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Improvement in Fingerprint Recognition Using Delaunay Technique

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***Abstract*— Fingerprint recognition is basic method used for identification in biometric system. Now days as collections of fingerprints is increasing day by day then the technique also available in market to face problems. There are many techniques available that are used for recognition of fingerprints. There are some kinds of restrictions on degree of freedom with some unacceptable error rates. In this paper we are going to represent improvement in Delaunay technique for fingerprint recognition using histogram technique. We also add the technique Morphological operation for binarisation and thinning of image. Neighbourhood operation performs to extract the feature of image. So in conclusion we define that enhancement provide results better than existing technique.**

***Keywords*— Fingerprint Recognition, Delaunay Technique, Morphological Operation, Neighbourhood Operation.**

I. INTRODUCTION

Mostly all of application which provides service is used by many users, so there is requirement of a verification method that is reliable in nature. The applications which required this type verification method are those which we face in our daily life. In that applications ATM, phone, laptops etc. are comes. There is absence of robust verification method in these applications; due to which there is chances of wiles by an imposter in a system. Annually millions of dollar is fraud by credit card, this fraud happen because of lowest level technique used for customer verification. A sensor module is used as base of a biometric system, there is requirement of module for feature extraction and for process of matching there is also a module required.

Four components are used to develop a general biometric system [1]:

1. Module for Sensing:-

We acquire data of biometric for each user. A fingerprint sensor is required to capture the impression of finger. This impression is store in database for further process of verification method.

2. Feature extraction:-

This module helps in extracting feature values for that impression which we have stored in last process. Like an example of fingerprint image we have to find out the position and minutiae points. So in fingerprint image value of feature is extracted that we need feature extraction module.

3. Matching module:-

This is an important module in which matching process for feature values are performed and this comparison between stored feature value of impression. This caparison performed on basis of score gained by matching process. For example, in this module, we have to compute some points that are known as minutiae between query request and template.

4. Decision-making module:-

After matching, machine give response for ID of user is true or not. The decision is taken by biometric system that either that ID matched or not. If it match then accepted otherwise it is rejected.

II. RELATED WORK

V. Vijaya Kumari and N. Suriyanarayanan [2] proposed a method which measure performance in fingerprint by detecting the edges of fingerprint images using five local operators namely Sobel, Roberts, Prewitt, Canny and LoG. Individual segments from image are extracted from the edge detected image.

Raju Sonavane, and B.S. Sawant [3] presented a method for enhancement in fingerprint by using a special domain in which the fingerprint image is decomposed into a set of filtered images after that we estimated orientation field. We required a mask for quality purpose that differentiates between corrupted regions in the input image are generated. Using the estimated orientation field, enhancement in fingerprint image is adaptively done in the recoverable regions.

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Eric P. Kukula, et al., [4] proposed a work on the investigation of that five force levels that affect the performance, quality of image and minutiae count between optical and capacitance fingerprint sensors. He chose three images from 75 participants that are indexed in sensing technology. Kruskal-Wallis conducted a test of nonparametric which found differences in minutiae counts and image quality scores based on the force level. The results concluded that there was no difference in minutiae count of images but the quality of images has much difference based on the force levels of the capacitance sensor. There were many factors that affect image quality score by force and sensor type, yet the removal of low quality images does not improve the system performance at each force level.

Mana Tarjoman and Shaghayegh Zarei [5] proposed an approach that structural in type for fingerprint classifications. This approach is using a directional image of fingerprint instead of singularities. Dominant directions of ridge lines are included in directional image.

Sharath Pankanti et al., [6] proposed a technique for matching and representing fingerprint is known as Scale Invariant Feature Transformation (SIFT). Hybrid approaches with combination of both SIFT and conventional minutiae are providing better results than available individual schemes.

Bhupesh Gour et al., [7] have developed a method in which midpoint ridge contour representation is used for extraction of minutiae in fingerprint images. At initialisation of process segmentation process is performed separately for foreground from background of fingerprint image. Size of region is 64x64 that is extracted from fingerprint image. 64 x 64 normalized windows are used in normalization contrast of the ridges for enhanced of filtering by appropriately tuned Gabor filter. Scanning of image is performed from top to bottom and left to right and transitions from white (background) to black (foreground) are detected. Calculation is done for contour length vector in all eight directions. Each element of contour is represented as a pixel on the contour, the x, y coordinates contain field for pixel.

III. DELAUNAY TECHNIQUE

The comparison of minutiae triangles is a common approach to matching a pair of minutiae's sets.

For this task it is necessary are forming triangles from minutiae triples and matching them using invariant features. The Figure 1 shows an example. Enough information is provided by minutiae pairs to compute a transformation that potentially aligns the minutiae sets. To compute good alignments, voting technic is applied in the transformation space to find transformations that are supported by many minutiae triangles. A number of hypothetical transformations are then found by considering transformations that have received high number of votes. Each hypothetical transformation is explicitly verified by using it to align the minutiae sets and counting the number of overlapping minutiae. The best alignment is the one maximizing the number of overlapping minutiae.

