FINGERPRINT RECOGNITION SYSTEM

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Dedicated especially to my beloved mom and dad

Zainal Bin Hashim and Sarimah Binti Tunas

Supervisor

Noor Asyikin Binti Sulaiman

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ABSTRACT

Fingerprints are part of human identity. Fingerprints are the most mature biometric; automated method of recognition a person based on physical or behavioral characteristics technology. In this thesis, a neural network in MATLAB was used to train and simulated data of fingerprint. A multi-layer neural network based on the popular feed-forward (FF) algorithm has been used for classification. At the end, all the simulate network will interface with Graphical User Interface for user application.

ABSTRAK

Cap jari merupakan sebahagian daripada identiti manusia. Cap jari juga adalah biometrik yang paling matang; kaedah automatic teknologi dalam mengenali individu berdasarkan pada sifat fizikal ataupun tabiat. Dalam tesis ini, "neural network toolbox" didalam Matlab digunakan untuk melatih dan menganalisa data cap jari. Rangkaian "multi-layer" berdasarkan pada algoritma popular iaitu "fd-forward" digunakan untuk mengklasifikasi cap jari. Pada akhirnya, kesemua data yang telah disimulasi akan berhubung kait dengan "Graphical User Interface (GUI)" aplikasi.

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LIST OF ABBREVIATIONS

DNA	-	Deoxyribonucleic acid
MATLAB	-	Matrix Laboratory
AFIS	-	Automated Fingerprint Identification System
NNTool	-	Neural Network Toolbox
FF	-	Feed-forward
MLP	-	Multilayer Perception
RBF	-	Radial-Basis Function
ANN	-	Artificial Neural Network
GUI	-	Graphical User Interface
GUIDE	-	GUI in Matlab
M-file	-	Matlab coding file
API	-	Application Program Interface

CHAPTER 1

INTRODUCTION

1.1 Background

For the past many years, different types of automatic personal identification method have been developed and market using human biometrics features. Human biometrics features divide into two categories; physiological features and behavioural features. Physiological features such as face, fingerprint, hand, iris and DNA where as behavioural features such keystroke, signature and voice. Fingerprints are one of the most popular and reliable biometrics features for verifying a person's identification. It usually uses to prevent user confidential information. The fingerprint recognition is the process of verifying the user's identity by checking the fingerprint.

1.2 Objectives of project

The major objective of this project is to develop a system that can recognize fingerprint. In this project, only a small number of fingerprint data people were selected to be trained in Neural Network Toolbox (NNTool). All simulations performed by using Matlab which specific in NNTool.

1.3 Problem statement

Nowadays security is the most important thing especially in application of a bank-machine, a network and others. Everyone is known to have unique, immutable fingerprint. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by pattern of ridges and furrow as well as the minutiae points. So fingerprint identification is one of the cheapest and the best way for security system.

1.4 Scope of work

The scope of this project is to develop a system that can recognize fingerprint by using Matlab. Fingerprint data selected was used in this project as described in [1]. All simulations are performed using Matlab/NNTool. The neural network is trained to learn and distinguish between match and non-match features of fingerprint. All trained data were interfaced with Graphical User Interface (GUI) to recognize fingerprint based on test data.

1.5 Methodology

This project is designed to identify the type of fingerprint. There are several project planning as described by following flow chart to complete this project. This methodology was used to accomplish this project using Neural Network Tool (NNTool) in Matlab. After that, an appropriate data of fingerprint extracts will be used as data train. A complete methodology for this project is described in Figure 1.1.

