Fingerprint Recognition by Minutiae Matching Method for Evaluating Accuracy

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***Abstract*— Today, Fingerprint recognitions are used for person identification and verification. In fingerprint recognition, matching methods and algorithms are most important for research area. Matching methods based on the different types of patterns are important for matching and algorithms based on the minutiae points are important for finding and calculating the matching points into the fingerprint of any person. But there are some drawbacks that affect the accuracy of fingerprint matching like, insensitivity to change the direction of fingerprint, size, difference between the two fingerprints, features of fingerprints and poor quality fingerprint image. To remove these drawbacks, we use a method that describes the different patterns of fingerprint (Arch, Whorl, and Loop) using different orientation and algorithm that improves the extraction of minutiae points based on ridges, dots and splitting ridges. It matches and compares the whole fingerprint and verifies the original fingerprint, and after that it identifies the person. This method give the result in form of FMR and FNMR and shows the 0.00 for FNMR and 0.023 for FMR which is better than the Fingerprint Recognition using Minutia Score Matching system.**

***Keywords*— Fingerprint Recognition, Verification, Identification, Fingerprint Matching Techniques and Algorithms.**

I. INTRODUCTION

A fingerprint is the group of ridges and furrows of all or any part of finger. Through various studies it has been observed that each person has its own fingerprint and doesn't change during whole life. Hence, they are unique for every individual [1, 3, 5]. A fingerprint quality is damaged when, our fingerprint cuts or burns. But after some time it is come back in its original quality. So it is used for identification and verification of any persons and used by many organizations.

A. Fingerprint Modes: - It has two modes [5, 7, 8, 10].

1) Fingerprint Verification: - In this, two fingerprints are compare by using some methods and verify original fingerprint.

2) Fingerprint Identification: - After verification, system automatically identify the person.

In my thesis I have used both modes.

B. Fingerprint Matching: - In fingerprint matching minutiae points are extracted from both the fingerprints and calculate the similarities between two fingerprint images [1].

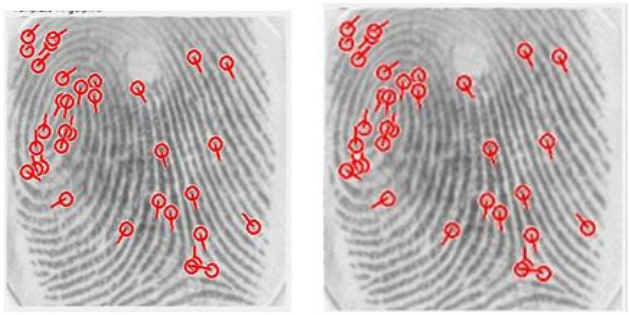

Fig 1 a) Query Fingerprint Image b)Template Fingerprint Image

II. BACKGROUND AND RELATED WORK

Fingerprint recognition is one of the oldest methods. Fingerprints have been studied for many years ago. The study about the properties of fingerprints started at 16th century and in 20th century, fingerprint recognition was formally accepted as valid personal identification [12]. There are a number of different strategies and published approaches through which fingerprint identification can be done, among which verification through minutiae points is the most simple and easy[11]. Many researchers develop new fingerprint matching algorithms that have high performance than the previous ones or they create a new way to match. Other researchers try and search to hybrid the existing matching algorithms to minimize the errors. And other uses the existing algorithm and

matching methods for improving the accuracy of fingerprint. Due to the high complexity, many techniques are not usable to match and verify the fingerprint because, i) Extracting minutiae from poor-quality image is difficult. ii) Size and orientation of fingerprint are changed, and then accuracy is low.

A. Fingerprint Representation: - A representation of fingerprint is classified into three parts.

1) *Global Level Representation:* - This type of representation is known as pattern, which is an aggregate characteristic of ridges, and minutiae points [2].

Fig 2 Fingerprint

2) *Local Level Representation:* - Local representation consists of several components within a restricted region in the fingerprint. Which are unique features found within the pattern that are used to unique identification. In this some small points are represented [6].

Fig 3 Local Representation

3) Very Fine Level Representation: - A small point which is called a minutiae point is sometimes opening in the skin or other surface [4].

