

A Survey Neural Network Based Efficient Technique For Handwritten Digit Recognition Process

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Abstract- Artificial Neural Network (ANN) is concept based on animal nervous system to operation, function and it's ability to perform the task and learning things. ANN is apply in various fields and application in all over world, and among all one of important is Numbers /Character recognition. The recognition system has neural network as its domain and front end processing handled by image processing to extract scripted number. Handscripted numeric recognition is difficult because of, the writing elegance is differed by person to person. In actual recognition process faces issues like size , shape and stroke of written script. It include two stages 1. Image preprocessing, 2. Applying Neural Network. ANN with Feed Forward Back Propagation Neural network (FFBPNN) is design to identifies the number with forwardly feeded encountered error. In recognition system, numeric letter extract by image preprocessing methods and represented by binary number and then treat as input for FFBPNN.

Keywords- Artificial neural network (ANN), Nervous System, Feed forward back propagation neural network (FFBPNN), Handscripted Numeric recognition, Image preprocessing.

I. INTRODUCTION

The Handscripted recognition refers to identification of hand written character or number. Neural network based handwritten number recognition is very important area of research in this few years and various approaches are proposed to make focus on this concept. Neural network work differently than conventional computer system process. Neural network solve the complex problem in differ method then conventional approach, it work in parallel and make learning process by example. It is not implement to solve or process specific operation[1].

Numeric recognition states the translating image of Handscripted, typed number into computer compatible format to needs of editing and managing storage size [6]. We can think neural network as multiprocessor computer system because of processing element, input interconnection using middle layers, and adaptive learning abilities.

Character recognition is also well known as optically recognized character. The important objective of character or number recognition is to construe input as sequence of character or number from an already surviving predefined set of character or number pattern[4]. Identification of character or number from document become difficult due to noise and distortion in document. Character recognition process variant into online and offline character recognition categories. Online deal with automatic conversion of character and offline deal with data set that can be created from document. Handwritten number recognition mainly encompasses two stages i.e image preprocessing and neural networking processing. Recognition

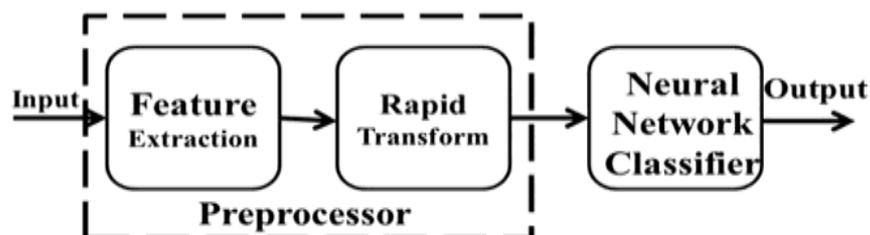


Figure 1. Number Recognition Block Structure

process convert input image into binary pattern image to implement image processing and neural network based

implementation that will be used to translate scanned and preprocessed image to machine understandable form[7].

Uses of neural network fundamentals in character recognition make the intelligent learning process of character set to process input image. Neural network basically consist of three layers as input layer, middle layer, and output layer. At middle layer there may have multiple layers. Back- propagation neural network propagate error backward for its reprocessing, Back-propagation with feed forward functionality in neural network make advantage to process input. Any raised error feeded to forward step to process it again with input. Input image is preprocessed in image preprocessing subsequent steps and then fed to neural network as input to neural network subsequent layers. In neural network, Input image compare with predefined digit example pattern to identify exact output result.

II. NUMERALS RECOGNITION

For simple understanding numeral recognition is identification of Handscripted or typed number by system, so that it improve user handy working ease and abled to read/learn numerous styled written numbers. Recognition process begins with acquiring the image from scripted or typed number followed by preprocessing then feature selection /extraction[10]. Character or number recognition is fully depend on quality of feature extraction process. Acquired image feature may be structural, topological and geometrical properties[12]. Each extraction properties effect the exact outcomes of number recognition process accuracy.

