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A Novel Approach For Character Recognition System using Neural Networks

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Abtract

Neural Network proves to be a very effective tool in pattern classification problems The proposed system finds its applications not only in pattern recognization but also in machine learning .In machine learning various algorithms are developed for speech recognization and character identification. The proposed system involves extracting the textual part of the image containing the English character and eliminating the non textual part like images . A highly simplified structure of the artificial neural network is used in the proposed work, the system is tested by varying the various parameters of neural network like Learning rate, mean square error, Number of hidden layer and Number of output layer. The parameters are varied until an optimized output is achieved. Learning rate represent learning step size, in the beginning learning rate is kept at .1 and then it is increased by step of .1, and its effect on pattern classification and training time is observed. The proposed system is tested and for a learning rate of .9 the system provides maximum efficiency in minimum time. Larger learning rate result in coarse-grained weight updating and the system takes larger time to converge. The degree of freedom largely depend upon the number of hidden layer in the network ,the proposed system is implemented using a single hidden layer. Hidden layer node can very effectively increase the system performance but the training time increase drastically if the number of nodes are increased.

Introduction

Character recognization is an art of detecting, segmenting and identifying character from an image. Character recognization is classified into offline and online character recognization system. An example of online recognization system is the electronic personal data assistant and offline recognization include number plate recognization systems. The proposed system is developed using offline character recognization system which utilize only the static images of characters. Character recognization is a challenging field that is socially very relevant .The social relevance lies from the fact that we can effectively preserve rare document of the past for posterity .Many ancient manuscripts can be digitized and can be preserved using character recognization system.
Neural Network is nowadays widely employed in most pattern recognization system because of the robustness and effectiveness of the neural network systems. Neural Network is a branch which is trying to mimic the human brain

functionality comprising of lakhs of neurons which are the information carrying units and with the help of this branch of science we have developed artificial neurons using various software tools. The main block of the proposed system is the neural network with the help of which a size invariant neural network is developed. Neural Network proves to be an excellent tool in character recognization due to its humanoid properties such as adapting to changes and learning from experience. The proposed work consist of two phase ,in the first phase the system is trained using images of different character, in the second phase the system is tested by imputing different images. If the system is able to identify all the characters effectively no further training is required else the system is trained again.
`The system can also be made color invariant by first converting the test image into gray scale ,the formulae used for conversion is

Y= (int) (0.33 * R + 0.56 *G +0.11 *B)

Where R denoted the red component of a color pixel,G denotes the rd component of a color pixel,B indicates the blue component of the color pixel.The grayscale image obtain is then converted to binary image.

Network Training

In the proposed system the network is trained using back propagation neural network, which is a very effective and accurate method used in neural network training and testing phases In this method the system is trained by providing feature extracted from each sub-image of the main image of different characters as input to the neural network. First the system is made to learn characters of different font and after learning phase, the system adept itself in such a manner that the system can very effectively identify character of some

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different font with which the system is not trained. Each input neuron correspond to one binary value of the character matrix ,in the proposed system 81 binary value for each character is obtained after the feature extraction process and hence we have 81 input neurons ,in the figure X1 contain the first feature set of the character matrix and similarly X81 contain the last feature set .The system contain only one hidden layer ,each neuron in the input layer is connected with the each neuron in the hidden layer which act as the intermediate layer between input and the output layer. The following steps are used in implementing back propagation neural network

