OFFLINE SIGNATURE IDENTIFICATION USING HIGH INTENSITY VARIATIONS AND CROSS OVER POINTS BASED FEATURE EXTRACTION

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Abstract

Signature has its own advantage in person identification. The facts that people usually do not putting text in it; rather they draw a pattern as their signature. Even today, numbers of transactions are increasing related to banking and businesses are being identified via signatures. The main difficulty lies in the variations of the geometrical representation of the signature which is closely related to the identity of human beings. Hence, development methods for genuine signature verification must be needed. When bundles of documents, e.g. bank cheques, have to be verified in a limited time, the manual verification of account holders' signatures is often tedious work. So there is a need of Automatic Signature Verification and Identification systems. For that different logic should be considered to process such signatures. The present paper is done in the field of offline signature identify by extracting some special domain features that make a signature difficult to forge. In this paper existing signature verification systems have been thoroughly studied and a model is designed to develop an offline signature idenfication system. Here off-line signature idenfication system that depends on high intensity variation based features as well as cross over points based features. Main aim is to take various feature points of a given signature and compares them with the test signatures feature points by choosing appropriate classifiers.

Keywords: *signature identification, database creation, preprocessing, high intensity variations and cross over points based features*

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1. INTRODUCTION

We all are aware about signing various documents. In our daily life we are doing lot of signatures either it starts from bank work or in personal documents. So it is necessary to determine the genuineness and authentication which require identification marks using signatures. Most signature verification system required perfect signature that must be done on proper fixed angle. This cannot all times possible that it must be samely aligned. In that situations the proposed system will reject the signature even though it will done by genuine person. Though various techniques are available for verification of bank cheques before Clearing, it creates unavoidable errors. Signature verification system fall into two categories according to the grasping of the information: On-line methodology and Off-line methodology.

On-line methodology includes pen through which signatures are inserted and which are further scanned by sensors. It also includes location, velocity of pen, acceleration and pen pressure, as functions of time. Online systems use this information captured during acquisition. These dynamic characteristics are specific to each individual and sufficiently stable as well as repetitive [1].

Off-line data is a two dimensional image of the signature which is scanned by various scanners. Off-line signature process is complex task due to the absence of dynamic geometry of signatures. Difficulty also comes in the fact that due to different modern and unconventional writing styles, it is harder to segment signature strokes. The nature as well as the different pattern of pen may also affect the nature of the signature obtained. Sometimes signatures of genuine person cannot do proper way due to illness, mood, and age relaxation or emotional behaviour. As a result large intra-personal as well as interpersonal variations are generating. An intelligent system has to be designed which should not only be able to consider these factors but also detect various types of forgeries within less amount of time. The system should neither be too sensitive nor too coarse. It should have an acceptable trade-off between a low false acceptance ratio as well as low false rejection ratio. The designed system should also find such kind of feature points that reduces less amount of storage as well as less amount of computational time [2].

2. TYPES OF FORGERY

The basic types of forgery include [1]:

1. **Random Forgery:** Random forgery is done by a person who doesn't know the shape and structure of the original signature. Fig.1 (b).
2. **Simple Forgery:** In this type of forgery the person concerned has a vague idea of the actual signature, but is signing without much practice. Fig.1 (d).
3. **Skilled Forgery:** This type of forgery considers appropriate knowledge about the original signature along with sample time for proper practice. Our proposed scheme eliminates random and simple forgeries and also reduces skilled forgery to a great extentFig.1(c).

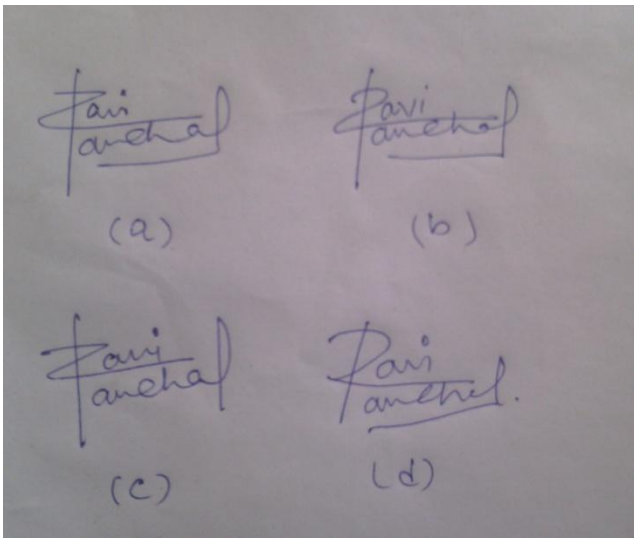


Fig-1 :(a) original signature,(b)random forgery,(c)skilled forgery,(d)simple forgery

