Cytometric Fingerprinting

Pramod Kumar Jaiswal , Priyanka Singh , Akansha Singh , Lalit Kumar
Galgotias University, Greater Noida

Abstract:- This paper is an outline of an exploration paper dependent on cytometric fingerprinting. In this paper we will examine about the past examinations about cytometric fingerprinting. Essentially Human fingerprints is utilized to distinguishing proof imprints for unique mark check. Unique mark check alludes to genuineness of an individual by his finger impression. The client gives unique mark together character data. Fingerprints have been utilized in measurable examination for the identity of people since nineteenth century. It is currently evident that fingerprints can gives fundamentally more data about any people. The point of this examination paper is to audit different as of late work on cytometric fingerprinting and clarify in insights concerning cytometric fingerprinting stages bit by bit and give synopses of cytometric fingerprinting information base with attributes and types. The Biometrics system is a method or technology which identifies humans based on their physiology or behavioral characteristics. A Fingerprinting recognition is a biometrics method that has been broadly used in various applications because of its convincement in the system of identifying and verifying a human's identity.

Keywords:- Cytometric, Measurable, Clarify, Evidence.

I. INTRODUCTION

A Fingerprinting Identification is the strategy for acknowledgment utilizing the impact made constantly edge developments or examples found on the fingertips. No two people have the very same examples of unique finger impression, and the examples of any one individual stay unaltered entire over the life. The Fingerprints proposed a positive method for individual recognizable proof. Other individual attributes of human body may change; however, fingerprints don't change for the duration of the life. This Fingerprints used to record on a norm unique mark card or might be recorded carefully and sent electronically to the FBI for acknowledgment or examination. Through the correlation of fingerprints at the location of any crime with the finger impression record of dubious people, authorities can set up complete verification of the presence of personality of that individual. A Fingerprinting identification technology is usually categorized into optical fingerprinting technology, and ultrasonic fingerprinting technology.

Everyone has an alternate unique finger impression design for makes finger impression biometric fingerprinting is extremely protected as a preservation framework. On the Other hand, finger impression acknowledgment has a high exactness. There is another biometrics framework like voice acknowledgment, face acknowledgment, iris acknowledgment, and palm vein acknowledgment. [14]

| Biometric	Accuracy	Easy to Use	User Acceptance
Face	Low	High	High
Fingerprint	High	Medium	Low
Iris	High	Medium	Medium
Palm Vein	High	High	Medium
Voice	Medium	High	High

Table 1. Differentiation of biometrics

II. LITERATURE REVIEW

History of Fingerprints

Human fingerprinting have been investigated on a large amount of archeological antiquities and verifiable things. Despite of the fact that these discoveries give indorsement to show that old individuals knew about the uniqueness of fingerprints, such cognizance doesn't seem to have any logical premise LEE and GAE 2001 and MOE. It was not until the late by sixteenth century that the ongoing logical unique mark method was first started CUM and MID 1976, GAL 1892, and LEE and GAE 2001.

In 1685, The English plant morphologist and Nehemiah, distributed the main logical paper declaring his organized examination on the edge, wrinkle, and scrutinize structure in fingerprints LEE and GAE.
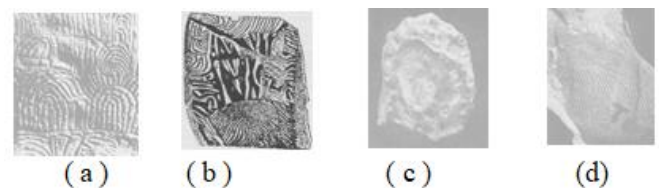

ARCHAEOLOGICAL FINGERPRINT

a) Standing stone
b) A Chinese dirt seal
c) An impact on Neolithic carvings
d) A Palestinian light

From that point forward, countless specialists have contributed gigantic measures of exertion on unique mark contemplates. In 1789, a definite depiction of the anatomical arrangements of fingerprints was made by Mayer MOE 1971 in which various unique mark edge qualities were recognized and described. Beginning in 1809, Thomas

