



Migration of Classification Techniques in Fingerprint Recognition System

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Abstract: The Fingerprint Matching is the most important step of any Fingerprint based authentication system. The procedural implementation of data mining approach helps to get meaningful information from the data source. The integration of data mining approach used to improve the performance of the Fingerprint Matching. Classification is the most commonly used data mining approach. Fingerprint Image may classify into classes, which may further sub divided into sub classes. The motivation of this research paper is to study about the Classification Techniques over Fingerprint Image. This research paper discusses about the different of Classification based data mining approaches.

Keywords: Fingerprint Matching; Classification; Data Mining; Data Warehouse; Feature Extraction

I. INTRODUCTION

In the recent years, biometrics takes effective steps for person recognition. Biometrics is a field of science and technology which is used to be measure life features. A person has two types of features first one is physiological (face, fingerprint, iris) and another one is behavioral (handwriting, voice). Fingerprint is still active topic for research in person identification. Normally, we used physiological feature for person identification because it is unique and remain unchanged throughout the life time of a person. Fingerprint is a combination of ridge and valleys found on the upper surface of the finger. Ridges are the dark area of the fingerprint and valleys are the light area exit between the ridges.

Mostly we use fingerprint for person recognition because of small and inexpensive fingerprint capture devices, fast computation, and especially for its scalability, reliability and accuracy.

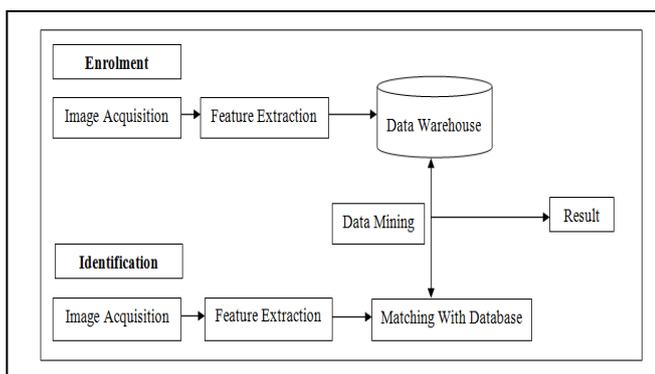


Figure.1 Fingerprint identification system

There are two types of methods of fingerprint recognition system (a) Fingerprint verification (b) Fingerprint identification. Fingerprint verification is one to one matching and it is used to verify the authenticity of a person by his fingerprint. Fingerprint identification is one to many matching and it is used to specify one person identity by his fingerprint. Fingerprint verification is comparatively

easy in computation by fingerprint identification. Fingerprint identification take more time and it has many computational complexity for fingerprint matching, because it match one fingerprint image with many fingerprint images. Fingerprint identification is used in criminal investigation cases.

Figure 1 shows Fingerprint identification system which have large amount of fingerprint data for identification. It is very complicated process of matching one fingerprint image with N fingerprint images, so it is very important to applying data mining methods in fingerprint database for better and effective results. Data mining plays important role for performance evaluation of fingerprint recognition system [1] [2].

II. MINING IN FINGERPRINT DATABASE

Data mining is a collection of techniques and methods for efficiently handle and manage a large amount of information and data. Data mining is a practice of automatically searching large stores of data to discover patterns and trends that go beyond simple analysis.

Fingerprint recognition system includes many active steps like (a) Fingerprint acquisition (b) Fingerprint Segmentation (c) Fingerprint image enhancement (d) Feature extraction (e) Minutiae matching (f) Fingerprint classification. Overall steps fingerprint classification is a very efficient step for improve performance of fingerprint recognition system. Fingerprint classification is used for create indexing in fingerprint database.