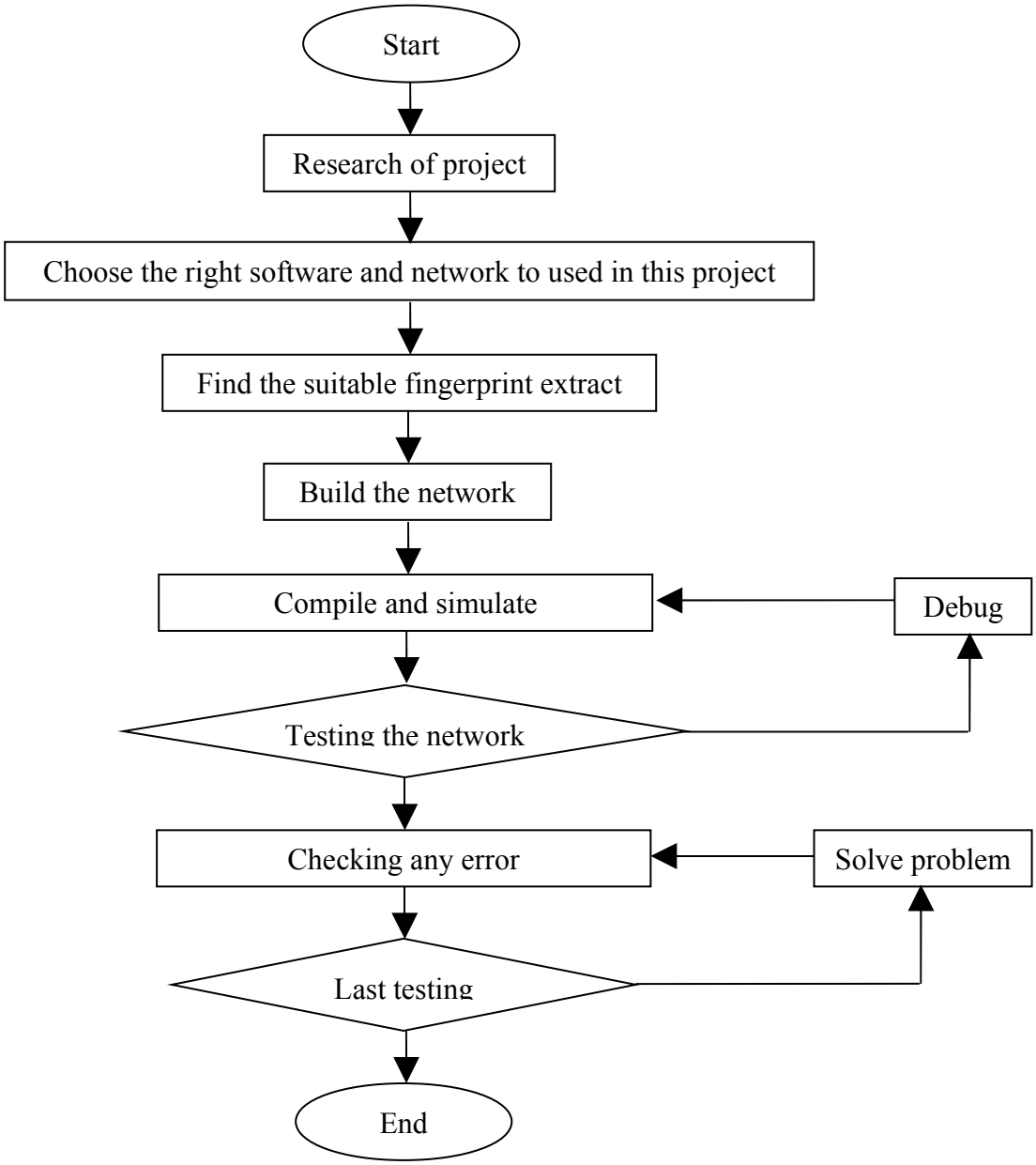


Figure 1.1 Methodology of the project

1.6 Outline of the project report

This thesis is divided into five chapters. Chapter One, is an introduction on fingerprint recognition for security implemented. This chapter also discusses about the aim of this project, problem statement and methodology for this project. Chapter Two includes some research of biometrics features, classification of fingerprint patterns and fingerprint recognition. Chapter Three explains all methodology that

used for this project. It is including the software design, Neural Network Toolbox and Feed-Forward algorithm.

Chapter Four is followed with simulation results. And last chapter which is Chapter Five is a conclusion and summary of a project done. Further works based on the findings of the projects are also suggested in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Biometrics features

Biometrics recognition is an automated recognition of individuals based on their behavioral and biological characteristics. Biometric recognition is measuring an individual's suitable behavioral and biological characteristics in a recognition inquiry and comparing these data with the biometric reference data which had been stored during a learning procedure, the identity of a specific user is determined.

Biometrics characteristic can be divided in two main classes which is physiological and behavioral biometric. Physiological is related to the shape of the body. The oldest traits, which have been used for more than 100 years, are fingerprints. Other examples are face recognition, hand geometry and iris recognition. Behavioral is related to the behavior of a person. The first characteristic to be used, still widely used today, is the signature. More modern approaches are the study of keystroke dynamics and of voice. The comparisons of various biometric recognitions are shown by table below.

Table 2.1 Comparison of various biometric recognitions

Biometrics:	Universality	Uniqueness	Permanence	Collectability	Performance	Acceptability	Circumvention*
Hand geometry	M	M	M	H	M	M	M
Keystrokes	L	L	L	M	L	M	M
Gait	M	L	L	H	L	H	M
Ear Canal	M	M	H	M	M	H	M
Face	H	L	M	H	L	H	L
Signature	L	L	L	H	L	H	L
Voice	M	L	L	M	L	H	L
Odor	H	H	H	L	L	M	L
DNA	H	H	H	L	H	L	L
Fingerprint	M	H	H	M	H	M	H
Hand veins	M	M	M	M	M	M	H
Iris	H	H	H	M	H	L	H
Retinal scan	H	H	M	L	H	L	H
Facial thermograph	H	H	L	H	M	H	H

Legend

L = Low

M = Medium

2.2 Introduction of Fingerprint

Fingerprints are the tiny ridges, whorls and valley patterns on the tip of each finger. They form from pressure on baby's tiny developing fingers in the womb. No two people have been found to have the same fingerprints; they are totally unique. There's a one in 64 billion chance that your fingerprint will match up exactly with someone else [10]. Fingerprints are even more unique than Deoxyribonucleic acid (DNA), the genetic material in each of our cells. Although identical twins can share the same DNA but they cannot have the same fingerprints.

