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Signature Recognition and Verification System Using Offline Artificial Neural Network

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ABSTRACT: A number of techniques have been proposed for personal identification of humans in the past. Among the vision-based ones are mostly face recognition, fingerprint, iris scanning and retina scanning. Signature verification or Voice recognition are known among the non-vision based ones. The human signature is most proven to be the important for access. Signature of the person is proven to be the important bio-metric attribute of a human being which can be used for authenticating human identity, As signatures continue to play an important role in commercial, financial, and legal transactions, truly secured authentication becomes more crucial. A signature by a person is considered as the "seal of approval" and is the most preferred means of authentication. The methods presented in the paper consists of geometric feature extraction/ image prepossessing, neural network training with extracted features and verification. A verification stage includes applying the extracted features of test signature to a well trained neural network which will classify it as a genuine or duplicate.

I. INTRODUCTION:

Since the signature is the main method of verification and legalization of transactions, the need to do well Automatic signature verification solutions is advanced. Unlike passwords, PIN, PKI or key cards – identification unforgettable, lost, stolen or shared data – taken the handwritten signature values vary from person to person and it is impossible to repeat. Signature confirmation by natural and intuitive. Technology is easy to define again trust. The main advantage is signature verification programs have technology of some kind that signature have already been adopted as a standard form of ownership to confirm. Signature verification system and techniques used to solve this problem can be divided into two categories online and Offline, The Internet connection method uses an electronic tablet and computer-connected pen to extract information about the file signature and takes strong details as pressure, speed, typing speed etc for verification purposes. Offline verification involves less electronic control as well uses signature photographs taken by a camera or scanner. The offline signature verification system uses features released from scanned signature image. Features used offline signature confirmation is very easy. In this case only pixel the image needs to be checked. However, off-line systems It is difficult to design as many desirable features as arrangement of strokes, speed and other dynamics details are not available in the off-line case. The verification process should rely entirely on the incompetent features is removed from the following image signature images only. Intensive research has been followed in the analysis of handwriting and pattern matching for several years. In place of Handwritten Signature Verification (HSV), especially offline HSV, a different technology has been used and is being made locally is being tested. In this section we review some of the latest papers on HSV offline. Methods used separately researchers differ in the type of features released, training method, and the separation and validation model used.

II. LITRATURE REVIEW:

With the use of modern technology, there are several ways to identify a person. A handwritten signature is one of them. It is important to perform the authentication process on a handwritten signature in order to distinguish between the original and the signed one(signed for verification). References [1] can be seen to obtain information about the two types of accuracy errors occurring in signature verification namely "False Rejection Rate" and "False Acceptance Rate". Reference [2] provides full details of the types of counterfeit signatures present in the handwritten signature. In order to maximize the effectiveness of the signature verification system, there are many ways for such authentication. Some of the latest works under the heading offline signature verification can be found as [3] when the authors proposed a grammatical template matching program. Depending on the strength of the pixels,

an offline verification model is suggested for [4] to obtain an actual signature. Much work has been done in the SVM for offline signature verification, detailed reviews can be obtained as a reference [25], In addition, as per reference [5-7] various researchers have used different concepts to achieve an effective offline signature verification. Some of the most commonly used signature verification techniques are as follows:

A. Signature Verification Strategies:

1) Hidden Markov Model: For the purpose of analyzing sequences in signature verification, it is recommended to use the Hidden Markov Model (HMM). A handwritten signature is considered a unit of value letters associated with all the individual points of the signature in their path. Therefore, it is important to create an effective signature verification system by selecting the appropriate set of feature variables for Markov's hidden models. The type of models is stochastic and these types of models have the ability to immerse the similarity of pattern diversity. In Markov's hidden models, similar signatures and models are possible. This comparison can be obtained by distributing the probability of the signature feature or by discovering the probability of the calculation occurring in the original signature. Signatures are regarded as real person when the opportunities that arise are greater than the possibilities of test signatures, otherwise the signatures were rejected. The HMM system uses only global features and "Sinograph" which is discrete random. This discrete random transform is to be computed for all individual binary signature image that lie under the range of 0 – 360.