3. RELATED WORK

A novel feature extraction scheme has been suggested for offline signature verification [1]. This method used the concept of feature extraction with help of identifying geometric centre as well as Euclidean distance of different signatures. The performance of classifier used here is faster as well better for feature extraction. Results that are achieved by this method are better than all existing methods. The process of Threshold selection is done with help of standard deviation and average.

Another method for off-line signature identification and verification is proposed based on the description of the signature envelope and the interior stroke distribution in polar and Cartesian coordinates [2]. In this paper, a new geometrical feature for an offline signature verification system (ASV) is used. The proposed features can be calculated with a fixed-point microprocessor. Therefore, the features can be extracted from inside a personal device such as a smart card. The system is check out with various classifiers like SVM, HMM and EDC for identifying forgeries.

The Improved Offline Signature Verification Scheme Using Feature Point Extraction Method [3] is proposed for reducing FAR compare to different proposed methods. The scheme is based on selection of 60 feature points from the COG of the signature and compares them with trained feature points. The classification of the feature points depends on mean and variance. A smaller change of a signature results in a large change in the values of threshold distance from the COG. Therefore in this algorithm the value of FRR is increased.

The generation of a digital skeleton is often one of the first processing steps taken by a computer vision system when attempting to extract features from an object in an image. Various algorithms have been proposed to produce the skeleton of a digital binary pattern. The Hilditch thinning algorithm [4] is widely used as a useful method of preprocessing in image process is proposed for speeding real-time process. Hilditch proposed an algorithm to obtain the skeleton of one object in an image. There are two versions for this algorithm, one using 4×4 mask and the other one using 3×3 mask. With a 3×3 mask image, the result of process output can be saved to a memory "table". The output results of all different 3×3 masks are saved to this "table" at the beginning of starting application. When an image will be processed, the thinning results of every 3×3 masks in the image can be extracted by the method of "looking for table". Thus the thinning result is same but the process speed is high.

A method based on multi-feature and multi-stage verification is proposed in paper [5] for Chinese signature. This paper carries out a two-stage verification to make decision. For an input image, extract its direction features firstly. If it is justified as forgery, the final output decision is forgery; if it is justified as genuine, and then extracts the dynamic features, to carry out the second stage verification, and the decision of the second stage is taken as the final decision.

There is another way to authenticate genuine signature by using Cross-validated Graph Matching (OSACGM) algorithm [6]. In this paper, OSACGM (Offline Signature Authentication using Cross Validate Graph Matching) algorithm is proposed, in which they use two concepts viz., Graph matching and Cross-validation for signature verification. The signature extraction method is used in pre-processing to obtain high resolution of signature for smaller normalization box. The signatures are compared by constructing a bipartite graph from which a minimum cost complete matching is obtained and the measure of dissimilarity i.e., the Euclidean distance is determined.

The idea of finding the location variations of the strokes of signature geometry for signature verification is proposed and tested [7]. Two methods are proposed. The first method helps

in determine the positional variation of the projection profiles of the signature, while the second method helps in finding out the actual positional variations of individual strokes in the 2-D signature patterns. In both methods, the statistics on these variations are computed. Here posional variations are finding out by applying various signatures as a input. The genuineness of the input is determined by judging the state of the training sets. The decision process involves the computation of a distance measure which takes the positional variations and the correlation between them into account.

