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APPLICATION OF NEURAL NETWORK IN BIOMETRIC AUTHENTICATION SYSTEM HANDWRITTEN SIGNATURE AUTHENTICATION SYSTEM

YEP HUI YENG

This report is submitted in partial fulfillment of the requirements for the Bachelor of Information Technology (Software Development).

KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA
FAKULTI TEKNOLOGI MAKLUMAT DAN KOMUNIKASI
2004

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STUDENT   : _____   Date : _____
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DEDICATION

To my beloved parents and dear God...

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First of all, I would like to express my gratitude and appreciation to my final year project supervisor, Mr.Shekh Faisal Bin Abdul Latip for giving me the opportunity to complete this documentation as a part of my degree program. As a busy man, he is willing to sacrifice his time in order to guide me throughout the document preparation period. Under the guidance and supervision of Mr.Shekh Faisal Bin Abdul Latip, I had the opportunity to widen my view and interest in IT world. Mr.Fared Said, a programmer is the key person who guided me to build the computer program.

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ABSTRACT

Handwriting signature authentication is a subset of biometric authentication. It is crucial to detect a genuine signature not only manually, but electronically as well since a lot of business transactions have been switch to electronic process lately. Traditional authentication methods face bottlenecks in guiding modern applications. Existences of biometric authentication technologies offer good alternatives to public. Over years, researchers have been presenting ideas of teaching the machines to act like human theoretically. This project seeks possibilities of applying neural network algorithm in handwriting signature authentication like how a human does practically by creating an application to recognize human signatures. This project conducts research and attempt to build a computer program that apply neural network algorithm to recognize genuine signatures. The computer program has two interfaces that will accept input and stored data into database for future comparison. Comparison between commercial products is beyond project scope since no manufacturers have disclosed details of products' performance. Handwriting signature authentication is a good solution because this method offers moderate security level with inexpensive development and installation costs compared to other biometric technologies such as iris scans or hand geometry scans. It is a field worth attentions from academic researchers and commercial companies.

ABSTRAK

Pengecaman tanda tangan merupakan subset bagi pengecaman biometrik. Adalah penting untuk mengecam sesuatu tanda tangan yang sah, bukan sahaja secara manual tetapi juga secara elektronik memandangkan semakin banyak perniagaan telah bertukar kepada proses elektronik. Sistem pengecaman tradisional gagal menjaga aplikasi moden. Kemunculan pengecaman biometrik menawar alternative yang baik kepada umum. Dari tahun ke tahun, pengkaji telah mempersembahkan teori mengajar mesin untuk berkelakuan seperti manusia. Projek ini mencari kemungkinan untuk memasukkan algoritma rangkaian neural ke dalam sistem pengecaman tanda tangan seperti manusia dengan mendirikan satu aplikasi pengecaman tanda tangan. Projek ini mengadakan kajian dan cuba mendirikan satu program computer yang menggunakan algoritma rangkaian neural untuk mengenalpasti tanda tangan. Program computer mengandungi dua antaramuka yang akan menerima tanda tangan dan simpan ke dalam pangkalan data untuk tujuan perbandingan. Perbandingan antara keberkesanan produk-produk komersial adalah di luar skop projek ini kerana setakat ini belum lagi ada sebarang maklumat sah dikemukakan oleh pembangun sistem biometrik. Pengecaman tanda tangan adalah satu cara penyelesaian yang baik kerana cara ini menawarkan tahap keselamatan yang agak baik dengan kos pembangunan dan pemasangan yang rendah berbanding dengan teknologi biometrik yang lain. Pengecaman tanda tangan adalah satu bidang yang patut diberi perhatian.

