



Review on Enhanced Offline Signature Recognition Using Neural Network and LDA

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Abstract: - *Biometrics refers to recognizing an individual based on his or her physiological or behavioural qualities. Signature verification systems can be classified as offline (static) and online (dynamic). This paper presents neural network based distinguishment of offline signatures system that is prepared with low-resolution scanned images of signature. The signature of a person is a vital biometric attribute of a person which can be utilized to verify the identity of human. However human signatures can be taken care of an image and recognized using computer vision and neural network techniques and LDA (Linear Discriminant Analysis). With advanced computers there is have to develop fast algorithms. With a lot of scope of research there are various approaches to signature recognition. In this paper off-line signature recognition & verification using neural network and LDA is proposed where the signature is caught and displayed to the user in the format of an image. Utilizing various image processing techniques the Off-line Signature Recognition and Verification is implemented. This work has been tested and discovered suitable for its motivation.*

Keyword: - *Signature Recognition, Neural Network (NN) and Linear Discriminant Analysis (LDA).*

I. INTRODUCTION

The traditional and acknowledged means for a person to identify and verify himself either to an alternate person in our society or to a computer system is based on one or more of these three general standards:

1. What the human being knows
2. What he has
3. What he is

The written signature is viewed as the primary means of identifying the signer of a written document based on the implicit assumption that a person's normal signature changes gradually. It is extremely hard to delete or modify or produce. The handwritten signature is one of the approaches to approve exchanges and verify the human identity which is contrasted with other electronic identification methods. For example fingerprints scanning and retinal vascular pattern screening. To move from utilizing the popular pen-and-paper signature to one where the handwritten signature is captured and verified electronically is easier for people.

The signature of a person is an imperative biometric characteristic of a person and utilized with the end goal of approval. The different methodologies are possible for signature recognition with a lot of scope of research. It deals with the technique that is off-line signature recognition. Signatures are made out of unique characters and twists. Signature recognition is the methodology of confirming the identity by checking the signature against samples. The result of this process is generally somewhere between 0 and 1. Signature recognition is used frequently to depict the capacity of a computer to translate human writing into text image. This may happen in one of two ways either by scanning of written text (off-line method) or by writing directly on to a peripheral input device. [13]

The principal of these recognition techniques, known as Optical Character Recognition (OCR). Most scanning suites offer some form of OCR which permitting user to scan handwritten documents. OCR is additionally used by some annalist as a technique of converting massive quantities of handwritten verifiable documents into searchable or effectively open advanced structures.

II. OVERVIEW OF SIGNATURE RECOGNITION

An issue of individual verification and identification is an effectively growing research area. The methods are based on distinctive individual attributes that are voice, hand geometry, face, odor, gait, iris, retina and fingerprint which are the most regularly utilized. All these mental and behavioral attributes are called biometrics which are the main impetus of the advancement in this field is over all the developing part of the web and electronic moves in cutting edge society and accordingly extensive number of uses is moved in the zone of electronic trade and electronic managing an account frameworks. [2]

The biometrics have a significant advantage over traditional authentication techniques because of the way that biometric attributes of the individual are not easily transferable are exceptional of each individual and can't be lost. The decision of one of the biometric solutions depends on several factors which include:

1. User acknowledgement
2. Level of security needed
3. Accuracy
4. Cost and execution time

The method of signature verification explored in this paper advantages of being very acknowledged. The utilization of the signature has a long history which backtracks to the appearance of writing. Use of the signature as a confirmation technique has already become a tradition in the western development and is regarded.[8] The signature is an acknowledged verification of identity of the person in an exchange. Consequently users are more prone to approve this sort of computerized verification method.

Signature verification systems vary in both their choice methodologies and their feature selection. More than 40 distinctive feature types have been utilized for signature verification. Features can be arranged into two major types: local and global. Global features are features identified with the signature as a whole for instance the average signing speed and the signature bounding box and Fourier descriptors of the signatures. Local features relate to a particular example point along the direction of the signature. [1]

Signature recognition and verification includes two different but strongly related tasks one of them is identification of the signature owner and the other is the choice about whether the signature is genuine. Additionally depending on the need and signature recognition and verification issue is put into two major classes:

- On-line signature recognition and verification systems (SRVS) and
- Off-line signature recognition and verification systems (SRVS). [7]

On-line SRVS requires some uncommon peripheral units for measuring hand speed and pressure on the human hand. Then again all Off-line SRVS systems depend on image processing and feature extraction strategies.