Berwick started to utilize his unique mark as his brand name, which is accepted to be one of the most significant achievements in the logical investigation of finger impression acknowledgment MOE 1971. Purkinje, in 1823, proposed the principal unique mark grouping plan, which arranged fingerprints into nine classifications as indicated by the edge designs MOE 1971. Henry Fault in 1880, first deductively make recommended the independence of fingerprints dependent on an experimental perception. Simultaneously, Herschel declared that he had rehearsed unique mark acknowledgment for around 20 years LEE and GAE 2001 and MOE 1971. These discoveries established the foundation of present day unique mark acknowledgment. In the late by nineteenth century, Lord Francis Galton led a broad examination on fingerprints GAL 1892.
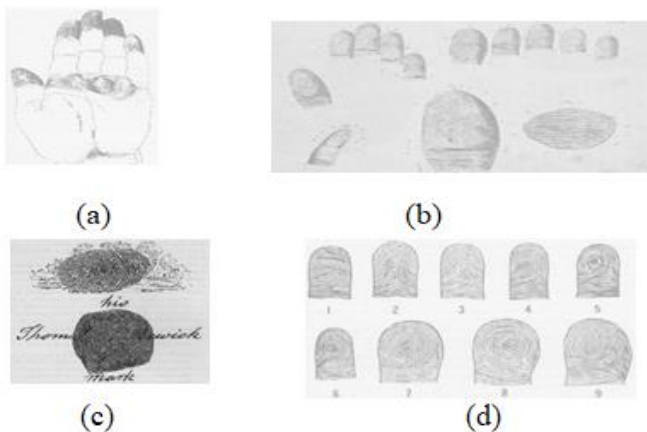
Historic fingerprint impressions

a) Dermatoglyphics
b) Mayer's fingerprints
c) Trademark of Thomas Berwick
d) Purkinje's proposal

Types of Fingerprinting
There are mainly four types of fingerprinting.
a) Arches
b) Loops
c) Whorl
d) Composite

a) Arches:
These fingerprints patterns found approximately 5 percent of the whole population. In this pattern, the ridges run from one side of the print to the other side, and as the name implies in an arch-like fashion. There are no re-curving ridges in an arch/pattern.

(i) Plain Arch (A)
This is the simplest of all fingerprint patterns. Plain arch is made by the ridges get in the pattern on the left, flowing smoothly towards the right of the pattern with a small rise in the center resembling a hill or a hump.

(ii) Tented Arch (T)
Risen Arch is an example wherein most, yet not the entirety of the edges enters the example on the left side, stream, or will in general stream, to the correct side, with at least one than one edges in the middle developing either an unequivocal point or standing practically straight up (an up push).

(a) Loop:
Approximately 62 to 65 percent of all patterns are of loop pattern type. A loop is made by one or more than one ridges get in at one side of the pattern, continuing up to the center of the pattern, and recurving around a core to form a loop; then flowing reverse and terminating on the same hand of the pattern from which they entered. A loop always has a 'delta', a 'core', and at least one ridge passing independently between the core and delta. On this stage it is necessary to define delta' and 'core' to correctly illustrate the patterns. The 'Core' or internal terminus is the nearly center of the pattern. The different type of cores varies according to the pattern. Arch patterns do not have any cores. The core in loops is vested on or within the innermost recurving ridge based on a series of prescribed rules. The 'Delta' or outer terminal may be made either by bifurcation of single ridge or by the abrupt divergence of two. In the other hand, the point of bifurcation forms the point of delta and in the latter the point of divergence of two ridges forms the point of delta ridges running side by side.

i) Radial loop:
The Radial loop is formed by ridges, which enter from one side and flow reverse, after recurving around the core, to the same side with the opening of the loop indicating towards the radial bone or the thumb of the same side.

ii) Ulnar loop:
This Ulnar loop is also formed by ridges, which enter from one side and flow back, after recurving around the core, to the same side with the opening of the loop indicating towards the ulnar bone or the little finger of the same hand. To decide whether a loop is radial or ulnar pattern, it is necessary to know the hand from which the fingerprint originated.

(b) Whorl:
Around 30 to 35% of all examples are of whorl type. A whorl design is an edge making a total circuit, two deltas and at any rate one example having which might be twisting, oval, round or some other sort of a circle. A fanciful line drawn between the two deltas should reach one another or across at any rate one of the recurving edges in the interior example.

