2015 IEEE International Conference on Engineering and Technology (ICETECH), 20th March 2015, Coimbatore, TN, India.

Fingerprint Matching and Similarity Checking System using Minutiae Based Technique

Adhiyaman M
School of Advanced Sciences
VIT-University
Vellore, India
adhimsc2013@gmail.com

Ezhilmaran D
School of Advanced Sciences
VIT-University
Vellore, India
ezhilmaran.d@vit.ac.in

***Abstract*— Fingerprint matching is one of the most important problems in Automatic Fingerprint Identification System (AFIS). It has emerged as an effective tool for human recognition due to its uniqueness, universality and invariability. The significance of this work is to monitor the matching and similarity for two or more fingerprint images simultaneously. This proposed algorithm has been formulated based on minutiae points which examine n number of images.**

Keywords*— *biometric; fingerprint image; minutiae points; euclidean distance; matching; similarity

I. INTRODUCTION

According to the biometric security, the identification of each person can be divided into ways: physical and behavioral. Fingerprint image is a unique physical parameter which will never change even for twins. Voice, iris, DNA and fingerprints are the biometric features which are very suitable for human recognition due to their uniqueness, universality, invariability and extraction facilities[1] and [2]. Fingerprints are patterns formed in the epidermis of the fingertip. The global features of fingerprint are ridge orientation map, ridge frequency map, singular points and the minutiae points. The combination of ridge ending and bifurcation is referred as minutiae. There are three basic fingerprint patterns: loop, whorl and arch. Fingerprint images have a nine type of classification namely, arch, Tent arch, right loop, left loop, double loop, right pocket loop, left pocket loop, whorl and mixed figure. Various research works use this type of minutiae points towards authentication, matching and identification. Among all biometric traits, fingerprints have highest level of reliability and are extensively used by forensic experts in criminal investigations. In the current investigation using the minutiae point gives the accurate results in fingerprint images.

II. LITERATURE SURVEY

[3] improved the minutiae matching algorithm of Jain et al. (2000). Additionally, the ridge information into the process of matching and used a changeable sized box in the matching process. All the above process deals with the nonlinear deformation more robustly. [4] have described the performance of a minutiae-based fingerprint verification system which can be improved by providing feedback in feature extraction (Fig.1)

The survey of topology-based techniques for fingerprint recognition was discussed by [5]. It describes an original fingerprint alignment and matching scheme based on two powerful computational geometry data structures: Voronoi diagram and Delaunay triangulation.

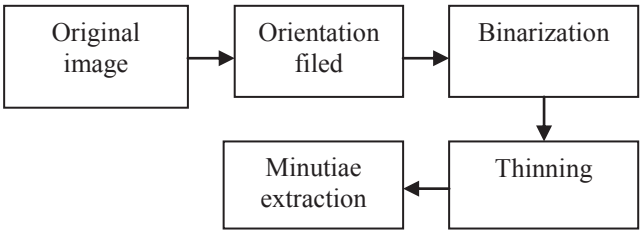

Fig.1. minutiae extraction algorithm

[6] Have presented a new quality of image which was enhance by means of convolution of a given image and Gaussian kernel. The fingerprint images are poorly illuminated and hardly visible, because of these images are captured from crime places. It has useful to be an authentication and matching. Local binarization is applied for enhancement. The new technique for fingerprint image post-processing and a windowing post-processing method was introduced by[7].It takes into account of the neighborhood of each minutia within a defined window and check for minutia validation and invalidation. This post-processing is used to eliminate a large number of false extracted minutiae from skeletonised fingerprint images.

The descriptor-based Hough transform algorithm was proposed by[8]. It is significantly used to align fingerprints and measure similarity between fingerprints by considering both minutiae and orientation field information. The multi-finger indexing is used to minutiae quadruplets in combination with a clustering scheme which was explained by [9]. Four, five and ten fingerprints from a subject are fused at the rank level using

978-1-4799-1854-6/15/$31.00 ©2015 IEEE

the highest rank rule. The minutiae quadruplet features are observed to be robust and the clustering scheme assists in quickly identifying a list of potential candidates in the gallery database. This method considers the local topology of minutiae using two closest points triangle for index key generation and it is tested in NIST DB4 and FVC 2004 the databases[10].

