



Signature Verification Using Image Processing Techniques

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ABSTRACT

The major problem associated with signature verification is the availability of limited data. As signature data are legally accepted as the authentication means for many financial or other official works, this is difficult to have a sufficient amount of data required to develop a signature verification system. As a result, robust parameter estimation on limited sample sets is still one of the major research issues in this field. One technique to address this problem is to extend the techniques of classical model adaptation for discriminative training. The other challenging problem in offline signature verification is the feature extraction process. Choice of features depends on the style of the signatures and hence different styled-signatures will have different characteristic features. So, it is difficult to develop one general system to classify every style of signatures. Signatures in different scripts may not be recognized by a single classifier or even a classification system. It has been observed that most of the researchers have proposed or developed their systems for a limited type of signatures. However achieving an acceptable accuracy in various individual signature styles will make it Handwritten signature recognition can be divided into online (or dynamic) and off-line (or static) recognition. Online recognition refers to a process that the signer uses a special pen called a stylus to create his or her signature, producing the pen locations, speeds and pressures, while off-line recognition just deals with signature images acquired by a scanner or a digital camera. In general, offline signature recognition is a challenging problem. Unlike the on-line signature, where dynamic aspects of the signing action are captured directly as the handwriting trajectory, the dynamic information contained in off-line signature is highly degraded. Handwriting features, such as the handwriting order, writing-speed variation, and skilfulness, need to be recovered from the grey-level pixels. In the statistical approach, each pattern is represented in terms of N features and is viewed as a point in a N -dimensional space. The effectiveness of the representation space (feature set) is determined by how well patterns from different classes can be separated.

KEYWORDS : Signature Verification, Image Thinning

Introduction

The fact that the signature is widely used as a means of personal verification emphasizes the need for an automatic verification system. Verification can be performed either Offline or Online based on the application. Online systems use dynamic information of a signature captured at the time the signature is made. Offline systems work on the scanned image of a signature. In this paper we present a method for Offline Verification of signatures using a set of simple shape based geometric features.

The features that are used are Baseline Slant Angle, Aspect Ratio, Normalized Area, Center of Gravity and the Slope of the line joining the Centers of Gravity of two halves of a signature image. Before extracting the features, preprocessing of a scanned image is necessary to isolate the signature part and to remove any spurious noise present. The system is initially trained using a database of signatures obtained from those individuals whose signatures have to be authenticated by the system.

For each subject a mean signature is obtained integrating the above features derived from a set of his/her genuine sample signatures. This mean signature acts as the template for verification against a claimed test signature. Euclidean distance in the feature space between the claimed signature and the template serves as a measure of similarity between the two. If this distance is less than a pre-defined threshold (corresponding to minimum acceptable degree of similarity), the test signature is verified to be that of the claimed subject else detected as a forgery.

Related Works

This paper verifies the offline signatures in bank cheques. Boundary of the entire signature is taken and a pixel comparison is done. Detection process is done after data acquisition and preprocessing. Experimental results show 50% accurate matching with the existing signatures in the database. Signature is acquired using a scanner. [1]

This paper describes an off-line signature identification process based on Fourier Descriptor (FDs) and Chain Codes features. Signature identification is classified into two different problems: recognition and verification. In the recognition process, Principle Component Analysis is used. In the verification process a multilayer feed forward artificial neural network is designed. Experiments on real data sets show that the average error rate can be up to 3.8%. [2]

This paper proposes a signature recognition and verification system based on global, grid and texture features sets. A unique two stage Perceptron OCON (one-class-one-network) classification structure has been implemented for each one of these feature sets. In the first stage, the classifier integrates the decision results of the neural networks and the Euclidean distances obtained using the three feature sets. The results of the first-stage classifier are fed to a second-stage radial base function (RBF) neural network structure, for the final decision. The system showed high recognition and verification rates during experimentation. [3]

In this paper, a method for off-line Persian signature identification and verification is proposed. Since a Persian signature consists of a graphic rather than text, therefore a method different from identification of a text signature is required. This method is based on Image Registration, DWT (Discrete Wavelet Transform) and Image Fusion. In the image registration stage training signatures of each person are registered to overcome shift and scale problem. In the next stage features are extracted using DWT, to access details of signature. In the Image fusion stage several registered instances of each person's signatures are fused together to generate a reference pattern of a person's signatures. Finally, in the classification phase, Euclidean distance between the test image and each pattern is used in different sub-bands. Experimental results confirmed that the proposed method is highly effective. Taking advantage of the unique nature of this method in identifying graphic patterns this method can be used for identification of signatures in any language. [4]