2) Neural Network: In detecting the pattern, neural networks (NNs) are widely used as powerful and easy to use. An easy way to start is to choose a feature set like height, length etc. of the signature by taking many examples from various signatories. Learning the connection between the signature and its category ("real" or "fraud") will be NN's second step, once the relationship has developed. The network contains a sample signature of a specific signature. Therefore, to create global features of handmade signatures, NNs are better suited. The program suggested in this paper will use the features of the signature structure, the modified directional feature and other elements for example length, space, centroid etc.

3) Model simulation: In template simulation, acquiring skills acquisition has two suggested methods as in. [8]. Proper matching of guessing signature pattern profiles is one way while the other is for two-dimensional signature patterns depending on the elasticity of the stripes. To validate the signature of a given sample, there will be an analysis of position variations using training set statistics, in addition depending on the distance rating decision to be made.

4) Mathematical Method: Relationships, deviations etc. Between data can be determined using statistical information. When disclosure within a set of data items is to be disclosed, the concept of Correlation Coefficients is often used. To validate a recently launched signature, the mathematical method follows the concepts of combinations to determine the value of the difference between a newly introduced signature and a pre-stored signature. Kolmogrov Smirnov's statement is a unique way of confirming a signature in which various items are released. This feature includes image gradient, mathematical features (distribution of signature pixels, geometry and landscape descriptions). The classification consists of collecting differences in the author's signatures and obtaining distribution in the space. If the signature is confirmed, then the process protects the distribution compared to the known. The Kolmogorov-Smirnov test is used to find similarities.

5) Support Vector Machine Machines (SVMs): SVMs are basically an algorithm, these machine learning algorithms require high-level space space and calculate the imbalances between the given data categories to create invisible data. Signature features (global, directional & grid) are used in the system and in the verification and separation system uses SVM as in [9].

6) Self Organizing Map (SOM) and Multilayer Perceptron (MLP): Suggested by Paigwar Shikha et al. [22]. Personalization Map (Artificial Neural Network) is used to solve a wide range of tasks. This is why SOM is used for pattern recognition problems. The SOM structure is made up of a single layer. In contrast to SOM, MLP has multiple lines (input layer, output layer and hidden layer) MLP is used to detect data or from sound data.

7) Back Propagation Neural Network: Signature verification and recognition can also be done using Back Propagation of the Neural network as proposed by Nilesh Y. Choudhary and can be seen in [23]. In this case, in the exclusion of the elements, methods such as a fixed interval and Zernike minute are used. Easy implementation is a key benefit of the Back Propagation approach based on three-layer architecture.

8) Signature Envelope and Method of Separating Multiplicity: This method is suggested by Vahid Malekian et al. [24]. The separation

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occurs in this way in the pre-processing image into four parts by making the center of gravity as its center point. Each part is further divided into four parts. Thus, in this way there are sixteen parts of the total signature.

B. Image preprocessing techniques.

In this process namely, pre-image processing; authenticity of the scope exists for the methods used manipulation and manipulation of images. The first step is processing the image through the signature verification process and awareness that produces the best results accuracy levels. Table I presents the key variables image previewing methods have been used.

TABLE I. IMAGE PREPROCESSING TECHNIQUES

Literature Review	List of Papers													
List of preprocessing techniques	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]
Background Elimination	T	F	T	T	T	T	T	T	T	T	T	F	T	F
Signature Normalization	F	F	T	F	F	T	T	T	F	T	T	F	T	F
Thinning	T	F	T	T	F	T	T	F	T	F	T	T	T	T
Convert Image to Binary	T	F	F	T	T	T	T	F	F	T	F	F	T	T
Bounding Box of the signature	F	F	F	T	F	T	F	F	F	F	F	T	T	T
Image Resize	T	T	F	F	F	T	F	F	F	F	F	T	T	T
Convert Image to Gray Scale	F	F	F	F	F	F	T	T	F	T	F	T	T	F
Noise Reduction	T	T	F	F	F	T	F	T	F	F	T	T	T	F

C. FEATURE EXTRACTION:

After image editing, the feature release is one important step in signature recognition and verification. The purpose of the feature release is to create potential features it serves as a comparison measure. As it is noted that the problems associated with the signature verification is a very sensitive process, it is suggested to produce more than one rate in order the accuracy of the result can be improved. Table II is as follows to highlight the various features used with regard to the signature verification process.

