



A Review Paper on Offline Signature Verification Using Back Propagation

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ABSTRACT: The signature of a person is a biometric trait of a human being which is used to confirm human identity. A number of methods have been recommended for the identification of signatures. There are two kinds of authentication systems, one is the vision based and the other one is the non-vision based. The vision based includes face recognition, fingerprint recognition, iris scanning and retina scanning and the non-vision based includes voice recognition and signature verification. Majority of the organizations primarily focus on the visual appearance of the signature for verification purposes. Many official papers, such as bonds, cheques, and card transactions require the signing of a signature. We need an automatic verification system because of the adverse side-effect of being easily abused by those who would fake the identification or objective of an individual. An offline signature verification system generally consists of four components: data attainment, processing, extraction of features, recognition and verification. In this system the signature is captured and presented to the user in the form of an image. The Signatures are then verified based on parameters extracted from the signature using different image processing techniques. The system was tested with signatures including both genuine and forged signatures and then letting the system decide whether the signature is genuine or forged. In this paper we verify whether the signature using the neural network architecture.

KEYWORDS: Neural Network, Signature Verification and Back Propagation Algorithm.

I. INTRODUCTION

A signature is known as a behavioural biometric. Signature is the main mechanism both for authentication and authorization in official transactions, the need for proficient auto-mated system for signature verification has increased. The writer who does the signature is known as the signatory or the signer. A person's signature is considered and treated as the legal and common means for verifying the identity of an individual. A signature is a grouping of characters or a person's name and is always written in a special way. Signatures having static and dynamic characteristics classify the verification system of signature into two kinds on-line and off-line. In off-line verification, the amount of features, which are extracted from off-line mediums, exceed those obtained from on-line verification i.e. time, pressure and velocity. In online or offline, the design of a verification system requires the five stages of data attainment, pre-processing, extraction of features, process of comparing, and conclusion. The design of an offline signature verification system is more intricate than online verification system due to the lack of timing and dynamic information. Many automatic signature verification methods.

have been planned throughout the literature but still offline signature recognition and verification system remains tough. Signature recognition is the process of authenticating the person's identity by checking his signature against samples which are kept in the database. The result is usually between 0 and 1 which signifies a fit proportion where 1 represents a match of signature and 0 represents a mismatch of signature.

There are three kind of forgeries and they are

- 1) Random forgery
- 2) Simple forgery and
- 3) Skilled forgery.

Random forgery are those in which the person has no knowledge of the original signature. Simple forgery are those in which the person knows the name of the person but has no practice of signature. Skilled forgery are those which are written by person who knows the original signature and also has an idea how the signatures are done. There are three kinds of features which are extracted and they are as follows:



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- 1) Global features
- 2) Local features and
- 3) Geometric features

Global features are those which are extracted from the image of the signature and they contain signature height to width ratio, signature area and center of gravity etc. Local features are those which are extracted from a small area of signature image. They are expensive but are more accurate than the global features and they contain pixel density, critical points, slant features etc. Geometric features are those which represent the geometric characteristics of a signature.

Signature recognition is used mostly so as to explain that a computer can translate human signature into text. This may take place in one of two ways either by scanning of written text which is an off-line method or by writing directly on an input device. An artificial neural network is proposed and is trained so that it can identify matches and patterns among all the different handwritten signature samples.

Performance of the system is tested by measuring the following rejection, acceptance and error rate:

False Acceptance Rate (FAR): This is the calculation of false signatures which are accepted and rejected

$$\text{FAR} = 100 * \frac{\text{Number of accepted forgeries}}{\text{Number of rejected forgeries}}$$

False Rejection Rate (FRR): This is the calculation of genuine signatures rejected and tested.

$$\text{FRR} = 100 * \frac{\text{Number of rejected originals}}{\text{Number of tested originals}}$$

II. RELATED WORK

V A Bharadi.*et. al* in 2010 [10] suggested that paper is an analysis on signature recognition systems in depth and that special thought is given to the analysis of offline Signature Recognition Systems . The performance of some systems are measured and is done by comparing it on the basis of their feature extraction mechanisms. Both the conventional feature set and cluster based features are the features on which the discussion of the offline signature recognition system is done. This system is a system in which multiple algorithms are used so as to combine the benefits of feature sets and improve the rates of recognition. The accurateness of the system is 95.08% which is more than a single performance metrics.

Othman o-khalifa.*et. al* in 2013 [2] suggested that in this paper they explain the characteristics of an offline signature verification procedures and they also say that there is a need for the development of a robust and constructive signature verification system. It also highlights the evaluation among various methods and challenges to mend the verification systems. The main advantage of offline systems is to identify the correct person and offer secure services.

