

ELECTRONIC LOCK USING SIGNATURE VERIFICATION

JULITA BINTI ALI

This report is submitted in partial fulfilment of the requirements for the award of Bachelor Degree of Computer Engineering (Computer Electronic) With Honours

**Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka**

April 2009



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : ELECTRONIC LOCK USING SIGNATURE VERIFICATION

Sesi Pengajian : 2008/2009

Saya JULITA BINTI ALI mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan () :

SULIT*

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD*

(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

(TANDATANGAN PENULIS)

Alamat Tetap: No. 51, Jalan Bayan 12,
Taman Bukit katil,
75450 Melaka

(COP DAN TANDATANGAN PENYELIA)

AMAT AMIR BIN BASARI

Pensyarah

Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer

Universiti Teknikal Malaysia Melaka (UTeM)

Karung Berkunci No 1752

Pejabat Pos Durian Tunggal

76100 Durian Tunggal, Melaka

Tarikh: 30/04/09

Tarikh: 30 APRIL 2009.

DECLARATION

“I hereby declare that this report is the result of my own work except for quotes as cited in the references”

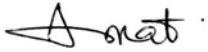
Signature : 

Author : JULITA BINTI ALI

Date : 28 APRIL 2009

SUPERVISOR DECLARATION

“ I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award Bachelor Degree of Computer Engineering (Electronic Computer) With Honours”

Signature : 
Supervisor's Name : Mr AMAT AMIR BIN BASARI
Date : 30 APRIL 2009.

Special dedication to my loving father Ali Bin Othman, my mother Mintan Binti Amat, my brother Mohd Helmi Ali and wife Nor Hidayah Suleiman, my kind hearted supervisor Mr Amat Amir Bin Basari, and my dearest friends.

ACKNOWLEDGMENT

My sincerest thanks go to my supervisor, Mr Amat Amir Bin Basari for his dedication to his student and patience in assisting me with this thesis. I appreciate his valuable advice and efforts offered during the course of my studies. I would also like to thank to Mdm. Fauziah Binti Salehuddin lecturer of Faculty of Electronic Computer and my senior Ho Foo Yeap for their equally valuable support generously given during do my thesis.

Special thanks to go to my roommate Nur Hidayah Bt Seth and my friends for their invaluable assistance towards thus thesis project. I appreciate their friendship and sympathetic help which made my life easier and more pleasant during graduate studies. Lastly, I would like to thank my lovely parents for their enormous encouragement and assistance, without them, this project would not have been possible.

ABSTRACT

The Electronic Lock Using Real Time Signature Recognition System is a process of verifying the writer's identity by using signature recognition as a key to the electronic lock. This project highlights the development of signature recognition using visual basic to recognize the input signature. This system can be use as a security system such as Verification for Assessing Entry Application and Password Substitutions. The electronic lock will be functioning when it receives correct signature. This project is divided into two parts. In the first part, focus is given on Real Time Signature Recognition where this technique is far sophisticated than a simple analysis of a finished signature. As a person signs on a pressure-sensitive tablet, the software records the character shape, writing speed, stroke holder, off tablet motion, pen pressure and timing. These characteristics uniquely identify a person and cannot be mimicked or stolen. In this part, Support Vector Machine (SVM) will be used to focuses in verifying the signature. Second part, electronic key will be functioning when it receives the correct signature. DAQ card (Multifunction USB Module) will connect the program from the computer to the Electronic Key circuit. Once the signature is recognize the door will automatically open.

ABSTRAK

Kunci Elektronik Menggunakan Sistem Pengenalan Tandatangan Masa Nyata adalah suatu proses mengenal pasti tandatangan penulis sebagai kunci kepada pintu elektronik tersebut. Projek ini mengenengahkan pembangunan sistem pengesahan dimana proses mengenali tandatangan menggunakan Microsoft Visual Basic untuk membuka pintu elektronik. Sistem ini boleh digunakan sebagai sistem keselamatan, kunci elektronik ini hanya akan berfungsi sekiranya mendapat input iaitu tandatangan yang betul. Terdapat beberapa proses untuk mengenal pasti tandatangan yang asli atau yang palsu. Data tandatangan akan direkodkan dengan menggunakan digitizing tablet dan pen khas yang disambungkan pada Universal Serial Bus Port (USB Port) pada komputer. Sistem ini akan merekodkan bentuk tandatangan, masa yang digunakan untuk menandatangani tandatangan yang lengkap, point dimana 'pen-down' dan 'pen-up' akan direkodkan dan juga tekanan diberikan pada digitizing tablet akan direkodkan. Semua proses ini digunakan menggunakan kaedah Support Vector Machine (SVM). Dalam projek ini, DAQ card digunakan untuk menghubungkan komputer kepada PIC yang telah di programkan pada kunci elektronik dan hanya tandatangan yang terdapat dalam data dan dikenali pasti asli akan membolehkan kunci elektronik berfungsi.