III. PROPOSED METHOD

A. Binarization and Thinning

In general, the fingerprint matching algorithm is used to identify and verify a person. This system analyzes two images; input image and query image.

Fig.2 (a) Binary image and (b) Thinned image

Gray scale image (Input image) is converted into a binary image (Fig.2 (a)) which is termed as binarization (black and white). Binary images are labeled as bi-level or two-level. This means each pixel is stored as a single bit i.e. 0 or 1. Where 0 refers to black and 1 refers to white. Minutiae extraction algorithm is used to obtain the binary ridge image from gray level fingerprint image.

Image thinning (Fig.2 (b)) is used to reduce the darkness of all ridge lines. It is one of the pre-processing techniques for minutia matching because clear image is the necessary for the identification a person. Thinning process does not convert the original (x, y) location. In an image, the angle of direction of minutiae points assures the true calculation of minutiae points and it is known as Block Filtering. Ridge thinning is used to destruct the extra pixel of ridges until just one Pixel broad [11].

B. Minutiae matching for fingerprint image

After the pre-processing step, the matching algorithm is described. Three main types of fingerprint matching algorithms are given below: 1.Correlation matching 2. Minutiae based matching 3. Pattern based matching. Minutiae based fingerprint matching is the most popular it is widely used in the forensic investigators and researches. Here we propose the minutiae based matching algorithm. The algorithm is performed as follows:

Step 1: Introduce the input fingerprint image

Step 2: Acquire the input image

Step 3: convert the Gray scale image into the binary image and apply the thinning process to the image

Step 4: extract Feature from the binary image and count the minutiae points of the input image

Step 5: Pick up the query image form the database and count the minutiae points for query image

Step 6: Calculate the Euclidean distance between input image and query image.

Step 7: Sort the output image and find out which one is perfect match to the given query image

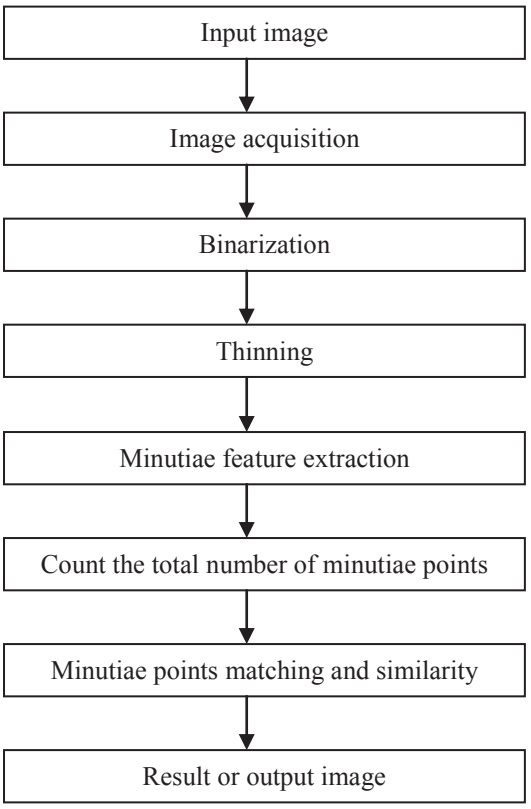

Fig.3.Block diagram of algorithm

This process of algorithm (Fig.3) is counts the minutiae points for n number of image respectively. It is performing to count the both ridge-end and bifurcation. All the minutiae points (Fig.4) are located at a specific place in fingerprint image which are stored as a data. The location of every point in the digital image is given by pixel position. Ridge ending and bifurcation points are easily taken and stored separately. This algorithm compares the computed values with stored minutiae values by calculating the Euclidean distance between input image and query image.