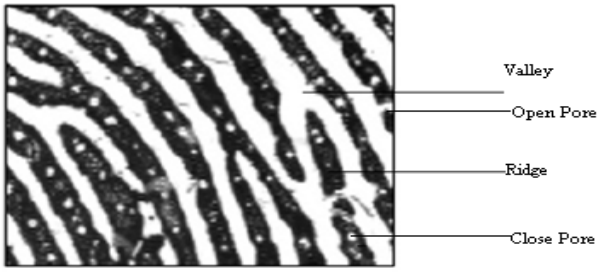

Fig 4 Very Fine Level Representation

III. PRAPOSED WORK

The operation of fingerprint recognition system is that by acquiring data from an individual, entering a feature set from the acquired data, and comparing this feature set against the template set in the database. After comparing system verify fingerprint image and identify the person who have enrolled. Our work is done with different size and orientation of fingerprint and performs verification and identification.

Ridge orientation is the process of obtaining the angle of the ridges throughout the image. The orientation field of a fingerprint image represents the directionality of ridges. Fingerprint image typically divided into number of non-overlapping blocks and an orientation representative of the ridges in the block is assigned to the block based on grayscale gradients in the block. The block size depends on the inter-ridge distance, i.e. it should include at least one ridge and one valley in a block. The block orientation can be determined from the pixel gradients by averaging or voting (optimization). The orientation field of block *(i, j)* is given by

$$\theta(i,j) = 0.5 \tan^{-1}\left(\frac{Vx(i,j)}{Vy(i,j)}\right)$$

Where

$$Vx(i,j) = \sum_{u=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} (Gx(u,v)Gy(u,v))$$

And

$$Vy(i,j) = \sum_{u=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} (G^2{}_x(u,v)\, G^2{}_y(u,v))$$

Where w is the size of block, Gx and Gy are the gradient magnitudes in x and y directions, respectively.

IV. RESULT

For evaluation of fingerprint accuracy we have used three types of dataset. Each data set consists of 8 fingerprint images. These datasets are experimented and result is evaluated.

Fig 5 Sample Fingerprint Images from the Dataset

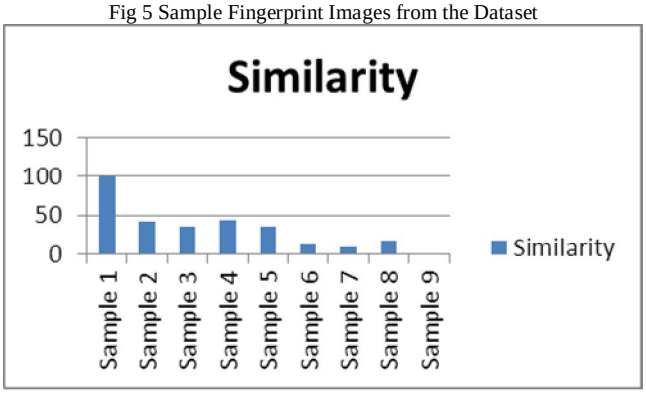

Fig 6 Similarity Graph for Sample Images From Data Set 1.

In figure 6, X –axis shows the different sample of fingerprint and Y – axis shows the similarities of fingerprint samples for dataset 1.

SIMILARITY AND NO OF MINUTIAE POINTS FOR DATASET 1

Fingerprint Set1 With Different Orientation	Minutiae Points	Similarity
Sample 1(SAME)	42	100%
Sample 2	21	42%
Sample 3	15	35.71%
Sample 4	19	43.18%
Sample 5	15	35.71%
Sample 6	5	11.90%
Sample 7	4	9.52%
Sample 8	8	17.02%
Sample 9(different)	0	00%

Table I describes that the minutiae points calculated between two fingerprint samples and the similarities for dataset 1.

A. Performance Evaluation:- The accuracy is calculated in terms of FMR and FNMR

1) *False Matching Ratio:* - when a fingerprint matches with the different fingerprint individual than it is called as false matching ratio.
2) *False Non Matching Ratio:* - when a fingerprint is not completely matches with the different fingerprint individual than it is called as False Non matching ratio.
3) *Threshold:* - it is a value at which true or false will be considered. If value of matching equals to or greater than threshold then accepted otherwise rejected. I have been take threshold as 30 for fingerprint matching.

TABLE II
FMR AND FNMR FOR THRESHOLD

Data Sets	Threshold	FMR (%)	FNMR (%)
Data set 1	30	0.019	0.40
Data set 2	30	0.028	0.280
Data set 3	30	0.024	0.53

Table II describes that the 3 datasets using threshold value and their corresponding FMR and FNMR values.