Kanawade M. V.*et.al* in 2013[9] suggested that in this paper various methods were discussed to verify an off-line handwritten signature. They showed a new technique for signature verification and recognition which was based on grid features and global mask.

Pooja.*et. al* in 2014[7] suggested that this paper tells us about the latest works which have been done on offline signature verification. Different approaches which have been used for signature verification are compared and then the discussion about their False Acceptance Rate and False Rejection Rate is done. The results the signature verification system shows that the accuracy of this system is not enough to implement it in public use and so more research work is to be done on Static Signature verification. There are several experiments done on this system which says that the signatures of a particular person is similar but not identical. Signature of a person often changes because of geographic location, illness, age and also sometimes the emotional state of the person. Thus to enhance the system we need to combine different feature vectors with different characteristic in upcoming work.

Mujahed Jarad.*et. al* in 2014 [6] suggested that these Signatures are generally used as personal verification and this is the reason why there is a need for an automatic verification system. Verification of signatures can be performed either by offline or online method based on the application. Dynamic information of a signature is captured in online system at the time the signature is made. Offline schemes work on the scanned image of a signature. In this paper they have presented a method for verification of signatures by using the back-propagation algorithm of neural network. In this

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system extraction of the features is done using the neural networks and it then distinguishes different pattern among all the signatures. Back-propagation algorithm is used because it provides flexibility to use layers of any number. To evaluate and test the system, a number of signatures were collected from different sources so as to train the system. The result with respect to speed, accuracy and throughput were excellent.

Vineeta Malik.*et. al* in 2015[8] suggested that the benefits of this systems is that the user doesn't have to remember any password or data for identification purpose and authentication purpose. The advantage of this system is that the person is in a habit of signing daily and so his signature will remain same as that stores in the database. Verification system for signature are of two forms: static that is off-line and dynamic that is on-line. Satic digitalized image of the signature is used in static verification system. When documents like forms bank cheques etc. have to be verified in a restricted time, then the manual verification of a person's signature is often not realistic. This is the reason why a number of verification systems have been developed. Dynamics of the signature which includes pressure, coordinates, and angle of the pen are considered in the dynamic signature verification system.

III. PROPOSED ALGORITHM

Basic Problems due to which offline signature recognition and verification is required is because of Signature fraud and also because it is difficult to verify & is time consuming. Problems in existing system are that we have to perform manual checking and in existing system time taken is more and it does not have enough accuracy. The Software targets automation of processes signature verification so it increases the accuracy as well as reduces the time required by a human to verify signature manually. It provides a simple way to administrator to verify the given signature with the corresponding user. Biometric is based on physiological and behavioral characteristics. Voice, iris, signature, fingerprint, are now a days more used instead of passwords and personal identification numbers because identity of every individual is unique and it can't be stolen. Recognition systems are of two type's offline and online. In offline the signature is signed and then scanned whereas in online the signature is signed on a digitizer and then the dynamic features like pressure and speed are captures along with the image of the signature.

Artificial neural networks (ANNs) are a family of models inspired by biological neural networks. By using ANN we extract features like the length, height, duration, etc. of the signature and we do this for all the samples from different signers. In second step the NN will learn the relationship between the signature and its class that whether it is genuine or forged. NN's are basically for modeling inclusive features of handwritten signatures.

The recognition system include the following steps:

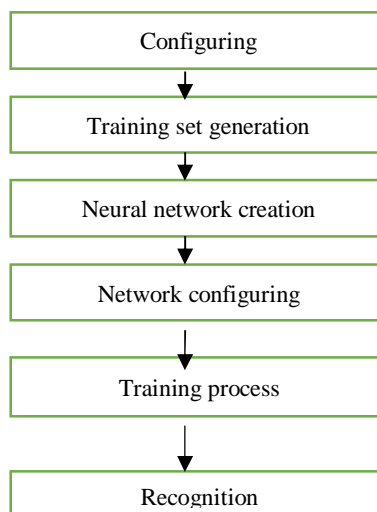


Fig. 1. Signature Verification Methodology

METHODOLOGY

The diagram of planned signature verification structure which confirms the authenticity of given signature of a person is shown below. The design of the system is distributed into two stages:

- 1) Training stage

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2) Testing stage

The training step comprises of four steps

- 1) Retrieving image of signature from database
- 2) Pre-processing of image
- 3) Extraction of feature
- 4) NN training.