A. Image Pre-processing and Features Extraction: We approach the issue in two stages:

- The scanned signature image is pre-processed to be suitable for extracting features.
- The pre-processed image is utilized to extract significant geometric parameters that can recognize forged signatures from definite ones utilizing the ANN approach.

A.1. Pre-processing: The signature is initially captured and changed into a format that can be transformed by a computer. Presently its prepared for pre-processing. In pre-processing stage the RGB image of the signature is converted into greyscale and afterward to binary form. The reason of this stage is to make signatures prepared for feature extraction. The pre-processing stage incorporates two stages: Colour inversion, Filtering and Binarization.[11]

A.2. Colour Inversion: The genuine colour image RGB is changed over to the greyscale intensity image by eliminating the hue and saturation information while holding the luminance. A greyscale image is a data matrix whose qualities represent intensities within some range where every component of the matrix compares to one image pixel.

A.3. Image Filtering and Binarization: Any image when resample is filtered by a low pass FIR filter and to avoid aliasing this is carried out. This aliasing happens in view of sampling the data at a rate lower than double the largest frequency of data component.[14] So a low pass filter will remove the image high frequency components. And for this reason the filter utilized. Presently the greyscale image is segmented to

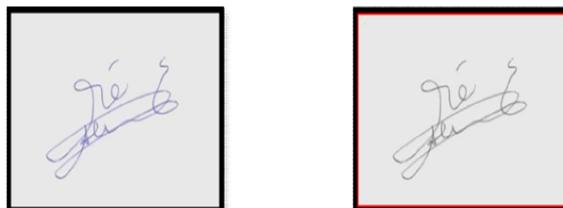


Fig.1 (a) A sample signature to be processed (b) A Greyscale Intensity Image

get a binary image of objects. In a binary image every pixel expect one of just two discrete values are 0 or 1. A binary image is stored as a logical array.[9]



Fig. 2 Binary Image interpreting the bit value of 0 as black and 1 as white[9]

A.4. Features Extraction: is the way to develop an offline signature recognition system. We utilise a set of five global features that can't be influenced by the temporal shift.[1]

B. Types of Signature Verification: It is based on the definitions of signature it can prompt to two different approaches of signature verification:

B.1. Off-Line or Static Signature Verification Technique: This approach is based on static attributes of the signature. In this sense signature verification turns into a typical pattern recognition task realizing that variations in signature pattern are unavoidable and the task of signature authentication can be limited to drawing the threshold of the range. In the offline signature verification techniques images of the signatures written on a paper are acquired utilizing a scanner or a camera. [6]

B.2. On-line or Dynamic Signature Verification Technique: This methodology is in view of the signing process of dynamic qualities. This verification utilizes signatures that are captured by pressure sensitive tablets that extract dynamic properties of a signature. Dynamic features include the number of order of the strokes and the overall speed of the signature and the pen pressure at each point that make the signature more unique and more difficult to genuine. Application regions of Online Signature Verification include protection of small personal devices approval of computer users for getting to sensitive data or programs and authentication of people for access to physical devices or buildings. [12]

C. Nature of Human Signature: It is gathered that the features of the process of signing begin from the characteristic properties of human neuromuscular system. Realizing that this system is constituted by a substantial number of neurons and muscle and fiber is possible to declare based on the central limit theorem that a fast and routine development speed profile tends toward a delta-log ordinary equation. This statement clarifies security of the signature qualities. Accordingly the signature can be treated as an output of a system obscured in a certain time interval important to make the signature.[14]

III. NEURAL NETWORK

Neural network is situated of interconnected neurons which is utilized for estimate of widespread. Artificial neural networks are made out of interconnecting neurons that are artificial or fake. Artificial neural networks might either be utilized to pick up an understanding of biological neural networks or for solving artificial intelligence issues without essentially making a model of a genuine biological system. The genuine or natural nervous system is exceptionally in which artificial neural network algorithms attempt to abstract this quality and concentrate on what might hypothetically matter most from a data handling perspective. Good performance (e.g. as measured by good predictive ability and low generalization error) or execution copying creature or human error patterns can then be utilized as one source of proof towards supporting the theory that the reflection truly caught something essential from the perspective of data. An alternate motivating force for these abstractions is to reduce the measure of processing needed to simulate artificial neural networks.