III. WHAT IS CLASSIFICATION?

Classification is a process of finding model or function that describe and distinguish data, classes and concept. Fingerprint classification is an important indexing method for any large fingerprint database. Use of data mining and classification technique in fingerprint database is if we want to search for the name and information to a set of fingerprints, we would enter fingerprint into the query, and then we get a name and other information if it is in the database, and if we were looking for the fingerprint to a person, we would like to enter a name and we get the fingerprints for him. Classification in fingerprint database is

used to eliminate the need of matching one fingerprint image with whole fingerprint database. It is requires for reduce time complexity and computing complexity, and it improves performance of fingerprint recognition system.

IV. CLASSIFICATION OF FINGERPRINT DATA

Fingerprint classification is a process of classifying fingerprint data into a number of classes such as (patterns, minutiae points, location of minutiae points, pores, and ridges contours). It present result of relatively similar fields which is very useful for fast computing in large data

A. Patterns

Patterns are the flow of the ridges on the fingerprint. Patterns in fingerprint are divided into three major groups.

(i) Loop (ii) Whorl and (iii) Arch.

1) Loop Patterns

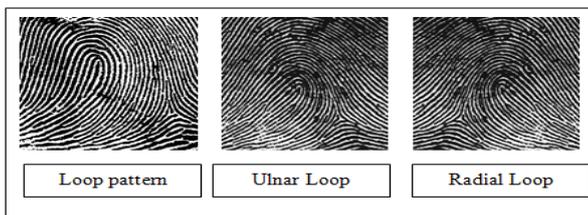


Figure.2 Fingerprint Loop Pattern

In loop pattern, ridges will flow on one side, and exit on the same side from which it entered. The loop pattern consists of one or more re-curving ridges and one delta. There are two types of loop patterns:

a) *Ulnar loop*: In ulnar loop pattern the ridges flow in from the little finger side.

b) *Radial loop*: In radial loop pattern the ridges flow in from the thumb side

2) Whorl Pattern:

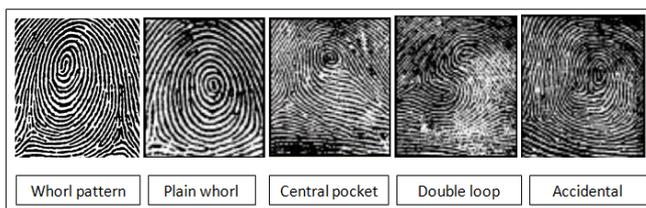


Figure.3 Fingerprint Whorl Pattern

Whorl pattern consist of one or more re-curving ridges and two deltas. A whorl pattern consists of a series of concentric circles. There are four types of whorl patterns:

a) *Plain whorl*: Plain whorls consist of one or more ridges and two deltas which make a complete circuit between at least one re-curving ridges within the inner pattern area is cut or touched.

b) *Central Pocket Loop whorl*: Central pocket loop whorls have one re-curving ridge with two deltas, when an

imaginary line is drawn; no re-curving ridge within the pattern area is cut or touched.

c) *Double Loop Whorl*: Double loop whorls consist of two separate and distinct loop formations, two deltas and one or more ridges which make a complete circuit.

d) *Accidental Whorl*: The accidental pattern will contain two deltas. One delta will be related to a re-curve and the other will be related to an up thrust.

3) Arch Pattern:

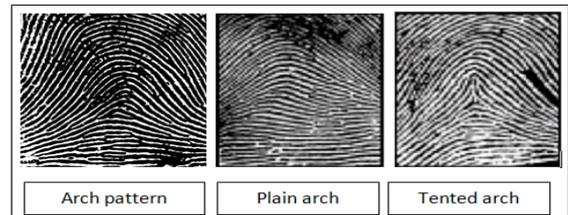


Figure.4 Fingerprint Arch Pattern

In an arch pattern, ridges enter in one side and exit the opposite side. There are no deltas in an arch pattern. There are two types of arch patterns:

a) *Plain arch*: Plain arches consist of a flow of ridges from one side to the other of the pattern; the ridges enter on one side of the impression, and flow out the other with a slightly rise in the center.

b) *Tented arch*: Tented arches consist of an angle, an up thrust, or two of the three basic characteristics of the loop. In this pattern ridges starts on one side of the finger and flows out in a similar pattern to the other side.