CONTENTS

CHAPTER	ITEM	PAGE
	PROJECT TITLE	i
	STATUS REPORT DECLARATION FORM	ii
	DECLARATION	iii
	DECLARATION SUPERVISOR	iv
	DEDICATION	v
	ACKNOWLEDGMENT	vi
	ABSTRACT	vii
	ABSTRAK	viii
	CONTENT	ix
	LIST OF TABLE	xii
	LIST OF FIGURE	xiii
	LIST OF ABBREVIATIONS	xv
I.	INTRODUCTION	
	1.1 Background	1
	1.2 Objectives	3
	1.3 Scope of the Project	
	1.4 Problem Statement	4
	1.5 Report Structure	5
II.	LITERATURE REVIEW	
	2.1 Introduction	6
	2.2 Literature Review On Related Project	
	2.2.1 Literature Review On Signature Verification	7
	2.2.2 Literature Review On Support Vector Machine	8
	2.3 Development Tools	9
	2.3.1 Microsoft Visual Basic 6.0	
	2.3.2 GUI (Graphical User Interface)	10

2.4	Digitizing Tablet	12
2.5	Data Acquisition Card	
2.5.1	Data Acquisition Process	15
2.6	Electronic Lock	
2.6.1	Microcontroller (PIC16F628)	16
2.6.2	Program the PIC	18
2.6.3	Relay	
2.6.4	Electromagnetic Lock	20
2.6.5	Transistor	22

III. PROJECT METHODOLOGY

3.1	Introduction	23
3.2	Block Diagram of the Project.	24
3.3	Block Diagram for Signature Verification	25
3.4	Methodology	26
3.4.1	Input signature	27
3.4.2	Data Acquisition	
3.4.3	Normalization	28
3.4.4	Pre-Processing	29
	3.4.4.1 Re-Sampling Distance	30
	3.4.4.2 Re-Sampling Time	31
3.4.5	Feature Extraction	32
	3.4.5.1 Based on Time	33
	3.4.5.2 Based on Strokes	34
3.4.6	Signature Verification Using SVM	37
	3.4.6.1 Basic Architecture & Algorithm	38
	3.4.6.2 Application of Support Vector Machine	
3.5	Software Architecture	39
3.6	Data Acquisition Card (DAQ Card)	41
3.7	Electronic Lock	42
3.7.1	Electronic Lock Circuit	
3.7.2	Power Supply	43
3.7.3	Rectifier	44
3.7.4	Voltage Regulator	45

3.7.5	Inputs	46
3.7.6	Outputs	47
IV.	PROJECT FINDINGS	
4.1	Introduction	48
4.2	Experimentation Analysis and Results	49
4.2.1	Software Validation	
4.2.2	FRR and FAR Analysis	54
4.3	Connection between Software and Hardware	56
4.4	GUI for DAQ Card Declaration	57
4.5	Electronic Door	58
4.6	Discussion	60
V.	CONCLUSION	
5.1	Conclusion	61
5.2	Suggestion	62
5.3	Project Application	
5.3.1	Verification for Assessing Entry Application	

REFERENCES

APPENDIX

LIST OF TABLE

NO	TITLE	PAGE
2.1	PIC16F628A Pin Description	17
4.1	Result Obtained Through FRR and FAR Analysis	53

LIST OF FIGURE

NO	TITLE	PAGE
2.1	GUI (Microsoft Visual Basic 6.0)	11
2.2	Digitizing Tablet	12
2.3	USB DAQ card	12
2.4	Connection of DAQ between PC to Output	15
2.5	PIC16F628	16
2.6	PIC16F628A Pin Diagram	17
2.7	Serial Port ICSP Programmers	18
2.8	Relay – Normally Open	19
2.9	Relay – Normally close	19
2.10	12V Relay	20
2.11	Electromagnetic Lock	20
2.12	Basic Concept of Electromagnetism	21
2.13	NPN Transistor	22
3.1	Signature Verification System	25
3.2	Process of Signature Verification	26
3.3	Connection between PC and Digitizing Tablet	27
3.4	Process of Normalization	28
3.5	Process of Re-sampling Distances	30
3.6	Feature Extraction Based on Time	33
3.7	Feature Extraction Based on Stroke	34
3.8	Feature extraction Based on Curvature	35
3.9	Flowchart of the Software Process	40
3.10	USB 4716 Card	41
3.11	Electronic Lock Circuit	43
3.12	Step Down Transformer	43
3.13	Full Bridge Rectifier	44

