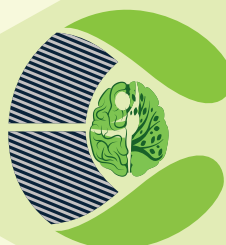


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Analysis of Fingerprint System based on Performance Measure



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Biometric securities are the most widely used security solution to prevent security attacks and threats because it is more reliable and safer than any password, pin, or motion sensing etc. Biometric Systems are based on performance measures like accuracy, efficiency, speed, uniqueness etc. which help in security of data and valuable goods. In this paper we discuss about the previous studies on fingerprint system. This paper discusses about the fingerprint verifications and identifications techniques with the use of various patterns and with all the technical steps involved in it like fingerprint capturing, pre-processing, minutia extraction, post-processing and minutia matching stage. This paper highlights the accuracy of fingerprint among the other biometric systems.

The aim of this paper is to show the importance, efficiency, and speed of fingerprint recognition technique among all other biometric techniques.

Keywords

- Minutia
- Fingerprint Verification
- Fingerprint Identification
- Fingerprint Ridges
- Minutia Extraction

Introduction

Human fingerprints are having very good patterns that is also called as minutiae, which is widely used as identification method. Fingerprint print safety is classified as the best method of identification and security. It is a secured way of identification and security. It is easy to use fingerprint recognition system as compared to other biometric security concepts like iris scanning, facial recognition, retina scanning, body motion, etc. Fingerprint recognition is among the most widely used Biometric Technology. Cheers to its uniqueness and constancy over time, fingerprints are used for

verification since very long period, in recent time changing into machine-controlled thanks to advancements in computing.

Fingerprints were used as a way to identify the persons in late nineteenth century. The “Galton points” the base of inspiration for the growth of fingerprint during the late nineteenth century, with the growth and advancement in computer technology the use of fingerprint for security and authentication purpose was increased.

A diversity of sensor kinds — visual, ultra sound, and capacitive, used

for creating the numerical image of a fingerprint minutia. Visual devices get a copy of the fingerprint, and capacitive sensors are the leading detector nowadays [11].

The 2 main groups of fingerprints extracting methods component are dimension minutiae-based extraction and design based extraction. Design matching just compares two photos to determine how similar they are. Design matching is often utilised in fingerprint schemes to get patterns. the foremost used recognition technique, minutiae-based matching, depends on the physical patterns.

Fingerprint

A finger print is an important part of human body. It's inspired from the analysis that everyone has their completely unique finger prints and these finger print patterns are permanent for the entire human lifetime. Therefore, fingerprints are used for the rhetorical application associated identification for an extended period [2].



Fig 1 Fingerprint on machine [1]

The fingerprint is a pattern which consist of the various ridges. Finger patterns can't distinguish by their edges and furrows. it's illustrated through detail, that unit using some irregular points edges [2].

Minutiae is split in to a pair of components such as: termination and bifurcation. Termination is referred to as ending and bifurcation is referred to as branch. Over again detail contains of edges besides troughs. depression is mentioned as furrow [3].

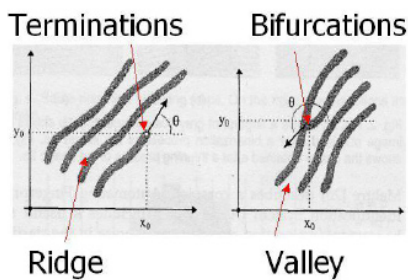


Fig 2 Ridges Diagram

Classification Techniques

Fingerprints is nothing but a pattern or you can say impression on the fingers of humans which are identical to each other. Fingerprints is one of the most widely used biometric technique for its different purposes as it possesses lot

of benefits. The fingerprint is classified on the basis of its pattern varieties, size, and position of the finger^[4].

The 3 basic principles of fingerprints are [6]:

- A minutiae is a personal identity (unique).
- Minutiae will remain unchanged throughout associate individual's period of time
- Fingerprints have basic patterns.