(c) Composite:
The composite is mentioned three classes. This constitutes around 1 to 2 per cent of the whole population of the world. Composite are sub-divided as:

(i) Central pocket loop

This pattern combines features of radial and ulnar loop and the whorl. In this pattern the majority of the ridges have the appearance of a loop, but in which one or more than one of the ridges within the pattern pocket. On the off chance that a line doesn't cross or contact some other of the round edges in the focal point of the example. territory recurve about the center, along theselines developing fanciful line is drawn between the two deltas that line doesn't cross or contact any of the roundabout edges in the focal point of the given example.

(ii) Lateral pocket loop:

This is generally a double loop pattern. It is made by and in which the ridges around the cores of the loops terminate on the opposite side of the delta. In other words, both of loop constructions flow in the same direction with core lines without being divided loops, either overlapping or surrounding each other, two by either of the deltas.

(iii) Twin loop:

This is again a double loop pattern. The pattern is made by two loops overlapping having the termination of the ridges showing the core of each loop distributed by surrounding each other, and or one of the deltas.

(iv) Accidental:

Patterns, which are too irregular to be placed of the above categories, in known as accidental pattern. In this, patterns are made by the combination of any two different patterns except combo in which one of the patterns is an arch. This pattern must contain at least two deltas, but may have as many as four When a pattern is formed by a loop over a plain arch it is explained not as an accidental but as a puissant loop or a nascent loop.

III. RESEARCH METHODOLOGY

Uniqueness Finger Skin Pattern

- Human finger skin comprises of erosion edges with pores.
- These edges are framed in ninety-seven-day stretch of a fetal advancement life, and continue as beforethroughout the entire life.
- A seriously harmed skin might be recreated to equivalent to previously.
- Identical twins have various fingerprints and no two individuals have a similar unique mark.
- Every individual's unique finger impression is exceptionally one of a kind and appropriate for use asa type of verification.

Unique mark Security

- Deny Intruders – Higher Accuracy calculation
- 97% will restore right outcomes
- Prevent Re-development of unique mark information

Image insurance

- Minutiae is recovered and format made – Encrypted information

Image decimation

- Cannot remake the unique mark from information
- Fake Fingerprints Detection

1. Scratched or grimy touch surface can cause awful picture
2. Effectively tricked by counterfeit finger
3. Massive plan, just reasonable for bigger static establishment

Capacity:

1. Reflected picture of unique mark caught by camerafrom the underside of a crystal.
2. Picture is put away for correlation with the information base.
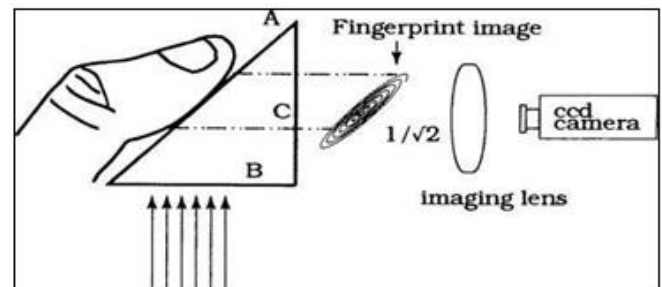
Pressure type fingerprint Sensors: Weight type unique

Ignore Latent Print Residue

- Cannot take from past client

Detect counterfeit/severed finger

- Sensors recognize existences of

Temperature, Pulse, Heartbeat sensors, Bloodstream

Mark Sensors: Pressure detecting scanners can be made extremely slight and are regularly utilized in electronic gadgets. Early weight detecting scanners needed to make a compromise among strength andquality in light of the fact that any defensive layer on the finder surface would reduce the differentiation of the impression. There are two sorts of weight detecting identifiers accessible, conductive film indicators and miniature electro-mechanical gadgets (MEMS). Conductive film sensors utilize a twofold layer cathode on adaptable movies. MEMS is a fresher innovation that utilizes amazingly minuscule silicon turns on a silicon chip. At the point when a unique mark edge contacts a switch, it closes and is recognized electronically.
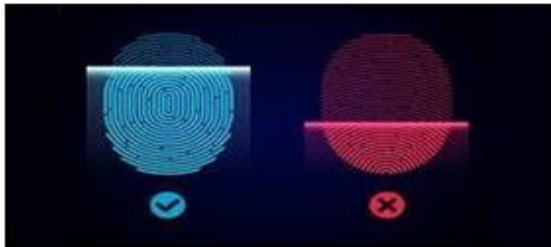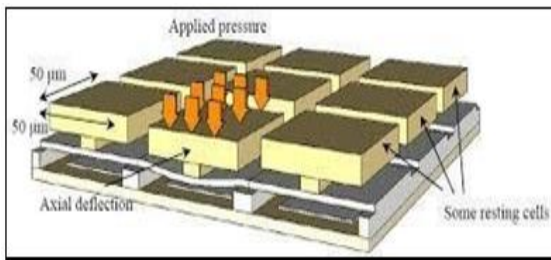
Optical Fingerprint Sensors Problem:

