FINGERPRINT RECOGNITION USING MINUTIAE MATCHING

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Dedicated to my beloved parents and friends, for their everlasting support and encouragement to complete the course of studies.

ACKNOWLEDGEMENT

Thank for the divine grace and mercy, I finally managed to complete this report along with my project successfully on time has been set. In addition, my thanks and gratitude to my family who always gave encouragement and enthusiasm from the initial idea and the project is issued until the full report can be generated as desired. Not forgetting my supervisor, En Rosman Bin Abd.Rahim and he is a lecture who has always given much of teaching ideas either from the beginning until the project is designed and until to improve the project. In addition, to my all roommate that helped me a lot and taught to create and indirectly also help in the construction of the coding associated with the Matlab. Besides, I also would like to-many thanks to the energies of other lectures and friends who assist in providing useful insights to make this a better project and successfully implemented.

ABSTRAK

Projek ini adalah untuk mewujudkan dan reka bentuk pengiktirafan cap jari melalui detel sepadan dengan pengesanan peratusan yang tinggi. Pengiktirafan cap jari adalah salah satu tugas yang paling mencabar dalam pengenalan biometrik, oleh yang demikian fakta bahawa cap jari yang mudah untuk mendapatkan dan yang paling penting ia boleh dipercayai. Beberapa kaedah pengiktirafan corak telah digunakan untuk melaksanakan cap jari yang sepadan. Salah satu seperti yang hampir sama kaedah cap jari berdasarkan ciri-ciri detel adalah masalah penyelidikan. Algoritma yang hampir dengan berkesan cap jari berdasarkan pengekstrakan ciri dan detel yang sepadan. Analisis cap jari untuk tujuan yang hampir sama detel secara amnya memerlukan perbandingan beberapa ciri-ciri corak cetak. Ini termasuk corak, adalah ciri-ciri gabungan penamatan rabung, pencabangan dua, rabung bebas, dot, merangsang dan crossover yang merupakan ciri unik yang terdapat dalam corak. Beberapa kajian juga menyatakan penyesuaian merupakan perkara penting dalam menentukan identiti seseorang tetapi mereka mengira secara manual. Di dalam projek saya, pengiraan penyesuaian perincian berdasarkan perisian Matlab dimana ralat dapat dikurangkan. Di akhir projek, boleh dinyatakan, penyesuaian perincian amat berkesan dan penggunaan detel yang hampir sama sebagai pemproses imej sebelum dimasukkan ke dalam perisian amatlah diperlukan untuk membezakan alur dan benteng sesuatu cap jari.

ABSTRACT

This project is to create and design a fingerprint recognition using minutiae matching with high percentage of detection. Fingerprint recognition is one of the most challenging tasks in biometrics identification due to the fact that the fingerprint are easy to obtain and most importantly it is reliable. A number of pattern recognition methods have been used to perform fingerprint matching. One such method fingerprint matching based on the minutiae features is the researched problems. So effectively fingerprint matching algorithm based on feature extraction and minutiae matching. The analysis of fingerprints for minutiae matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are combined characteristics of ridge termination, bifurcation, independent ridge, dot, spur and crossover, which are unique features found within the pattern. Some studies show minutia is the main feature of fingerprint identification where they calculate the minutia of each fingerprint manually. In my project, I will analyze the minutia by using created software in Matlab which is the error can be reduced. In the end of the project, it can be concluded that the minutia matching is the best way in identify a fingerprint and pre-processing image is needed in making the image more clear and the ridges and furrow can be differentiate easily.

CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF APPENDIXES

CHAPTER I

INTRODUCTION

1.0 INTRODUCTION

This chapter will discuss the overview process that involved for this project which is project background and specific objectives of the project, problem statements, scope of work and expected result. The end of this chapter the thesis outline will be listed.

1.1 PROJECT BACKGROUND

Each person has an unique set of fingerprints. No two people in the world share the same fingerprint, even sibling. The fingerprint recognition is one of the most promising biometric identification due to the fact that the fingerprint are easy to obtain and most importantly it is reliable. A number of pattern recognition methods have been used to perform fingerprint matching. One such method is the fingerprint matching based on minutiae features become research problem in this work. So effectively fingerprint matching algorithm will be developed based on feature extraction and minutiae matching. The analysis of fingerprints for minutiae matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are combined characteristics of ridge termination, bifurcation, independent ridge, dot, spur, crossover and many other patterns.

