Fingerprint Classification based on Orientaion Estimation

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Abstract: The geometric characteristics of an object make it distinguishable. The objects present in the Environment known by their features and properties. The fingerprint image as object may classify into sub classes based on minutiae structure. The minutiae structure may categorize as ridge curves generated by the orientation estimation. The extracted curves are invariant to location, rotation and scaling. This classification approach helps to manage fingerprints along their classes. This research provides a better collaboration of data mining based on classification.

Keywords: fingerprint recognition system; data mining; classification; orientation estimation; gradient based approach, sobel operator.

I. INTRODUCTION

The Fingerprint Recognition System (FRS) is most signification and old biometric authentication. After the concept of Digital Image many Image processing algorithms have been developed. The performance concern about FRS is it must be efficient. The performance of any system is represented by two common factors:

(i) Purity of Result (ii) Computation Time

Purity of result is very important characteristic for any recognition system even if the data is not appropriate. Other main characteristic of recognition system is its computational time. Computational time show the robustness of the recognition system. Any fingerprint recognition system has very large database for identification. It is very important that the recognition system produce the pure result with less execution time. Orientation estimation is a basic step of any fingerprint recognition system. The orientation field describes a very fundamental characteristic of a fingerprint image. It can be very useful to restore the texture for poor quality fingerprint images and is also an important feature for fingerprint classification and matching [1].

The previous research about Fingerprint Classification is the core principle of based on object that is extracted from the image. Orientation estimation is categorized into local estimation and global modeling. Singular points of fingerprint image are an important section of orientation modeling. Image enhancement help to improve the quality fingerprint classification. As preprocessing step histogram equalization process is produce best result. The main concept behind the orientation estimation is to find out the rotation of ridges, but due to some problems the acquit image is improper. The new task is to remove false minutiae points.

II. FINGERPRINT CLASSIFICATION

Fingerprint classification is a data mining technique which is used to improving the performance of recognition system as well as it reduce time and computational complexity of fingerprint recognition system. Classification is a categorical class labels. Classification is classifies data based on the training set and the values in a classifying attribute and uses it in classifying new data. Fingerprint classification is a process in which fingerprints are grouped in a consistent and reliable way, such that different impressions of a same finger fall into a same group. And the fingerprint images store and fetch from the classified table in the database. The Fingerprint Classification technique sometime used to create databases according to the classes of fingerprint images. These classes may be represented by a table or a separate database. For classifying characteristics of fingerprint image, we easily match fingerprint images with their related criteria means there is no need to match one fingerprint image with whole database. Fingerprint classification is an indexing method for large databases. Using classification fingerprint data are categorized into many fields like fingerprint patterns, minutiae points, pores, ridges contours etc.
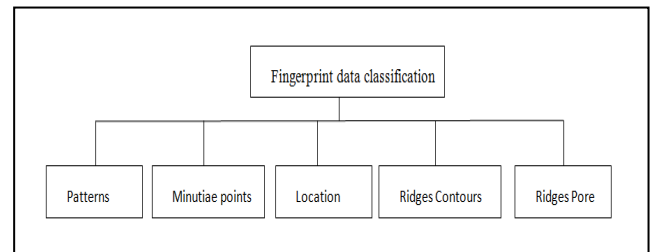

Figure 1. Fingerprint data classification

Fingerprints are unique for each individual person. Sometimes it is not easy to be match one fingerprint with whole databases so we can distinguish fingerprints properties for matching. Using classification method we are not dependent upon only one type of matching technique for example if our input fingerprint image are noisy and not proper it is difficult to match it with minutiae points so we will match it by using patterns of fingerprints [2][3].

Fig.1 shows classification of fingerprint data into different classes. Fingerprint classification make fingerprint recognition system comparatively easier and reliable.

III. WHAT IS FINGERPRINT ORIENTATION?

After image enhancement another major step is image segmentation. In the matter of segmentation digital image is partitioning into multiple segments that is a set of pixels. Generally segmentation is use to make the image simpler which can be represent very easily and to make the image meaningful so that it will be easy to analyze.

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The meaning of orientation is to determining the direction of one is facing towards. Here, the term orientation meaning is same but it is slightly dependent on the operation perform on the fingerprint image. The fingerprint image is categorized by its class from which it belongs. So the main task is "How one can classify the fingerprint image?" The answer of this question is to focus on the minutiae. Many image processing operation provide freedom to operate image on the basis of feature present inside the image. Minutiae are an essential feature of any fingerprint image.
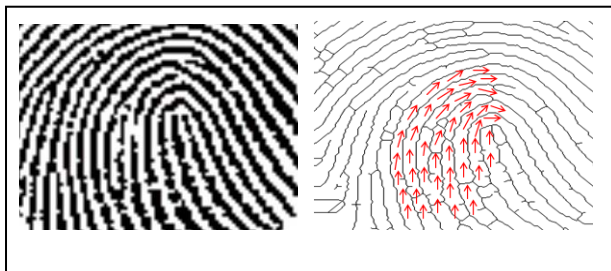

Figure 2. Orientation flow of fingerprint ridges

Fig.2 shows two images (a) Original fingerprint image. And (b) fingerprint image after applying enhancement technique and orientation estimation. The technique which is used to get feature from any object is known as Feature Extraction. Face Detection is the best example of feature extraction which is used to find features (like eyes, nose, and lips) from the image (that contains face). Similarly, orientation is a technique that is used to identify the minutiae and then focus on the rotation angle of minutiae lines.

