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Offline Hindi Signature Recognition Using Surf Feature Extraction and Neural Networks Approach

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Abstract: ***The signatures are one of the ways to identify the signer. Signature recognition is the process of verifying the person's identity by checking their signature with the signatures which are stored in the database. This process is of two types: offline and online. This paper deals with the offline technique. This technique recognizes the person whether he/she is genuine or forged. In this paper the offline signature recognition technique is proposed using neural networks and surf feature extraction. The signatures are taken as an image form, which are captured by any camera or digital scanner. The parameter are extracted with the help of surf feature extraction method is proposed. The feature extraction is the key to develop the offline signature recognition system. The proposed code is implemented on the Matlab software.***

Keywords: Document authentication, Neural Network and Signature Recognition, Hindi signatures.

1. Introduction

Image registration plays an important role in the image processing application such as remote sensing and computer vision. Its purpose is to overlay two or more images of the same scene which are taken at different times from different viewpoints and by different sensors[1,2].

Image registration method can be divided into two categories: One is based on gray pixel, which works on the gray scale pictures. The other is based on characteristics, which match the different images by analyzing interest points. There are some important steps in feature-based image matching method. First, features of image are extracted, second, matching between the features, third, completing the features matching in the different images.

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:
1) User acceptance
2) Level of security required
3) Accuracy
4) Cost and implementation time

The objective of signature verification system is to differentiate between original and forged signature, related to intra personal and inter personal variability. Intra personal variations is distinction among the signatures of the same person and inter personal is the variation between the originals and the forgeries. There will always be slight variations in a human's handwritten signature, the consistency generated by natural motion and practice over time generates a recognizable pattern that makes the handwritten signature suitable for biometric identification. A signature forgery means an attempt to copy someone else's signature and use these against to steal his/her identity. There can be basically three types of forgeries [5]. Both offline and online systems are used to detect various types of forgeries.

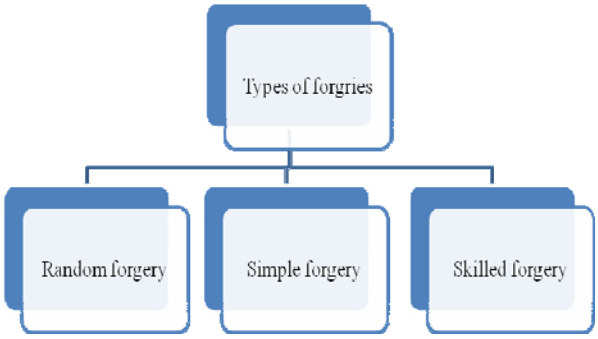

Figure 1: Classification of Forgeries

As shown in fig 1. The types of forgeries are as following:

- **Types of Forgeries**: Basically there are three types that have been defined-
- **Random forgery:** This can normally be represented by a signature sample that belongs to a different writer i.e. the forger has no information whatsoever about the signature style and the name of the person.
- **Simple forgery:** This is a signature with the same shape or the genuine writer's name.
- **Skilled forgery:** This is signed by a person who has had access to a genuine signature for practice[3].

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[10] 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[4]. 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[10]. On-line SRVS requires some special peripheral units for measuring hand speed and pressure on the human hand when it creates the signature. 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. On the other hand, almost all Off-line SRVS systems rely on image processing and feature extraction techniques. . In the offline signature verification techniques, images of the signatures written on a paper are obtained using a scanner or a camera. 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[8].

2. Literature Survey

Ms. Vibha Pandey et. al.(2012) proposed Signature Verification Using Morphological Features Based on Artificial Neural Network. For identification of a particular human being signatures prove to be an important biometric. In this paper, off-line signature recognition & verification using neural network is proposed, where the signature is captured and presented to the user in an image format. Signatures are verified cbn based on parameters extracted from the signature using various image processing techniques. This paper presents a proposed method for verifying offline-signatures. Novel features are used for classification of signatures.

Ashwini Pansare et. al.(2012) proposed Off-line Signature Verification Using Neural Network. A number of biometric techniques have been proposed for personal identification in the past. Among the vision-based ones are face recognition, fingerprint recognition, iris scanning and retina scanning. Voice recognition or signature verification are the most widely known among the non-vision based ones. As signatures continue to play an important role in financial, commercial and legal transactions, truly secured authentication becomes more and more crucial. A signature by an authorized person is considered to be the “seal of approval” and remains the most preferred means of authentication. The method presented in this paper consists of image prepossessing, geometric feature extraction, neural network training with extracted features and verification.