The Testing stage comprises of five major steps

- 1) Retrieval of signature that is to be tested from a database
- 2) Pre-processing of image
- 3) Extraction of feature
- 4) Presentation of features which are extracted in a trained NN
- 5) To check the output generated from neural network.

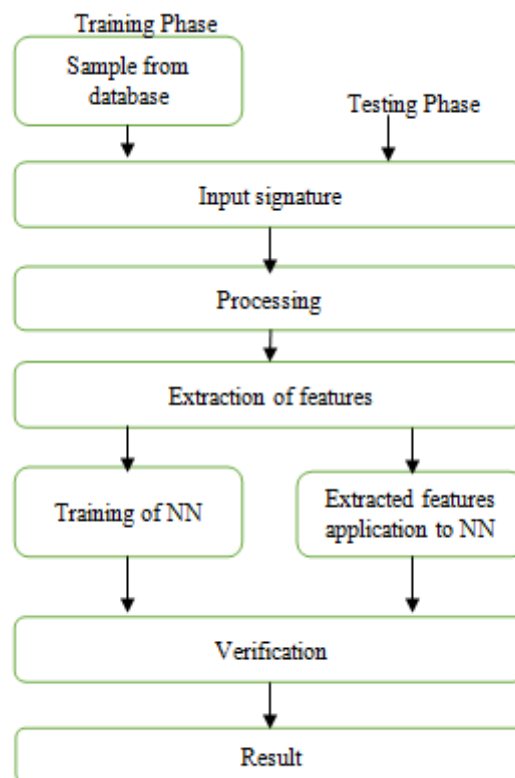


Fig. 2. Diagram of Offline Signature Verification

Back Propagation Algorithm

PRE-PROCESSING

Pre-processing is applied in both the phases that is the training phase and the testing. Image of the signature is scanned in gray scale. This stage takes place so as to make the image ready for feature extraction. The quality of image is improved in this stage. The pre-processing has many stages and it includes: converting image to binary, image resizing, thinning and bounding box of the signature.

BINARIZATION

Binarization is done by using the Niblack algorithm. Binarization is done in gray scale images.



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BACKGROUND ELIMINATION

This is done so as to get the feature extraction done perfectly. To capture the signature from background P tile thresholding is used. When the thresholding is done the pixels of the signature will be "1" and pixels of the background will be "0".

NOISE REDUCTION

To eliminate black pixels on white background noise reduction filter is used on the binary image. 8-neighbors of a pixel are tested. If number of black pixels are greater than the number of white pixels, then the chosen pixel will be black otherwise white. Noises in the scanned images are introduced by either imperfection in the scanner, dirt or scratches on the camera or scanner lens. Filtering functions are used to remove the noises. For noise reduction Gaussian filter is used because in Gaussian function smoothing is done equally and it is symmetric and the edges in the image will not be biased.

SKELETONIZATION

Skeletonization is the process of dropping image to a single pixel. An iterative process is applied to generate a skeleton. This process corrodes the object layer by layer. This is done till the object spines that forms the skeleton remains. This process is called thinning. The step for skeletonization are-

Stage 1: on signature image all the points are marked that are to be removed

Step 2: Examine the pixel one by one along the contour lines of the image, and then remove it as it will not cause any break in the result pattern.

Step 3: If only one point is deleted then go back and repeat the process from starting.

The extracted features become invariant to the image characteristics just like the paper, qualities of the pen, the signer and the digitizing method.

THINNING

Thinning is done to reduce the thickness differences by creating the image one pixel thick. To reduce the computation time the thinning process is done. Thinning is done by using the coupling point. This algorithm is best for signature images because it preserve the intricate details and other properties of the signature.

FEATURE EXTRACTION

Features which are extracted from the image are used in creating feature vector. Features which are extracted from the image are geometrical features which means they are built on the dimensions of the signature image and also on its shape. The features are extracted in the following way: Feature extracted using horizontal splitting and geometric centre.

NEURAL NET WORK TRAINING

The features are normalized so as to bring it in 0 to 1 range .The normalized features are then applied as input to the neural network.

VERIFICATION

In this stage, when normalization is done a feature vector is provide to the capable neural network which will then classify a signature by letting us know whether it is genuine or forged.

IV. CONCLUSION AND FUTURE WORK

The system is healthy and can detect random, simple and semi-skilled forgeries. A larger database can reduce false acceptances as well as false rejections. This system is more efficient as it uses the back propagation algorithm. The concepts of Neural Networks hold a lot of promise in building systems with high accuracy.

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