On the basis of this patterns after visualisation the fingerprint pattern is divided into three parts whorls, loops and arch's as we can see in fig 3.

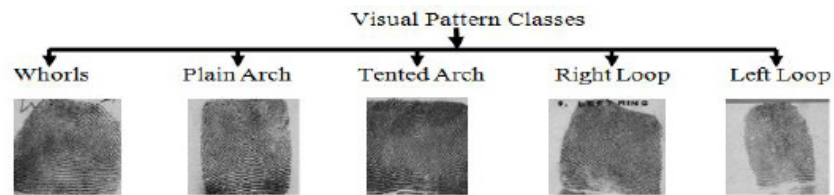


Fig. 3 Pattern types [15]

There are many interesting facts about fingerprint which we don't know about, one of the facts is that about 60 percent of people have loops, 35 percent have whorls and only about 5 percent have arches in their fingerprint. There is a huge amount of data which was retrieved in the form of fingerprint every day and further processed for different aspects. In fingerprint classification the grouping the similar nature or types of fingerprint is done in categories [4]. There are different kind of techniques available for this classification. It is very important step in FRS to classify the fingerprints. When the classification is done before the FRS it reduces the time to be taken in further processing and also minimizes the technology. The classification of fingerprint is done to check matching technique throughout the process and to extend the efficiency of whole system. In FRS, the patterns like ridges and furrows are matched because it provides the unique identity to each fingerprint

means if two fingerprints are having the same pattern then it is of the same finger. A twin child or a very similar pattern having humans can't have the same fingerprint. Arch, ellipse, loop, duct gland, bifurcation, island, tented arch, rod & spiral are shown in fig. 4 are used for line sort classification.

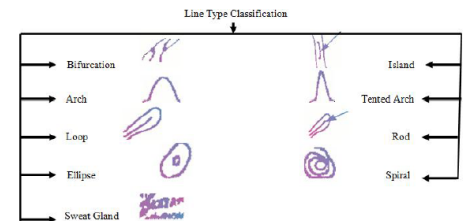


Fig. 4 Line Type Classification [14]

Matching techniques are the one which is responsible for the pattern authentication and verification [5]. There are different kinds of matching techniques as we can see in fig 5 A perfect matching method delivers a fast and improved outcome during each matching.

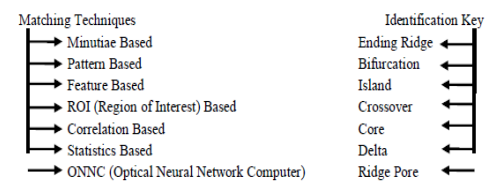


Fig. 5 (i) Matching Techniques
(ii) Identification Keys

	Termination
	Bifurcation
	Lake
	Independent ridge
	Point or island
	Spur
	Crossover

Fig. 6 Symbols of Identification Keys

Fingerprint Recognition

The fingerprint recognition is divided into two sub parts: -

- i. Fingerprint/minutia Verification [8]
- ii. Fingerprint/minutia Identification

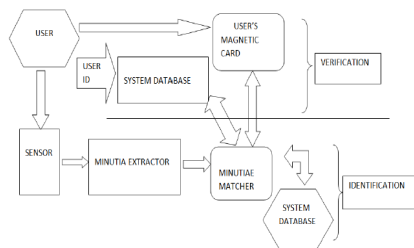


Figure 7 Fingerprint Recognition [5]

Fingerprint Verification

Fingerprint/minutia Verification, is also known as 1:1 (one-to-one) fingerprint/minutia matching or Fingerprint/minutia Authentication, it is the process of making sure that a person who they claim to be is real or not. In fingerprint Verification a person mainly gives some identification, for ex.- a ID or username or a Radio Frequency card before placing his/her finger on the scanner. The fingerprint verification machine takes the user ID and tries to verify the new fingerprint with the fingerprints associated with saved ID [11]. If a fingerprint match found then the user is allowed access else access denied. In fingerprint verification, the biometric software needs to search through only the single record [7].

