutia Points between two fingerprint images

IV.   RESULTS AND DISCUSSION

It should include important findings discussed briefly. Wherever necessary, elaborate on the tables and figures without repeating their contents. Interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. However, valid colored photographs can also be published.

V.   CONCLUSION AND FUTURE SCOPE

Fingerprint recognition is a standout amongst the most well-known and accurate Biometric technology. The above implementation of figure print recognition and detection is used in many applications like biometric measurements, solving crime investigation and also in security systems. It is easy to use and require no special training and equipment. Fingerprint is unique for every person it can be imitated or fabricated. We can avoid manual errors. Nowadays, it is used in many real time applications.

REFERENCES

[1] Karthikeyan, S., and J. Nithya. "Secured Electronic Voting Machine Using Biometric." (2017).

[2] Harshada Jadhav, Ruksar Khan, Anusha Gugale, Bhushan Thakare "Detection and Rectification of Distorted Fingerprints Paper."(2017).

[3] Prof.K.Mahajan, SharvariTatwawadi, Ayesha Shaikh, RashmiShewatkar, "Biometrics Based Security System for Bank Lockers with OTP Support."(2017).

[4] Arunkumar and A.Arun Raja, "Biometrics Authentication Using Raspberry Pi."(2015).

[5] A. Aditya Shankar, P.R.K.Sastry, A. L.Vishnu Ram, A.Vamsidhar, "Finger Print Based Door Locking System."(2015).

[6] Manisha Redhu AndDr.Balkishan, "Fingerprint Recognition Using Minutiae Extractar."(2013).

[7] Pallavi Verma and Namit Gupta, "Fingerprint Based Student Attendance System Using GSM."(2013).

[8] Kocharyan, Davit, and Hakob Sarukhanyan. "High Speed fingerprint recognition method." 2nd International Conference on Multimedia Technology (ICMT2011).

[9] https://www.androidauthority.com/how-fingerprint-scanners-work-670934

[10] http://www.biometric-solutions.com/fingerprint-recognition.html

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