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AI	-	Artificial Intelligence
CPU	-	Central Processing Unit
FMR	-	False Match Rates
FNMR	-	False Non-Match Rates
FTE	-	Failure To Enroll Rates
GUI	-	Graphic User Interfaces
HSAS	-	Handwritten/ Handwriting Signature Authentication
KUTKM	-	Kolej Universiti Teknikal Kebangsaan Malaysia
NN	-	Neural Network
OO	-	Object Oriented
PIN	-	Personal Identification Number
PSM	-	Projek Sarjana Muda

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CHAPTER I

INTRODUCTION

1.1 Project Overview

Authentication is a basic portion in human-computer interaction. PINS (Personal Identification Numbers) and passwords are common ways of interaction. PINs and passwords face several problems that call into suitability question for modern and critical applications such as accessing online financial accounts or medical data. Hence, more powerful authentication technologies, capable of providing higher degrees of the user identification are becoming commonplace. Biometrics is one such strong authentication technology. Biometric authentication relies on any automatically measurable physical characteristic or personal trait that is distinctive to an individual. Biometric can be divided into two major categories, which are physiological such as voice scan or fingerprint scan and behavioral such as signature recognition or keystrokes. Signature recognition technology's strengths such as resistance to imposters and ability to change original signatures make it well suited for a specific band of application in which signatures are part of existing processes.

Neural network got attention when McCulloch and Pitts published the first mathematical model of a biological neuron [9]. Neural network is a network of interconnected elements. These elements were inspired from studies of biological nervous systems. In other words, neural networks are attempt at creating machines that work in a similar way using components that behave like biological neurons.

The function of a neural network is to produce an output pattern when presented with an input pattern. So one of the operations that neural network can be made to do is pattern classification and recognition.

The Boehm Spiral Model is the main software methodology used throughout the entire project in order to control the project progress. At the same time, other software methodologies also been integrated into spiral model at necessary possibilities.

1.2 Problem Statement

Current authentication systems' development and implementations reach its bottleneck. Traditional authentication systems cannot cope with security requirements which are more demanding nowadays. The search for more powerful and robust authentication methods must be engineered in order to find authentication algorithms that parallel with the evolving security demands.

Biometric technology is rather new in authentication field. The possibilities to implement neural network in handwritten signature authentication is yet to be determined. Application of neural network in biometric authentication systems requires more research work to be done in order to evolve to become a mature technology.

Biometric data should never be exposed since it contains the most private information of a person. Biometric characteristics do not change and it will remain within a person for entire life. Misuse of biometric data will bring disaster to human. Biometric information storage issues must be highlighted in biometric authentication system development so that privacy legislation issues do not occurred.

The implementation cost of advanced biometric authentication systems is too high for medium-sized organizations that do not need tight security level compare to the implementation cost of other traditional authentication system. Thus an biometric algorithm that need less implementation cost but capable of offering reasonable security level need to be drawn to benefit medium-sized organizations.

Generally there is limited information about biometric systems performance. Existing commercial product vendors do not disclose the performance statistics of products, thus it is difficult to compare products performance. There are no standards of performance measures for biometric systems.

1.3 Project Mission

This project has a few tasks to be accomplished. Main target is to conduct research on combination of biometric authentication and handwriting signature authentication.

Secondly is to produce a simple computer application that can be able to store signature templates and authenticate users.

Thirdly is to seek possibilities for the application to integrate with other softwares or systems as future expansion purposes.

Fourthly performance measures for biometric authentication systems need to be drawn.

Fifth is to determine a suitable method to store biometric data in a safe way.

Lastly this project acts as a reference for other researchers who interested in similar fields.

1.4 Project Objective

Project objective describes about matters want to be achieved in PSM. There are three main objectives in this project which are searching for authentication with higher degree of security, determine the possibility of applying neural network in biometric authentication system and study the most suitable method of storing biometric data.