Pradeep Kumar et. al.(2013) proposed Hand Written Signature Recognition & Verification using Neural Network. The signature of a person is an important biometric attribute of a human being which can be used to authenticate human identity. The method presented in this paper consists of image prepossessing, geometric feature extraction, neural network training with extracted features and verification. A verification stage includes applying the extracted features of test signature to a trained neural network which will classify it as a genuine or forged. In this paper, off-line signature recognition & verification using neural network is proposed, where the signature is captured and presented to the user in an image format. 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 MATLAB.

Nilesh Y. Choudhary et.al.(2013) proposed Signature Recognition & Verification System Using Back Propagation Neural Network. The fact that the signature is widely used as a means of personal identification tool for humans require that the need for an automatic verification system. Verification can be performed either Offline or Online based on the application. 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. . In this paper, off-line signature recognition & verification using back propagation neural network is proposed, where the signature is captured and presented to the user in an image format. Signatures are verified based on

features extracted from the signature using 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, translation and rotation and shearing parameter.

Srikanta pal et. at.(2012) proposed Hindi offline signature verification. The purpose of this paper is to present an offline signature verification system involving Hindi signatures. It is a process by which the questioned signature is examined in detail in order to determine whether it belongs to the claimed person or not. To the best of the authors knowledge, Hindi signatures have never been used for the task of signature verification and this is the first report of using Hindi signatures in this area. The Hindi signature database employed for experimentation consisted of 840(35x24) genuine signatures and 1050 (35x30) forgeries. An encouraging accuracy of 7.42% FRR and 4.28% FAR were obtained following experimentation when the gradient features were employed.

Dipali K. Bhole et. al. (2011) proposed offline signature using cross validation and graph matching approach. This work proposed the comparison to the physiological base biometric system such as fingerprint, face, palm, vein and retina, behavioral based system such as signature, voice, gait etc. are less popular and many are still in infancy. Signature verification is used for banking transactions. In this paper, graph matching based approach for signature verification and cross-validation for same. Database signature is preprocessed in which signature extraction method is used to obtain high resolution for smaller normalization box. In Graph based approach the dissimilarity between two signatures are determined by finding minimum Euclidean distance by Hungarian method. In Cross-validation technique the authenticate the test signature. It is observed that this method gives remarkable reduction in Equal Error Rate (EER).

3. 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.

1. Pre-processing

a) The signature is first captured and transformed into a format that can be processed by a computer. Now it's ready for preprocessing [5]. 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. Importing the image with optical scanner or by digital photography.

b) Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.

c) Output is the last stage in which result can be altered image or report that is based on image analysis.

2. 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.

3. Extraction of SURF Features from Signatures

The SURF[6][7] algorithm is composed of mainly two parts: first, we detect interest point. Second, we perform interest point description. Both of these parts relay on a scale space representation and first and second order differential operators. Uniqueness of the SURF method is that these operations are speeded up by the use of an integral image and box filters techniques [8][9]. First compute an integral image with respect to an input image. Interested points are detected.

4. Methodology

1. Collect the sample signatures.
2. Then original signatures are loaded from the database and also the test signatures are loaded.
3. Now the preprocessing step is performed, all the thinning and rotation operation are performed.
4. After that the surf features are calculated and points are matched between the input and out signatures.
5. The neural network training tools are applied.
6. Check the output of the signatures.

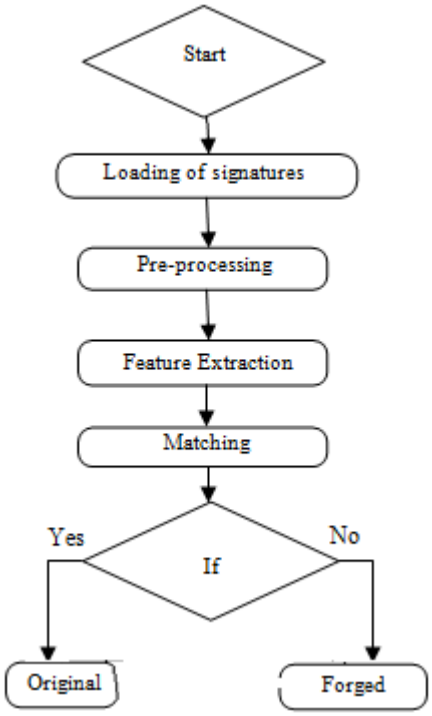

Figure 2: Flow chart of methodology

4.1 Recognition

Neural networks give effective results for solving multiple class classification problems. Chau [11] notes that neural network facilitate gate recognition because of their highly flexible and non linear modeling ability. Neural network has