3.14	AC Adapters	45
3.15	Voltage Regulator	46
3.16	Typical Connection	46
3.17	Electric Strike Circuit	47
4.1	Example of Signature Being Verified as Genuine	50
4.2	Example of Signature in Wrong Orientation	51
4.3	Sample of Signature	52
4.4	Example of Signature With Different Applied Pressure	53
4.5	GUI for DAQ Card	57
4.6	Door Model	58
4.7	Completed Circuit	58
4.8	Before (left) and After Unlocked	59

LIST OF ABBREVIATIONS

SVM	-	Support Vector Machine
FAR	-	False Acceptance Rate
FRR	-	False Rejection Rate
USB	-	Universal Serial Bus
DAQ	-	Data Acquisition Card
GUI	-	Graphic User Interface
PIC	-	Program Integrated Chip

CHAPTER 1

INTRODUCTION

1.1 Background

As we all know, each individual has his own special characteristics that no one has. These characteristics are indeed important in recognizing and authenticating individuals. Since authentication of individuals has rapidly become an important issue nowadays, researchers have carried out a lot of research in this biometric field using those special characteristics of each individual for authentication.

Biometric field research includes hand geometry, face prints, fingerprints, voiceprints, signatures and non-retinal blood vessel analysis. Biometrics has been widely used in physical access control applications. Unlike personal identification number of pin, biometric features are something about the characteristics of a person. Biometric features are used to provide an enhanced level of security and identification. Signature are one of the most popular and reliable biometric features for verifying a person's identity.

Signature verification is a project, which will focus on verifying a signature whether it is a genuine signature or a forged signature by an imposter. For signature verification, it involves two different types on input of signature, online and offline. Offline (static) signature verification takes as input the image of a signature and is useful in automatic verification of signatures found on bank checks and documents. Online (dynamic) signature verification uses signatures that are captured by pressure-sensitive tablets that extract dynamic properties of a signature in addition to its shape. In this project, focus will be given on the online signature input where the input of signature is of real time through the digitizing tablet connected to a computer. These signatures will create its own measurement of location in an x-y coordinate, velocity and pressure.

In this project, the real time input will be stored in a signature database. These inputs of signatures will be processed through data pre-processing involving size normalization and re-sampling of the data points that make up the whole signature. This data pre-processing has made work easier for future extraction. In feature extraction, the feature of each data point in the signature will be extracted and these features will show the signature characteristics such as displacement, pressure, direction, directions of strokes and curvature of strokes. The Support Vector Machine (SVM) to verify signature in the future.

1.2 Objectives

To achieve the goal of this project and objectives is defined as a guided:-

- i.To integrate software that recognize signature for personal identification by using Microsoft Visual Basic 6.0
- ii.To write a program to ensure the lock is functioning.
- iii.To design a keyless door by using signature verification system.

1.3 Scope Of The Project

The scope of this project is to developed software Microsoft Visual Basic 6.0 to recognize signature for personal identification. The signature data recorded with an electronic tablet or digitizer will be sent to a recognizer that will check the similarity of the writer's signature. After the input signature image has been recognized, all the information of that input image will be stored in database as authorized user. This is a process of verifying the writer's identity by using signature recognition as a key to the electronic lock.

Beside that, this project is improving the classifier and classification module using Support Vector Machine to classify signature either genuine or forgery signature. Implementing SVM in this project requires a specific program for it to work properly on verifying signature. SVM is actually a supervised training algorithm in which has to be trained first before it can be used for verifying signatures. The electronic key only can function when it receives the genuine signature.

1.4 Problem Statement

Many of the applications for identity authentication use a password or a pin code. Other types of authentication (signature, face and eye recognition) are more complicated. The modern society has come to rely heavily on cards, passwords and PIN when it comes to the safe guarding of resources and privacy, but as we all know these can sometimes be lost, stolen, cracked or simply forgotten. The particular biometrics system will develop based on Dynamic Signature Verification; Real Time Signature Recognition is chosen to overcome this problem. This project is also to avoid common problem when using a key to lock or open the door. The common problems such as the key are missing, stolen so that can be duplicated. By using electronic lock using real time signature recognition, these problems may not occur and can be solved.

Signature verification is one of the biometric strategies. The technique is far sophisticated than a simple analysis of a finished signature. As a person signs on a pressure-sensitive tablet, the software records the character shape, writing speed, stroke holder, off tablet motion, pen pressure and timing.

1.5 Report Structure

This thesis consists of 5 chapters.

Chapter 1 will includes the background, objective, problem statement, all the necessary scope of work regarding the project.

Chapter 2 is a literature review on theoretical concepts applied in this project. This chapter will explain and discuss about the project and the component that use in this project.

Chapter 3 will discuss about the project methodology and introduces the construction of the project, which involves hardware development and software development. This chapter will explain about the approach taken in order to achieve the objectives of the project and a closer look on how the project is implemented.

