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A REVIEW PAPER ON OFFLINE SIGNATURE RECOGNITION SYSTEM USING GLOBAL FEATURE, ACO AND NEURAL NETWORK

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ABSTRACT

Signature verification systems can be categorized as offline (static) and online (dynamic). This paper presents neural network based recognition of offline signatures system that is trained with low-resolution scanned signature images using Global Feature with ACO. The signature of a person is an important biometric attribute of a human being which can be used to authenticate human identity. However human signatures can be handled as an image and recognized using computer vision and neural network techniques. With modern computers, there is need to develop fast algorithms for signature recognition. There are various approaches to signature recognition with a lot of scope of research. In this paper, off-line signature recognition & verification using neural network is proposed with Global Feature with ACO, where the signature is captured and presented to the user in an image format and with the help of Global Feature we extract total feature of signature and these features are train using neural network. Signatures are verified based on parameters extracted from the signature using various image processing techniques. The Off-line Signature Recognition and Verification is implemented using Image Processing and Neural Network Toolbox MATLAB Software. This work has been tested and found suitable for its purpose.

KEYWORDS: Offline Signature Recognition; Global Feature; Back Propagation Neural Network (BPNN) and Ant Colony Optimization (ACO).

INTRODUCTION

In our society, traditional and accepted means for a person to identify and authenticate himself either to another human being or to a computer system is based on one or more of these three general principles:

- What the person knows
- What he possesses or
- What he is

Signatures are most legal and common means for individual's identity recognition and verification since people are familiar with the use of signatures in their daily life. A signature is a unique identity of a person. Therefore we are in great need to develop a system which can recognize signatures. A signature verification system decides whether a given signature belongs to a claimed owner or not. A signature recognition system, on the other hand, has to decide a given signature belongs to which one of a certain number of writers. Signature recognition is split into two according to the available data in the input. Offline (static) signature recognition takes as input the image of a signature and is useful in automatic recognition of signatures found on bank checks and documents. Online (dynamic) signature recognition uses signatures that are captured by pressure sensitive tablets that extract dynamic properties of a signature in addition to its shape.

Offline systems are of interest in scenarios where only hard copies of signatures are available where as in online systems most of the features are extracted at the time of signing. So the offline signature recognition is more challenging Therefore, in offline signature recognition methods, less information is available than online methods. Offline signature recognition primarily focus on the visual appearance of our signature for recognition purposes,

Signature Recognition examines behavioral aspects that manifest themselves when we sign our name. Therefore it is essential to recognize the signatures with high accuracy

The written signature is regarded as the primary means of identifying the signer of a written document based on the implicit assumption that a person's normal signature changes slowly and is very difficult to erase, alter or forge without detection. The handwritten signature is one of the ways to authorize transactions and authenticate the human identity compared with other electronic identification methods such as fingerprints scanning and retinal vascular pattern screening. It is easier for people to migrate from using the popular pen-and-paper signature to one where the handwritten signature is captured and verified electronically. The signature of a person is an important biometric attribute of a human being and is used for authorization purpose. Various approaches are possible for signature recognition with a lot of scope of research. Here, we deal with an off-line signature recognition technique. Signatures are composed of special characters and flourishes and therefore most of the time they can be unreadable. Also intrapersonal variations and interpersonal differences make it necessary to analyze them as complete images and not as letters and words put together. Signature recognition is the process of verifying the writer's identity by checking the signature against samples kept in the database. The result of this process is usually between 0 and 1 which represents a fit ratio (1 for match and 0 for mismatch). Signature recognition is used most often to describe the ability of a computer to translate human writing into text. This may take place in one of two ways either by scanning of written text (off-line method) or by writing directly on to a peripheral input device. The first of these recognition techniques, known as Optical Character Recognition (OCR) is the most successful in the main stream. Most scanning suites offer some form of OCR, allowing user to scan handwritten documents and have them translated into basic text documents. OCR is also used by some archivist as a method of converting massive quantities of handwritten historical documents into searchable, easily-accessible digital forms.

OVERVIEW OF SIGNATURE RECOGNITION

A problem of personal verification and identification is an actively growing area of research. The methods are numerous and are based on different personal characteristics; voice, lip movement, hand geometry, face, odor, gait, iris, retina and fingerprint are the most commonly used authentication methods. All these psychological and behavioral characteristics are called biometrics. The driving force of the progress in this field is above all, the growing role of the internet and electronic transfers in modern society. Therefore considerable number of applications is concentrated in the area of electronic commerce and electronic banking systems.

