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Vellore Institute of Technology
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School of Information Technology & Engineering

M.Tech Software Engineering

Soft Computing –SWE 1011

REVIEW-III

Topic: Digit Recognition

DATE: 24/10/2018

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CERTIFICATE

This is to certify that the project work entitled “DIGIT RECOGNITION USING NEURAL NETWORK” that is being submitted by “group” for Soft Computing (SWE-1011) is a record of bonafide work done under my supervision. The contents of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Place: Vellore

Date: 24/10/2018

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ACKNOWLEDGEMENT

The student is free to acknowledge all those he/she feels he/she should acknowledge on the basis of the guidance and help provided during the implementation of the project. If the student has conducted his project elsewhere (viz. outside VIT) appropriate acknowledgement should be given to all concerned.

It is customary to acknowledge the University Management / respective School Dean for giving the candidate an opportunity to carry out his/her studies at the University.

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Abstract:

Using neural network , a computer can be trained to recognize a number. The goal of the automation is to identify the numbers written in the particular box, compare against the expected patterns, and estimate the correct number with some probability. The idea is to take large number of handwritten digits, known as training examples, and then develop a system which can learn from those training examples. In other words, the neural network uses the examples to automatically infer rules for recognizing handwritten digits. Further more, by increasing the number of training examples , the network can learn more about handwriting, and so improve its accuracy. so we have planned to give some training examples for each digit, perhaps we could build a better handwriting recognizer by using thousands or even millions or billions of training examples.

Introduction:

Digit recognition is basically a process of detecting and recognition digits from input image and convert it into appropriate machine editable forms, but constructing a system for this type of recognition faces a challenging task for the researches due to the various types of shapes of digits that Includes a large set with curves, loops, thickness ,orientation size ,and may depend upon writer, width, color etc.

The performance of handwritten digit recognition system is highly depend upon two things:

(I)first it depends on feature extraction techniques which is used to increase the performance of the system and improve the recognition rate.

(ii)second is the neural network approach which takes lots of training data and automatically infer the rule for matching it with the correct pattern.

Literature survey for digit recognition:

Sr. No	Name of the author	Title	Description	Pros	Cons
1.	jalalvand,F abian triefenbach	Novel feature extraction technique for digit recognition	Here the digit recognition is done based on support vector. novel feature is based on transition information In the vertical and horizontal directions of a digit image combined with the famous freeman chain code	The main advantage of this feature extraction algorithm is that it does not require any normalization of digits	Performanc e will be low when compared to other techniques
2.	Shruti R. Kulkarni ,B ipin Rajendran	Spiking neural networks for handwritten digit recognition-supervised learning and network optimization	Here in this paper spike triggered normalized approximate descent algorithm were used inorder to recognize the digit	SNNs achieved the best accuracy rate than other methods	Result may vary using other classifier.
3.	F.Laucer, C.Y.Suen, G.Bloch	A trainable feature extractor for handwritten digit recognition	Trainable feature extractor based on the LeNet5 convolution neural network architecture is introduced to solve the first problem in a black box scheme without prior knowledge on the data.	Experiments are performed on the well known MNIST database to validate the method of result.	Classifying the task may be difficult.
4.	Junfei qiao, gongming wang , wenjing li,min chen	Adaptive deep Q-learning strategy for handwritten digit	Here in this paper adaptive deep Q-learning strategy is proposed to improve accuracy and shorten running time for	High recognition rate	Certain digit causes issue recognition