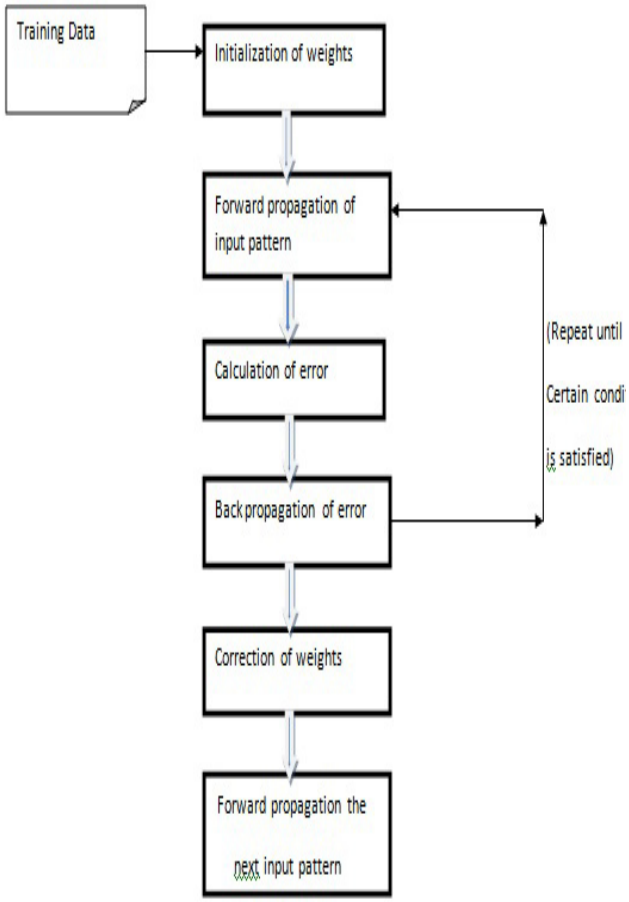

Figure 1. Flowchart showing back propagation

Selection of Training Data

The training data consist of feature set of character from A – Z .The feature are obtained using two steps which involves

Segmentation

Segmentation plays a very vital role in character recognization from an image in offline character recognization system. Segmentation involves isolating an image from the background, segmentation involves three basic steps Line Segmentation, word Segmentation, Character Segmentation. In the proposed system segmentation abcind invidual character from a list of character of different fonts present in the image, the feature of each character segmented from the image is then used for neural network training. A numbers of methods are developed for image segmentation like Hough transformation , Whitespace Division ,in the proposed word segmentation is done using Hough segmentation technique which segment the images of different English characters into sub-images of individual English character.

Figure 2. Images of A used for network training

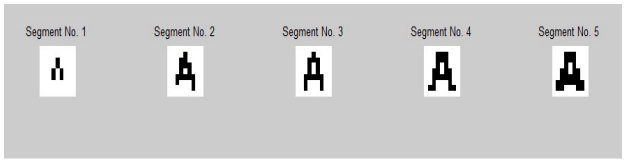

Figure 3. Image Segmentation

Feature Extraction

Feature extraction is the most vital component of the character recognization system, the ability of the system to effectively identify a character is based on the quality and effectiveness of the features extracted from the individual characters during the learning phase. In the proposed system the features are obtained from the digitalized image of individual character. In the process of the digitization the input image is sampled into a binary image which act as a input to the system. A binary image matrix *I of* each character is form containing black and white pixel ,a binary

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value 1 is assign to each black pixel and 0 is assign to whitepixel.If the system is now trained using the binary matrix features only the system will be able to identify the character of the same size only and there will not be any size invariance in the system, the system can be made size invariant by first extracting the boundary of the each character and then normalized the binary matrix i.e. convert the binary matrix of each character into pre-determined dimensions. In the proposed system we have convert boundary detected input character matrix into 12*8 normalized matrix. The effective value of dimension can make the network learn in a fast and effective manner. If matrix of very large dimension is taken then it will put more burden on the network as the network have to process large feature set of each character and it will make the training time too long ,on the contrary part if the size is taken too small the system will be trained in a short time but there will be error during the training phase of the network as the network is trained using a very miniature feature set. The image can be thin using thinning operation before the segmentation and feature extraction. For the proposed system we obtain a total of 130 feature set which are used for network training

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1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1;

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1,
1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0,
1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1;

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1,
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1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1;

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1,
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1, 1, 1;

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1,
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1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1;
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Figure 5. Binary Feature Set of different fonts of character A

Initialization of weights.