B. Minutiae Points

In fingerprint series of ridges and valleys create some unique points, which are known as Minutiae points. We also calculate the location of these minutiae points in fingerprint image as a hierarchical matching which is very reliable for matching system.

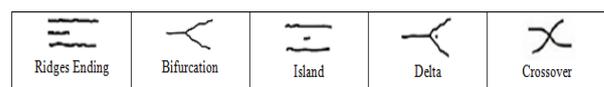


Figure.5 Minutiae Points

- **Ridge ending**: Ridge ending are the point where a ridge break.
- **Bifurcation point**: It is a point where ridges divided into two directions.
- **Island**: An island is a line type which stands alone, that is it does not touch another ridge.
- **Delta**: The delta is the point where the ridges spread into three directions.
- **Crossover**: Crossover is a short ridge that runs between two parallel ridges.

C. Pores:

Pores are the opening of the sweat glands and they are distributed along the ridges. Pores are classified into two categories: Open pores and closed pores.

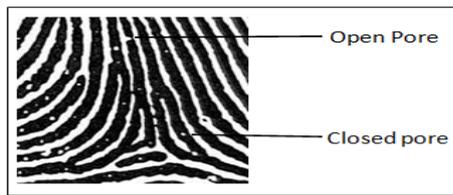


Figure.6 Pores In Fingerprint Image

A closed pore is entirely enclosed by the ridges while an open pore intersects with the valley lying between two ridges.

D. Ridges contours:

Ridge contour contain valuable information including ridges width and edge shape. Ridges contour can be classified into following categories [3]:

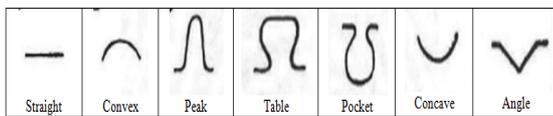


Figure.7 Fingerprint Ridges Contour

V. CLASSIFICATION TECHNIQUES

To apply classification techniques in fingerprint database is very useful for fingerprint recognition system. The benefit of fingerprint classification is it comfortable with any type of fingerprint image. It is used to generate fingerprint indexes, which reduces time and computing complexity while matching fingerprint images. There are a number of fingerprint classification approaches have been developed.

A. Neural Networks Classifier

Classification approach is effectively works with neural network. Neural networks are useful for pattern-recognition and data-classification. The neural network is inspired by biological nervous system. It is used to process the extracted patterns [4].

B. Support Vector Machine Classifier

SVM-based Fingerprint Classification system used to classify the fingerprints into classes like: (whorl, arch, tended arch, left loop, right loop and twin loops). The method uses orientation mechanism and support vector machine during classification. It estimates the orientation field through pixel gradient values, and then calculates the percentages of the directional block classes [5].

C. k-Nearest Neighbour Classifier (k-NN)

The k-nearest neighbour algorithm (k-NN) is a technique for classifying objects (in the feature space) based on closest training samples. K-NN classifier is best suited for classifying persons based on their images. The simplest classification scheme is a nearest neighbour classification in the image space [6].

Table 1: Classification of Algorithms

Features	Techniques	Area Improved
Ridges line, Singular point	Neural network classifier	Performance degradation With large

		databases
Finger code features and structural representation	Support vector machine classifier	Increased the time complexity
Directional Fields, delta points and Singular Points	K nearest neighbor classifier	The line detector algorithm can be improved to work with noisy images

D. CONCLUSION

The data about data is known as metadata and data mining is an operation to find data about data. Basically, data represents the information and it can be an image. The Classification is the best approach to find and operate meaningful data (information). The research about Fingerprint Image reflects that image property segmentation helps to classify fingerprint into subclasses. As the paper only focuses on the Classification Techniques, the fundamental of data mining is revised. Over all study about the topic presents different methods to migrate of data mining techniques with fingerprint image. After studying many research papers, the concluded result is the Classification of Fingerprint Images helps to minimize time complexity of Fingerprint Recognition System.

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