		recognition.	handwrittendigit recognition		
5.	Luca B. Saldanha, Christophe Bobda	An embedded systems for handwritten digit recognition	The goal of this work is the design and implementation of low-cost system-on-FPGA for handwritten digit recognition	This effort reinforce the fact that FPGAs are suited for depoying complex artificial intelligence modules	Performanc e decreases
6.	Azarakhsh jalalvand, Fabian triefenbach, kris demuynck, Jean-pierre martens	Robust continuos digit recognition using reservoir computing	Here discovery of new relations between RC control parameters, input and output dynamics, study of robustness of Reservoir computing based continuous digit recognizer	Process time is quick	Other classifier may vary the result
7.	K. Gaurav, Bhatia P. K.	character recognition with different kind of images	It deals with the various pre-processing techniques involved in the character recognition with different kind of images ranges from a simple handwritten form based documents and documents containing colored and complex background and varied intensities.	It was concluded that using a single technique for preprocessing, we can't completely process the image	after applying all the techniques might not possible to achieve the full accuracy in a preprocessi ng system
8.	Salvador España-Boquera	Hybrid Hidden Markov Model (HMM)	The goal of this model is proposed for recognizing unconstrained offline handwritten texts.	different techniques are applied to remove slope and slant from handwritten text and to normalize the size of text images with supervised learning methods. The key features of this recognition system	Classifying the task may be difficult

				were to develop a system having high accuracy in preprocessing and recognition, which are both based on ANNs.	
9.	Mohammed Z. Khedher, Gheith A. Abandah, and Ahmed M. Al Khawaldeh	handwritten Arabic characters	Recognition of characters greatly depends upon the features used. Several features of the handwritten Arabic characters are selected and discussed.	An off-line recognition system based on the selected features was built. The system was trained and tested with realistic samples of handwritten Arabic characters. Evaluation of the importance and accuracy of the selected features is made.	The recognition based on the selected features give average accuracies of 88% and 70% for the numbers and letters, respectively
10.	A. Brakensiek, J. Rottland, A. Kosmala, J. Rigoll	Handwriting recognition	A system for off-line cursive handwriting recognition is described which is based on Hidden Markov Models (HMM) using discrete and hybrid modelling techniques	A segmentation free approach is considered to develop the system. It is found that the recognition rate performance can be improved of a hybrid modelling technique for HMMs.	Performance will be low when compared to other techniques .

Methodology:

Digit Recognition using back propagation neural network algorithm.

Back propagation neural network.

Artificial neural network (ANN) is used to analyze and recognize the handwritten digits. The ANN used is a multi-layer network that uses backpropagation learning for training purposes.

BACKPROPAGATION ALGORITHM

- A. Back propagation (BP) learning is a supervised learning method. In this type of learning methods the network is first trained with a training set that has fixed input patterns and the output for each of the patterns is predefined. This helps the network to learn and adjust the weights accordingly before the actual inputs are applied to the network. The network is tested once its fully trained using a testing/validation set. BP learning is simply adjusting the weights of the system in direct proportion to the error
- B. Back propagation Network Architecture The typical BP network consists of three layers, input layer, hidden layer and output layer. The bold lines denote the forward path which is propagation of the normal inputs in the network while the dotted lines denote the backward path which is propagation of the error.

Generally, a neural network model prearranges the amount of layers in advance. A BP neural network may include a number of hidden layers. The BP neural network model used in this project uses only three layers, they are,

Input Layer Design:

The input layer receives the external input data. Thus the amount of nodes lies on the dimension of the input vector. In this project the binary images under consideration are of the size 16x16 pixels. Therefore, the input layer includes a total of 256 nodes.

