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Fingerprint Recognition System Using MATLAB

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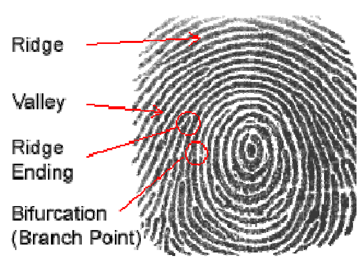
Abstract—Fingerprint is a very vital concept in making us completely unique and can not be altered. It is necessary to recognize fingerprint in proper manner. Here we are trying to recognize the fingerprint image samples by using minute extraction and minute matching techniques. In minute extraction it counts the crossing numbers and from the count it will be classified as normal ridge pixel, termination point and bifurcation point. Then the input finger print data is compared with the template data. This is called as minute matching.
Keywords— ***minute extraction, minute matching, ridge, termination point, bifurcation point.***

I. INTRODUCTION

Fingerprint provides us the unique identity so it can be use for various aspects. Fingerprint is of greater importance in fields where unique identity of each person is required. Its other advantage is that, it can not be change. So for entire life of a person it keeps its uniformity. In 1892, Francis Galton established a classification system for fingerprints working on the old principle of an Indian magistrate who made people sign contracts with their fingerprints. This was appraised as the most personal way of signing contracts and though time he noticed that each fingerprint is different. It is found that fingerprint evidence is very reliable. The chances of any two individuals having the same fingerprints are one in sixty four billion. So, it is very reliable way. Fingerprints offer a reliable means of personal identification. That is the requisite justification for fingerprints having replaced other methods of creating the identities of criminals reluctant to admit previous arrests. The science of fingerprint recognition stands out among all other forensic sciences for many reasons as follows:

A. From 100 years it is providing the correct identification of criminals worldwide to governments. In many billions of human no two fingerprints have ever been found same. Worldwide fingerprints are the important notion for criminal history at every police service.
B. The International Association for Identification (IAI), is estimated as the first forensic professional organization in 1915.
C. IAI established the first professional certification program for forensic scientists. It certified Latent Print Examiner (CLPE) program in 1977.
D. Remains the most commonly used forensic affirmation worldwide - in most jurisdictions fingerprint examination cases match or outnumber all other forensic examination casework combined.
E. For positively identifying persons it is found to be premier method.

Other visible human characteristics changes but fingerprints are very insistent. Finger and palm print features have never been observed to move about or change throughout the life of a person, excepting injuries or surgery resulting in deep scarring, or diseases such as leprosy damaging and developing layers of friction ridge skin.



Fingerprints are basically made up of ridge termination, bifurcation and termination angle. In the biometric process of finger scanning. Curved line in a finger image is called as ridge. The point where ridge ends is the termination. So, the end point of

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ridge is considered as ridge termination, bifurcation is the location where a ridge divides into two separate ridges. The angle between the horizontal and the direction of the ridge is called as Termination angle. Fingerprint matching can be done by using these vital features in fingerprints.

II. SYSTEM OVERVIEW AND PROPOSED METHODS

Sample fingerprint image is processes at various stages as shown in flowchart given below:

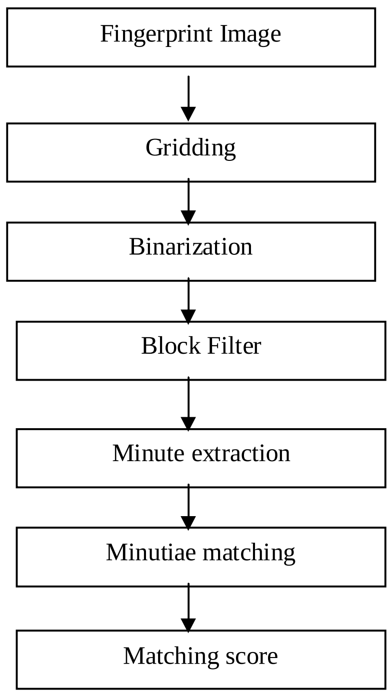


Fig.: Flow Chart for fingerprint recognition

A. *Gridding*

The fingerprint image is divided into nxn grids. The size of the grid should not be too large or too small. Here, the size of the grid considered as 3x3, as it is found to be more effective. Now for each grid we repeat the same steps as shown in block diagram. By comparing the results Fingerprint Recognition by Global structure with that of the Fingerprint Recognition using Local structure, it can be observed that local structure based Fingerprint recognition is more accurate.

