

OFFLINE SIGNATURE VERIFICATION BASED ON
IMPROVED EXTRACTED FEATURES USING NEURAL
NETWORK

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This dissertation is dedicated to my family for their endless support and encouragement.

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“In the Name of Allah, Most Gracious, Most Merciful”

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ABSTRACT

The verification of handwritten signatures is one of the oldest and the most popular biometric authentication methods in our society. A history which spans several hundred years has ensured that it also has a wide legal acceptance all around the world. As technology improved, the different ways of comparing and analyzing signatures became more and more sophisticated. Since the early seventies, people have been exploring how computers may aid and maybe one day fully take over the task of signature verification. Based on the acquisition process, the field is divided into on-line and off-line parts. In on-line signature verification, the whole process of signing is captured using some kind of an acquisition device, while the off-line approach relies merely on the scanned images of signatures. This thesis addresses some of the many open questions in the off-line field. In this thesis, we present off line signature recognition and verification system which is based on image processing, New improved method for features extraction is proposed and artificial neural network are both used to attend the objective designed for this thesis, Two separate sequential neural networks are designed, one for signature recognition, and another for verification (i.e. for detecting forgery). Verification network parameters which are produced individually for every signature are controlled by a recognition network. The System overall performs is enough to signature recognition and verification signature standard and popular dataset, In order to demonstrate the practical applications of the results, a complete signature verification framework has been developed, Which incorporates all the previously introduced algorithms. The result was very good comparing with other work, sensitivity was more than 0.94% and 0.80% for training and testing data respectively, and for specificity it was more than 0.78% and 0.74 for training and testing data respectively, and for specificity. The results provided in this thesis aim to present a deeper analytical insight into the behavior of the verification system.

ABSTRAK

Pengesahan tandatangan tulisan tangan adalah salah satu yang tertua dan yang paling popular kaedah pengesahan biometrik dalam masyarakat kita. Sejarah yang menjangkau beberapa ratus tahun telah memastikan bahawa ia juga mempunyai penerimaan undang-undang yang luas di seluruh dunia. Sebagai teknologi yang lebih baik, cara-cara yang berbeza membandingkan dan menganalisis tanda tangan menjadi lebih dan lebih canggih. Sejak awal tahun tujuh puluhan, orang telah meneroka bagaimana komputer boleh membantu dan mungkin satu hari sepenuhnya mengambil alih tugas pengesahan tandatangan. Berdasarkan proses pengambilalihan, keseluruhan proses tandatangan ditangkap menggunakan beberapa jenis alat pemerolehan. Tesis ini menyentuh beberapa banyak soalan terbuka dalam bidang di luar talian. Dalam tesis ini, kaedah baru yang lebih baik untuk pengekstrakan ciri adalah dicadangkan dan rangkaian neural tiruan kedua-duanya digunakan untuk menghadapi objektif direka untuk tesis ini. Dua berasingan rangkaian neural berurutan direka, satu untuk pengiktirafan tandatangan, dan satu lagi untuk pengesahan (iaitu untuk mengesan pemalsuan). Parameter rangkaian pengesahan yang dihasilkan secara individu untuk setiap tandatangan dikawal oleh rangkaian pengiktirafan. Sistem keseluruhan melakukan cukup untuk pengiktirafan tandatangan dan pengesahan standard tandatangan dan dataset popular. Dalam usaha untuk menunjukkan aplikasi praktikal dalam keputusan, rangka kerja pengesahan tandatangan yang lengkap telah dibangunkan, yang menggabungkan semua algoritma diperkenalkan sebelum ini. Hasilnya adalah sangat baik membandingkan dengan kerja lain, kepekaan adalah lebih daripada 0.94 % dan 0.80 % bagi latihan dan ujian data masing-masing, dan untuk kekhususan ia adalah lebih daripada 0.78 % dan 0.74 untuk latihan dan menguji data masing-masing, dan untuk kekhususan. Keputusan yang diberikan di dalam tesis ini bertujuan untuk membentangkan gambaran analisis yang lebih mendalam ke dalam tingkah laku sistem pengesahan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In terms of identification and verification, many studies have been done by scientists and engineers in the field of Computer Science, particularly on human biometrics. The biometric is the most commonly defined as measurable physiological such as finger print, DNA, iris of eye and behavioral characteristics of the individuals like handwriting, signature, voice, and gait.

1.2 Background of Problem

The style of a person's handwriting is a biometric feature that can be used for authentication. Researches in this field have been started since 1970s and until now it is still fast growing field to explore and various methods for various types of classification have been investigated for this issue. However, most of them are not extendable to other languages, because every language has their own specific characteristics and several writing styles. One of the biggest problems that they encounter to find a language-independent method is the features dissimilarity for different languages (Helli & Moghaddam, 2010).