1.2 PROBLEM STATEMENT

As mention earlier, it is important to have reliable personal identification due to growing importance of information technology. A biometric system is the best way to be the core of identification compares to other verification. The most popular biometric is fingerprint. Fingerprint is unique and differs from one person to another. The main problem of the fingerprint recognition system can make two type of error which still need to be improved although the probability of finding two fingerprints alike is high. The first is the false match, when a match occurs between images from two different fingers. The second is the false non-match, when images from the same finger are not a match.

Therefore, this project is to analyze the recognition rate under various fingerprint images and various condition in term of accuracy with percentage of fingerprint matching.

1.3 OBJECTIVES

The objective of the project includes:

- To design fingerprint recognition software using Matlab.
- To develop database for fingerprint matching.
- To simulate and testing the program using Matlab in comparing the fingerprint from database with the selected fingerprint.
- To investigate the performance of minutiae technique under various fingerprint images and various conditions in term of accuracy with percentage of fingerprint matching.

1.4 SCOPES OF WORK

This project is divide into several scope of work include:

- This research is to design fingerprint recognition using minutiae matching.
- Construct fingerprint database using the code in Matlab. This Matlab code use to save the identity of the selected fingerprint in database.
- After the fingerprint save to database, the other fingerprint is selected to compare between the fingerprint in the database.
- To compare these fingerprint, the minutiae extraction is use to define the shape of the selected fingerprint.
- Minutiae matching is use to determine the percentage of the similarity of the selected fingerprint and the fingerprint in database.

1.5 EXPECTED RESULT

The expected result of the project includes:

- Design the code in Matlab that able to extract fingerprint minutiae from the input images.
- Obtain high recognition rate which is more than 80% matching.

CHAPTER II

LITERATURE REVIEW

2.0 INTRODUCTION

Chapter 2 describes on the analysis and review about component and its importance in this project. This chapter discuss about the background of boimetric technologies, the algorithm process, basic operation of image processing, the fingerprints types and minutiae point of each fingerprint pattern. The algorithms used in a fingerprint recognition system are also explained in detail. By referring to this chapter, the new software of fingerprint recognition software will be implemented.

2.1 BIOMETRIC VERIFICATION SYSTEM

The biometric verification task is to determine whether or not an input and a template belong to the same individual [1]. Two basic questions that often need to be answered are "who are you?" (identification) and "are you who you claim to be?" (verification). For example, one may have to be authenticated before gaining access to a bank, a protected site or to draw cash from an ATM. Biometric-based person identification is considered more reliable since the biological characteristics cannot be forgotten (like passwords) and cannot be easily shared, misplaced or duplicated. The characteristics could be passive physical traits such as fingerprints and hand. Geometry or active behavioural characteristics such as voice and signature [2].

A biometric system is essentially a pattern recognition system that acquires biometric data from an individual, extracts a feature set from the data, compares this feature set against the feature set(s), and executes an action based on the result of the comparison. Therefore, a simple biometric system has a sensor module, a feature extraction module, a matching module and a decision module [3,4]:

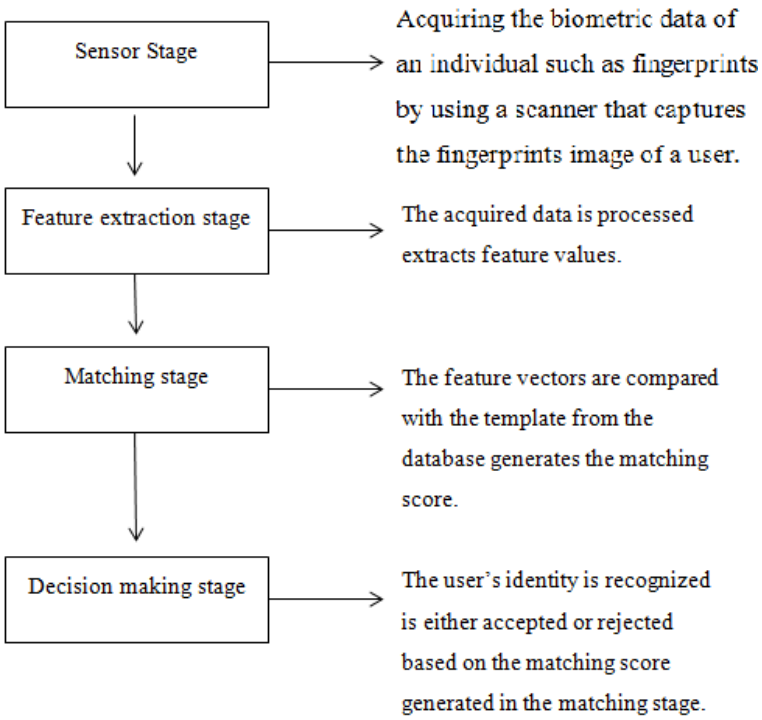

Figure 2.1: Flow chart of biometric system.

