Fingerprint Recognition Based on Fractal Dimension

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Abstract— The fingerprint recognition is widely used for solving the crimes and considered as a legitimate proof of evidence in control law all over the world. It is also used for personnel identification for a long time. In the recent years, more civilian and commercial applications are use fingerprint based identification system because of its availability in inexpensive and compact solid state scanners and also its superior and proving matching performance in many biometric technologies. Matching is one of the most popular biometric technique; minutia matching based methods are widely used for fingerprint recognition and can be classified ridge ending and ridge bifurcation. Fingerprint matching is used to identify fingerprints by analyzing finger complexity based on estimating their feature. This paper proposed a method to recognize the fingerprint images by using fractal dimension. Fractal dimension is used to measure the image complexity and irregularity of the images to match the self-similarity by image segmentation and shape recognition.

Key words: Fingerprint recognition, fingerprint based identification, minutiae based feature extraction, fractal dimension

I. INTRODUCTION

Fingerprints are widely used in daily life for more than 100 years due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability. The false minutiae are the false ridge breaks due to insufficient amount of ink and cross-connections due to over inking [1]. A good quality fingerprint contains 25 to 80 minutiae depending on sensor resolution and finger placement on the sensor. In most current AFIS systems, only a limited part of discriminative features are utilized. It is believed that incorporating more discriminative information available on fingerprint images into matching [2]. The matching algorithms may be classified into three types: minutiae-based approach, correlation based approach and feature-based approach. However, as analyzed, the score of these algorithms is not high especially in case fingerprints are of the same finger but they are rotated or intersection is too small. In fingerprint recognition process, the important step which affects on system accuracy is matching between template and query fingerprint. [3]. Biometric systems operate on behavioural and physiological biometric data to identify a person. The behavioural biometric parameters are signature, gait, speech and keystroke, these parameters change with age and environment. However physiological characteristics such as face, fingerprint, palm print and iris remains unchanged throughout the life time of a person. Fingerprint is a pattern of ridges, furrows and minutiae, which are extracted using inked impression on a paper or sensors. Automatic fingerprint recognition is one of the most common applications of machine pattern recognition. Because of this, there is a popular misconception that fingerprint recognition is a fully solved problem. On the contrary, fingerprint recognition is still a complex and very challenging pattern recognition task [5].

II. LITERATURE REVIEW

Ravi. J et al., [1] presents fingerprint recognition by using matching scores, minutiae are extracted from the thinned image for both template and input image, then both images are subjected to matching process and matching score is computed. These can be done by using AFIS (automatic fingerprint identification system). Jinwei Gu et al., [2] propose a novel representation for fingerprints which includes both minutiae and model-based orientation field. Then, fingerprint matching done by combining the decisions of the matchers based on the global structure (orientation field) and the local cue (minutiae) conducted a set of large-scale databases and made thorough comparisons with the state-of-the-arts. Le Hoang Thai et al., [3] developed a standardized fingerprint model to synthesize the template of fingerprints and find the transformation between templates by use of Genetic algorithm adjust parameters, synthesize fingerprint, and reduce noises. Then, use the final fingerprint to match with others in FVC2004. Ashish Mishra et al., [4] in this paper, fingerprint recognition and matching is done by classification of fingerprint images and Euclidean distance is used to measure pixel value of extracting images. Kuntal Barua et al., [5] propose an on-line fingerprint identification system for matching minutia points by various stages for feature point extraction. Feature points (minutia) such as endpoints, bifurcations, and core point are then extracted, followed by false minutia elimination, which can be used as identification marks for fingerprint verification. Muzhir Shaban Al-Ani, [6] presents fingerprint algorithm is the improvement of the thinning process, enhancement and minutiae extraction based on optimal thinning. The output results indicate a significant improvement of the fingerprint recognition pattern. Prateek Verma et al., [7] propose a modified minutiae matching method which utilize the correlation score between local neighbourhood minutiae pairs and edges are connect to neighbouring matched minutiae pairs. Madhuri et al., [8] they can use a local features of fingerprints for recognition and these technique performs well in presence of rotate image and also in partial image. The technique gives the better result as compared to others with corresponding error. Mahmoud H et al., [9] proposed fractal geometry as a tool for fingerprint identification. The pre-processed image features are extracted based on average of fractal dimension array. From these ridge attributes, the fractal dimension is computed to produce fractal arrays. Mahdi Jampour et al., [10] presents fractal dimension to measure iris image values and then classify the iris images respectively in order to increase the performance. The result of simulation on Phoenix database's data shows that this method is suitably efficient for classification. Hossein Ebrahimpour-Komleh et al., [11] propose fractal image coding by using quad tree partitioning based on recursive splitting the image quadrants. The