1.4.1 In Search Of An Authentication System Which Offers Higher Degree Of Security

As a general rule, an authentication system which is created by humans can be defeated by humans. The most frequently used authentication technologies are passwords and PINs. Passwords can be intercepted and reused. Many users select obvious words or numbers for password or PIN authentication, such that an unauthorized user may be able to break into an account with little effort. One of the reasons passwords kept simple is that users tend to forget passwords. Because biometrics are difficult if not impossible to forget, they offers greater convenience than systems based on remembering multiple passwords or on keeping possession of an authentication token. Given the increased awareness of security issues in the enterprise and in customer-facing application, the need for strong auditing and reporting capabilities has grown more pronounced. Biometrics can provide a greater degree of security compared to traditional authentication methods, meaning that resources are accessible only to authorized users and are kept protected from unauthorized users. Passwords tokens can be stolen. By contrast, biometrics data cannot be guessed or stolen in the same fashion as a password or token. Thus biometric authentication systems offer higher security.

1.4.2 Determine The Possibility Of Applying Neural Network In Biometric
      Authentication System

Authentication is always the first line against attacks. Handwriting signature authentication eliminates phenomena such as buddy-punching and provides a high degree of certainty as to what user accessed what computer at what time, with that, increase accountability.

Brian Cogan said:

'Neural networks represent a new computing paradigm based on the parallel architecture of the brain. They can be "trained" to produce an accurate output for a given input', [1].

Theoretically neural network seems to be appropriate for the task of signature verification for these reasons:

a. NN has the ability to learn and generalize. This should be enabling NN to cope with the diversity and variation of signatures.

b. The speed of NN towards an input is extremely fast once the learning is achieved. This is an important consideration if an automated system is to be developed for treating a flow of signatures.

c. NN learning process can continue with newly presented signatures to follow their evolution over time. Also, it should be possible to retrain a NN using new signatures.

1.4.3 Study The Most Suitable Method To Store Biometric Data

Biometric storage issue is a critical topic in biometric systems since disclosure of biometric data will bring up certain humanity issues such as gene discriminations. Biometric data need encryption to protect and be fair to system users. Research will be conducted and at final stage, the possible of biometric data storage will be proposed.

1.4.4 Determine Necessary Performance Measures For Biometric Authentication System

Biometric authentication systems need to be evaluated. This project studies set of possible performance measures to evaluate a biometric system.

Bare in mind that biometric authentication is providing fraud-reducing functionality instead of replacing passwords or PINs. Biometric authentication technologies somehow complement the current IT security technologies; consequently upgrade the security level in human civilization as a whole.

1.5 Project Scope

The project purpose is to determine relationship between neural network algorithm and biometric authentication generally and workflow of handwriting signature authentication specifically. Researcher runs survey and sampling on existing handwriting signature authentication programs. This project also includes the construction of a new handwriting signature authentication application and seeking the possibilities to integrate the existing sample programs with the newly built application under supervisor's monitor. Few important aspects such as impact

of implementation, cost involved, chances of successive practice in real environment and robustness are also matter of concern.

Figure 1.1 shows the typical process of granting authentication from a handwriting signature authentication application. Biometrics can provide incredibly convenient authentication, but can also suffer from a variety of shortcomings. This project also will discuss about the limitations of using handwriting signature authentication application. In this research, signature recognition is off-line and only concern with the authentication problem. Further, though off-line systems have to cope with different pen types, thickness and speed, in the research, the process is simplified by using one electronic pen to produce all signatures. The idea of integrating this system with other drawing tools also one of the missions for this project.