IV. ORIENTATION ESTIMATION TECHNIQUE

The orientation estimation is a technique which is use to estimate direction flow of the minutiae present inside the image. This concept includes many individual image processing operations to extract require feature.

The most popular Orientation Estimation Techniques are:

1) *Gradient based approaches.*

2) *Filter-bank based approaches.*

Estimation of orientation fields is an essential step in a fingerprint recognition system. Gradient based approaches are popular but very sensitive to noise. Gradient-based methods use spatial and temporal partial derivatives to estimate image flow at every position in the image. The filter-bank based approaches are comparatively more resistant to noise but they do not provide as much accuracy as the gradient-based approaches because of the limited number of the filters [4]. Fingerprint orientation plays important roles in fingerprint enhancement, fingerprint classification, and fingerprint recognition and also it is very useful for restore poor quality fingerprint image.

V. GRADIENT BASED APPROACH

As fingerprint image contains minutiae as feature, now the significant task is to detect minutiae from the image. Minutiae Detection can be perform by basic operation of Image Processing as Edge Detection.

Edge Detection method can be categories as: Search-based and zero-crossing-based. This paper focuses on the search-based method that detects edges by just computing edge

strength in the term of Gradient Magnitude. It actually finds the directional maxima of the gradient magnitude. After getting the values of edge strength (i.e. Gradient Magnitude), the next step is to apply threshold. Threshold is used to decide the actual presence of an edge at image. The results of this research are obtained by using sobel operator to detect edges. Sobel operator is either the corresponding gradient vector or the norm of this vector. [5]

Sobel operator used in by Matlab expression as:

h = fspecial('sobel');

It returns a 3-by-3 filter. And then Horizontal Gradient is gained by using filter as:

Gx = filter2(h, image);

Finally, the corresponding Vertical Gradient is achieved by just transpose function. i.e

trans_h=transpose(h);

Gy = filter2(trans_h, image);

The output achieved by Sobel filter is further utilized by some mathematical operations. Mathematical operations are used to interact with angles. The calculation is finally converted to the arrow representation with the respective angles.

VI. RESULT

The figure given below presents the input fingerprint image. The algorithm takes input as binary image and performs operation.

Figure 3. Input Image

Figure 4. Filtered Fingerprint Image

The first step of the algorithm is to filter fingerprint image. Figure 4, above shows the enhanced fingerprint image. The filter operation is used to remove the noise and blurriness from

the input image. The output input facitlitate to detect ridges ang minutiae points.

This Fingerprint Classification is based on Gradient then, next step is to get Gradient values in both direction either horizontal and vertical from the image. Matlab is an image processing tool which facilate to simulate image processing by providing inbuilt functions. As discussed in Gradient Based Approach, the Sobel operator is used to calculate Gradient Values.
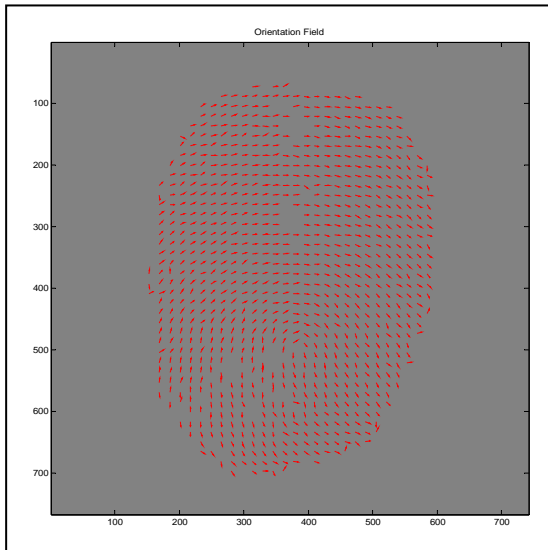

Figure 5. Orientation Field of Fingerprint Image

The Figure above demonstrates the orientation field of the fingerprint image. In this image the arrow lines show the path where the ridges lines are elongate.

VII. CONCLUSION

The conclusion of this research is better estimation of the fingerprint class by orientation examination. As discussed, a fingerprint image can be classified based on the structure of minutiae feature, the input image is first enhanced and then the orientation is perform based on Gradient based approach. The output image as shown, presents the orientation of overall minutiae present inside the image. One can easily classify the output image by analyzing the rotation and further compare

with the images stored in the database. This research results the fingerprint classification is the best approach to improve efficiency of the fingerprint evaluation step.

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