A Review on Offline Signature Recognition and Verification Techniques

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Abstract- As signatures are widely accepted for the purpose of authentication and identification of a person, given the fact that every person has a distinct signature with its specific behavioral property. Hence it of high importance to prove the authenticity of the signature itself. A huge increase in the number of forgery cases have induced a need of a reliable and efficient "Signature Verification System". These systems can be online or offline based on the pre-processing that is done. This paper represents a brief review on various approaches used in the offline signature verification systems.

I. INTRODUCTION

Handwritten signature is amongst the first few biometrics to be used even before the advent of computers. Of all biometric technologies, whether biological or non-biological, signature verification offers most potential in terms of adaptability and implementation. This holds true from a number of perspectives i.e. ease of use, low implementation cost and the ease of embedding the system in an organization, without excessively disrupting or affecting existing operations. Signature verification has many applications including use in financial transactions, providing electronic signatures for documents, and in providing additional security measures for computer system authentication. Signature verification also has the advantage that is culturally more accepted and less intrusive than other biometric techniques, such as fingerprinting and iris scanning. Signature verification procedures can be carried out in offline and online modes. For offline signature verification, the images of signatures found on bank checks and documents are used for verification and are useful in automatic verification of signatures. On the other hand for signatures that are captured by tablets online signature verification is used. Offline signature systems are more applicable and easy to use in comparison with online systems in many parts of the world however it is considered more difficult than online verification due to the lack of dynamic information.
In signature verification systems, firstly during enrollment users provide a number of signature samples (reference signatures). Then, when a user presents a new signature as test signature claiming to be a particular individual, it is compared with the reference signatures for that individual. If the dissimilarity value is below a certain threshold value the user is authenticated, otherwise denied.

II. PROPOSED METHODS

All the proposed methods have certain common steps namely Signature Acquisition, Signature Pre-processing, Feature Extraction, Feature Training, Signature Training and Signature Verification. The methods mostly differ in the way they train the system using the extracted features. A few of the training algorithms are discussed here.

A. Artificial Neural Network:

Features extracted in this system are based on the geometric center of the image. Geometric features are extracted based on two set of points in 2 dimensional planes, the vertical and the horizontal. These features helps to classify the signature as genuine or fake. First Euclidean distance with respect to the geometric center is calculated for all the

feature points. After getting Euclidean distance, we calculate weighted average by multiplying with depth of feature point.
The proposed system will give better result in terms of FAR and FRR than existing techniques. This method works very well on the signatures that it had been trained for previously. However, the performance is poor when it is presented with signatures that it was not trained for earlier.

B. Pixel Matching Technique:

The pre-processing in this technique uses linear algebra to transform the input image into the same co-ordinate system as the stored image. The algorithm scans every pixel color of the scanned image and the sample database image. Both the images are scanned from left to right for the pixel color. If the pixel color is black, then it shows that it is a part of the signature and compares the corresponding pixel with the other image. If the pixel color is same for two images than a counter (m) is increased. And if the match is not found then another counter (n) is increased. By scanning every black pixel, a counter (p) is also increased. Then percentage matching is calculated using m/(n+p) * 100. This implementation is fast as it uses co-ordinate geometry only. The color matching technique also makes this technique more secure. The limitations of the technique are that it cannot identify dynamic changes in the signature.

C. Gaussian Mixture Model:

This method uses variety of features and applies the statistical Gaussian Mixture Model to cluster those features and verify the signature. There can be a number of features that can be extracted like contour based, geometry based, grid based etc. These features are then given as an input to the Gaussian Mixture Model. Gaussian Mixture Model is a statistical method in which we have to cluster low level data with the help of several multidimensional Gaussian probability distribution. GMM can be defined as a weighted sum of m component Gaussian densities.
This system is robust and as no vector analysis is used in GMM, it gives fast output response and low storage requirements. FAR and FRR can be reduced by increasing the size of the database.

D. Support Vector Machines:

A support vector machine (SVM) is a tool used for classification and regression prediction and is based on machine learning theory in order to maximize predictive accuracy. The main aim of SVM is to draw a decision plane among a set of objects having different class memberships and classify them.
There are two broad categories of classifiers one is linear and another is non-linear. SVM falls into the category of linear classifier. In case the data set is non-linear, SVM uses one of the four kernel functions to map the data such that they are linearly separable.
A SVM generally aims at producing a large margin hyper plane, i.e. the perpendicular distance between the nearest point from the hyper plane and the hyper plane must be maximum. However in the real life scenario there exists over lapping data set and hence the SVM relies on loss functions. These loss functions ignore the errors that are present within certain range of the true value. Hard margin, L1 soft margin, L2 soft margin are the widely used epsilon intensive loss functions.
In other words, SVMs measure the complexity of hypotheses according to the margin, which separates the data. Thus, even with many features present, we can apply SVMs if input data is separable with a wide margin using functions from the hypothesis space.

III. CONCLUSION

From the above study it is clear that different methods are used for the signature verification. SVM has been considered a good choice for solving the signature verification problem as it is frequently used for pattern recognition applications, classification and regression problems. In order to achieve more accuracy & optimize run time result can be achieved through Support Vector Machine classifier.

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