B. *Binarization*

It converts grey scale image into binary image. In this process a threshold value is fixed. The pixel values above the pre decided threshold are set as 1 and the pixel value below the threshold are set as 0. So, the grey scale image is converted to binary as the *binary image.*

C. *Block filters*

The binary image of fingerprint is filtered using block filter. The binary image is thinned by using block filter. It reduces the thickness of the ridges to the width of a single pixel. It extracts minute points effectively. Thinning keeps the location or orientation of minute points compared to the original fingerprint remains same. So, it provides effective estimation of minute points. Thinning places white pixels at the boundary of the image. So only outermost pixels are processed by it. As a result first five and last five rows are assigned value one. Also, first five and last five columns are assigned value of one. Dilation and erosion are used to thin the ridges. In dilation the output pixel is set to the maximum value of all the pixels in the input pixels neighbourhood. In a binary image, if any of the pixel is set to the value 1, the output pixel is set to 1. In erosion the value of the output pixel is minimum value of the entire input pixels neighbourhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0. In mathematical morphology Dilation is one of the two basic operators, the other being Erosion. It is typically applied to binary images. The operator gradually enlarges the boundaries of regions of foreground pixels *i.e.* white pixels, typically of a binary image. Thus areas of foreground pixels grow in size while holes within those regions become smaller. The dilation operator takes two pieces of data as inputs. The first is the image which is to be dilated. The second is a (usually small) set of coordinate points known as a structuring element also known as a *kernel*. It is this structuring element that determines the precise effect of the dilation on the input image.

D. The mathematical definition of dilation for binary *images is as follows*

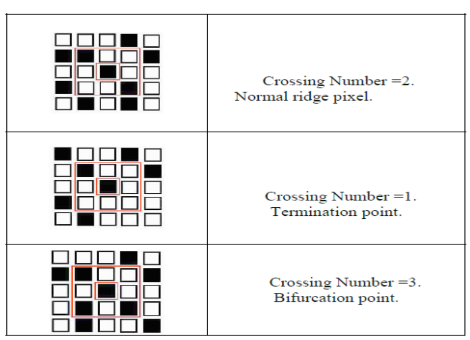
Consider the set of Euclidean coordinates of the input binary image be X. Kx be the translation of K and its origin is X. Then the set of all points X is the dilation of X by K such that the intersection of *Kx* with *X* is non-empty. The mathematical definition of grayscale dilation is identical except for the way in which the set of coordinates associated with the input image is extracted. These coordinates are 3-D rather than 2-D. Erosion is typically applied to binary images. It erodes away the boundaries of regions of foreground pixels (*i.e.* white pixels, typically) of a binary image.. Thus areas of foreground pixels shrink in size, and holes within those areas become larger. The erosion operator takes two pieces of data as inputs. The first is the image which is to be eroded. The second is a (usually small) set of coordinate points known as a structuring element (also known as a *kernel*). It is this structuring element that determines the precise effect of the erosion on the input image.

E. The mathematical definition of erosion for binary *images is as follows*

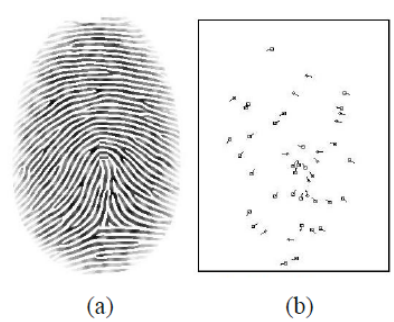
Consider the set of Euclidean coordinates of the input binary image be X. Kx be the translation of K and its origin is X. Then the set of all points X is the dilation of X by K such that the intersection of *Kx* with *X* is non-empty. The mathematical definition for grayscale erosion is identical except in the way in which the set of coordinates associated with the input image is derived. In addition, these coordinates are 3-D rather than 2-D.

F. Minute extraction

The minutiae location and minute angles are derived after minute extraction. The terminations which lie at the outer boundaries are not considered as minutiae points. Here, crossing number term is used. It is use to locate the minutiae points in fingerprint image. Crossing number is defined as half of the sum of difference between intensity values of two adjacent pixels. If crossing number is 2 then it is considered as normal ridge pixel. If crossing number is 1, then it is considered as termination point. If crossing number is 3, then it is considered as bifurcation point.



Crossing Number and Type of Minutiae.



(a) Gray-scale Fingerprint (b) Minutiae points.

III. MINUTIAE MATCHING

Here, the sample fingerprint image is compared with the database. The extracted data is stored in matrix forms. It improves the efficiency of matching process. The data matrix is as follows:

Number of rows should be equal to number of 1 minute points. Number of columns are 4.

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First column: row index of estimation point
Second column: column index of each minima point
Third column: orientation angle of each minima point
Fourth column: Type of minutia.
A value of '1' is assigned for termination, and '3' is assigned for bifurcation.

IV. MATCHING SCORE

Finally the matching score is calculated. The maximum score gives the best recognized fingerprint image.

V. CONCLUSION

We presented Fingerprint matching using local structure. The pre-processing the original fingerprint involves image gridding, binarization, ridge thinning, and noise removal. Fingerprint Recognition using Minutia Score Matching method is used for matching the minutia points. The proposed method gives better FMR values compared to the existing Fingerprint Recognition using Global structure.

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