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Offline Signature Verification Using Chain Code and Wavelet Feature

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Abstract—*Abstract - Signature verification is a topic which is being discussed among the researchers for long time .Off-line signature data is 2-D image representation. Offline signature verification is a process of verifying the signature on the basis of feature of signature either it is genuine or forged. The purpose of Offline Signature Verification is to authenticated signature. A robust system has to be designed which should also detect various types of forgeries .The system should neither be too sensitive nor too coarse. It should have an acceptable trade-off between a low False Acceptance Rate (FAR) and a low False Rejection Rate (FRR). So we present a new approach which yields more accurate result as compared to the already existing algorithms. The application of Offline Signature Verification is to identity theft, signature in retail, banking etc.*

The Algorithms are based on the chain code and Wavelet feature which are called as Feature points in our thesis. As Feature points increases results will be more accurate but complexity and time require for testing will be more. So we have taken 64 feature points which improves security and maintains same complexity level. All calculations are done on the basis of these feature points. Results are expressed in terms of FAR (False Acceptance Rate) and FRR (False Rejection Rate) and subsequently compare these results with other existing Techniques. Results obtained by this algorithm are quite impressive. Random and Simple forgeries are eliminated and skilled forgeries are also eliminated in greater extent. As signature image is tested rigorously so FRR is more in the Algorithm proposed by us.

Processing Off-line is complex due to the absence of stable dynamic characteristics. Difficulty also lies in the fact that it is hard to segment signature strokes due to highly stylish and unconventional writing styles. The non-repetitive nature of variation of the signatures, because of age, illness, geographic location and perhaps to some extent the emotional state of the person, accentuates the problem. All these coupled together cause large intra-personal variation.

Keywords: *Chain code histogram, wavelet feature, FAR, FRR, SVM*

1. INTRODUCTION

The objective of the signature verification system is to discriminate between two classes: the original and the forgery, which are related to intra and interpersonal variability. The variation among signatures of same person is called Intra Personal Variation. The variation between originals and forgeries is called Inter Personal Variation. Signature verification is so different with the character recognition, because signature is often unreadable, and it seems it is just an image with some particular curves that represent the writing style of the person.

Signature is just a special case of handwriting and often is just a symbol. So it is wisdom and necessary to just deal with a signature as a complete image with special distribution of pixels and representing a particular writing style and not as a collection of letters and words. A signature verification system and the techniques using to solve this problem can be divided into two classes: online and off-line. In an online system, a signature data can be obtained from an electronic tablet and in this case, dynamic information about writing activity such as speed of writing, pressure applied, and number of strokes is available.

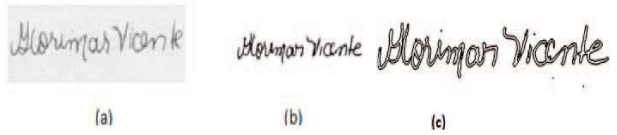
In off-line systems, signatures written on paper as has been done traditionally are converted to electronic form with the help of a camera or a scanner and obviously, the dynamic information is not available. In general, the dynamic information represents the main writing style of a person. Since the volume of information available is less, the signature verification using off-line techniques is relatively more difficult. Our work is concerned with the techniques of off-line signature verification. The static information derived in an off-line signature verification system may be global, structural, geometric or statistical. This paper is divided into four sections. Section II describes proposed method; Section III describes Test result and Section IV describes conclusion of a approach.

2. PROPOSED METHOD

In this section we present our approach of Offline Signature Verification which includes various modules. Fig. 1 shows an overview of the proposed architecture.

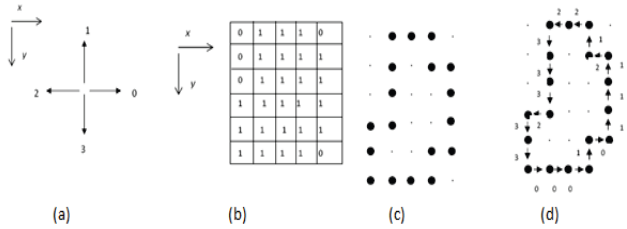
2.1 Preprocessing

Preprocessing is done after getting a scanned image by different technology such as scanner with 300 dpi. Preprocessing includes binarization (2.1a), Noise removal (2.1b) and contour extraction (2.1c).