Issue:

Ultrasonic type fingerprint Sensors:

Ultrasonic scanners have a preferred position of having the option to see underneath the skin. This gives not just confirmation of a live finger; it gives more data as a biometric measure. Be that as it may, this innovation is moderate, costly, cumbersome, and excessively information serious for most access control applications.

Required tools

Four apparatuses can be utilized to evaluate cytometric unique mark informational collections of microbial networks: Dalmatian Plot, CHIC, CyBar, and Flow FP. The working standards and methods are clarified in the accompanying.

Dalmatian Plot

The Dalmatian Plot was first implied by Bombast et al in 2011. The name insinuates the dealt with high differentiation pictures that are made during the analyzing framework. The underlying advance of the framework is that the most bountiful subsets of cells in the 2D histograms are circumnavigated by the head. The settled pictures at that point address dark smudges on a white foundation for every single estimation. The Dalmatian Plot was first depicted by. The subsequent pictures at that point speak to dark blotch on a white foundation for each estimation. Essential, the relative wealth data of the individual bunches is lost when just the high contrast blend is utilized, in this way speaking to presence/nonattendance data. Higher settled data can be acquired if the cell number is coordinated as dim degree of the smears. In the subsequent advance, the improved pictures are handled with picture examination programming. This picture examination system can be resultant after performed utilizing ready to-utilize macros and the unreservedly accessible programming Image J. The macros decide the overall region of the doors in each picture by matching the quantity of dark pixels. After a short span of time the uniqueness Prim between each pair of pictures are determined dependent on a changed Jacquard list or

separation, personally A divergence lattice of whole sets of pictures under examination is consequently made and can be utilized for measurable investigation and cognition in an appointment plot or group investigation.

Cytometric histogram image comparison

Up-to-date is similarly an image based examination mechanical assembly in any case, as antagonistic to Dalmatian Plot, needn't bother with an under lying manual advance. The 2D histograms are directly changed over to dull scaled pictures using cytometric programming (DakoCytomation). Considering the two-overlap code of the electronic sign acquiring, a histogram objective in the extent of channel numbers can generally be picked and will be reflected in pictures that will be produced using the histograms. Each picture will, in this way, have a characterized goal, speaking to the size of a network. To assess the pictures a similar standard framework ought to be picked for all intentional examples of a testing effort. Utilizing Image J the cytometric pictures are contrasted with each other. This examination depends on two numerical calculations. The select disjunction work makes a XOR picture of two cytometric pictures while the subsequent calculation delivers their cover. Along these lines, the normal dim worth per useful pixel, i.e., pixel coming about reason of dummy cells, is determined utilizing the total of pixel esteems from the XOR picture and the quantity of useful pixels from the cover picture. The normal dim worth can straightforwardly be utilized as uniqueness esteem Psim for each pair of pictures and a divergence framework of all sets of pictures is reason after made. All macros are intelligible in and can likewise be found under the QR-Code.] (Koch, Harnisch, & Schröder, 2014)

Cytometric Barcoding (CyBar)

Cybar plays out an individual investigation of cytometric histograms with no picture inspection step. This procedure, as in most looking at techniques in FCM, a chairman ward, and thus experience based obstruction step should be performed. Each pack of cells in a histogram is set for an entryway. The individual entryways of every model are solidified to one entrance design for an educational list. Such an entrance design can include up to 30 entryways and more when basic microbial organization indicatory assortment is explored. The cell bounties in each entryway are effectively separated for all examples. Therewith, the abundance assortment per entrance can straight forwardly be dissected between trial of different medications and over a period course. The quick assessment of cell abundance assortments between doorways with high and low cell numbers is empowered by data normalization. The CyBar plot permits distinguishing static or profoundly mutating subsets of cells. Along these lines, an isolated examination of individual cell group reactions is conceivable notwithstanding the overall pattern translation investigation which was at that point gave by Dalmatian plot and CHIC. In addition, record sub communities can be recognized, for example, potential capacities relegated to groups of cells by relationship examination, and arranged for additional investigation. A point by point bit by bit strategy and

prepared to- utilize macros for the CyBar methodology are given in and were as of late distributed as R bundle on the Bioconductor stage.