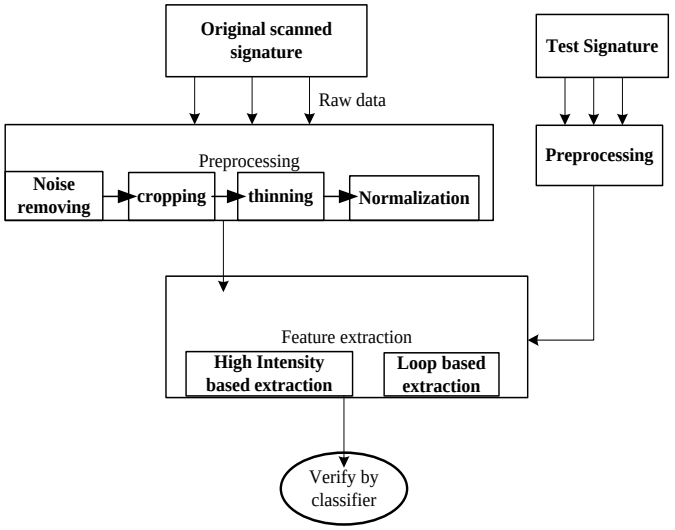
Another method for off-line Persian signature identification and verification is proposed that is based on Image Registration, DWT (Discrete Wavelet Transform) and Image Fusion [8]. Training signatures of each person are registered to overcome shift and scale problem. To extract features, at first, DWT is used to access details of signature; then several registered instances of each person signatures are fused together to generate reference pattern of person's signatures. In the classification phase, Euclidean distance between the test image and each pattern is used in different sub bands. Experimental results confirmed the effectiveness of the proposed method.

The method for identifying genuineness of bank cheque signatures is proposed [9]. It describes how signature is identifies in cheques using various verification algorithm. Here proposed algorithm can be used for an effective signature verification system in the banking industry. The proposed methodology verifies a cheque by recognizing and analyzing the major details in a cheque, which includes the account holder's signature. The results show the FAR and FRR in the verification process and the success ratio.

In [11] the author presented new approach for signature region of interest pre processing. He used new auto cropping preparation on the basis of the image content, where the intensity value of pixel is the source of cropping. This approach provides both the possibility of improving the performance of security systems based on signature images, and also the ability to use only the region of interest of the used image to suit layout design of biometric systems.

4. PROPOSED SYSTEM ARCHITECTURE

In order to design a system, which will detect the forge signatures by comparing some special features with original one, the following architecture has been proposed.



The design process can be categorized into three main parts:

- Preprocessing
- Features extractions from both genuine and test signatures and
- Compare the extracted features between them.

4.1 Pre Processing

The principal objective of preprocessing is to obtain a transformed image with enhanced quality. It includes Noise removal, cropping, Thinning and Normalization.

4.1.1 Noise Removal

Noise removal is required to eliminate the pixels that are not part of the signature, but contained in the image. When we scan signature from paper then some unwanted pixels comes with the scanned image that is not a part of the signature. So this unwanted part must be removed before feature extraction.

4.1.2 Cropping

Cropping process removing unnecessary white back ground from the image.so as result it reduces the size of signature. The resultant signature only incudes the main framework of the signature.

4.1.3 Thinning

Thinning is a morphological process necessary for the reduction of data and computational time. To reduce all objects in an image to lines, without changing the essential structure of the image, use the bwmorph function. Thinning works for objects consisting of lines (straight or curved). This method does not work for object having shapes that encloses a large area. Thinning is most of the time an intermediate process, to prepare the object for further analysis. It reduces the signature to a skeleton of unitary thickness.

4.2 Feature Extraction

Each person's signature has different style. When someone tries to copy other's signatures then they basically try to maintain the shape. But some important features can make a signature difficult to be copied. Now this features are analyzed and are used in this proposed method to differentiate genuine from forge one. Here we use high intensity variation and cross over points as a feature extraction.

4.2.1 High Intensity Variation

Person usually does signatures with reference to fix angle. While doing signature person follow same kind of writing technique. So as result different intensity is generated the entire signature. Use of ball point as well as ink pan also create large different in intensity. This feature can be extracted easily to compare genuine and test signatures. Figure.2 and figure.3 represents the examples which includes high intensity variation points shown by arrow in it.