TABLE II. IMAGE FEATURE EXTRACTION

Literature Review	List of Papers													
List of Features	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]
Signature Shape like area	T	T	T	T	T	T	F	T	T	T	F	T	F	T
Signature Height-to-Width ratio	T	F	T	T	T	T	T	T	T	T	T	F	T	F
Center Gravity	F	F	F	T	F	T	F	F	T	F	F	F	T	T
Edge Point of Signature	F	T	T	F	F	F	T	F	T	F	F	F	F	F
Direction of Line	T	F	T	F	F	F	T	T	F	T	F	F	F	F
Density of Thinned line	F	F	F	F	F	F	T	T	F	T	T	F	T	F
Aspect Ratio	T	T	F	T	T	F	F	F	F	F	F	T	F	T
Texture Feature	F	T	F	F	T	F	F	F	F	F	F	T	T	F

III. PROPOSED SYSTEM:

Signatures are treated as the most promising authenticity in all legal and financial documents. So it is important to build such a system that works well for it confirm (correct or confirm) the handwritten signature. In the program banking industry, long-term signatures used automatic deletion of checks. Signatures from people like that it is often regarded as a visual image through computer and neural network techniques. In to solve this problem, offline recognition and the verification system using the

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neural implant network is the best solution for our book review is her current research practice. The purpose of this program is to confirm the signature using an existing standard signature obtained from a set of already signed signature and therefore a reduction time required to verify Signature. There are too many algorithms in which the neural network can be done but with some back benefits distribution algorithm. It has been shown to be the first option neutral network implementation. Easy to use while maintaining an efficient neural network. If we talk about distribution back NN [10] of the structure, consists of three layers (see Fig. 1) where the input layer begins the second is the hidden layer and the last extraction layer. In between a layer called Hidden Secrets Work to Distribute (In this case layer nodes / samples are separated based on the proposed techniques) information from one layer to another. Extrusion layer basically contains augmented data and compares the data that can be displayed and results shown using stated condition.

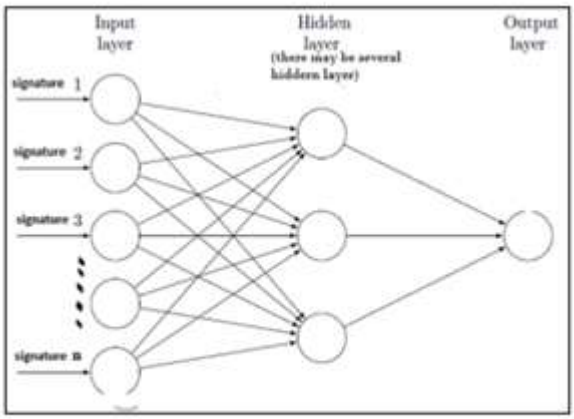


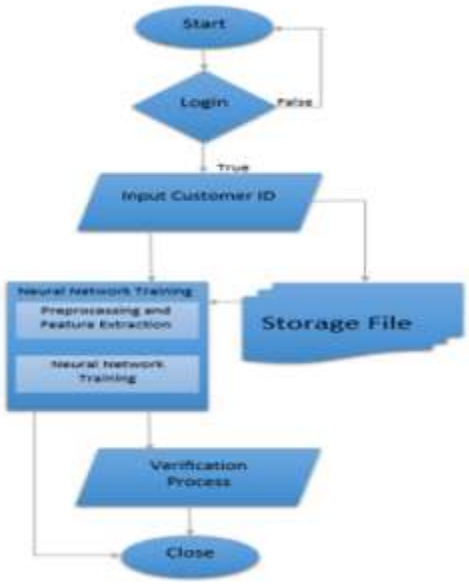
Figure 1. Back Propagation Neural Network