A. Architecture of artificial neural network: The fundamental architecture comprises of three types of neuron layers are input and hidden and output. In feed-forward networks the signal flow is from input data to output units entirely toward feed-forward. The data preparing can extend over multiple layers of units however no feedback connections. The recurrent networks contain some connections of feedback. In opposition to feed-forward networks the dynamical properties are crucial of the network. Now and again the activation values of the units undergo a relaxation process such that the network will develop to a stable state in which these activations don't change any longer.[10]

B. Artificial Neural Networks: Artificial neural networks are made out of interconnecting artificial neurons. Artificial neural networks might either be utilized to gain an understanding of biological neural networks or for solving artificial intelligence issues without essentially creating a model of a system of genuine biological system.[15] The real or biological nervous system is highly complex. The artificial neural network algorithms attempt to abstract this complexity and focus on what may hypothetically matter most from an information processing point of view. Good performance or performance mimicking animal or human error patterns and it can then be used as one source of evidence towards supporting the hypothesis that the abstraction really captured something important from the point of view of information processing in the brain.

C. Delta Rule: The delta rule is a gradient descent learning rule for redesigning the weights of the artificial neurons in a single-layer perceptrons. It is a uncommon instance of the more general back propagation algorithm. For a neuron j with activation function $g(x)$, the delta rule for j 's, the weight is given by

$$\Delta W_{ij} = (t_j - y_j) g'(h_j) x_i \quad (1)$$

In above equation the delta rule is generally expressed in simplified form for a perceptrons with a linear activation function as $\Delta W_{ij} = \alpha (t_j - y_j) x_i$, where α is known as the learning rate parameter.[9]

IV. LINEAR DISCRIMINANT ANALYSIS

The Linear Discriminant Analysis is a technique which is used for data classification and dimensionality reduction.

And in PCA the shape and the location of the original data sets changes when transformed to a different spaces whereas LDA doesn't change the location but only tries to provide more class separability and draw decision between the given classes.

In Discriminant analysis there are two scatter matrices, called *within-class* (S_w) and *between-class* (S_b) matrices are defined to quantify the quality.

V. PREVIOUS WORK

Nilesh Y. Choudhary et al. proposed off-line signature recognition & verification utilizing back propagation neural network is proposed where the signature is captured and introduced to the user in an image format. Signatures are verified based on features extracted from the signature utilizing Invariant Central Moment and Modified Zernike moment for its invariant feature extraction because the signatures are hampered by the large amount of variation in size and translation and rotation and shearing parameter. Before extracting the features preprocessing of a scanned image is important to isolate the signature part and to remove any spurious present noise. The system is first prepared using a database of 56 persons signatures got from those 56 persons whose signatures must be verified by the system and for every subject a mean signature is gotten coordinating the above features got from an arrangement of his/her genuine sample signatures. This signature recognition & verification system is composed utilizing MATLAB.[4]

Ashwini Pansare et al. proposed Off-line Signature Verification Using Neural Network. Various biometric techniques have been proposed for individual identification. Among the vision-based ones are face recognition or unique signature recognition or retina scanning and iris scanning. Voice recognition or signature verification are the most generally known among the non-vision. As signatures proceed with it play a vital role in financial or business and lawful exchanges which are genuinely secured validation gets to be more vital. A signature by an approved individual is thought to be the "seal of approval" and remains the most favored. The technique presented in this paper comprises of image preprocessing or geometric feature extraction or neural network training with extracted features and verification of signature. A verification stage incorporates applying the extracted features of test signature to a prepared neural network which will arrange it as a genuine or produced.[5]

Vibha Pandey et al. proposed off-line signature recognition & verification utilizing neural network is proposed where the signature is captured and introduced to the user in the format of an image. Signatures are checked based on parameters extracted from the signature utilizing different methods of image processing. This paper shows a proposed technique for confirming offline-signature. Novel features are utilized for arrangement. A Feed Forward Neural Network will be utilized for checking signatures and to focus its accuracy. Signatures are confirmed based on parameters removed from the signature using various methods of an image processing. This paper will be finished when the utility of signature verification is demonstrated i.e it helps in recognizing the accurate individual and it gives more accuracy of verifying signatures when contrasted with former works. For verification of signatures some novel features need to be extracted and for usage of over this paper uses Feed Forward Neural Network (FFNN) for recognition and verification of signatures of people.[3]