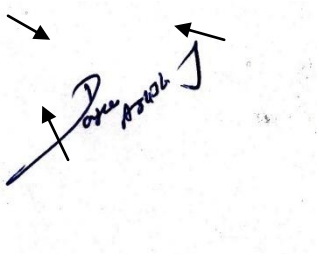


Fig-2

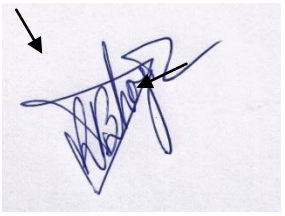


Fig-3

4.2.2 Cross Over Points

Each user has some monopoly in doing signature. Here each and every time shape of some special letter is always remaining constant. So as result it creates same cross over points. This point is very helpful for identify authors own signature among all. Figure 4 and figure 5 represents example of which includes cross over points shown by arrow in it.

Fig-4

Fig-5

5. ALGORITHM FOR PRAPOSED SCHEME

Step 1: Hand written signature is scanned.
Step 2: Signature is preprocessed and converted into binary or gray scale as per requirement, removing noise from signatures, thinned signature and finally normalize the signature.
Step 3: thinned signature is used for feature extraction. here special domain feature as high intensity variation points and cross over points are extracted from genuine as well as test signature.
Step 4: These features are compared with the features of original one, which have already been extracted with help of appropriate classifier.

6. IMPLEMENTATION AND RESULTS

6.1 Database Creation

During my research work we have taken total 100 signatures from total 10 faculty members.here each faculty member have to sign total 10 signature.here 10 signature includes 2-genuine signature,3-training signature and remaining five signature represents test signature.the following table represents the total signature database overview.

Table 1 Database overview

Sr no	Name of faculty	Notification	No of signatures			Total
			Genuine	*Training*	*Test*	
1	Kishan K Govani	KKG	3	2	5	10
2	Ashish j J Donga	DA	3	2	5	10
3	Dhaval Patel	DD	3	2	5	10
4	Divyang D Vyas	DDV	3	2	5	10
5	Dhaval R Bhojani	DRB	3	2	5	10
6	Manoj N Popat	MNP	3	2	5	10
7	Mitul R Khandhedia	MRK	3	2	5	10
8	Neha Hirani	NH	3	2	5	10
9	Raju J Kadivar	RJK	3	2	5	10
10	Nitin Rola	NR	3	2	5	10

6.2 Noise Remove

We applied a noise removal technique, which basically based on the size of pixel. In this algorithm some pixels, which are not connected with rest of the signature and have less than 8 pixel values are considered as noise and removed using MATLAB (R2012a). we choose 4 reference signatures. The output of each signature is shown below figure 6 to figure 8

Fig- 6 (a) original sign_DA **Fig**-6 (b) Noise marked_DA

Fig-6(c) after Noise removed_DA

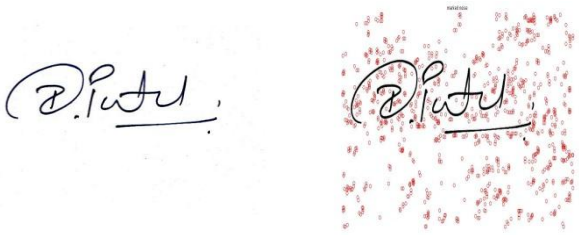


Fig- 7 (a) original sign_DD **Fig**-7 (b) Noise marked_DD

Fig-7(c) after Noise removed_DD

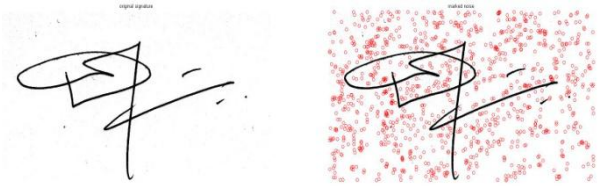


Fig-8 (a) original sign_DDV **Fig**-8 (b) Noise marked_DDV

Fig-8(c) after Noise removed_DDV

6.3 Thinning

To reduce all objects in an image to lines, without changing the essential structure of the image, use the thinning algorithm**.** Figure 9 to figure 12 shows the resultant thinning output of reference signatures obtained by database respectively.