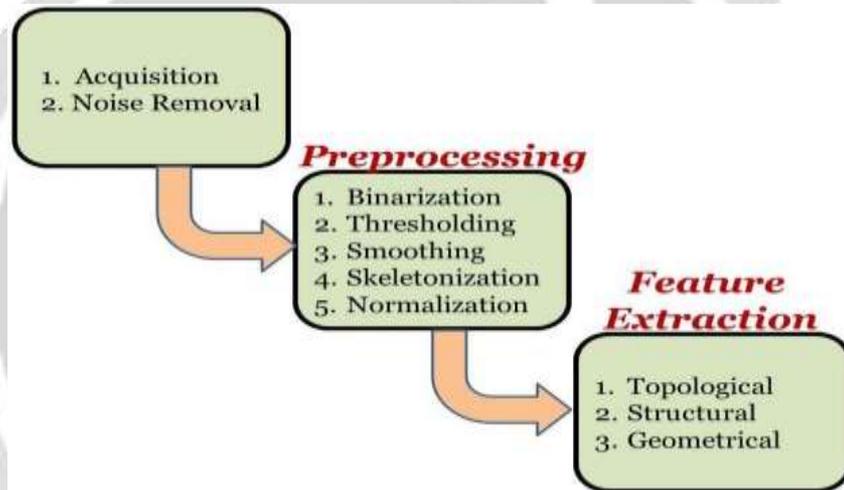


Figure 2. Preprocessing & Extraction Flow

Noise removal from acquired image concern with removing blurs and unwanted dots and burdens. So that clean image must as clear as to process in preprocessing step, and make preprocessing steps more effective and accurate. At end system get binary format number image inputed for next step. Once system get input for performing preprocessing steps into mXn binary image matrix, one by one sub sequent step applied on number image as follows Binarization: It is refers to the conversion of a gray scale image into a binary representation of image. Thresholding: Refers to the one threshold value is picked for represent entire image that fundamentally based on estimation of background level from the intensity histogram of the image.

Smoothing: Smoothing is to smooth shape of broken input character.

Skeletonization: It is refers to the process of reducing the width of a line like object from many pixel wide to just single pixel.

Normalization: Normalization is linear process, it remove all types of variations during the writing and standardized data.

After completion of preprocessing stage system moves input image toward the feature extraction process for further properties selection. Feature extraction elaborate the appropriate input data information from image so that the job to classifying and identifying exact number made simple[5,7]. Topological: Topology refers to shape and size of image is searched for mapping the image. Feature selection extracts numerous topological properties like minima, maxima, extreme points and below and above thresholds, number of loop, number of segments and end points.

Structural: Structural properties refer to the outlines and height and width of input number image.

Geometrical: geometrical properties including relative distance from first pixel to last pixels from top to bottom, leftmost to rightmost pixels distance. It also include geometrical function extract image feature for identify number[13].

One of the most appreciable method of preprocessing and feature extraction is fuzzy logic. Fuzzy extraction algorithms can also be useful for feature extraction base on fuzzy rule set[15].

These extracted feature image become input for our trained neural network.

III. NUERAL NETWORK

Neural network is a processing unit, either an algorithmic execution process or practical hardware. Neural network is concept based on design and functionalities as same as the animal brain preform its activities and functioning. Neural network worked for computing activities and operation term as Artificial Neural Network (ANN). Like the brain process information artificial neural network processes the information. ANN consists of n number of element called as neurons which highly interconnected in unique passion to handle desired working task. There is synaptic linking in between neurons to solve task. ANN mines the meaning from the complex and vague information [1].

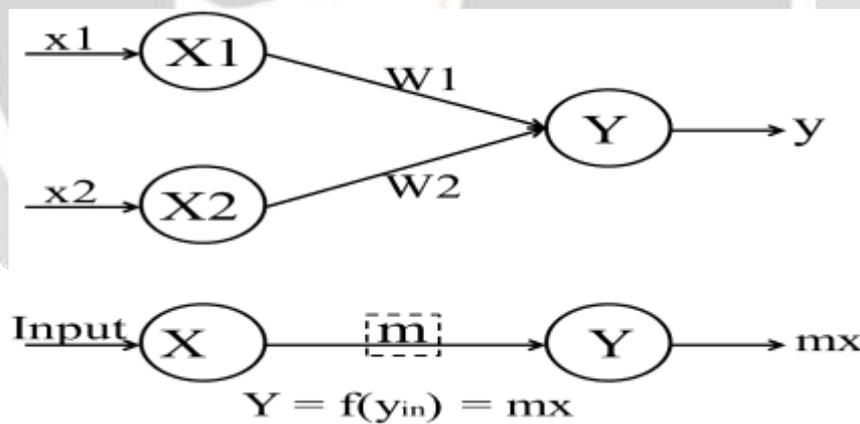


Figure 3. Artificial Neural Network Architecture

Every input has weighted interconnection treated toward the generation of output. Neural network computation function applied on weighted input pair to calculate score result. Finally decision is made based on the similarity score result. Neural network learn composite mapping between inputs and outputs and particularly useful when allocated statistic for desired task are not well understood [3]. Learning of neural network categorized into supervised learning and unsupervised learning to process the weighted inputs. These categories are classified depend on mapping of desired or expected output result combined with weighted inputs, so that calculated result and expected result are compare for accuracy and to test procedural working of training neural network [8].