Fingerprint Identification

Fingerprint Identification, also known as 1: N (one to many) fingerprint matching [10], is process of comparing an extracted fingerprint/minutia against all fingerprints in Datawarehouse to see if a match is found. In fingerprint Identification the machine needs to search the entire database [7].

Structure Strategy

Block Figure of fingerprint recognition organization encompasses machine (sensor), minutia(fingerprint) extractor and minutia(fingerprint) matcher (as shown in fig 8).

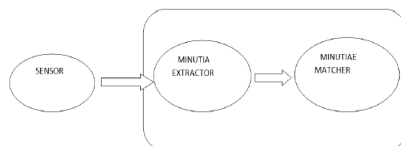


Figure 8. System Design

There are few stages involved in minutia extractor [9]: -

- 1. Pre-processing
- 2. Minutia extraction
- 3. Post processing

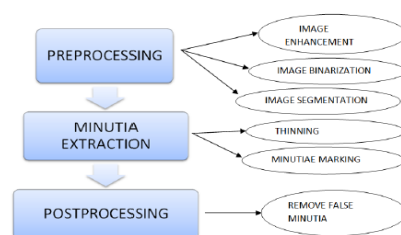


Fig 9. Extractor

Pre-processing

Once more, pre-process phase is split in to 3 deputize phases known as:

- 1. Picture improvement
- 2. Picture binarization
- 3. Picture segmentation.

For copy improvement I have a tendency to used 2 strategies such as: - bar graph levelling and Fourier rework. once increasing the quality of image, I want to binaries the picture for that I have a tendency to use the domestically adaptative threshold technique [3].

For image segmentation I have a propensity to most well-liked a three-step technique like: -

- 1. Block way approximation
- 2. Division by direction strength
- 3. Region of Interest (ROI) removal by Morphological procedures.

Minutia removal: -

Minutia removal phase is further separated in to binary deputize phases: -

- 1. Fingerprint ridge diminishing
- 2. Minutia design

I used continuous parallel dilution algorithmic rule for point removal phase. Ridge dilution is employed to use to delete the jobless peels of the ridges until the ridges area unit of 1 pixel varied. The point marking is a humble task. Now journey variety (CN) construct is employed [12].

Post processing: -

For the post process part, the aforementioned just one deputize method that is: -

Elimination of untrue point.

Also, a unique illustration for bifurcations is projected toward join ends and bifurcation.[1]

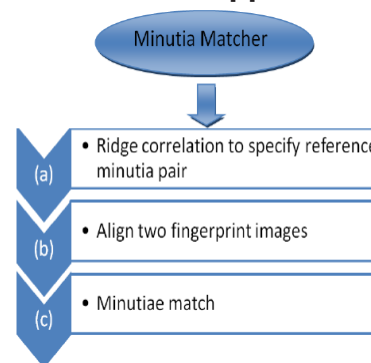


Figure 10 Minutia matching technique

The detail mediator checks if 2 detail circles area unit from identical finger are same or not. If the patterns match fine, formerly the 2 fingerprint pictures are allied and corresponding is led for all residual detail.[6]

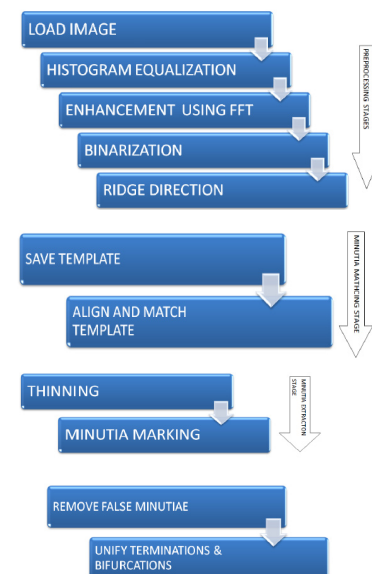


Figure 11 All the steps involved in fingerprint recognition algorithm see [5]

Performance Measure: -

There are two kinds of working assessment directories to control the presentation of Fingerprint Recognition System:

IRD (Incorrect Rejection Degree): -

Occasionally the biometric safety structure might mistakenly discard correct fingerprint tried by a certified user. to check these errors of incidents IRD is largely used. [5].