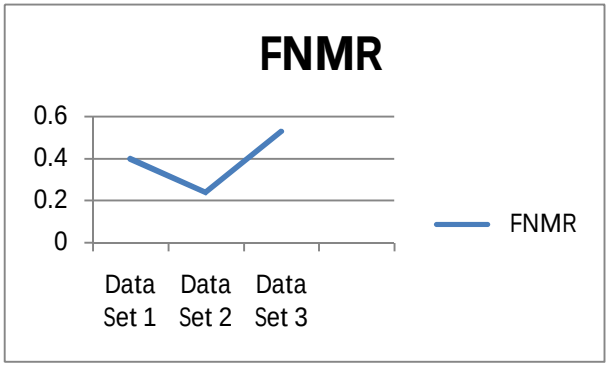

Fig 7 Values of FNMR for Each Data Set

In figure 7 the graph shows the FNMR value for data set 1, dataset 2, and dataset 3.

Fig 8 Values of FMR for Each Data Set

In figure 8 the graph shows the FNMR value for data set 1, dataset 2, and dataset 3.

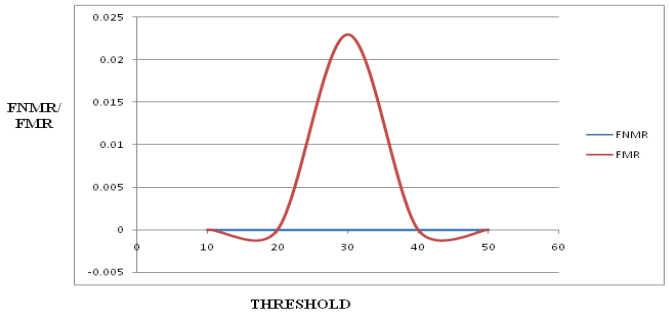

Fig 9 FNMR and FMR for A Given Threshold

In figure 9 the graph shows the FMR and FNMR values with threshold for data set 1, dataset 2, and dataset 3.

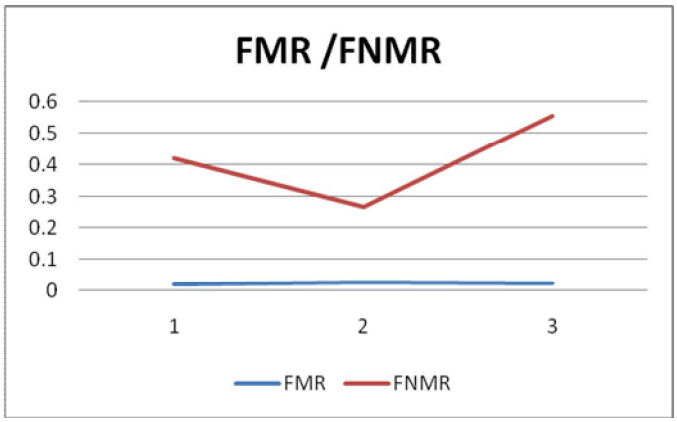

Fig 10 ROC Curve between FMR and FNMR

In figure 10 the graph shows the ROC curve between FMR and FNMR values for data set 1, dataset 2, and dataset 3. X axis shows that the three datasets. And Y axis shows the values in points for FNMR and FMR.

B. Evaluation with Existing Methods: - This section describes comparison between the existing methods to proposed method. This shows comparisons of FNMR and FMR between FRFNN, FRMSM and proposed method.

Table III
COMPARISONS OF FNMR AND FMR WITH EXISTING METHODS

	FRFNN	FRMSM	PROPOSED METHOD
FNMR	0.00	0.00	0.00
FMR	0.23	0.026	0.023

This table shows that the FNMR is 0.00 and FMR of FRMSM is 0.026 and our method is 0.023 which is better than existing matched.

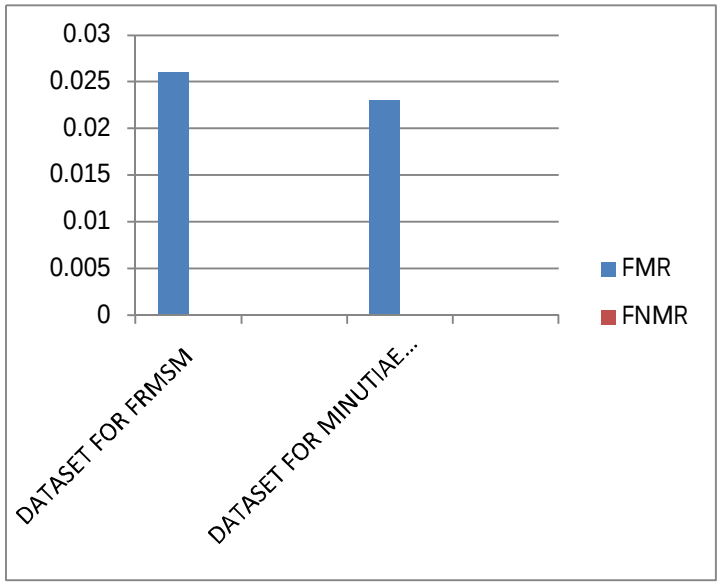

Fig11 Comparison Graph between FRMSM and Minutiae Method.