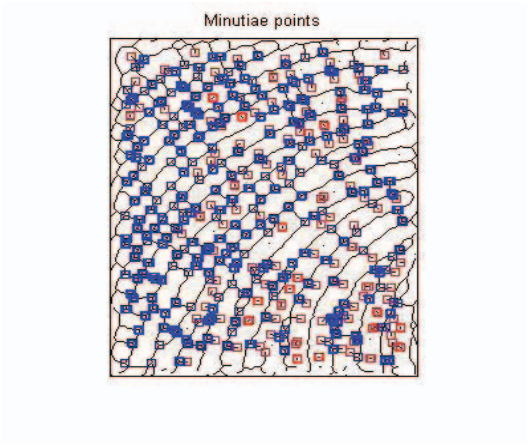

Fig.4.Minutiae points in fingerprint image

Mathematically, the Euclidean distance is the "ordinary" distance between two points in Euclidean space.

$$D(p,q) = \sqrt{\sum_{i=1}^{n} (p_i - q_i)^2} \qquad (1)$$

The matching process is completed and matched image will be displayed in the screen.

IV. Results and Discussion

These fingerprint images are taken from the rural fingerprint database (Indraprastha Institute of Information Technology (IIIT) –Delhi). Experimentally, 20 images are taken from the fingerprint database and tested with a query image. Furthermore, if a query image matches with any one of the 20 images that an image should be matched. (i.e.) equal to 0 otherwise similarity value will be shown (Fig.5). [4], [3] and [12] these authors have described the performance of a minutiae based matching, verification and authentication using up to minutiae extraction step. This proposed algorithm extends to check the matching and checking by counting the minutiae points for the respective image separately.The unique of this algorithm is finding the exact match from the query image to avoid the fake matches.

1	'D:\images\Fingerprint Rural Database Test\01_2.bmp'	<661x508 uint8>	130	699	130	699	[130,699]	[130,699]	0
2	'D:\images\Fingerprint Rural Database Test\01_4.bmp'	<661x508 uint8>	141	701	130	699	[141,701]	[130,699]	11.1803
3	'D:\images\Fingerprint Rural Database Test\01_8.bmp'	<661x508 uint8>	148	690	130	699	[148,690]	[130,699]	20.1246
4	'D:\images\Fingerprint Rural Database Test\01_7.bmp'	<661x508 uint8>	149	623	130	699	[149,623]	[130,699]	78.3390
5	'D:\images\Fingerprint Rural Database Test\01_3.bmp'	<661x508 uint8>	159	578	130	699	[159,578]	[130,699]	124.4267
6	'D:\images\Fingerprint Rural Database Test\01_1.bmp'	<661x508 uint8>	170	525	130	699	[170,525]	[130,699]	178.5385
7	'D:\images\Fingerprint Rural Database Test\01_6.bmp'	<661x508 uint8>	172	488	130	699	[172,488]	[130,699]	215.1395
8	'D:\images\Fingerprint Rural Database Test\01_5.bmp'	<661x508 uint8>	206	380	130	699	[206,380]	[130,699]	327.9283
9	'D:\images\Fingerprint Rural Database Test\01_9.bmp'	<661x508 uint8>	205	362	130	699	[205,362]	[130,699]	345.2448
10	'D:\images\Fingerprint Rural Database Test\01_10.bmp'	<661x508 uint8>	265	296	130	699	[265,296]	[130,699]	425.0106

Fig.5. Matching results

Matching result is carried out and graph (Fig.6) showed only for twenty images and it can be applicable for n number of images. MATLAB is used to implement this technique.