The weights are initialize to a random value before the network is trained. Since the system is design in MATLAB ,**rand** command is used to randomly assign values to the weights in the network.

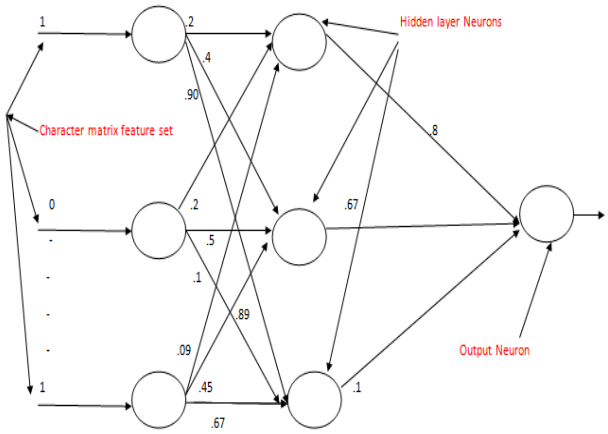

Figure 6. Random assignment of weights

Forward Propagation

This step includes the forward propagation of the first input pattern of the training set from the input layer over the hidden layer(s) to the output layer, where each neuron sums the weighted input, passes them through the nonlinearity and passes this weighted sum to the neuron in the next layer. During feed forward stage each input unit(Xi) receives an input signal and transmits this signal to each of the hidden units z1…..zp.Each hidden unit then calculates the activation function and send its signal zj to each output unit.

ERROR-Error is defined as the difference between the actual and value obtained after training.

ERROR=Actual value-value obtain

In the proposed system actual value is set manually in such a way that after the system is trained ,during the testing phase when character A of different fonts is presented to the system the system gives an output 1/6,for character B a value of 2/6,for character C value of 3/6, for character D value of 4/6,for character E a value of 5/6,and for character F a value of 1.These values are user given values and system is trained and tested for these values only.

Backward-propagation Step

During back propagation of errors each output unit compares its computed activation with its target value to determine the associated error for that pattern with that unit. The errors are reduced starting from the output layer to the input layer.

Correction Of Weights

In the end the optimized weights are obtained after reduction of error from each stage, and these weight are the memory of the system and now the system is ready to for testing purpose.

Testing phase

Testing phase is the most dominant part of the whole system, after the training is done the weights are updated with a normalized value and the system now ready to identify different characters.

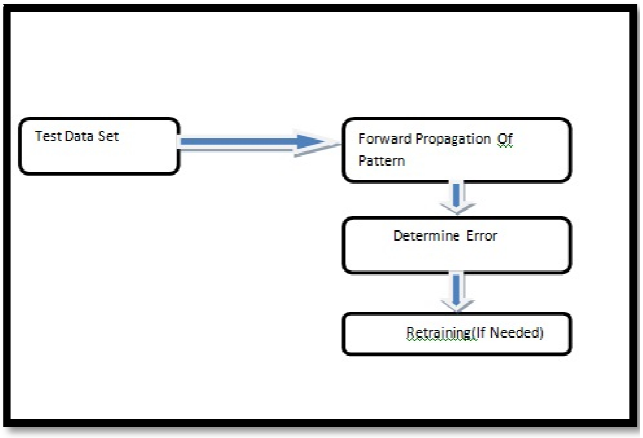

Figure 7 Flowchart of Training phase

Forward Propagation of Pattern- The features of the character to be identify is extracted and is propagated to the trained neural network.The weights which are normalized are used in character recognization.

Determine Error- The Error is determine but there is no weight updation in this step.

Retraining- If system properly able to identify all characters the weights are not change and the net is stored for future purpose. If system properly able to identify all characters the weights are not change and the net is stored for future purpose. If there is degradation in system performance the system is trained again by changing some parameters as number of hidden layers,learning rate and mean square error

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