2.2 Feature Extraction

We will apply wavelet feature with chain code feature which improves best signature pattern result. Chain code is a boundary based feature extraction which can be done with either 8-connectivity or 4-connectivity. Fig.2.2 (a) shows 4-connectivity of pixel in image. Fig.2.2 (b) shows pixel density of image which identifying on and off pixel. On pixel has a value '1' and off pixel has value '0' in matrix. Fig 2.2(d) shows pixel connectivity according to direction.



Global and local wavelet features are extracted from the image. The procedure employed in this stage is described in the following steps. First- the global features such as height, width and area are extracted from whole image. Second- DWT (Discrete Wavelet Transform) is applied on signature image and maximum vertical projection position and maximum horizontal projection position features are extracted from each of the three sub images.

2.3 Support Vector Machine

Next step is to classify nature of signature with using Support Vector Machine which tells us either it is genuine or forged signature. The SVM classifier is widely used in bioinformatics (and other disciplines) due to its high accuracy, ability to deal with high-dimensional data such as gene expression, and edibility in modeling diverse sources of data.

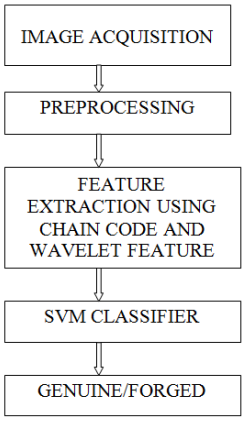


Fig. 1

SVMs belong to the general category of kernel methods; a kernel method is an algorithm that depends on the data only through dot-products. When this is the case, the dot product can be replaced by a kernel function which computes a dot product in some possibly high dimensional feature space. This has two advantages: First, the ability to generate non-linear decision boundaries using methods designed for linear classifiers and another less time consuming.

3. MEASURES FOR EXPERIMENTAL VERIFICATION

The following two parameters are used for the comparison of results of proposed approach and the existing approach. Those parameters are:

3.1 False Acceptance Rate (FAR)

It is defined as ratio of no. of feature acceptances divided by no. of identification attempts.

3.2 False Rejection Rate (FRR)

It is defined as ratio of no. of feature rejected divided by no. of identification attempts.

4. EXPERIMENTAL MEASURES

A database of about 130 signatures with 7 signatures per person was used for training. The signatures were scanned with a precision of 200 dpi.

Table 1: Comparison of Signature images on the basis of average values of FAR, FRR, value.

Publication	Extracted Feature	Verification Method	performance
Offline Signature Verification by using Pixel based Method	Chain code and Wavelet Feature	SVM	FRR-3.2 FAR-2.42
Off-line Signature Verification Using Contour Features	Length based and direction based	Euclidean distance based	FAR--9.44% FRR-8.2
A Multi-Hypothesis Approach for Off-Line Signature Verification with HMMs	States of signature	HMM	FAR-4.9% FRR-4.9
Fusion Of Static Image And Dynamic Information For Signature Verification	Contour Feature	Euclidean distance based	FAR-5.0% FRR-5.0

5. CONCLUSION

The algorithm uses simple wavelet and chain code 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. A larger database can reduce false acceptances as well as false rejections. Using a higher dimensional feature space and also incorporating dynamic information gathered during the time of signature can also improve the performance.

Our algorithm takes 64 feature points for threshold calculations, a small variation of a signature results in a large change in the values of threshold distance from the geometric center. Therefore in our algorithm the FRR value will not increased. So it is important for a user to sign his signature with utmost care so that there is not a large variation of his signature to his training signatures. Otherwise there is a probability of rejection of an original signature.

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