The biometrics have a significant advantage over traditional authentication techniques (namely passwords, PIN numbers, smart cards etc) due to the fact that biometric characteristics of the individual are not easily transferable are unique of every person and cannot be lost, stolen or broken. The choice of one of the biometric solutions depends on several factors which include:

- User acceptance
- Level of security required
- Accuracy
- Cost and implementation time

The method of signature verification reviewed in this paper benefits the advantage of being highly accepted by potential customers. The use of the signature has a long history which goes back to the appearance of writing itself. Utilization of the signature as an authentication method has already become a tradition in the western civilization and is respected among the others. The signature is an accepted proof of identity of the person in a transaction taken on his or her behalf. Thus the users are more likely to approve this kind of computerized authentication method. Signature verification systems differ in both their feature selection and their decision methodologies. More than 40 different feature types have been used for signature verification. Features can be classified into two major types: local and global. Global features are features related to the signature as a whole, for instance the average signing speed, the signature bounding box and Fourier descriptors of the signatures trajectory. Local features correspond to a specific sample point along the trajectory of the signature. Examples of local features include distance and curvature change between successive points on the signature trajectory. Most commonly used online signatures acquisition devices are pressure sensitive tablets capable of measuring forces exerted at the pen-tip, in addition to the coordinate of the pen. The pressure information at each point along the signature trajectory is another example of commonly used local

feature. Some of these features are compared in order to find the more robust ones for signature verification purposes. Other systems have used genetic algorithms to find the most useful features. Due to the high sampling rate of the tablet, some consecutive sample points may mark the same trajectory point especially when the pen movement is slow. Most verification systems resample the input so as to obtain a trajectory consisting of equidistant points. This is often done in order to remove redundant points to speed up the comparisons and to obtain a shape-based representation, removing the time dependencies, separately keep track of the local velocity values and use them in aligning two signatures. Signature recognition and verification involves two separate but strongly related tasks: one of them is identification of the signature owner, and the other is the decision about whether the signature is genuine or forged. Also, depending on the need, signature recognition and verification problem is put into two major classes: (i) On-line signature recognition and verification systems (SRVS) and (ii) Off-line SRVS. On-line SRVS requires some special peripheral units for measuring hand speed and pressure on the human hand when it creates the signature. On the other hand, almost all Off-line SRVS systems rely on image processing and feature extraction techniques.

IMAGE PREPROCESSING AND FEATURES EXTRACTION

We approach the problem in two steps. Initially, the scanned signature image is preprocessed to be suitable for extracting features. Then, the preprocessed image is used to extract relevant geometric parameters that can distinguish forged signatures from exact ones using the ANN approach.

Preprocessing:

The signature is first captured and transformed into a format that can be processed by a computer. Now it's ready for preprocessing. In preprocessing stage, the RGB image of the signature is converted into grayscale and then to binary image. The purpose of this phase is to make signatures ready for feature extraction. The preprocessing stage includes two steps: Color inversion, Filtering and Binarization.

Color Inversion:

The true color image RGB is converted to the grayscale intensity image by eliminating the hue and saturation information while retaining the luminance.

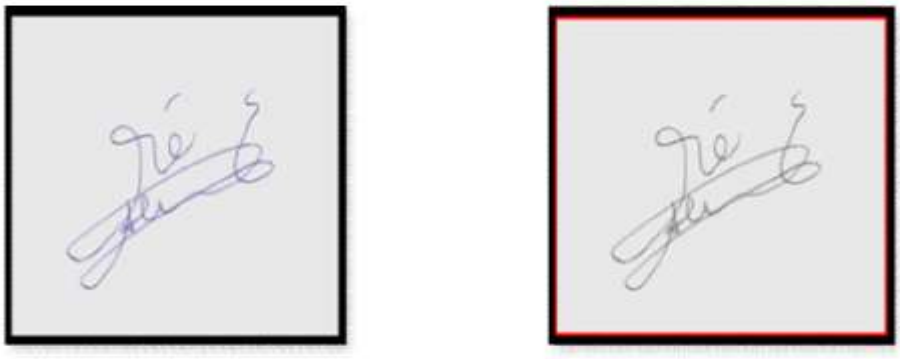

Fig.1. (a) A sample signature to be processed; (b) A Grayscale Intensity Image

A grayscale image is a data matrix whose values represent intensities within some range where each element of the matrix corresponds to one image pixel.

Image Filtering and Binarization:

Any image when resample is filtered by a low pass FIR filter. This is done to avoid aliasing. This aliasing occurs because of sampling the data at a rate lower than twice the largest frequency component of the data. So a lowpass filter will remove the image high frequency components. And for this purpose the filter used. Now the grayscale image is segmented to get a binary image of objects. In a binary image, each pixel assumes one of only two discrete values: 1 or 0. A binary image is stored as a logical array.