IRD

$$(\%) IRD = (IR/NS) * 100$$

IR=incorrect refusals
NS= no. of trials

IAD (Incorrect Acceptance Degree): -

Occasionally the biometric security scheme might wrongly accept the fingerprint of an illegal operator. To check these kinds of events IAD is essentially used. [5].

IAD

$$(\%) IAD = (IA/NS) * 100$$

IA= incorrectly accepts
NS= no. of trials

Verge Rate	Incorrect Acceptance Degree (In Fraction)	Incorrect Reject Degree (In Fraction)
6	0.0071	7.22
7	0.0034	9.34
9	0.0005	15.53
10	0.0001	11

Conclusion

In this paper we have reviewed on FRS (Fingerprint Recognition System), some discussion about further improvements in the system and get some easiness and efficiency in usability and implementation. All the steps and order of FRS (Fingerprint Recognition System) are elaborated and discussed with multiple techniques for matching & with many keys of identification for a good understanding of this system. Challenges and problems are checked and well defined in this field to know the actual process clearly.

Using the above analysis, we are able to understand how and why Fingerprint Recognition technique is being used from centuries and is used in multiple applications like biometric dimensions, finding corruption search and conjointly in safety organizations.

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Annexure I

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Word Count

2345

Character Count

11741



SIMILARITY %		MATCHED SOURCES		GRADE	
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4.	22	gatorcare.org	<1	Internet	
5.	3	IEEE 2011 19th Telecommunications Forum Telfor (TELFOR) - Belgrade,	<1	Publication	
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Reviewers Comment

Reviewer's Comment 1: Author precisely provided the information about the fingerprint processing along with the industrial approach of implementing. Also the authors provided the new terms which are being used nowadays as a new approach of fingerprint reading and scanning. The authors did a very good job in defining the measures and techniques and the verification metrics with them in a hierarchical manner. The article shows a flow very proficiently.

Reviewer's Comment 2: The article shows an impression based approach of delivering the impacts of showing the fingerprint analysis by various modes of techniques and methods that show how they have been distinguished digitally on the visualisation approach of understanding. They also stated very good facts and often made them cleared by giving the examples for each of them. The authors very generically show the introductions and made a very good impact on the reader.

Reviewer's Comment 3: The authors verifies the approach very concisely and delivers an impactful knowledge about the fingerprint impressions that how they practically are being readed. Also they show different techniques and methods which beautifully delivers the meaning of the content. The paper showed a very processed way of delivering the pre and post processing of getting the impressions and how they can be further classified. The authors did a good job and delivered the upro mark material.



Editorial Excerpt

The article has 8% plagiarism which is an acceptable percentage for publication. The comments related to this manuscript are noticeable related to "Fingerprint Recognition" both subject-wise and research-wise. The article demonstrates Fingerprint Recognition as one of the most widely used technology for verification and identification in the Security world. As the technology is increasing the fear of data breach is also increasing, so to provide security to only data but also to the user's identity the fingerprint is one of the most secure and easiest ways to achieve this goal. In this paper we have explained about the fingerprints deeply and also shown how the fingerprint recognition system works and what are the measures taken to check the quality of our fingerprint and its recognition system. After comprehensive review and suggestions by the editorial board the paper has been categorized under the category "Argument Based Credentials"

Acknowledgement

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Disclaimer

All the views expressed in this paper are my own, of which some of the content is taken from open source websites for knowledge purpose. The content drawn from different sources have been mentioned above in the references section.



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