transformations consist of four 90 degree rotations and the reflected version of each. ShraddhaViraj Pandit et al., [12] propose a search engine which may allows user to retrieve the similar images from the database by applying fractal image compression algorithm employing quad tree iterated function system rather than the image is rotated. When a user input is an image query then this system may generate image eigen value data, compare the eigen values with the stored image eigen values in the database and output the result based on quad tree partitioned iterated function system. FeiSn Jingao et al., [13] proposed a fingerprint classification employs Discrete Fractal Brownian Motion to describe fingerprint images. This is the first method known to use the fractal dimension in classification of fingerprints. The algorithm is a hierarchical structure for given sub-fingerprint image, directional fractal dimensions (d.f.d.) are calculated, and then the image is classified by comparison of the calculated d.f.d pattern with predefined images. The results show that heavily noise corrupted images can still be classified correctly using this new method. Odemir Martinez Bruno et al., [14] proposed a method to identify plants by analysing leaf complexity based on estimating their fractal dimension. Leaves were analyzed according to the complexity of their internal and external shapes. Analyze and extract the features of leaf images, then allow for automatic plant identification. A comparison is made to estimate fractal dimension (box-counting and multiscale Minkowski). Salah S. Al-Rawi et al [15] in this paper, analyzing samples of textures by using three methods fractal dimension, blocking approach and Hybrid method (fractal dimension method with block approach). The fractal dimensions get a highest recognition rate as compare with blocking approach model & Hybrid method. Jyotismita Chaki et al., [16] propose an automated system is used to recognize plant leaf images by two different methods, first is moment invariant that can use normalized central moments of plant leaves studied in various combinations and second is centroid radii the edge detector has been used to find the boundary of plant leaf.

III. FINDINGS

Some fingerprint images are poor qualitied and due to this shapes of images are not easily recognized. In this paper, use methods for automatic recognition of fingerprints by analyzing their shapes using fractal dimension. The method requires careful designing of algorithm, programming and its implementation. The method deals with one of the great real world application such as personnel identification. This method requires a scanner and PC that means this is very easy, portable, less time consuming and is also cost effective. The fingerprint analysis process given in figure 1, recognize and segment the shape of fingerprint images by using fractal dimension approach. Fractal Dimension is used to recognize the shape of the fingerprint and segmentation the fingerprints for shape analysis to find the matching between images. Results exhibit the future aspect of the technique, which overcome traditional shape recognition and analysis methods found in various literatures.

A. Block Diagram:

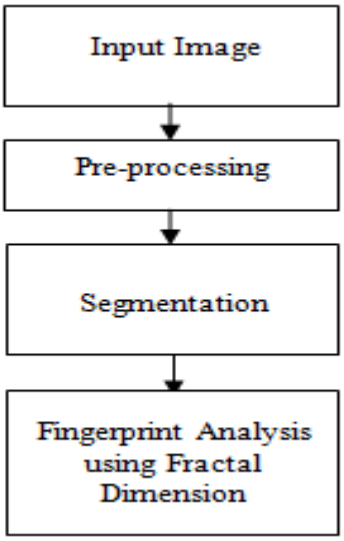

Fig. 1: Basic Block Diagram of Fingerprint Analysis

B. Pre-processing:

In preprocessing, an image is read and then enhances the image after enhancement they are binarized and thinning. The fingerprint image input for identification is a BMP images file, the color resolution of the image is taken 8 or 24 bit/pixel. The image data is loaded i.e. red, green and blue components and then used to compute the gray array from the red (), green (), and blue () arrays. The gray image is the output of this stage.