In figure 11 the graph shows the FMR values is 0.026 for FRMSM and our FMR values is 0.023 for minutiae method, which is better than previous one[9].

V. CONCLUSION & FUTURE WORK

The core fingerprint identification technology, that is fingerprint feature extraction, fingerprint classification and fingerprint matching are extremely important but challenging problems and even though several commercial system exist for fingerprint verification, the performance needs to be improved for a wide adoption in many applications The goal of this thesis is to study the fingerprint methods and to develop a system that is used to overcome the drawbacks and increase the performance of fingerprint verification and identification. The main points of my thesis are-The primary

advantage of our thesis is to fingerprint matching with the entire template fingerprint that is stored in the database. We have used a minutiae based method for matching two fingerprint images with different direction. Our project is also work in size variations, if the stored fingerprint is big in size than the current fingerprint image, then it is recognize by system and verified.

Our system extracts the maximum minutiae points from the damaged fingerprint image. Our project can also used in any Employee Management Attendance System. Compared with the traditional matching methods, our method is able to handle more complicated imaging conditions such as direction changes, size or poor quality fingerprint. The execution time of the algorithm must be substantially reduced and the accuracy will be improved.

There is a scope of further improvement in terms of efficiency and accuracy which can be achieved by improving the hardware (biometric) to capture the image. Also I will use the standard database to take fingerprint images and by these images I will experimented and compare to other existing work.

REFERENCES

[1] Andrew Ackerman, Professor Rafail Ostrovsky "Fingerprint Recognition".

[2] Anil Jain, Yi Chen, and Meltem Demirkus, "Pores and Ridges: Fingerprint Matching Using Level 3 Features", Department of Computer Science and Engineering Michigan State University.

[3] Anil K. Jain, Fellow, IEEE, Salil Prabhakar, Lin Hong, and Sharath Pankanti, "Filter bank-Based Fingerprint Matching", IEEE Transactions on Image Processing, Vol. 9, No. 5, May 2000

[4] Ary Noviyanto And Reza Pulungan,"A Comparison Framework For Fingerprint Recognition Methods",Proceedings of "The 6th SEAMS-UGM Conference 2011" Computer, Graph and Combinatorics, Pp.601–614.

[5] Asker M. Bazen, Gerben T.B. Verwaaijen, Sabih H. Gerez, Leo P.J. Veelenturf and Berend Jan Van Der Zwaag University Of Twente, Department of Electrical Engineering," A Correlation-Based Fingerprint Verification System" Prorisc 2000 Workshop on Circuits, Systems And Signal Processing, Veldhoven, The Netherlands, November 2000.

[6] Jie Zhou, Member, IEEE, and Jinwei Gu "A Model-Based Method For The Computation Of Fingerprints' Orientation Field", IEEE Transactions on Image Processing, Vol. 13, No. 6, June 2004.

[7] Kalyani Mali, Samayita Bhattacharya,"Fingerprint Recognition Using Global and Local Structures", International Journal on Computer Science and Engineering (IJCSE), ISSN: 0975-3397 Vol. 3 No. 1 Jan 2011 16.

[8] R. Singh1, M. Vatsa1, and A. Noore2, "Fingerprint Indexing Using Minutiae and Pore Features", West Virginia University, Morgantown, USA, Afzel.Noore@Mail.Wvu.Edu.

[9] Ravi. J, K. B. Raja, Venugopal. K. R, "Fingerprint Recognition Using Minutia Score Matching", International Journal of Engineering Science and Technology Vol.1 (2), 2009, 35-42.

[10] Sangram Bana1 and Dr. Davinder Kaur2, "Fingerprint Recognition using Image Segmentation" (IJAEST) International Journal of Advanced Engineering Sciences and Technologies Vol No. 5, Issue No. 1, 012 – 023.

[11] Shaole Zhang, Xiaojun Jing, Bo Zhang, Songlin Sun, "An Adaptive Fingerprint Image Segmentation Algorithm Based On Multiple Features", 978-1-4244-5848-6/10/$26.00 ©2010 IEEE.

[12] History of Fingerprint, http://www.crimtrac.gov.au/our_services/ Histor of Fingerprinting .html.