Signature is another behavioral biometric that is mostly like handwriting and very useful for individual authentication, but there are some characteristics that make it different from handwriting (Shanker & Rajagopalan, 2007). For instance most of the signature styles are independent to the language of person who sign, in some cases they are just a painting consist of curved shape lines even if it is mixed with somehow name writing. This could be advantage and also disadvantage for starting a research on new methods for signature verification, in case of advantage it will help us to focus our research on algorithms which are in independent-language classification. It means that we will not have any problem for different language signatures and can increase the compatibility of applications on this issue without any specific situation like other methods. However, due to this characteristic that persons don't follow exact rules in their signatures make it difficult to find a new method for extracting the signature features that could be expandable to other languages.

In general, signature verification systems can be categorized into two main classes: offline like (D. Samuel & I. Samuel, 2010; Shanker & Rajagopalan, 2007; Wen, B. I. N. Fang, Y. Y. A. N. Tang, T. A. I. P. Zhang, & Chen, 2007) and online systems (Khalid, Mokayed, Yusof, & Ono, 2009; Yanikoglu & Kholmatov, 2009). Due to available dynamic information such as pressure, acceleration, stroke orders, angle and etc, online verification systems are more accurate. Thus, online classification task considered to be less difficult than offline one.

1.3 **Statement of Problem**

Because of the importance of offline signature verification on discriminating the genuine signature from the forgery and its useful application in bank service and forgery detection, it is necessary to provide an accurate person identification method based on signature. In this research we want to propose an offline, language-independent signature verification method. Our feature extraction and data representation are all new in field of signature verification and have not been presented before in this domain.

Our feature extraction filter is orientation of the Skelton combination by gravity center point that has been used in literatures frequently but separately for pattern based features extraction. Also, in similarity matching we will use a graph matching that can be done with graph similarity algorithms to do the classification phase. We hope our method can verify all signatures with high level of accuracy and performance.

1.4 **Research Questions**

1. How can we design a new approach for Automatic signature verification based on new features extracted by new division technique of signature image to develop an improved extracted pattern features based ?
2. How can we verify the signature feature extracted using neural network ?
3. How can we implement whole accurate system independent offline signature verification ?

1.5 **Purpose and Objectives**

Automatic signature verification remains as an interesting area of study for researchers to date. Generally speaking due to high level of acceptance and usage of signature verification systems like automatic cheque clearing system in banks, this kind of system is highly desirable in applications. Unfortunately, because of sensibility of handwriting signatures to forgeries, achieving an offline system with high performance and accuracy is a challenge involved with it. Many researchers are trying to find better feature extraction methods every day; this made us start a new study to work on a new accurate offline signature method.

The objectives of this study are:

1. To develop an improved extracted pattern features based on angular span and distance span division of signature image.
2. To verify the offline signature features using neural network classifier.
3. To verify and implement a whole accurate language independent offline signature verification system for skilled and random forgery detection.

1.6 **Scope of the Study**

For test and experiment the system performance we will use SigComp11-NFI signature collection dataset as our signature resource for learning and testing individual identification, because SigComp11-NFI signature collection dataset is one of the most popular databases which is used for performance estimation.

1.7 **Significance Of The Study**

The most important output of this study is an offline signature verification system with some special advantages. First, our system can be used to discriminate the genuine signature from skilled or random forgery one with high performance and accuracy in a very short time. This achievement is due to our new feature extraction method with low rate of errors and optimal graph matching algorithm in classification level of system learning. Second, our system is able to work for every author with different languages because it is a language-independent system.

1.8 **General Framework**

This study starts with the SigComp11-NFI signature collection dataset. The second step involves the design and implementation of the proposed method which

includes feature extraction and neural network classifier. The next step is the evaluation of the proposed method. Figure 1.1, depicts the framework of this study.

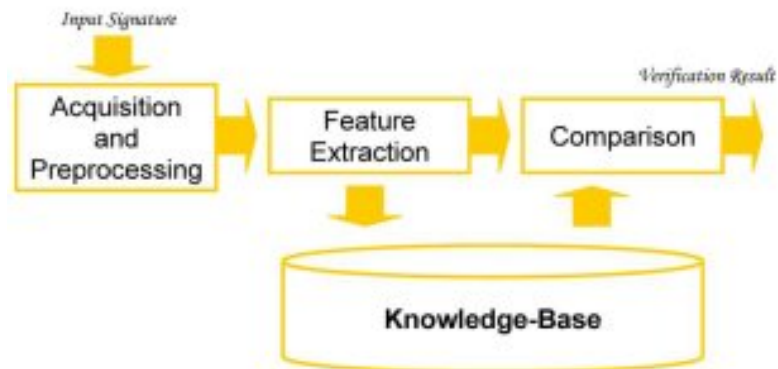


Figure 1.1 Framework of the study

1.9 Organization of the Dissertation

This chapter discussed the general idea of the project and shows this domain is still viable and interested among researchers. In the following chapters a more in-depth idea of proposed method will be discussed.

This project is organized as follows: in chapter two some recent methods and literatures are presented in order to become more familiar and understand better of this domain. Chapter three explains the whole methodology and algorithms used to implement our initial experimental results are presented in chapter four. Finally the conclusion in the end of this report.

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