Biometrics	Universality	Uniqueness	Permanence	Collectability	Performance	Acceptability	Circumvention
Face	High	Low	Medium	High	Low	High	High
Fingerprint	Medium	High	High	Medium	High	Medium	High
Hand Geom.	Medium	Low	Low	High	Low	High	Medium
Hand Vein	Medium	Medium	Medium	Medium	Medium	Medium	Low
Iris	High	High	High	Medium	High	Low	Low
Retina	High	High	Medium	Low	High	Low	Low
Ear	Medium	Medium	High	Medium	Medium	High	Medium
Signature	Low	Low	Low	High	Low	High	Low
Voice	Medium	Low	Low	Medium	Low	High	Low
Thermogram	High	High	Low	High	Medium	High	High

Table 2.1: Comparison of biometric technologies [4].

2.2 FINGERPRINT

Fingerprint has been used as identifications for individuals since late 19th century and it has been discovered that every individual has different fingerprints even for identical twins. Fingerprints have the properties of distinctiveness or individuality, and the fingerprints of a particular person remain almost the same (persistence) over time. These properties make fingerprints suitable for biometric uses [5].

Fingerprints are actually the ridge and furrow patterns on the tip of finger. The characteristics to be extracted in a given fingerprint image can be divided into two main categories, global or high level features and local or low level features. Core and delta are the global features while ridge ending and bifurcation of fingerprint ridge are the local features. Local features are commonly named minutiae[6]. All the feature are stored as principle component data.

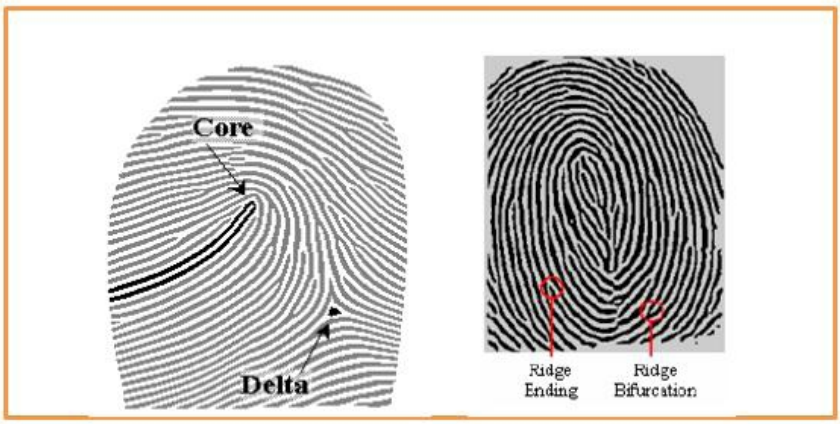

Figure 2.2: Global feature of core and delta [7].

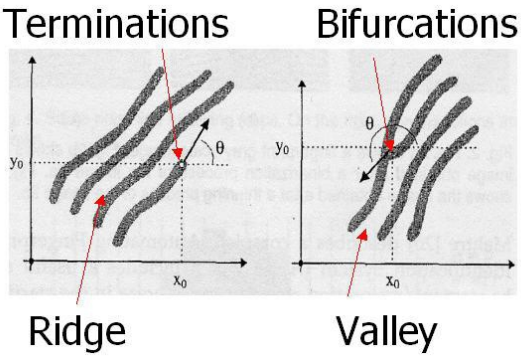

Figure 2.3: Local feature of minutiae [7].

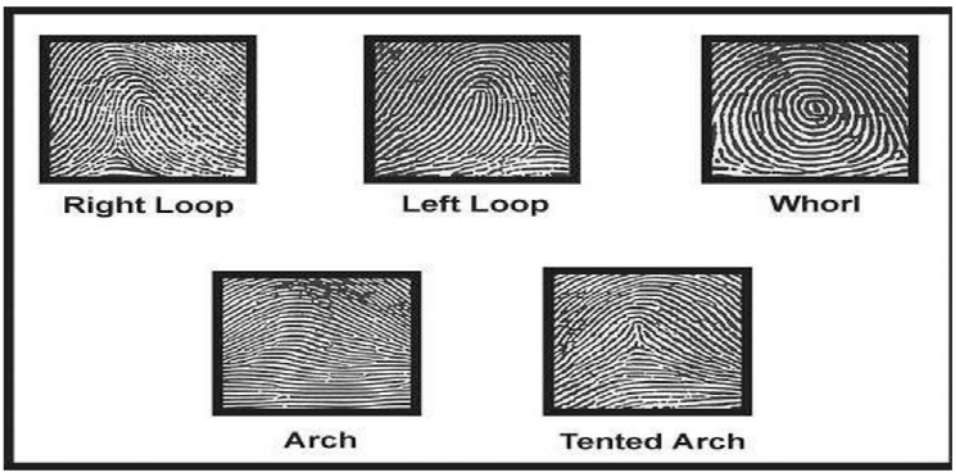

Figure 2.4: The variety of fingerprint pattern [7].