Flow FP

Flow FP is a product bundle of the Bioconductor stage. In this way, the total examining methodology can be acted in R. Flow FP was first created for dealing with FCM informational indexes for clinical exploration, yet was as of late likewise effectively applied to a microbiological informational index. The Flow FP breaking down system doesn't need a picture examination step or any manual gating choice yet chips away at the premise of a mathematical framework. These locales are noted as receptacles and next apportioned with indistinguishable likelihood circulation work making equivalent sub-canisters with indistinguishable virtual cell numbers. The finger impression procedure is reiterated for every canister, considering effectively characterized number of recursions. The resultant is a numerical lattice with fixed numbers and places of compartments. Subsequently, compartments in regions with high riches of virtual cells are humbler odd with those covering regions alongside low cell cost. Along these lines, the figured organization fills in as a cover which is applied to an absolute educational assortment. The amount of cells per repository is eliminated and consistent and fluctuating holders can be perceived. Therewith, detached components inside microbial organizations can be investigated similarly as likeness assessments performed.

Finger Print Recognition (Design Criteria)

Discovering subsystems during framework configuration is like discovering objects during examination. The essential subsystem disintegration ought to be gotten from the utilitarian prerequisites. The proposed unique finger impression validation framework is addressed as flowchart. In this examination paper, there are three types of sub- systems.

- Image obtaining
- Feature extraction
- Matching
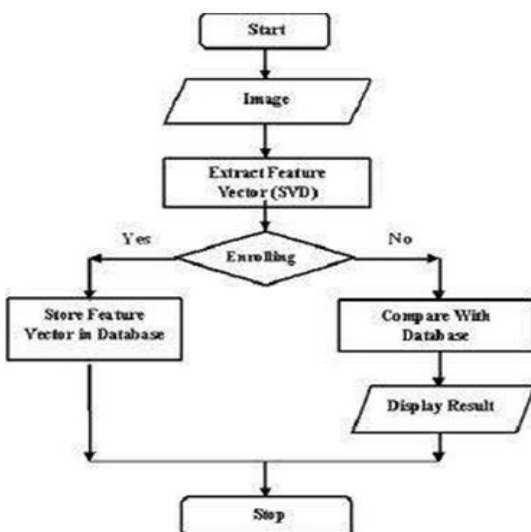
Fingerprint identification system Flow Chart

Image acquisition

Unique mark picture procurement is considered as the most basic advance of a robotized finger impression validation framework, as it decides the last finger impression picture quality, which effect sly affects the general framework execution. Available there are various kinds of finger impression peruses, yet the essential thought behind each catch approach is the action somehow or another the actual resist. The technique to catch a unique mark utilizing a sensor comprises in contacting with the finger onto a detecting territory, which as per the utilized actual guideline catches the distinction among glens. At whatever point a finger contacts onto a surface, the alterable skin turns. The whole and heading of the pressing variable applied by the client, the skin conditions and the projection of a conflicting 3D thing (the finger) onto a 2D level plane present turns, disturbance and irregularities on the got remarkable finger impression. The portrayal of a near finger impression changes each time the finger is set on the sensor platen, so 8 models for every individual are thought of and dealt with as an arrangement in data.

IV.   NUMERICAL & GRAPHICAL ANALYSIS

Singular Value Decomposition(SVD) :

Particular Value Decomposition (SVD) is supposed to be a critical theme in direct variable based math. SVD has numerous functional and hypothetical qualities. One exceptional component of the SVD is that it very well may be performed on any genuine (m, n) framework. It factors matrix A into three networks U, S, V, to such an extent that, $A = USV^T$ Where U and V are symmetrical grids and S is an askew framework The reason for (SVD) is to factor lattice An into USV^T. The lattice U contains the left particular vectors, the grid V contains the correct solitary vectors, and the askew network S contains the particular qualities. Where the particular qualities are organized on the primary inclining.

$$\sigma_1 \geq \sigma_2 \geq \cdots \geq \sigma_r > \sigma_{r+1} = \cdots = \sigma_p = 0,$$