Chapter 4 will describe the final outcome of this project and analysis that have been done to justify its function and to make sure it meets the objectives of project.

Chapter 5 will conclude the project and how it can be improved for further development.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Basically this chapter will reveal the knowledge pertaining this field of project in which is gained through a lot of resources such as reference books, papers, journal, articles, conference articles and documentations regarding applications and research work.

2.2 Literature Review On Related Project

Nowadays, a lot of researchers have carried out researchers on signature verification, which has become an active topic of biometric fields. A wide range of methods has been tried out to make signature verification research to success.

2.2.1 Literature Review On Signature Verification

Abdul Fadlil, Marzuki Khalid, Rubiyah Yusuf, Sairin Salleh, Nazaruddin Omar, Abddul Raof Mat Shaari, “High Performance Signature Verification Based On Two-Classfier Modules.” This paper proposes a new strategy by combining two classifiers based on local and global features captured include various aspects of signature shape and dynamics. This system uses two kinds of local features based on time and strokes.

Xuhong Xiao & Graham Leedham, “Signature Verification by NN with selective attention and small training set” presented that 1st is to locate the differences between the input signature and store the genuine signature by comparing local features, analyzing the stability on these features in genuine samples and judge whether the differences essential or accidental.

Dr. Mohan Krishnan, “A neural network based on-line signature verification system” This paper propose on dividing the project into 2 main parts, which are the development of neural network architecture and modalities of training and also the adaptation of dynamic time wrapping algorithm to formulate a new method foe enabling consistent segmentation of multiple signatures from the same writer.

Vishvjit S Nalwa. ” This system works by capturing velocities at each point. Author stresses, however, that one cannot exclusively depend on them because pen dynamics are not reliably consistent even from one signing to another. Velocities are hard to copy however, so they make good forgery detectors. It is still necessary that the shapes of the signatures correspond for the signature to be genuine. Look at both local and global models. Weighted and biased harmonic mean as a way of combining errors from multiple models.”

2.2.2 Literature Review on Support Vector Machine

Rychetsky (2001) "Support Vector machines (SVM) is a new statistical learning technique that can be seen as a new method for training classifiers based on polynomial functions, radial basis functions, neural networks, splines or other functions. Support Vector machines use a hyper-linear separating plane to create a classifier. For problems that can not be linearly separated in the input space, this machine offers a possibility to find a solution by making a non-linear transformation of the original input space into a high dimensional feature space, where an optimal separating hyperplane can be found. Those separating planes are optimal, which means that a maximal margin classifier with respect to the training data set can be obtained."

Cortes and Vapnik (1995) "The *support-vector network* is a new learning machine for two-group classification problems. The machine conceptually implements the following idea: input vectors are non-linearly mapped to a very high-dimensional feature space. In this feature space a linear decision"

Cristianini and Shawe-Taylor (2000) "Support Vector Machines (SVM) are learning systems that use a hypothesis space of linear functions in a high dimensional feature space, trained with a learning algorithm from optimisation theory that implements a learning bias derived from statistical learning theory"

D. Zhang and A.K. Jain "Support Vector Machines (SVM) is very popular since a few years. As they provide very good results for various pattern recognition problems, they also seem to be a good choice for online signature verification. Compared to most methods used for signature verification such as Hidden Markov Models (HMM) or Dynamic Time Warping (DTW), SVM, which are based on the principle of structural risk minimization, have various advantages such as a convex objective function with very fast training algorithms. On the other hand, SVM typically are applied to data sets containing feature vectors of fixed length and not to problems dealing with time series of variable length such as in online signature verification. In the following, the terms time series and sequence will be used equivalently.

Clauss Bahlman, Bernard Haasdonk and Hans Burkhardt. "Online Handwriting Recognition with Support Vector Machine A-Kernel Approach," "This paper reviews the classification techniques into 2 arts where the Bayesian classification for generative and Support Vector Machine classification for discriminative. It uses the new SVM kernel which is the Gaussian Dynamic Time Warping Kernel.

2.3 Development Tools

Basically, there are four important tools that enable this project to meet its objectives. The tools are:

- a. Microsoft Visual Basic 6.0
- b. Digitizing Tablet
- c. Data Acquisition Card
- d. Electronic Lock

2.3.1 Microsoft Visual Basic 6.0

Microsoft Visual Basic 6.0 is the programming tool used in this project. Microsoft based Visual Basic on programming language written for beginners are called BASIC (Beginner's All Purpose Symbolic Instruction Code). The BASIC programming language was developed at Darmouth College in the mid 1960's by professors John Kennedy and Thomas Kurtz, as a vehicle to be used to teach programming. BASIC has been around for more than 35 years in one form or another.

Since the beginners are developing a programming language that beginners could use, a BASIC like language can be both simple to understand and yet powerful at the same time.