Research Methodology on Offline and Online Signature Verification and Forgery Detection

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Abstract

This research review paper discusses about Offline and Online Signature Verification and Forgery Detection.In this paper we discuss various methods used in offline signature verification like DTW,HMM,GMM and Fuzzy Modellig. We propose to use SVC2004 Database of online signatures, making use of various measurements a digital signature tablet provides for the modelling of verification and forgery detection system.

Keywords

Signature Verification, Forgery Detection, Offline and Online Design.

I. INTRODUCTION

Biometrics is an emerging field of technology. It makes use of unique but measurable physical, biological or behavioral characteristics to perform the identity verification of a person. Physiological biometrics is based on direct measurements of physical parts (such as fingerprint, face, iris, hand geometry etc.) of human body. Behavioral biometrics is based on the measurement of an action performed (such as signature, gait, speech, gesture etc.) by the individual[1]. The main advantage that signature verification has over other forms of biometric technologies is that signature is a well accepted biometric for identity verification in our society for years. The long history of trust of signature verification means that people are willing to accept a signature based biometric authentication system. But the drawback is that some people exhibit a lot of variability between different manifestations of their signature. The way a person signs his or her name is known to be characteristic of that individual. Signatures are influenced by the physical and emotional conditions of a subject. A signature verification system must be able to detect forgeries, and, at the same time, reduce rejection of genuine signatures. Also signatures evolve with time and are influenced by physical and emotional condition of the signatories.

Signature analysis is categorized into two modes: offline and online. In the offline signature verification, signatures are captured with a scanner or camera, saved and stored in digitized form for further processing whereas the online signature verification uses an electronic tablet and a stylus connected to a computer to extract information about a signature. It provides dynamic information like pressure Signature being a behavioural biometric and it is mainly used in bank checks to make transactions. Unlike physiological biometrics such as face, iris, and fingerprint, it is fraught with the problem of change over a time and it is not difficult to forge. One of the main challenges in signature verification is related to the signature variability. While signatures from the same user show considerable differences between different captures (high intra-class variability), skilled forgers can perform signatures with high resemblance to the user's signature (low intra- class variability). Signature verification aims at using such properties for making reliable authentication. However the widespread acceptance of the signature by the public makes it more suitable for certain lower-security authentication needs. However, signature verification is a challenging task due to practical constraints. For instance, MasterCard estimates a $450 million loss each year due to credit card fraud, likewise some billions of dollars being lost because of fraudulent encashment of checks. Reliable automatic signature verification could be a proper solution to reduce such losses since handwritten signatures are already involved in the credit card transactions and encashment of bank checks.

Importance of online Signature Verification:

Signature is a special characteristic of any person. As signatures continue to play an important role in financial, commercial and legal transactions, truly secured authentication systems becomes more and more crucial.

A signature of an authorized person is considered to be the "seal of approval" and remains the most preferred means of authentication. On the other hand, the intrepidity of signature fraud continues to be on the rise dramatically. The measurements collected from a digital signature while it is being written are as unique to an individual as his DNA. Signature images can be captured using a pressure-sensitive digital pad. Signature verification is natural and intuitive. The online signature gives more information than the offline signature to verify. Moreover the chances of forgery are lesser here than in the offline signatures since online signature is based on real time.

Motivation:

The manual verification of signatures is based on template or sample signatures. There are a very few organizations which use the online signature verification technology to verify the signature of a given user. In a country like India, where the majority of the population still rely on the handwritten signatures for all their banking needs, the scope for forgery is quite high. Therefore, online signature verification technology will not only be helpful to the users but will also make the banking system safer. Since the system only requires a digital signature tablet and an electronic pen, the infrastructure needs are also low, thus proving to be the biometric of choice.

II. LITERATURE SURVEY

The online signatures verification techniques can be classified into two broad areas:

1. Methods based on features extracted from the visible parts of the signature and

2. Methods based on features extracted from virtual strokes or individual parts of the signature (the parts that are not created but are presumed).

The widely used approaches for the signature verification include:

A)   Dynamic time warping (DTW)

Dynamic time warping matches two signatures by aligning the pen-tip trajectories along a common time axis. The resulting distance depends on the sequence length of the two signatures and needs to be compared with a threshold to accept or reject the claimed identity. In this context, a major challenge for statistical analysis is the computation of a normalized distance value that is comparable between signatures of the same user as well as signatures of other user

B)   Hidden Markov Models (HMM)

Hidden Markov Model is used to model the changes in the discrete time signal. In essence, HMM is a double statistical process which is bound by Markov chain with a finite set of states and a set of probability functions combined with the output of an observer status. At the specific time t, the process will be in one of the states and it generates an observation symbol according to probability function corresponding to the current state [14].

C)   Gaussian Mixture Models (GMM)

A GMM is a parametric probability density function represented as a weighted sum of Gaussian component densities. GMMs are commonly used in different tasks as a parametric model of the probability distribution of continuous measurements

*D)   Fuzzy modelling and neural networks*

Global features of the signature like the skeleton of the pen trace and the structure of upper and lower envelope are used as shape descriptors. These are obtained by sampling upper and external points from the binary image of the signature. High pressure regions where the writer applies more pressure or emphasis are used for maximizing the correlation between the vertical and horizontal projections of the skeleton. For each of the above shape descriptors a multi- layer perception is assigned and the network is trained with a modified back propagation algorithm and the output of each individual network is combined through a fuzzy integral voter.