three types of layers: input layer, output layers and hidden layers. Hidden layer does intermediate computation before directing the input to output layer. Back propagation can also be considered as a generalization of delta rule. When back propagation network is cycled, an input pattern is propagated forward to the output units through the intervening input to hidden and hidden to output weights. Neural network have been widely used in image and signal processing.

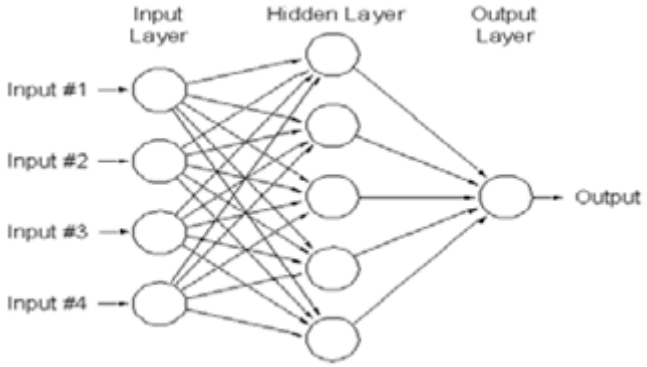

Figure 3: Neural Network

As shown in fig.2 [11] the layered structure of neural network is represented. Which shows the interconnection of the layer with the hidden layer.

The proposed system [12] using structure features from modified direction feature and other features as surface area, length skew and centroid feature where signature is divided into two halves and for each half a position of the centre of gravity is calculating with reference to the horizontal axis. For classification two approaches are compared the Resilient Back propagation (RBP) neural network and Radial Basic Function(RBF) using a database of 2106 signatures containing 936 genuine and 1170 forgeries. These two classifiers register 91.21% and 88 % true verification respectively.

The works of Alan McCabe [12] Several Network topologies are tested and their accuracy is compared. The most successful version of the NN based HSV system uses a single MLP with one hidden layer to model each user's signature. It is trained using five genuine signatures and one hundred zero-effort forgeries. Using this approach, a 3:3% OER is reported for the best case.

In [13] signature is captured and presented to the user in an image format. Then Signatures are verified cbn using parameters extracted from the signature based on various image processing techniques. It helps in detecting the exact person and it provides more accuracy of verifying signatures as compared to prior works. For verification of signatures some novel features needs to be extracted. For implementation of above this paper uses Neural Network (NN) for recognition and verification of signatures of individuals.

4.2 Feed Forward Artificial Neural Network:

Feed-forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs. They are extensively used in pattern recognition. This type of organization is also referred to as bottom-up or top-down.

5. Result and Discussion

The following are the result of the proposed system. As shown in Fig. 4 this is the starting window , it shows the two push buttons one is start button to start the code another is exit to exit front the window.

Figure 4: The basic layout of the proposed system

As shown in Fig. 5 it show the signature loading window from this window the further steps are processed.

Figure 5: Load the original signature image.

As shown in Fig. 6 various thinning and rotation operations are performed on the input signatures.

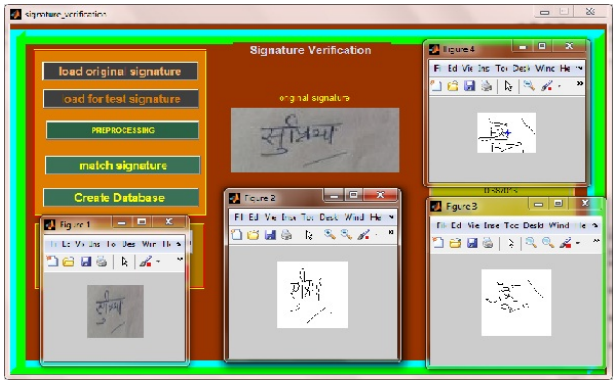

Figure 6: Various thinning and rotation operation is performed on input signature

As shown in Fig. 7 this window shows the both signatures original and the signatures which will be tested.