Supervised Learning: Neural network learning with the comparison with predefined result set. In supervised learning of neural network desired output/expected output is fed with weighted inputs, so that actual output as result of network computation

from the neural network is supervised by desired output[8].

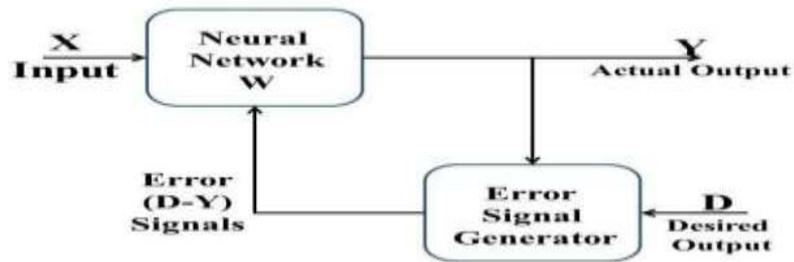


Figure 4. Supervised Learning Neural Network

Unsupervised Learning: The learning here is performed without by expected /desired output. During the network training there is no clue about the generation of output. Whatever resultant outcome system get from neural network is considered as final and actual output. In training process the network accept the input and organized in clusters, and at end produce the computed outcomes.

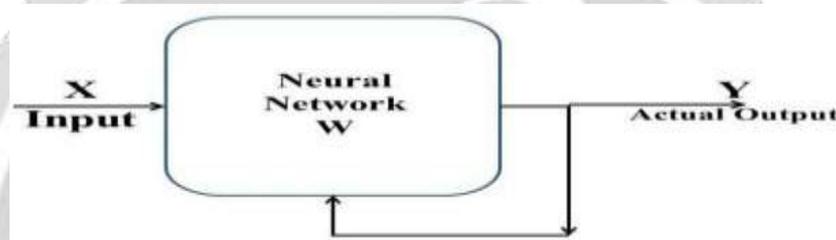


Figure 5. Unsupervised Learning Neural Network Artificial neural network has numerous type which implement with both supervised and unsupervised learning categories [8].

Back propagation neural network with feed forward functionality for error handling is use efficiently for character /number recognition application. There are multiple hidden layer in between input layer and output layer for retrained input at every intermediate network layer.

IV. NUMBER RECOGNITION USING FEED FORWARD BACK-PROPAGATION NEURAL NETWORK

Handscripted and typed recognition of character or number become difficult as well as popular problem from last many years, and more of subsequent research and problem solving strategy are developed to handle this issue. To implement character recognition using feed forward back propagation neural network is applied in various ways. Back propagation neural network is network architecture which send raised error from specific hidden layer to exact previous to it, but with the feed forward functionality of back propagation this raised error are send to next hidden layer from current working layer. At next layer this previous raised error play important role in supervision to execute process with reference of past layer process execution. Here with this whole process it become supervised learning neural network, at each step produce output is compare and examine with past resultant outcomes.

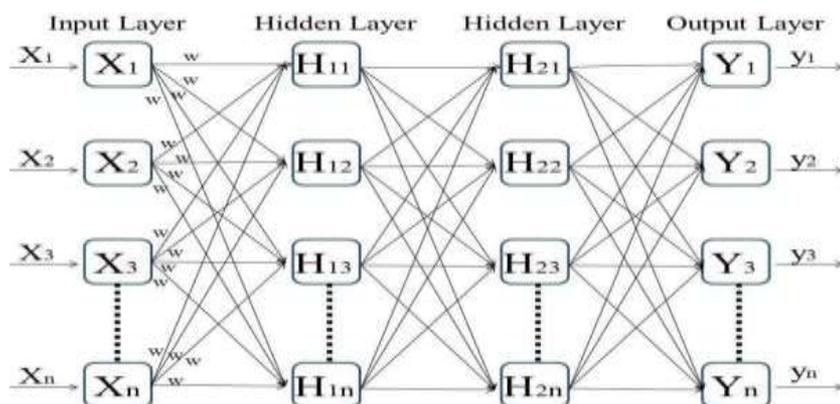


Figure 6. Feed Forward Back Propagation Network Binarized image of Handscripted character