3. Acquisition of On-line Signatures:

The First International Signature Verification Competition was held in 2004 to provide landmark on signature verification systems SVC 2004.The signature database SVC2004(Task2) is taken from the University of Science and Technology, Hong Kong and used for the verification. This database consists of 40 persons each having 20 genuine datasets stored in a text file.The database has two sets of signatures, namely Task 1 and Task 2. Each signature is represented as a sequence of points , which contains X coordinate , Y co-ordinate , time stamp and pen status (pen up or down) along with the additional information like Azimuth, Altitude and pressure in Task 2[18].The signature is acquired from a Digital Signature Tablet (WACOM STU-500 SDK) when the instrumented pen moves on the tablet. Each signature is simply represented as a set of discrete time dynamic sequences.

A total of 1600 signatures, including forgeries of different sizes is collected from a group of 40 peoples containing 6 skilled forgers. The database is divided into two kinds of forgeries: simple forgeries and skilled forgeries. In the simple forgery the imposter only knows how to spell the authentic signature whereas in the case of a skilled forgery, the imposter has an access to the genuine signature and also time to practice the imitations. The raw data available from the tablet consists of X, Y co-ordinates, pressure and time. Fig 1 below shows Signature samples.
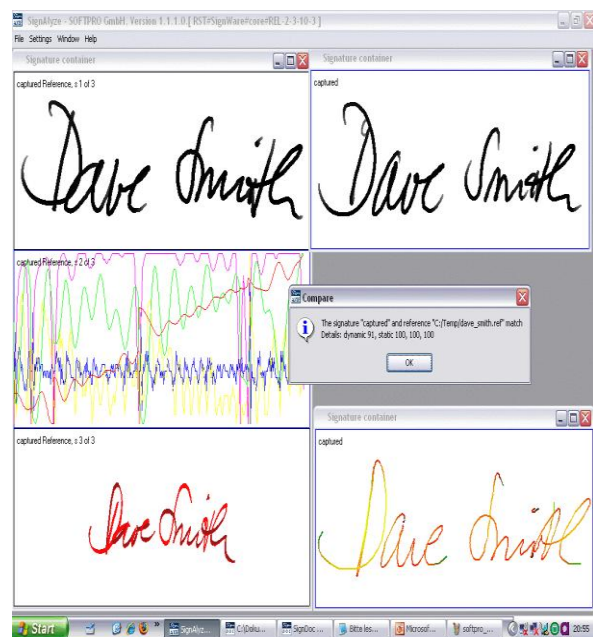
Fig 1: Signature Samples

A digital signature tablet provides the following measurements while a signature is being written:

1)   ΔX - X co-ordinate of the signature(x_k).

2)   ΔY - Y co-ordinate of the signature(y_k).

3)   Pressure - The pressure value of the pen i.e. the pressure applied by the user for his or her signature(p_k). It is assumed that the digital signature tablet senses the equal force at each point of the screen.

4)   Button Status- This keeps track of the pen movement(b_k), i.e. whether it is moving up or down with respect to time.

5)   Azimuthal angle- The angle between the user's pen and the line perpendicular to the surface of the screen(Az_k).

6)   Altitude angle – The angle between the users' pen and line horizontal to the surface of the screen (Az_k).

7)   Velocity – The speed of user's signature.

8)   Acceleration- The acceleration of the user's signature.

A sample at time tk consists of six measurements ($x_k,y_k,p_k,b_k,Al_k,Az_k$).We have not used the velocity and acceleration in this work. It may be noted that the time taken by different signatures of the same person may or may not be the same.

III.PROPOSED RESEARCH METHODOLOGY

Objectives:

The following are the objectives of our thesis proposal:

1) Offline signature verification and forgery detection using checks (Angle based/CNN based).
2) Design of entropy network for off-line signature verification.
3) On-line signature verification using on-line measurements.
4) Design of entropy network for the verification of on-line signatures.
5) Development of a secure signature verification system.
Issues involved in Signature Verification:
Some of the issues that we want to address are the following:
1) Categorization of signatures into different types(name, graphics form).
2) Categorization of forgery into skilled and unskilled types.
3) Investigation of suitable features for off-line signature verification.
4) Development of appropriate models for representing features of off-line signatures and measurements of on-line signatures.

5) Devising different performance measures for the evaluation of models.

6) How to store signatures in a secured environment.
7) Investigation of distributed computing like Hadoop for real-time performance of verification of signatures.

Several approaches have been investigated. But the uncertainty in the signatures which arises due to inherent variability has not been attempted. We are therefore motivated to pursue uncertainty representation in the signatures in the case of off-line signature verification or measurements in the case of on-line signature verification. As the entropy is a measure of disorder or uncertainty, we will explore the use of entropy both for feature extraction and subsequent verification. Some studies are already available in the literatures on biometrics. Signature being a behavioural biometric, it is prone to inherent variation in handwriting. So we will explore the entropy based uncertainty representation for the signature verification.

IV.CONCLUSION

This research review paper discusses about Offline and Online Signature Verification and Forgery Detection.

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