Fingerprinting is one form of biometrics, a science that uses people's physical characteristic to identify them. Fingerprints are ideal for this purpose because they are inexpensive to collect and analyze and they are never change, even as people age. It has been proved as presented in Table 2.1. Although hands and feet have many ridged areas that could be used for identification, fingerprints became popular form of biometrics because they are easy to classify and sort. They are also accessible.

2.2.1 Fingerprint patterns

Fingerprints are made of an arrangement of ridges, called friction ridges. All of the ridges of fingerprints form patterns called loops, whorl and arches.

Arches are found in about 5% of fingerprint patterns encountered. The ridges run from one side to the other of the pattern, making no backward turn. Ordinarily, there is no delta in an arch pattern but where there is a delta; no re-curving ridge must intervene between the core and delta points. There are four types of arch patterns: plain arches, radial arches, ulnar arches and tented arches. Plain arches have an even flow of ridges from one side to the other of the pattern; no “significant up thrusts” and the ridges enter on one side of the impression, and flow out the other with a rise or wave in the center. The ridges of radial arches slope towards the thumb, have one delta and no re-curving ridges. On ulnar arches, the ridges slope towards the little finger, have one delta and no re-curving ridges. Tented arches have an angle, an up thrust, or two of the three basic characteristics of the loop. They don’t have the same "easy" flow that plain arches do and particularly have “significant up thrusts” in the ridges near the middle that arrange themselves on both sides of a spine or axis towards which the adjoining ridges converge and appear to form tents.

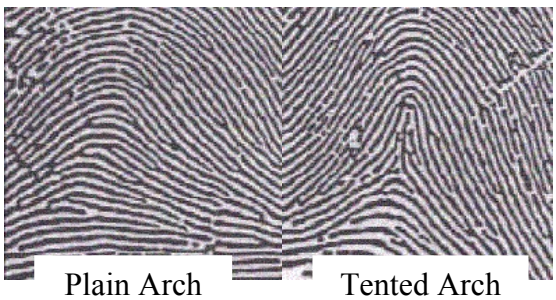
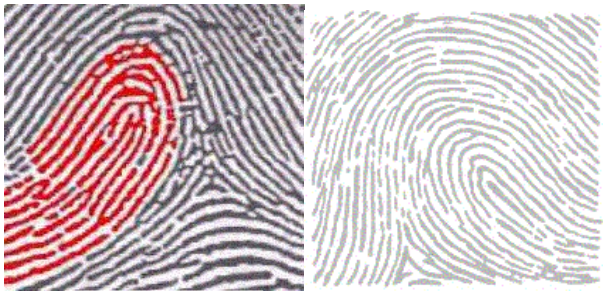


Figure 2.1 Types or arch patterns

Loops occur in about 60-70 % of fingerprint patterns encountered. One or more of the ridges enters on either side of the impression, re-curves, touches or crosses the line running from the delta to the core and terminates on or in the direction of the side where the ridge or ridges entered. Each loop pattern has is one

delta and one core and has a ridge count. Radial loops are named after the radius, a bone in the forearm that joins the hand on the same side as the thumb. The flow of the pattern in radial loops runs in the direction of the radius (toward the thumb). Radial loops are not very common and most of the time radial loops will be found on the index fingers. Ulnar loops are named after the ulna, a bone in the forearm. The ulna is on the same side as the little finger and the flow of the pattern in an ulnar loop runs in the direction of the ulnar (toward the little finger).



Radial Loop Ulnar Loop

Figure 2.2 Types of loop patterns

Whorls are seen in about 25-35 % of fingerprint patterns encountered. In a whorl, some of the ridges make a turn through at least one circuit. Any fingerprint pattern which contains 2 or more deltas will be a whorl pattern. There are four types of whorl patterns. Plain whorls consist of one or more ridges which make or tend to make a complete circuit with two deltas, between which an imaginary line is drawn and at least one re-curving ridge within the inner pattern area is cut or touched. Central pocket loop whorls consist of at least one re-curving ridge or an obstruction at right angles to the line of flow, with two deltas, between which when an imaginary line is drawn, no re-curving ridge within the pattern area is cut or touched. Central pocket loop whorl ridges make one complete circuit which may be spiral, oval, circular or any variant of a circle. Double loop whorls consist of two separate and distinct loop formations with two separate and distinct shoulders for each core, two deltas and one or more ridges which make, a complete circuit. Between the two at least one re-curving ridge within the inner pattern area is cut or touched when an imaginary line is drawn. Accidental whorls consist of two different types of patterns with the exception of the plain arch; have two or more deltas or a pattern which