Figure 7: Test Signature is uploaded and both input and test signature are processed.

As shown in Fig. 8 the surf features are calculated.

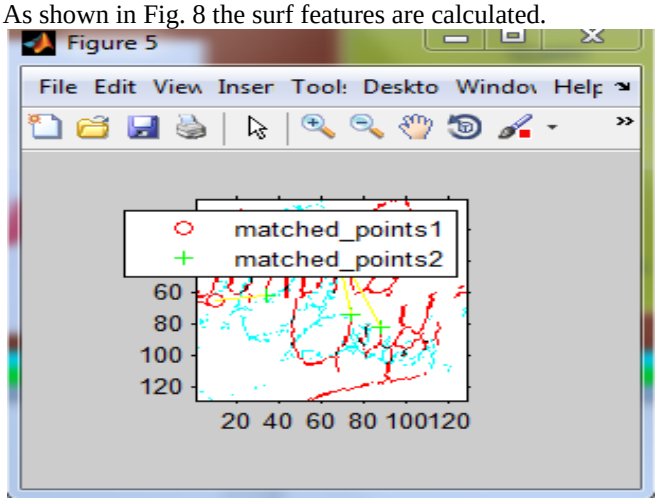

Figure 8: Surf Features are calculated and critical points are matched between input and test signatures.

As shown in Fig. 9 this the graph shows the comparison of surf and neural networks with the other techniques.

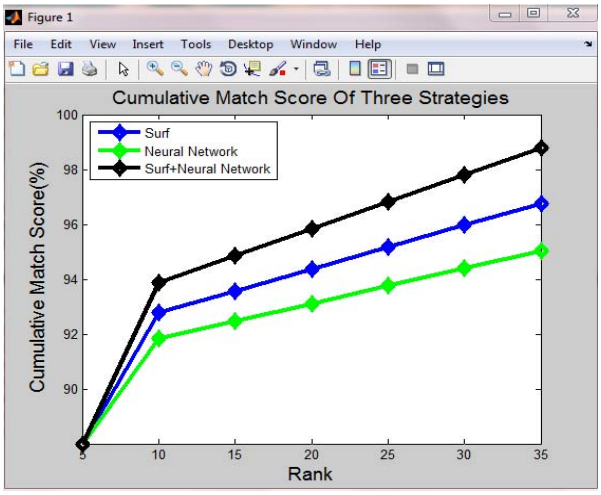

Figure 9: Comparison of various techniques

As shown in Fig. 10 it shows the mean square value between the input and the output signatures.

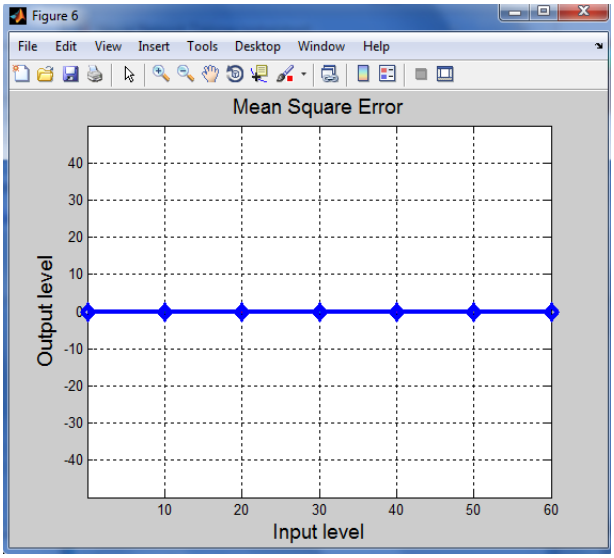

Figure 10: Mean square value between input and output.

As shown the Figure 11 it shows the output of neural network tool after processing.