Here r is the position of framework A, and where (p) is the more modest of the measurements m or then again n.[18]

Subjective Example:

We start the interaction of Singular Value Decomposition by choosing the framework A which has m lines and n segments. Presently, we need to consider A three lattices U, S, V^T. First we will discover V. In the event that we duplicate the two sides of the condition $A = USV^T$ by A^T

we get $A^TA = (USV^T)^T(USV^T) = V STU^T USV^T$
Since $U^TU = I$ this gives,

$A^TA = V S2V^T$

Presently we need to diagonalizable A^TA. This is basically the same as the diagonalization of framework A into $A = QQ^T$. But our symmetric lattice isn't A, it is A^TA. To discover V and S we need to discover the Eigen esteems

and Eigen vectors of A^TA. The Eigen values are the square of the components of S (the particular qualities), and the eigenvectors are the segments of V (the correct particular vectors). Killing V from the condition is basically the same as killing U.there than duplicating at the left by A^T, we will raise on the privilege by A^T. This gives:

M. James Stephen et al.

$AA^T = (USV^T)(USV^T)^T = USV^T V S^TU^T$.

Since $V^T V = I$, this gives

$AA^T = US^2U^T$

We have to discover the eigenvectors, however this time for AA^T. These are the segments of U (the left solitary vectors).This can be found in condition (2).

Since A is m × n, S is m × n and A^TA Produces a n × n network, and AA^T produces m × m lattice,

$$A = \begin{pmatrix} u_1 & \cdots & u_r & \cdots & u_m \end{pmatrix} \begin{pmatrix} \sigma_1 & & & \\ & \ddots & & \\ & & \sigma_r & \\ & & & \ddots & \\ & & & & 0 \end{pmatrix} \begin{pmatrix} v_1^T \\ \vdots \\ v_r^T \\ \vdots \\ v_n^T \end{pmatrix}$$

Where U is m × m, S is m × n, V is n × n.

SVD Algorithm:
Function   op=svd_ip(ipimg)   img=imread(ipimg);
k=double(img);
n=50; %%%%%%%% vector length[u,s,v]=svd(k,0);
temp=diag(s); temp=round(temp);op=temp(1:n); return;

Matching
Confirmation is checked by coordinating with the pictures in the information base with test picture. The coordinating with calculation continued in our methodology is Euclidean distance based coordinating.

Implementation
The work did in the space of fingerprints unmistakable verification is revolved around points of interest extraction (Halici, Jain, & Erol, 1999)[17].

The acquired picture from unique mark scanner is of top notch, 256 dark scale esteems in each and every pixel. The computation conveyed for include extraction of an uncommon engraving depends upon single attributes that is gotten by performing Singular Value Decomposition (SVD) assessment. The execution calculations are set in the Appendices. The test picture is taken from the intriguing finger impression scanner and its portion vectors are taken out. The Euclidean Distance [15] is settled between the portion vectors of test picture and the segment vectors of pictures present in the instructive file utilizing Euclidean Distance Algorithm.

V.   RESULTS

To discover the effectiveness of a validation framework it is important to discover its proportion of probability i.e., mistakenly tolerating or dismissing an entrance endeavor by an unapproved or approved client. Counterfeit elimination and False Acknowledgment are the two appraisals used to check the rightness of the circumstance.

False Rejection
Counterfeit elimination is the circumstance of a security system disregard to affirm or see an upheld person. Moreover, induced as a sort I goof, a fake excusal doesn't generally show a disfigurement in this structure; for example, in a finger impression based system, an erroneously changed finger on the scanner or soil on the scanner can achieve the scanner misreading the charming etching, causing a stunt excusal of the accepted customer. Table1 shows the evaluation for False Rejection. A Total of 680 tests were taken at each time.

Table 2: Analysis for False Rejection

Total Samples	Threshold	False Rejection	False Rejection Rate
680	1000	6	0.88
680	1500	2	0.29
680	2000	2	0.29
680	2500	2	0.29

False Acceptance
Sham Acceptance is the event of a security structure wrongly checking or recognizing an unapproved person. It furthermore insinuated as a benevolent II bungle. Counterfeit affirmation consistently is seen as the most certifiable of fingerprinting security botches as it gives unapproved customers permission to structures that unequivocally are endeavoring to keep them out. Second Table shows the assessment for False Acceptance with a measure of 680 tests wastaken at each time.

