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RELATIVE STUDY ON SIGNATURE VERIFICATION AND RECOGNITION SYSTEM

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Abstract -- Signature verification is amongst the first few biometrics to be used for verification and one of the natural ways of authenticating a person's identity. The user introduces into the computer the scanned images of the signature, then after image enhancement and reduction of noise of the image. Followed by feature extraction and neural network training images of signature are verified. Yet now thousands of financial and business transactions are being authorized via signatures. Therefore an automatic signature verification system is needed. This paper represents a brief review on various approaches based on different datasets, features and training techniques used for verification.

Keywords: feature extraction, neural network, Signature verification and recognition

I. INTRODUCTION

Biometrics can be broadly classified into two categories:

1. Behavioral
2. Physiological.

Handwriting, speech etc. come under behavioral biometrics. Iris pattern, fingerprint etc. are part of physiological biometrics.

Handwritten signature, verification represents a process of authenticating the identity of an user using the handwritten signature of the user as a form of behavioral biometrics. The most important benefit of signature verification is that it is already the most widely accepted biometric for identity verification in our society for years .The long narration of trust of signature verification means that people are very willing to accept a signature based biometric authentication system.

The verification of signer from scanned signs of documents that has received still much more importance in day to day life. Because still various transactions are done with the faith of signs as signature is most natural way to confirm an identity.

Signature verification can be alienated into two main areas depending on the process of data acquisition method used:

1. Offline signature verification
2. Online signature verification

Forgeries can be classifies into three types: 1. Random
2. Simple
3. Skilled

Random forgeries are not based on any Knowledge of the original signature

Simple forgeries are produced knowing the name of the signer but without having an example of signer's signature. *Skilled forgeries* are produced by people looking at an original instance of the signature, attempting to imitate as closely as possible.

The systems are mainly divided into two major parts: (i) Training signatures, (ii) Verification or recognition of given signature

II. DATA ACQUISITION

There are different datasets which are available consisting of different signers including some forgeries. Some available datasets are given below:

Real DB1: MCYT-75 Signature DB. This dataset includes 75 signers collected at four different Spanish universities. The corpus includes 15 genuine signatures acquired in two sessions. All the signatures were acquired with the same inking pen and the same paper templates, over the WACOM Intuos A6 pen tablet. The paper templates were scanned at 600 dpi with 256 grey levels. The database is distributed by the Biometric Recognition Group-ATVS from UAM1.

Real DB2: GPDS-960 Signature DB. This dataset contains 24 genuine signatures from 881 individuals acquired in one site in just one session. For the current work, only the first 350 users of the database were considered in the experiments. The repetitions of each genuine signature were collected allowing each donor to use his own pen on sheets of white A4 paper .Each sheet provided two different box sizes for the signature. The sheets were scanned at 600 dpi with 256 grey levels. The database is distributed by the Grupo Procesado Digital de Se˜nales (GPDS) of the ULPGC2.

Synthetic DB1: SSig-DB 1-Ink. This dataset was produced following the proposed synthetic off-line signature generation method, and comprises 30 samples of 350 synthetic signers. All samples were generated with the _spot = 0:35mm: ballpoint and the viscous ink. The database may be obtained from the Biometric Recognition Group-ATVS website.

Synthetic DB2: SSig-DB Multiple Inks. As the SSig- DB 1-Ink this dataset comprises 30 samples of 350 synthetic signers. However, in this case, samples were generated using the 6 standard ballpoint sizes and three different types of inks. For each signature, both the ballpoint and the ink were randomly selected. The database may also be obtained from the Biometric Recognition Group-ATVS website.

II. Image Pre-Processing

Image pre-processing represents a wide range of techniques that exist for the manipulation and modification of images. It is the first step in signature verification and recognition. A successful implementation of this step produces improved results and higher accuracy rates.

III. Feature Extraction

Feature Extraction Feature extraction Operating upon two-dimensional image arrays, feature extraction seeks to identify features, or characteristics, of objects contained within an image. These characteristics can be used to describe the object, or attributes of the object, such as shape or color. A descriptive list of the object is produced, known as a *feature vector,* which is then used in the subsequent task of pattern classification.