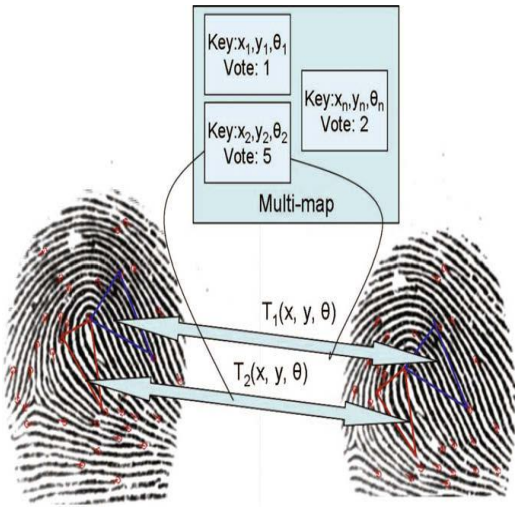

Figure 1 matching by comparing minutiae triangles.

The computational complexity to form the minutia triangles is O (n3). To keep complexity low, [8] proposes associating a unique topological structure with the minutiae using Delaunay triangulation and using the Delaunay triangles for matching. This reduces the number of minutiae triangles to O (n), speeding up matching considerably without affecting accuracy significantly. The Figure 2 shows the Delaunay triangulation of a set of minutiae, overlaid on the corresponding fingerprint image.

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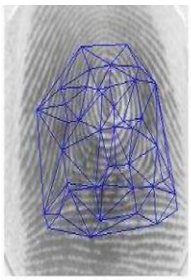

Minutiae

Id	x	y	D (degree)
1	200	47	42
2	125	49	117
3	173	69	160
4	219	71	60
5	139	74	309
...	...	...	...

Triangular Features

l_1/l_3	l_2/l_3	Cos(A)	m_1	m_2	m_3
0.47	0.69	-0.47	2	1	3
0.55	0.66	-0.36	3	2	5
0.66	0.76	0.01	3	4	1
0.32	0.96	0.03	3	4	6
0.76	0.98	0.36	3	5	11
...	...	...	...	...	...

Figure 2 an example of minutiae features extraction

IV. Histogram Technique

If there is a noise of type image acquisition then use of Gaussian Filter in fingerprint images will help efficiently for the enhancement of the image. However, contrast problem of an image cannot be solved by this filter. Best solution of this problem is Histogram Equalization. The appearance of poor image will improve using this Histogram Equalization. The histogram for selected image is generated as flat as possible. Mapping of Histogram Equalization is gray level p into gray level q, in this gray level q is distributed in uniform manner. Contrast of gray level stretches by this technique at maximum level [9]. Intensity level r_k for a pixel is defined in given formula with probability density function.

$$p_r(r_k) = \frac{n_k}{n}$$

Where value range of rk is between 0 and 1, in which value of k=0, 1… 255, n represents total number of pixels.

V. Morphological Operations

Thinning is a morphological operation which is used to remove selected foreground pixels from the binary images. A standard thinning algorithm from [10] is used, which performs this operation using two sub-iterations. The algorithm can be accessed by software MATLAB via the `thin' operation of the bwmorph function.

Each sub-iteration starts by examining the neighbor-hood of every pixel in the binary image, and on the basis of a particular set of pixel-deletion criteria, it decides whether the pixel can be removed or not. These sub-iterations go on until no more pixels can be removed.

Figure 3: (a) Original Image, (b) Enhanced Image, (c) Binarised Image, (d) Thinned Image

Morphological image processing (or morphology) describes a range of image processing techniques that deal with the shape (or morphology) of features in an image Morphological operations are typically applied to remove imperfections introduced during segmentation or we can say that morphology is a branch of biology that deals with the forms and the structure of animals and plants.

VI. Implementation Result

We implement our proposed algorithm in MATLAB tool. GUI of MATLAB is used to provide interface between user and matching process. The following figure shows that fingerprints which we are going to match

Figure 4 Same fingerprint select for how much it match

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As we click on find match operation then nieghbourhood operation starts as shown in following figure

Figure 5 Apply Neighbourhood Algorithm

The following figure repersents the percentage of matching of the fingerprints

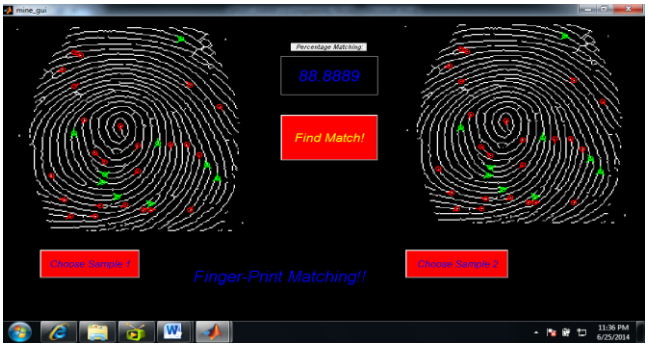

Figure 6 Matching Percentage

VII. CONCLUSION

In this work DT is proposed with histogram technique for a fingerprint matching algorithm. It combines matching and point pattern matching at principle to generate a structure that is known as synthetic algorithm. There are some steps required to complete the whole process of fingerprint recognition one of those steps is pre-processing.

In pre-processing step we use morphological operation for thinning of image and neighborhood operation is used for the extraction of feature. By applying these operations and techniques like histogram we achieve a conclusion that recognition of fingerprint is more accurate than existing technique. Hence its proved by the results of matching that achievement of this work is better.

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