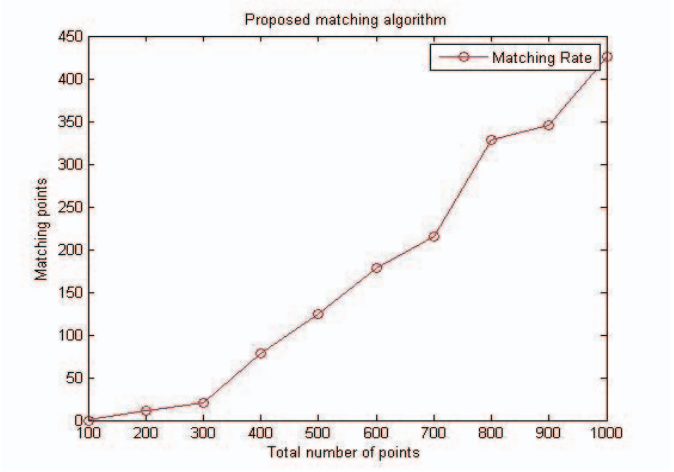

Fig.6. Minutiae points matching rate

V. Conclusions and Future Work

In this proposed frame work is briefly explained and results are shown. A new approach on minutiae based fingerprint matching and similarity checking technique is developed. The of minutiae points are fully occupied in the fingerprint image, compared to other features, such as ridge orientation map, ridge frequency map and singular points. Towards the matching, this algorithm is checks each minutiae point for each image and it is tested with query image. As biometric technology matures, there will be an increasing interaction among the (biometric) market, (biometric) technology, and the (identification) applications [13]. The finger print identification is one of the very few techniques employed in forensic science to aid criminal investigations in daily life, providing access control in financial security; visa related services and so on.

In the near feature, we are aiming to test with large fingerprint data base by matching and measuring similarity between fingerprints with time complexity based on minutiae points.

References

[1] D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, *Handbook of fingerprint recognition*. springer, 2009.

[2] D. Peralta, I. Triguero, R. Sanchez-Reillo, F. Herrera, and J. M. Benítez, "Fast fingerprint identification for large databases," *Pattern Recognit.*, vol. 47, no. 2, pp. 588–602, 2014.

[3] X. Luo, J. Tian, and Y. Wu, "A minutiae matching algorithm in fingerprint verification," in *Pattern Recognition, 2000. Proceedings. 15th International Conference on*, 2000, vol. 4, pp. 833–836.

[4] S. Prabhakar, A. K. Jain, J. Wang, S. Pankanti, and R. Bolle, "Minutia verification and classification for fingerprint matching," in *Pattern Recognition, 2000. Proceedings. 15th International Conference on*, 2000, vol. 1, pp. 25–29.

[5] M. L. Gavrilova, "Exploring fingerprint matching through a topology-based perspective," *Int. J. Biom.*, vol. 1, no. 1, pp. 20–35, 2008.

[6] P. Porwik and L. Wieclaw, "A new efficient method of fingerprint image enhancement," *Int. J. Biom.*, vol. 1, no. 1, pp. 36–46, 2008.

[7] M. U. Akram, A. Tariq, S. A. Khan, and S. Nasir, "Fingerprint image: pre-and post-processing," *Int. J. Biom.*, vol. 1, no. 1, pp. 63–80, 2008.

[8] A. A. Paulino, J. Feng, and A. K. Jain, "Latent fingerprint matching using descriptor-based Hough transform," *Inf. Forensics Secur. IEEE Trans.*, vol. 8, no. 1, pp. 31–45, 2013.

[9] O. N. Iloanusi, "Fusion of finger types for fingerprint indexing using minutiae quadruplets," *Pattern Recognit. Lett.*, vol. 38, pp. 8–14, 2014.

[10] O. P. Singh, S. Dey, and D. Samanta, "Fingerprint indexing using minutiae-based invariable set of multidimensional features," *Int. J. Biom.*, vol. 6, no. 3, pp. 272–303, 2014.

[11] G. T. Diefenderfer, "Fingerprint recognition," 2006.

[12] A. K. Jain, S. Prabhakar, L. Hong, and S. Pankanti, "Filterbank-based fingerprint matching," *Image Process. IEEE Trans.*, vol. 9, no. 5, pp. 846–859, 2000.

[13] A. Jain and S. Pankanti, "Fingerprint classification and matching," *Handb. Image Video Process.*, 2000.