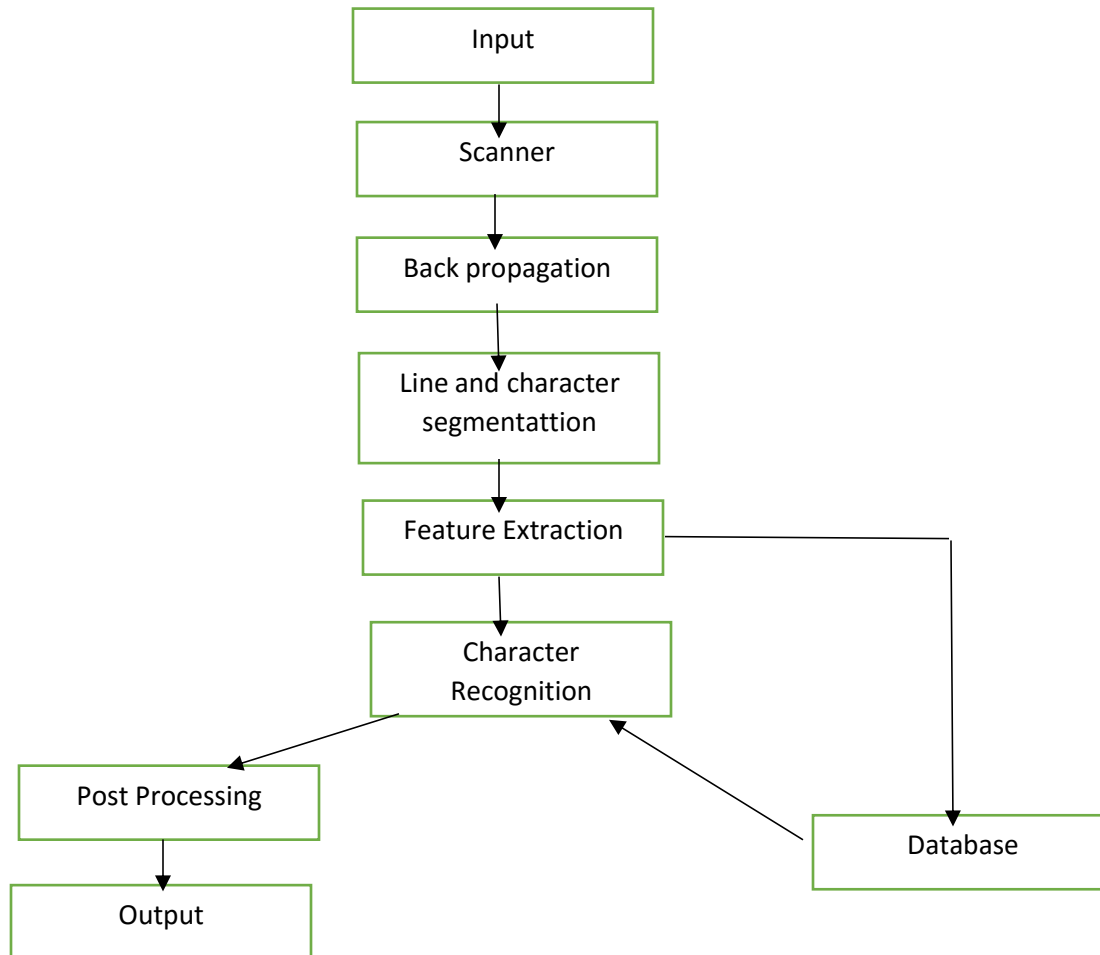
Hidden Layer Design:

The amount of nodes in the hidden layer depends on various factors. Numerous nodes may cost more time in learning while lesser nodes may result in lower recognition rate and lower fault tolerance. 37 nodes in the hidden layer prove to be able to obtain better learning speed and recognition rates after numerous experiments.

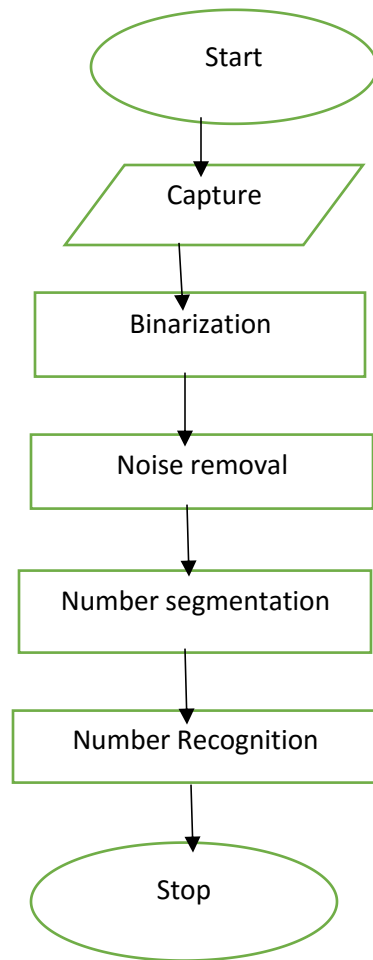
Output Layer Design:

The amount of nodes in the output layer relates to the type and size of the output data. Our project aims to recognize 10 digits (0 to 9) and thus one output node for every digit. The total number of output nodes amount to 10.