VI. CONCLUSION

By using neural networks is that they can extract the most discriminative and representative set of features. We have presented a learning vector quantization neural network architecture based on varying parameters and eliminating redundant hidden layer units or blind neurons that learns the correlation of patterns and recognizes handwritten signatures. The network classifier is trained on the random training samples to perform recognition task on the input signature image. The Empirical results yield an accuracy rate of 98% for a random test set of 150 handwritten signature images of 10 persons on the network that is trained with another set of 120 images of same subjects. The proposed algorithm can be used as an effective signature verification system. Then algorithm proposed was successfully made rotation invariant by the rotation of the image. The error rejection rate can further be improved by using better techniques for rotation; blurring and thinning.

ACKNOWLEDGEMENT

Thanks to my Guide and family member who always help and guide me during my dissertation. Special thanks to my father who always support my innovative thoughts

REFERENCES

- [1] Srikanta Pal, Michael Blumenstein and Umapada Pal, Hindi offline signature verification, International Conference on frontiers in handwriting recognition, July 2012.
- [2] Pradeep Kumar, Shekhar Singh et al., Hand Written Signature Recognition & verification using neural network, International journal of advance research in computer science and software engineering, Volume 3, Issue3, March 2013
- [3] Vibha Pandey and Ms. Sanjivani Shantaiya, "Signature Verification Using Morphological Features Based on Artificial Neural Network". International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 7, July 2012.
- [4] Nilesh Y. Choudhary et.al, "Signature Recognition & Verification System Using Back Propagation Neural Network". International Journal of IT, Engineering and Applied Sciences Research (IJIEASR), Volume 2, No. 1, January 2013

- [5] Ashwini Pansare and Shalini Bhatia, "Off-line Signature Verification Using Neural Network". International Journal of Scientific & Engineering Research, Volume 3, Issue 2, February-2012
- [6] A.I. Al-Shoshan. Handwritten signature verification using image invariants and dynamic features. Proc of the IEEE Int Conf on Computer Graphics, Imaging and Visualization (CGIV'06), 2006.
- [7] M. Piekarczyk. Hierarchical random graph model for off-line handwritten signatures recognition. IEEE Int Conf on Complex, Intelligent, Software Intensive Systems, 2010.
- [8] S.M.S. Ahmad, A. Shakil, M.A. Faudzi, R.M. Anwar. Analysis of 'goat' within user population of an offline signature biometrics. 10th IEEE Int Conf on Information Science, Signal Processing and their Applications (ISSPA 2010).
- [9] Rapanjot Kau et al., Review on: Enhanced offline signature recognition using neural network and SVM, IJCSIT, Vol. 5(3), 2014, 3648-3652
- [10] E.J.R. Justino, F. Bertolozzi, and R. Sabourin. A comparison of SVM and HMM classifiers in the offline signature verification. Pattern Recognition Letters, vol. 26, 1377-1385, 2005.
- [11] K. Delac and M. Grgic. A survey of biometric recognition methods. Proc of 46th IEEE Int Symposium Electronics, Croatia, 184-193, June 2004.
- [12] B. Kovari, Z. Kertesz, and A. Major. Off-line signature verification based on feature matching. 11th IEEE Int Conf on Intelligent Engineering Systems, Budapest, Hungary, 29 June - 1 July 2007.
- [13] A. Kholmatov and B. Yanikoglu. Identity authentication using improved on-line signature verification method. Pattern Recognition Letters, Volume 26, Issue 15, November 2005, pp. 2400-2408.
- [14] T.S. Ong, W.H. Khoh, A. Teoh. Dynamic handwritten signature verification based on statistical quantization Mechanism. IEEE Int Conf on Computer Engineering and Technology, 2009.
- [15] J. Edson, R. Justino, F. Bortolozzi, and R. Sabourin: "An off-line signature verification using HMM for random, simple and skilled forgeries," Proc. Sixth Int. Conf. Document Analysis and Recognition, pp. 1031-1034, Sept. 2001