A. Pre-processing and Feature Selection for Proposed System SRVS :

After having literature review as mentioned in Table I and II, following pre-processing steps and features are taken for signature verification

1) Pre-processing Steps:

- Image Resizing
- Converting to Gray Scale Image
- Background Elimination
- Image Thinning
- Bounding Box the Image



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2) Image Features for Verification:
• Signature area
• Signature Ratio
• Geometric Centre
• Edge Points
• Aspect Ratio

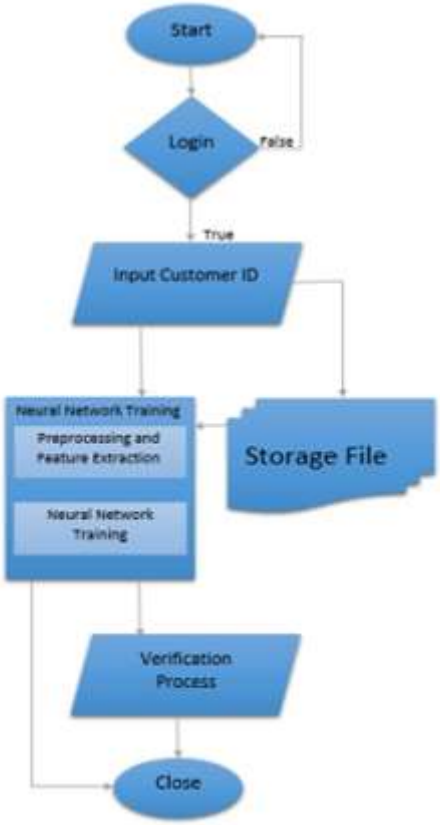

Figure 2. System Training Steps

B. The System Design: System design is split into two main stages:
1) Training stage of Signature:
This stage consists of following four major steps:
• Retrieval of signature images from a storage file
• Image pre-processing
• Feature extraction
• Neural network training
3) Testing stage of Signature:
The testing stage has the following five important steps:
• Retrieval of a 10 signature images from a storage file
• Image pre-processing
• Feature extraction
• Checking the output generated from a neural network
• Application of the extracted features to trained neural network

C. Preprocessing on Signature Image

Previous processing of signature image is deceptive again change image. It is regarded as the first step in the process of signature verification and enhanced recognition and production results and high levels of accuracy, See table III

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TABLE III. PREPROCESSING ON SIGNATURE IMAGE

Signature	Image
Original	
Resized	
Gray Scaled	
Background Eliminated	
Thinned	
Boundary Bounded	

1) Image resizing: Resizing an image is the first process of pre-signature image creation and makes the image even insert a box where that will be different for all sizes. Let us consider the height as H of the inserted image and the width as W for input image. We need to make the same image at 100 * 100 pixels using equation as:

X new = (X old * 100)/H;
Where X new is calculated using X old (original X coordinate).
Y new = (Y old * 100)/W;
Where Y new is calculated using Y old (original Y coordinate). By using these equations, transformation of the uniformed 100*100 pixels of image can be achievable.

2) Conversion to Gray Scale Image:

Now a day, all files the latest devices were able to take a picture again to scan, use color. For this reason, we have used color scanning device for the purpose of scanning the signature pictures. Usually a color picture consists of three colors matrices (labeled as RGB) and connection matrix (x, y edit image values). Strategies given in this regard The study is based on grayscale, and for this reason, Scanned or pre-colored color images are converted to the gray scale uses the figure as in [17] [20].