1) Enhancement:

The fingerprint gray image is enhanced using filter in the Fourier domain. The enhancement is able to recognize the local ridge orientation using Fourier analysis.

2) Binarization:

The stage can convert the gray level image into black and white image. In this stage, it is assume that the ridges are covered area which is nearly around 10% of whole image area so the histogram of image pixel values can be utilize for describing the statistical distribution of image pixels, then a scan from upper bound value (i.e. 255) is started down to lower values, to find at which gray value become more than 10% this tested gray value is considered as threshold of the image.

3) Thinning:

Thinning can generate the skeletons of fingerprint images that can consist of end points and hole points.

C. Segmentation:

Segmentation is a tool for subdividing the image into its constituent objects. The subdivision is carried depends on the problem being solved. The segmentation should stops the isolated of the objects of interest.

Types of Segmentation that can use:

1) Edge Detection:

It is a well-developed field on its own within image processing. Region boundaries and edges are closely related, since there is often a sharp adjustment in intensity at the region boundaries. Edge detection techniques have therefore been used as the base of another segmentation technique. In this proposed paper, the shape of fingers present in fingerprint images can be detected by mean of fingerprint

images by compare it with standard fingerprint image size using various edge detection techniques.

2) Thresholding:

Techniques which make decisions based on local pixel information are effective when the intensity levels of the objects fall squarely outside the range of levels in the background. Because spatial information is ignored however, blurred region boundaries can create havoc.

D. Fingerprint Analysis using Fractal Dimension:

1) Fractal Dimension:

The fractal dimension provides an objective means of quantifying the fractal property of an object and comparing objects observed in the natural world. Fractal theory of iterated contractive transformation has been used in several areas of image processing and computer vision. Fractal codes represent local contractive, affine transformations which when iteratively applied to range-domain pairs in an arbitrary initial image result in a fixed point close to a given image. The transformation parameters such as brightness offset, contrast factor, orientation and the address of the corresponding domain for each range are used directly as features in our method. The method to measure the fractal dimension of an object or image is:

2) Box Counting Method:

The box counting dimension is an easy and most widely used method that can measure the fractal dimensions of an object by simple concepts in the mathematical calculation and estimation. In this method, we estimate the BCD. Firstly we need to calculate the number of boxes for the entire block for solving the overlapping problem related to the calculation of FD for these blocks.

$$D \sim - \frac{\log N}{\log €}$$

Where D is dimension of image, N is no. of boxes in the image, € is size of boxes.

IV. Discussion & conclusion

In this discussion the image analysis has been done on the digital image for improving the result of measuring shape of fingerprint imges. In the previous methods have proven that are very tedious, have less accuracy to recognize the poor qualitied shapes of fingerprint images. Thus it may be possible to have many error. Therefore a rapid image processing method has been proposed. By the use of fractal dimension method to measure the shape of fingerprints in image processing. The fingerprint analysis using this method is much more advanced and better results are expected. A novel approach is used for identifying fingerprint images by using fractal dimension in this paper. The fingerprints are segmented and measure the values of the images. The fractal dimension is widely used for face or plant identification to recognize the shape in conjunction with neural networks. But in this paper, the fractal dimension is used to measure complexity and irregularity of fingerprint images to match self-similarity image, by image segmentation and shape recognition. Results demonstrate the potential of the technique, which overcome traditional shape recognition methods.

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