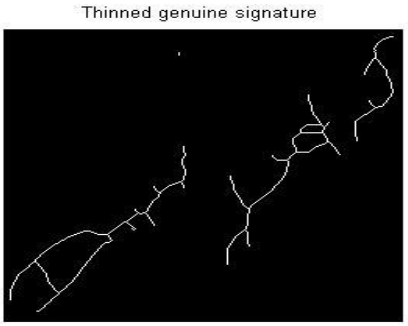


Fig-9 Thinning sign_DA

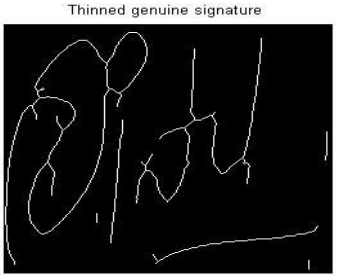


Fig-10 Thinning sign_DD

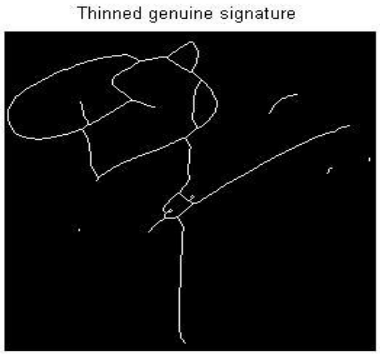


Fig-11 Thinning sign_DDV

6.4 Feature Extraction

After getting the preprocessed signature it is then come to find the forgery using feature extraction. Here we find out it with help of high intensity variation points and cross over loops from signatures. These features could be difficult to copy for a fake person. Figure represents high intensity variation points by blue colored "+" sign and cross over points are represented by red circled" sign.

6.4.1 High Intensity Variation based Feature Extraction

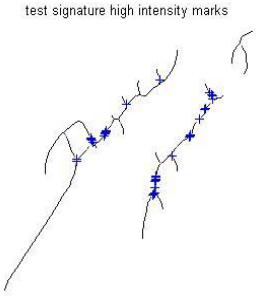


Fig-12 high intensity variation _DA

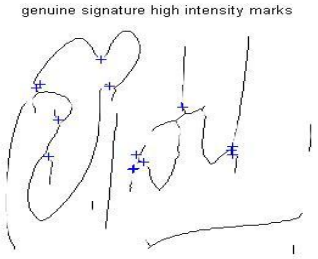


Fig-13 high intensity variation _DP

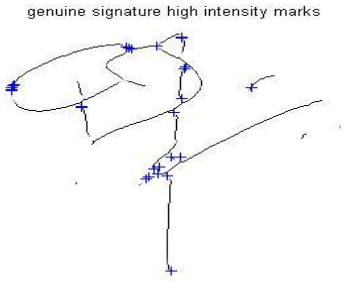


Fig-14 high intensity variation _DDV

6.4.2 Cross over Points based Feature Extraction

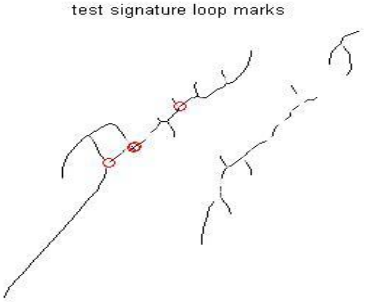


Fig-15 cross over points _DA

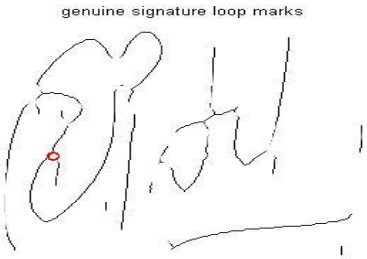


Fig-16 cross over points _DP

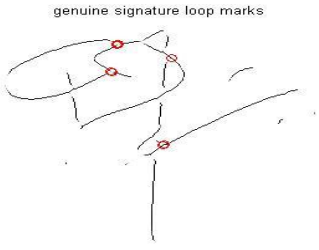


Fig-17 cross over points _DDV

7. CONCLUSIONS

The proposed signature identification system is been based on some special features extraction. These features included high intensity variations and cross over points it uses a compact and memory efficient storage of feature points, which reduces memory overhead and results in faster comparisons of the data to be verified. From intuition, the statistics on the positional variations of the features or strokes of signature samples should be useful for verification. Here in this paper we identify the genuineness of the signatures using such kind of features. Here verification of these signatures can be done by choosing appropriate classification methods. Similar to other real world problems, no single approach may solve the signature verification problem perfectly, and practical solutions are often derived by combining different approaches. This technique can be added with any existing verification system for better result.

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