This paper proposes a new method for off line signature verification and identification. The proposed method uses local Radon Transform as a feature extractor. The main idea of our method is to use Radon Transform locally for line segment detection and feature extraction, rather than using it globally. The advantages of the proposed method are robustness to noise, size and shift invariance. Support Vector Machine (SVM) is used as a classifier. Experimental results have been obtained on a dataset of 600 signatures from 20 Persian writers, and another dataset of 924 signatures from 22 English writers. The experimental results of this method are compared with two other methods. The comparison shows the method to have good performance in different types of signature in different cultures [5].

The procedure used in this paper extracts features from handwritten signature images. The extracted features are used for verification using a clustering technique [6].

This study proposes an algorithmic approach for the verification of handwritten signatures and applies statistical methods. An individual's average signature, based on a collection of a set of signature, was obtained using an algorithm. The decision of acceptance was taken after analyzing the correlation between the sample signature and the average signature [7].

This study proposes a new method for static handwritten signature verification based on an ensemble classifier. The proposed ensemble classifier improves accuracy by combining the output of the three simple classifiers. In this method, after pre-processing stage, the signature image is convolved with Gabor wavelets to compute the Gabor coefficients in different scales and directions. The resulting Gabor coefficients are used for extracting three different feature sets using statistical approaches. A nearest neighbor classifier classifies each feature set by an adaptive method. Although these simple classifiers look the same, but the different input feature set and the adaptive thresholds related to each classifier make them different from each other. The proposed method was experimented on Persian and South African signature datasets. Experimental results showed that this technique had the lowest error rate in comparison with other methods [8].

This paper describes a method for Off-line Handwritten Signature Verification. It measures the stroke gray-level variations by means of wavelet analysis and statistical texture features. First of all the background is removed. Next Wavelet Analysis is done to estimate and remove the global influence of the ink-type. Finally, properties of the Co-occurrence Matrix are used as features representing individual characteristics at local level. Real life samples were used to train an SVM model then professional and arbitrary forgeries were used for testing it. Results proved the practical usefulness of the proposed scheme [9].

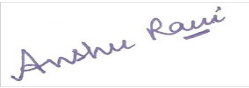
This paper presents a survey of various approaches and issues related to offline signature verification systems [10].

Signature Image Acquisition

Signature image is acquired using digital image scanner device. In computing, an image scanner—often abbreviated to just scanner—is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Common examples found in offices are variations of the desktop (or flatbed) scanner where the document is placed on a glass window for scanning. Hand-held scanners, where the device is moved by hand, have evolved from text scanning “wands” to 3D scanners used for industrial design, reverse engineering, test and measurement, orthotics, gaming and other applications. Mechanically driven scanners that move the document are typically used for large-format documents, where a flatbed design would be impractical.

Signature Image Preprocessing

The acquired signature image is now brought under some image pre-processing operations in order to enhance, thinning and binarization of the image. Finally, the signature image is obtained in true binary form with white as back ground and black as signature ink impression. Below images show the results:



Original Image



Processed Image



Image after Thinning

Signature Image Features

Signature Image after preprocessing is now applied to feature extraction algorithm, where a feature vector set is generated that is used to verify the signature with the database depository. Following features are extracted from the processed signature image:

- 1. Average No. of Pixels along x-axis from the signature start line (P1)
- 2. Distance graph from origin to each pixel on signature image (P2), Av. Distance from Origin
- 3. Signature Bounding Box Area (P3)
- 4. No. of pixels per unit bounding box area (P4)
- 5. Figure Aspect of the bounding box (P5)

Results

Following table shows the results obtained with different signature images:

Sig. Image	Total Sig. Pixels	P1	P2	P3	P4	P5
	1250	35	67	620	0.496	1.23
	2051	84	54	986	0.481	2.54
	1587	63	60	754	0.475	1.78

Conclusion

The proposed algorithm, uses various geometric features to characterize signatures that effectively serve to distinguish signatures of different persons. The system is robust and can detect random, simple and semi-skilled forgeries but the performance deteriorates in case of skilled forgeries. Using a higher dimensional feature space and also incorporating dynamic information gathered during the time of signature can also improve the performance. The concepts of Neural Networks as well as Wavelet transforms hold a lot of promise in building systems with high accuracy.

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