Features extracted for signature verification can be broadly divided into three main types:

- Global features
- Local features
- Geometric features
- Mask features
- Grid features

Global features describe or identify the signature as a whole. They are extracted from every pixel that lies within a rectangle circumscribing the signature. These features do not reflect any local, geometrical, or topological properties of the signature, but include transformations, series expansions, image gradient analysis etc. Although global features are easily extractable and insensitive to noise, they are dependent upon the position alignment and highly sensitive to distortion and style variations.

Some common global features discussed below:
Aspect Ratio: The ratio of signature pure height to signature pure width.
Signature height: It is the height of the signature image, after width normalization.
Image area: It is the number of black pixels in the image. In skeleton zed signature images, image area represents a measure of the density of the signature traces
Pure width: The width of the image with horizontal blank spaces removed.
Pure height: The height of the signature image after vertical blank spaces removed.

2) Statistical features that are derived from the distribution of pixels of a signature, e.g. statistics of high gray-level pixels to identify pseudo-dynamic characteristics of signatures. This technique includes the extraction of high pressure factors with respect to vertically segmented zones (for example, upper, middle and lower zones) and the ratio of signature width to short- or long-stroke height. The statistical features take some topological and dynamic information into account and consequently can tolerate minor distortions and style variations.

3) Geometrical and topological features that describe the characteristic geometry and topology of a signature and thereby preserve the signatures global and local properties, e.g. local correspondence of stroke segments to trace signature. Geometrical and topological features have a high tolerance to distortion and style variations, and they can also tolerate a certain degree of translation and rotation variations Mask features provide information about directions of the lines of the signatures.

Grid features provide overall signature appearance information. The choice of a powerful set of features is crucial in signature verification. Systems. For grid information features, the image is segmented into appropriate number of rectangular region. Grid segmentation procedures have been used extensively in the off-line signature verification approach. The skeletonized image is divided into 120 rectangular segments (15x8), and for each segment, the area (the sum of foreground pixels) is calculated.

The features used must be suitable for the application and for the applied classifier. In various systems, above mentioned features are used.

IV. PATTERN CLASSIFICATION.

The 'final' task of image processing is that of pattern classification. This problem consists of taking an object within an image before attempting to classify it by deciding which specific group of objects it belongs to. As there are a number of possible choices of groups, the problem of which to select arises. Awcock and Thomas (1995) state that "there are three main approaches to group classification;
(a) *Statistical based classification* relies on defining a set of decision rules based on standard statistical theory. (b) *Syntactic pattern classification* utilises the underlying structure of the patterns themselves. (c) *Alternative approaches* use architectures such as neural nets which can be trained to correctly associate input patterns. Some other pattern classification approaches are Template Matching Approach, Hidden Markov models approach, Wavelet- based approach
***Activation Functions*:** Sigmoidal activation functions were used in each of the NN nodes as they are generally more appropriate for HSV applications.

Training performance for network are shown in fig.1:

Training Algorithm	Number of Epochs	Relative Time
Back-propagation	1000	4.6%
Conjugate Gradient Descent	147	0.8%
Levenberg-Marquardt	1280	100.0%

Structure	Number of Epochs	Relative Time
Linear Network	1350	7.2%
MLP with 1 Hidden Layer	1000	60.1%
MLP with 2 Hidden Layer	1200	100.0%

Fig.1

Classification accuracy of these three implemented network training algorithm

Training Algorithm	FAR	FRR	OER
Back-propagation	2.0%	1.3%	3.3%
Conjugate Gradient Descent	1.9%	2.4%	4.3%
Levenberg-Marquardt	2.4%	1.6%	4.0%

Fig.2

V. PERFORMANCE EVALUATION PARAMETERS (ERROR RATE)

- False Acceptance Rate
- False Rejection Rate

While dealing with any signature verification system, we consider False Rejection Rate and False Acceptance Rate as its performance evaluation parameters. The Efficiency of signature verification systems can be represented by these two types of error rates i.e. the percentage of genuine signatures rejected as forgery which is called False Rejection Rate (FRR) and the percentage of forgery signatures accepted as genuine which is called False Acceptance Rate (FAR). Generally signature verification system shall have an acceptable trade-off between a low FAR and a low FRR.

V. COMPARISON:

Each type of forgery requires a different verification approach. Hence it becomes mandatory to compare these approaches with respect to various levels of forgeries.

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