Architecture Diagram:




Flow chart:



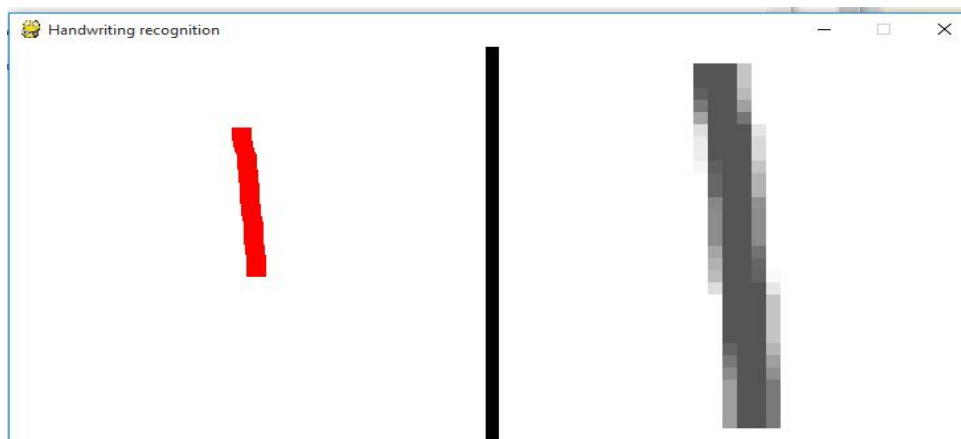
RESULT ANALYSIS:

Preparing for output screen:

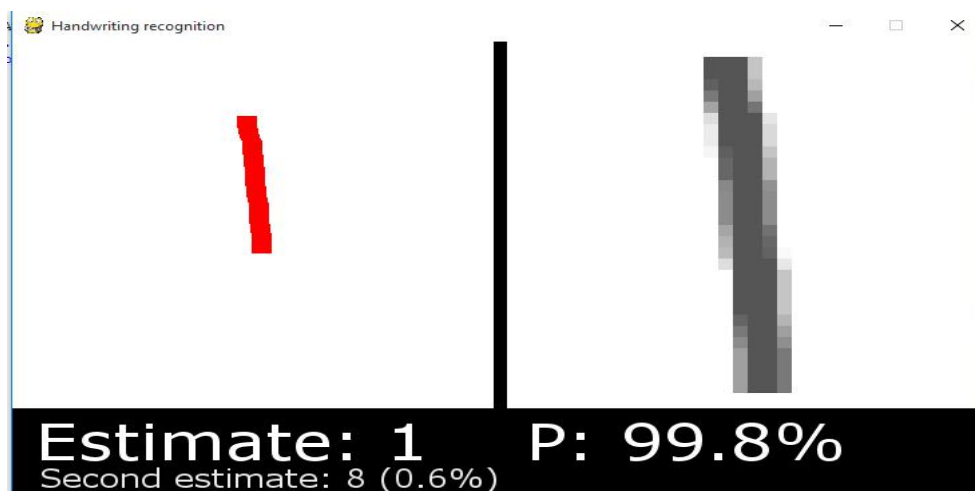


```
*Python 3.7.0 Shell*
File Edit Shell Debug Options Window Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
=== RESTART: C:\Users\Lourdu mary\Desktop\Digit Recognition\New\nn_demo.py ===
pygame 1.9.4
Hello from the pygame community. https://www.pygame.org/contribute.html
```

Giving manual inputs inorder to recognise the digits also then the given input is converted into gray scale image:



Getting the accuracy through comparing with image dataset:



Conclusion:

We can conclude that we reached the computer to the human's brain by the importance use of isolated digits recognition for different applications. This recognition starts with acquiring the image to be preprocessed throw a number of steps. As an important point, classification and recognition have to be done to gain a numeral text. In a final conclusion, neural network seems to be better than other techniques used for recognition.

Thus, understanding of neural networks

- we have more control over its applications
- now easy to implement such intelligence to identify objects into machines and computers
- In order to cater our needs in the industrial applications