Gray color = 0.299*Red + 0.5876*Green +0.114*Blue

3) Background Completion:

This step is focused on a true signature in this case, but when The signature included has a possible origin because of the page or some other image. By removing this background from signed photos, using blocking, widely used for image classification. In block, a number commonly known as the limit value and represented by "T" should be selected. In addition, a value 0 will be assigned to those pixels with smaller values there is a value equal to the limit value "T". Similarly, the number 1 will do given to those with the highest values "T" [20]. Using the limit method, the output of the signature pixels from background pixels is possible. In this application, we are interested in something dark with a small background, for this reason, careful selection of the approx limit value is required and applied to image pixels [17] as;

If $f(x,y) \geq T$ then
f(x,y) = Background else f(x,y) = Object

4) Image Thinning:

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It is used with to rid from the thickness variation of pen by adjusting image one pixel thick. Thinning was used to represent the global properties of the objects and to cut down the original image into a more better andthe compact representation [20]. An Stentiford algorithm is used for thinning process.

5) Boundary Bounded Image:

When images are captured we cannot have supposed to have exactly the same dimensions which we have testing box.. There is a big one a chance to discover something unusual during a photo shoot again the scanning process that leads to the change of signature size. The width is the height of the signatures the amount of signature even one person can have the same signature of a different size. So, of course it is important to remove the weight loss and get bench for all input signature size. When the process of normally done, there will be no changes to the file aspect ratio of the height and width of the signature. There it will be the same size for all signatures.

The following is the equation used for the standard procedure:
X new = [(X old-X min)/ (X max-X min)]*M
Y new = [(Y old-Y min)/ (Y max-Y min)]*M
Where X new, Y new = Normalized signature pixel coordinates, X old, Y old = Original signature pixel coordinates, M = Normalized signature Width/height meant.

D. Features Extraction:

Release feature is the name of the process there the data is extracted from the raw data and that will work in the assignment section. Data can be reduced within a class pattern inconsistency and increased variability between categories. Therefore, in to achieve maximum performance in signature recognition system, the selection of an effective method of extracting the element of great importance. There are two signs for the algorithm for feature efficiency namely: Invariance and rebuilding ability. Features will have the power to identify multiple types of signatures if they are consistent to specify a signature modification. Feature Release by the second most important step in signature recognition again to confirm. The purpose of this step is to create features can be used as comparative measurements. As noted that the issues related to signature verification are an extremely delicate process, suggested to produce more there is one factor / measure for the accuracy of the result can be improved.

1) Signature Area: It is signature's normalized area. Ratio of area that signature has occupies by pixels of signature in the bounding box is known as normalized area

2) Signature Ratio: Ratio of the range of x coordinates and the range of y coordinates is known as width to height ratio. To calculate the width to height ratio, use the following formula: Width to Height Ratio = (Xmax - Xmin) / (Ymax - Ymin)
Where, Xmax and Xmin = Maximum & Minimum values of x coordinates of non-zero pixels While, Ymax and Ymin = Maximum & Minimum values of y coordinates of non-zero pixels

$$X = \frac{1}{N}\left(\sum_{i=1}^{n} x_i\right)$$

$$Y = \frac{1}{N}\left(\sum_{i=1}^{n} y_i\right)$$

3) Geometric center: The center of gravity is the 2-tuple (X, Y) and is given by: Where, X and Y denote the column number and row number of ON pixels (value 1) respectively

4) Edge Points: A point that has only one 8-neighbor is known as edge point. With the purpose to extract edge point in a signature, an element structure of 3×3 should have one pixel equal to 1 and others equal to 0.

5) Aspect Ratio: The ratio of width to height of the signature is said to be the aspect ratio which is represented by A. Coordinates of bonding box are determined and height Dy and width Dx are measured using these coordinates.

IV. CONCLUSION:

In this study, Offline Signature Recognition and Verification System based on Artificial Neural Network is presented. Training the system is a necessary part as the success rate depends on the training sample. The success rate of Signature Recognition and Verification System (SRVS) is found approximately 95% (average). The quality of imageplays an important role as poor quality of signature image may lead to the failure to recognize or verify a signature. Increasing in the attributes/ features of signature will increase the verification ability of the system but it leads to higher computational complexity.

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