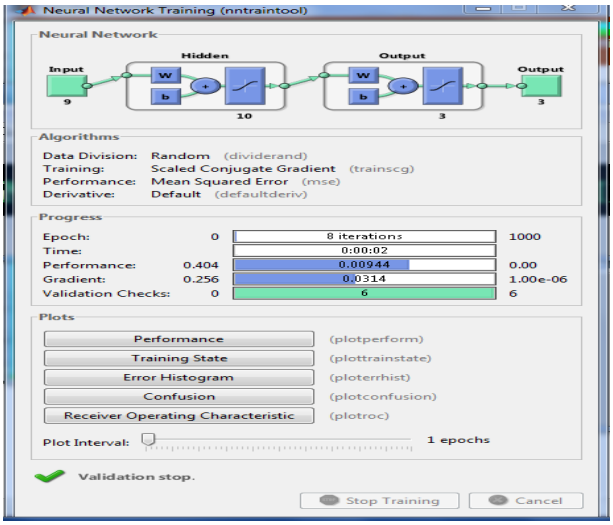

Figure 11: After proceesing output of NN Toolbox

6. Conclusions

This paper presents a learning vector quantization neural network architecture based on varying parameters and eliminating redundant hidden layer units that learns the correlation of pattern recognition handwritten signatures. The proposed algorithm can be used as an effective signature verification system. The 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. It uses less storage space in the system which reduces memory overhead and results in faster comparisons of data to be verified. This paper presents a method of offline signature recognition verification using surf feature extraction and neural networks. The method uses feature extracted from preprocessed signature images.

References

[1] G.A. Khuwaja. An adaptive combined classifier system for invariant face recognition. IEEE, international conference on Digital Signal Processing 12, 21–46, 2002.
[2] D. Zhang, J. Campbell, D. Maltoni, and R. Bolle. Special issue on biometric systems. IEEE Trans. Systems, Man and Cybernetics - C, 35(3):273–275, 2005.
[3] K. Bowyer, V. Govindaraju, and N. Ratha. Introduction to the special issue on recent advances in biometric systems. IEEE Trans. Systems, Man and Cybernetics - B, 37(5): 1091–1095, 2007.
[4] G. A. Khuwaja. Fingerprint identification with LVQ. Proc of the 9th IEEE Int Conf on Neural Information Processing (ICONIP'OZ), Vol. 2, Singapore, Nov. 2002.
[5] J.F. Vargas, M.A. Ferrer, C.M. Travieso, and J. B. Alonso. Offline signature verification based on pseudo-cepstral coefficients. 10th IEEE Int Conf on Document Anal. & Recognition, 2009.
[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] Ms. Vibha Pandey, Ms. Sanjivani shantaiya . Signature verification using morphological features basd on artificial neural network. International journal of advanced research in computer science and software engineering, issue 7, vol.2, july 2012.
[9] J.P. Drouhard, R. Sabourin, and M. Godbout. A neural network approach to off-line signature verification using directional PDF. Pattern Recognition, 29(3), (1996), 415--424.
[10] Pardeep Kumar, Shekhar Singh, AShwani Garg and Nishant Prabhat. Hand witten signature recognition & verification. International journal of advanced research in computer science and software engineering, vol. 3, issue 3, march 2013.
[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 International Conference on Intelligent Engineering Systems, Budapest, Hungary, 29 June - 1 July 2007.
[13] Srikanta Pal, Michael Blumenstein, Hindi Off-line Signature Verification in IEEE International conference on frontier in hand writing recognition in 2012.
[14] 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.
[15] B. Zhang, M. Fu and H. Yan: “Handwritten signature verification based on neural ‘Gas’ based vector quantization”, IEEE Int.Joint Conf. on Neural Networks, pp. 1862-1864, May 1998. verification using compression networks and positional cuttings”, Proc. 2003 IEEE Workshop on Neural Networks for Signal Processing, vol. 1, pp. 627-636, 2003.
[16] A. Chalechale and A. Mertins: “Line segment distribution of sketches for persian signature recognition”, IEEE Proc. TENCON, vol. 1, pp. 11–15, Oct. 2003.
[17] A. Jain, F. Griess, and S. Connell: “Online signature verification”, Pattern Recognition *35*, 2002, pp. 2963-2972.
[18] P.A. Hughes and A.D.P. Green. The use of neural networks for fingerprint classification. Proc. 2nd Int. Conf. Neural Networks, 79-81, Journal of Computer Applications in Technology, Vol. 16, No. 4, 181- 193, 2002.
[19] T.S. Ong, W.H. Khoh, A. Teoh. “dynamic handwritten signature verification based on statiscal quantization mechanism .IEEE international conference on computer engineering and technology”,2009.
[20] Prashanth CR, KB Raja,KR Venugopal, LM Patnaik,”Standard Scores Correlation based Offline signature verification system”, International Conference on advances in computing, control and telecommunication Technologies 2009 .

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