Boundaries of this project are limited to the workflow of handwriting signature authentication as well as the advantages and disadvantages of the method. Other behavioral authentication methods will not be discussed further. An application that can be able to recognize handwriting signature and make comparison with matching record available in record files is the expected finite outcome of this project.
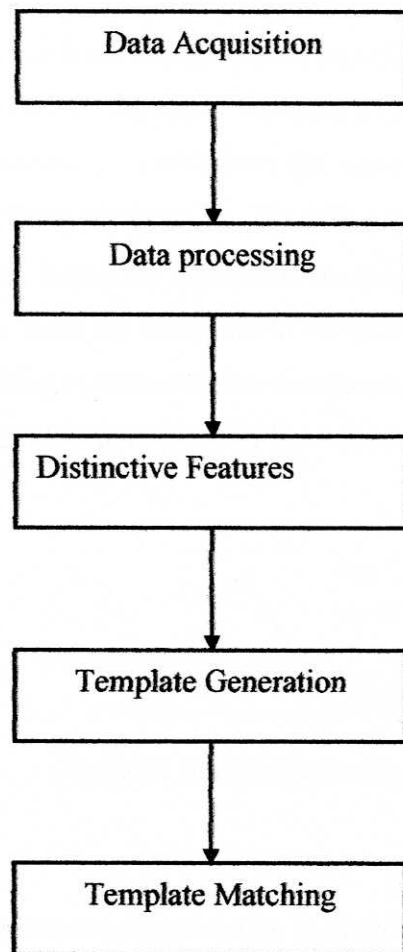
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Figure 1.1: Process of handwriting signature authentication

1.6 Contribution

For centuries, people have relied on guards, spoken passwords and hard-to-forge seals to prove identity and to verify important messages. Eventually the authentication evolves to PINs and passwords when computers arrive to complement human's life. However, PINs, passwords and tokens are no longer sufficient against the attack by unauthenticated intruders. Users also tend to forget and face difficulties while using passwords.

New technologies that offer higher security level are in active research area to guard confidential data and applications. Biometric is the solution for all.

Handwriting signature has been recognized as an authentication method long time ago and has been proven its efficiency. Building an application that implies the neural network of human brain to recognize the signature of different person will definitely a good idea for authentication. By doing research on handwriting signature authentication, hopefully could find the most suitable, fastest, most economic algorithm to teach the machines to recognize handwriting signature. Consequently handwriting signature authentication can be widely used in electronic world. Figure 1.2 suggests a paradigm for biometric authentication system.
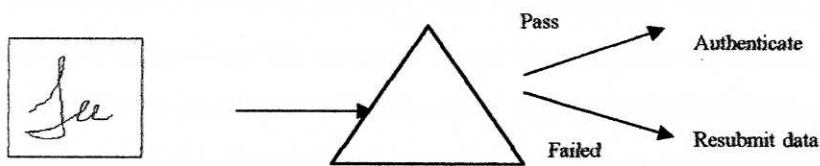

Figure 1.2: Suggested authentication process.

Handwriting signature authentication is likely to play a modest role in the biometric industry, integrated into applications and processes in which signatures are already acquired and in which nonrepudiation of a transaction is an important element. Although handwriting signature authentication seems less popular compare to other biometric elements but it is predicted to be shine like a bright star in the future. Researcher gets to understand what exactly is handwriting signature authentication, from IT security point of view. Research on the handwriting signature will definitely bring positive impacts not far away from now. This project can be a reference or additional reading for those who are interested in biometric authentication and handwriting signature authentication, while provide basic overview to interested amateur readers and embark experts for more innovative ideas.

1.7 Expected Output

As the project title sounds like- Application of Neural Network Algorithm in Biometric Authentication, this project is intend to analyze and identify the role played by neural network algorithm in biometric authentication matters by doing research regarding on handwriting signature authentication. Signature authentication technology utilizes the distinctive aspects of the signature to verify the identity of individuals. The technology examines the behavioral components of the signature, such as stroke order, speed and pressure, and by comparing visual images of signatures. The technology has not seen broad usage, but could eventually be widely utilized in electronic document authentication. Signature authentication is a field worth paying attention. An application program that can be integrated with other software to control logical access in a system will be developed as the final outcome of this project.

1.8 Report Organization

This paper consists of eight chapters. In the earlier chapters (Chapter I to Chapter V) are related to design issues while the program implementation issues can be found from Chapter VI onwards.

Chapter I provides introduction and explain briefly on what the project meant to be. This includes project overview, project objectives, problem statements, project mission, project scope, project contributions, expected output and report organization.

Chapter II is literature review and research on previous work done regarding on handwriting signature authentication. Research approach is stated in Chapter II. Conclusion of Literature Review will be drawn at the end of chapter.