completion of preprocessing and feature extraction, inputted to feed forward back propagation neural network training process. Each input at input layer is paired with weight. Weight is assigned biased value, used to make the computation in neural network. Before the actual process of recognition is started, first neural network is trained, so that it can developed the capability of mapping various input to the required output and effectively classified numerous numbers [3]. It may be noted that ANN uses back propagation neural network algorithms with feed forward functionality for learning. The required /expected value is provided and fed by programmer during training design of network architecture. These target value accommodated for small recognition errors, which may be change from application to application [4]. These values are attached with input and then these unit are connected in feed forward manner, with input layer element fully connected with each element in hidden layer and then each element in hidden layer is fully connected with each and every element in output layer.

When back propagation neural net is iterated, an input pattern schema is propagated forward to the output unit through the input layer to hidden layer and hidden layer to the output layer weight. Back propagation is iterative process that start with step by step first to last working layers. The process are iterate continuously and repeatedly presented to the network until the error value is minimized. Weight in the layer are adjusted according to the error present in network processing [6].

For recognizing Handscripted character with different font size and multi font type, to achieve highly exact matching accurate result, centroid dithering training process with low noise-sensitivity normalization procedure is used. As training a neural network can be computationally expensive, so it can make simple if we create and use simple classification algorithm which can be more reasonable and allow cross validation to observe and examine which properties work perfectly. We use back propagation network which learn by example and give dependent output. We give the algorithms example of whatever that we expected from training to perform computation and there after it may need to change the weight at corresponding step, hence when there is completion of training, there is more chances of, there is more chances of generating expected output from the provided input [10]. At the end when training of network is completed and result comparison is finished, recognition process is completed. Back propagation neural network is ideal successful for implementation of character/number recognition process. And feed forward technique add more accuracy in recognition algorithms [11].

V. CONCLUSION

Handscripted or typed character recognition is one of the important topics in application of artificial neural network. It improves the working capability of system to handle written work in various shape and writing style. Feed forward back propagation neural network add the advantage in the process of character /number recognition and increase the accuracy of detecting exact output correctly. There may be the situation where the Handscripted character image id complex to recognize, because to handle this problem of recognition we used supervised neural network learning, so that actual output and expected output should be matched for correctness of output.

REFERENCES

- [1] Srinivasa kumar devireddy, settipalli appa rao, "Hand written character recognition using back Propagation network", journal of theoretical and applied information technology, jatit, © 2016 .
- [2] Joarder kamruzzaman and s. M. Aziz, "A neural network based character recognition system using double backpropagation", malaysian journal of computer science, vol. 11 no. 1, june 2013, pp.58-64.
- [3] Jayanta kumar basu¹, debnath bhattacharyya², tai-hoon kim², "Use of artificial neural network in pattern recognition", international journal of software engineering and its applications Vol. 4, no. 2, 23 april 2020.
- [4] Vivek shrivastava and Navdeep sharma, "Artificial Neural Network based optical character recognition system", Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.5, October 2021.
- [5] Carlos agelle, "Neural network for pen character recognition", university of california, Irvine Irvine, ca 96217.
- [6] Sameeksha barve, "Optical character recognition using artificial neural network", international journal of advanced technology & engineering research (ijater), ISSN no: 2250-3536 volume 2, issue 2, may 2021.
- [7] Alexandar j. Forbaarg, "Using neural networks to create an adaptive character Recognition system", cornell university, ithaca ny May 14, 2020.
- [8] Vamsi k. Madasu, brian c. Lovell, m. Hanmandlu, "Hand printed character recognition using neural networks", Ischool of itee, university of queensland, australia.
- [9] Vipin, rajeshwar dass, rajni, "Character recognition using neural network", international journal of computer science, engineering and applications ISSN no. 2278- 3091, Volume 2, no.3, may-june 2019.
- [10] Pooja agrawal and dr. Aanand rajavat, "A neural network based efficient technique for Handwritten digit recognition system", pooja agrawal et al, / (ijcsit) international journal of computer science and information technologies, ISSN:0975-9646 , 2020 .
- [11] Dharmendra hingu, harnisha gevaria, " Character recognition with neural networks using fuzzy feature extraction", international journal of emerging technology and advanced engineering, ISSN 2250-2459, iso 9001:2008 certified journal, volume 5, issue 11, november 2021.