Total Samples	Threshold	False Acceptance	False Acceptance Rate
680	1000	6	0.88
680	1500	17	2.50
680	2000	36	5.29
680	2500	74	10.88

Table 3: Analysis for False Acceptance Rate

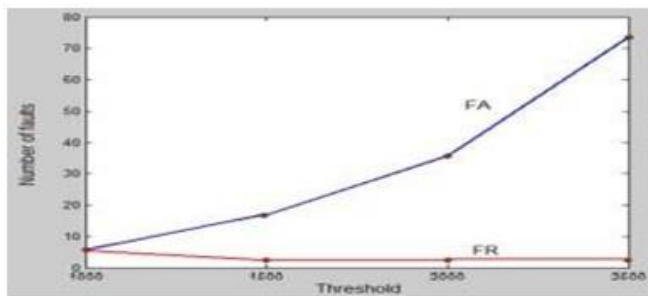Graphical Representation of the False Acceptance and False Rejection.

Fig. 4: Proposed study of FA and FR

FA stands for False Acceptance FR stands for False Elimination

Total no. of samples in the database isequal to 680
No. of samples per individual is equal to 8

VI.   CONCLUSION

The fundamental standard of SVD is basic. a picture may have numerous highlights or qualities. however, it may have (much of the time does) rely on just some of the highlights. additionally, there are existence limitations in putting away the entirety of the highlights also, this property is valuable here. so to catch properties of the picture with the end goal of putting away them or for additional adjustment single requirements just to distinguish these highlights and store them. svd is such a procedure. it recognizes the principle highlights of the picture. It tends to be done as such by playing out exact numerical calculations It licenses impressive decline in the proportion of limit required, making colossal pictures more sensible and less difficult to work with. svd based incorporate extraction takes less time appeared differently in relation to points of interest based extraction.

REFERENCES

[1]. Buysschaert, B., Kerckho, F. M., Vandamme,P.,Baets, B. D., & Boon, N. (Dec 2017). Flow Cytometric Fingerprinting for MicrobialStrain Discrimination and PhysiologicalCharacterization. *OriginalArticle*.

[2]. Jain, A., Cao , K., & Arora, S. S. (2014). "Recognizing infants and toddlers using fingerprints: Increasing the vaccinationcoverage".

[3]. Koch, C., Harnisch, F., & Schröder, U. (2014). Cytometric fingerprints: evaluation of new tools for analyzing microbial community dynamics. *Front Microbiol*.

[4]. A, P., & A, H. (2015). Getting the measure of biodiversity.

[5]. HM, D. (2010). Prospects for the automation of analysis and interpretation of flow cytometric data.

[6]. K., D. R., L., C., O, T., Y, W., & N, B. (2012). Flow cytometry for fast microbial community fingerprinting.

[7]. Koch, C., Harnisch, F., Schröder, U., & Müller, S. (june 2014). Cytometric fingerprints: evaluation of new tools for analyzing microbial community dynamics. *Front.Microbiol*.

[8]. M, S. H. (2013). Practical Flow Cytometry.

[9]. P, B., T, H., I, F., S, K., R, G., & H, H. (2011). Resolution of natural microbial community dynamics by community fingerprinting, flow cytometry, and trend interpretation analysis.

[10]. Rogers , W. T., & Holy, H. A. (Sept 2009). FlowFP: A Bioconductor Package forFingerprinting Flow Cytometric Data. *Advances in Bioinformatic*.

[11]. S, M. (2007). Modes of cytometric bacterial DNA pattern: a tool for pursuing growth.

[12]. Su , C., & Srihari, S. N. (2009). "Probability ofrandom correspondence for fingerprints".

[13]. Yoon , S., & Jain, A. K. (2015). "Longitudinal study of fingerprint recognition"

[14]. Rivandi, P., Winda , A., Satrio, D., & Solihin, M. I. (2019). Automotive Start-Stop Engine Based on Fingerprint Recognition System.

[15]. Gray, A. (1997). The Intuitive Idea of Distance on a Surface.

[16]. Priyanka.(2014).Fingerprintrecognitio techniques and its applications.

[17]. Halici, U., Jain, L., & Erol, A. (1999). Anintroduction to fingerprint recognition.

[18]. Stephen, M., & Reddy, P. P. (2011). Implementation of Easy Fingerprint Image.