2.3 FINGERPRINT VERIFICATION

Fingerprint verification can refer to two kinds of tasks:

- 1:1 verification: Whether two fingerprints, one an input and other a template, are impressions of the same finger.
- 1:M verification: Here, M impressions of a finger are enrolled(templates) and the question is whether or not an input impression belongs to the ensemble of enrolled impressions.

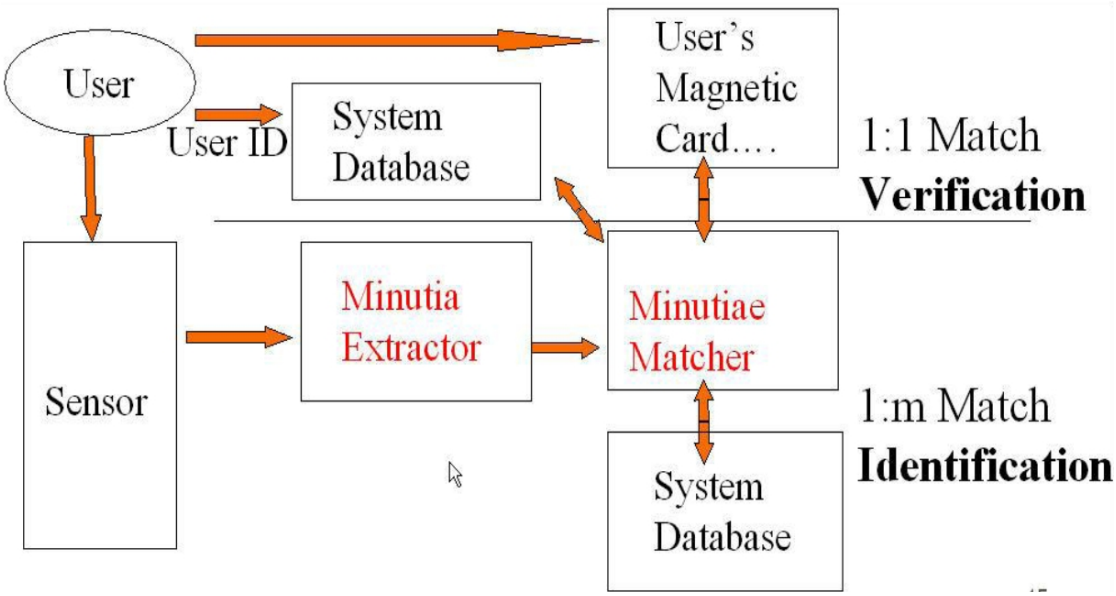

Figure 2.5: Verification and identification [9].

Fingerprint verification is used to verify the authenticity of one person by his fingerprint. The user provides his fingerprint together with his identity information like his ID number. The fingerprint verification system retrieves the fingerprint template according to the ID number and matches the template with the real-time acquired fingerprint from the user. Usually it is the underlying design principle of AFAS (Automatic Fingerprint Authentication System)[9].

Fingerprint identification is to specify one person's identity by his fingerprint(s). Without knowledge of the person's identity, the fingerprint identification system tries to match his fingerprint(s) with those in the whole fingerprint database. It is especially useful for criminal investigation cases and it is the design principle of AFIS (Automatic Fingerprint Identification System)[11].

However, all fingerprint recognition problems, either verification or identification, are ultimately based on a well-defined representation of a fingerprint. As long as the representation of fingerprints remains the uniqueness and keeps simple, the fingerprint matching, either for the 1-to-1 verification case or 1-to-m identification case, is straightforward and easy[11].

2.4 APPROACH FOR FINGERPRINT RECOGNITION

There are two representation forms for fingerprints separate the two approaches for fingerprint recognition. The first approach, which is minutia-based, represents the fingerprint by its local features, like terminations and bifurcations. This approach has been intensively studied, also is the backbone of the current available fingerprint recognition products.

The second approach, which uses image-based methods, tries to do matching based on the global features of a whole fingerprint image. It is an advanced and newly emerging method for fingerprint recognition. And it is useful to solve some intractable problems of the first approach[13].