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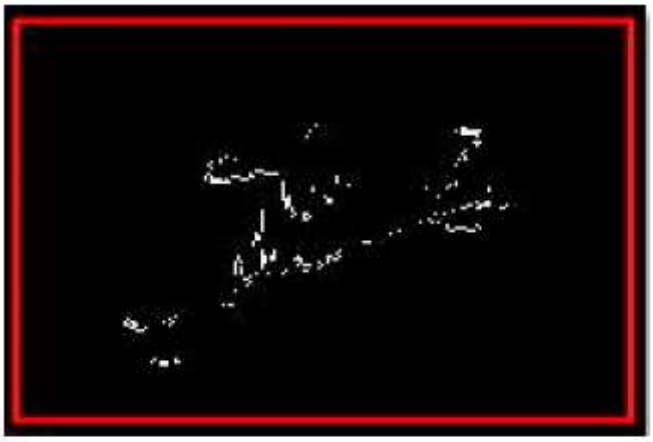

Fig.2. Binary Image interpreting the bit value of 0 as black and 1 as white

Features Extraction is the key to develop an offline signature recognition system. We use a set of five global features that cannot be affected by the temporal shift.

Types of Signature Verification
Based on the definitions of signature, it can lead to two different approaches of signature verification.

Off-Line or Static Signature Verification Technique
This approach is based on static characteristics of the signature which are invariant. In this sense signature verification, becomes a typical pattern recognition task knowing that variations in signature pattern are inevitable; the task of signature authentication can be narrowed to drawing the threshold of the range of genuine variation. In the offline signature verification techniques, images of the signatures written on a paper are obtained using a scanner or a camera.

On-line or Dynamic Signature Verification Technique
This is the second type of signature verification technique. This approach is based on dynamic characteristics of the process of signing. This verification uses signatures that are captured by pressure sensitive tablets that extract dynamic properties of a signature in addition to its shape. Dynamic features include the number of order of the strokes, the overall speed of the signature and the pen pressure at each point that make the signature more unique and more difficult to forge. Application areas of Online Signature Verification include protection of small personal devices (e.g. PDA, laptop), authorization of computer users for accessing sensitive data or programs and authentication of individuals for access to physical devices or buildings.

Nature of Human Signature
It is supposed that the features of the process of signing originate from the intrinsic properties of human neuromuscular system which produces the aforementioned rapid movements. Knowing that this system is constituted by a very large number of neurons and muscle, fibers is possible to declare based on the central limit theorem that a rapid and habitual movement velocity profile tends toward a delta-log normal equation. This statement explains stability of the characteristics of the signature. Thus, the signature can be treated as an output of a system obscured in a certain time interval necessary to make the signature. This system models the person making the signature.

Global Feature
The algorithm is based on extracting global features like Area, Height, and Width etc.

Area (A): Signature area is the number of pixels which belong to the signature. This feature provides information about the signature density. In this phase we only calculate the total number of the black pixels (0) in black and white image.

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Width (W): It is defined as the distance between two points from either ends in the horizontal projection which contain more than one pixels of the binary image.

Height (H): It is defined as the distance between two points from either ends in the vertical projection which contain more than one pixels of the binary image.

Height/Width Ratio: Signature height-to-width ratio is obtained by dividing signature height to signature width. Signature height and width can change. Height-to-width ratios of one person's signatures are approximately equal.Ratio=H/W.

Centroid: In is means that calculating the centre of the signature. We use centre x and centre y. We take x for Horizontal projection and y for vertical projection.

Four Area: The last feature that we implemented in our project is that dividing the image in four equal parts. Identifying them as a1, a2,a3 and a4.After that we only calculate its black pixel (0) area in the each part of image which we divided equally.

Ant Colony Optimization

The ant colony optimization algorithm (ACO) is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs based on the strategies of real ants. It was initially proposed in 1992 by Colorni, Dorigo and Maniezzo. In ACO, each artificial ant is considered as a simple agent, communicating with other ants only indirectly and by effecting changes to a common environment.

METHODOLOGY

To verify the effectiveness (qualities and robustness) of the proposed Signature Recognition we conduct several experiments with this procedure on several images. The methodology of our proposed work is given below:

Phase 1: Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading training dataset of signature image.
Phase 2: We develop the code for the feature extraction using Global Feature for training dataset. After that apply Ant Colony Optimization for feature reduction
Phase 3: we develop a code for the loading test signature image for the testing purpose.
Phase 4: we develop a code for preprocessing using Global Feature for feature extraction of test sample of signature. After that we apply ACO for feature reduction of test image.
Phase 5: we develop a code for Back Propagation Neural Network Classification for the simulation purpose of test feature and recognition of signature.

CONCLUSION

In this paper we propose "Offline Signature Recognition System Using Global Feature with ACO". Offline signature is one of the most widely accepted personal attributes for identity verification of the person. The written signature is regarded as the primary means of identifying the signer of a written document based on the implicit assumption that a person's normal signature changes slowly and is very difficult to erase, alter or forge without detection. The handwritten signature is one of the ways to authorize transactions and authenticate the human identity compared with other electronic identification methods such as fingerprints scanning and retinal vascular pattern screening. It is easier for people to migrate from using the popular pen-and-paper signature to one where the handwritten signature is captured and verified electronically.The average recognition accuracy from 90%to98%. Reduce error rate to 3-5%.We use training set of 500persons. Calculate FAR, FRR and EER.

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