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Number Script Recognition using Neural Networks

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ABSTRACT

Ability for accurate digit recognizer modelling and prediction is critical for pattern recognition and security. A variety of classification machine learning algorithms are known to be effective for digit recognition. The purpose of this experiment is rapid assessment of multiple types of classification models on digit recognition problem. The work offers an environment for comparing four types of classification models in a unified experiment: multi-class decision forest, Multi class decision jungle, Multi-class Neural Network and Multi-class Logistic Regression. The work presents assessment results using 6 performance metrics: Overall accuracy, Average accuracy, Micro-averaged precision, Macro-averaged precision, Micro-averaged recall and Macro-averaged recall. The experimental results showed that the highest accuracy was obtained by Multi-class Neural Network with the value of 97.14%. The purpose of this project was to introduce neural networks through a relatively easy-to-understand application to the general public. This paper describes several techniques used for preprocessing the handwritten digits, as well as a number of ways in which neural networks were used for the recognition task.

Keywords— OCR, Handwritten digit recognition, Slant Correction, PCA, Accuracy, Confusion Matrix, Digit recognizer, Machine Learning, Classification Algorithm

1. INTRODUCTION

Regarding recent progress in process technology, countless algorithms have emerged so as to classify and acknowledge hand written objects, paving the means for the concept of diverse of diverse finding some way to acknowledge Associate in Nursing verify written notes has perpetually been an obsession for scientists. this will be thus helpful in varied applications during which the operators tend to unify and integrate all the written notes with the aim of facilitating and enhancing the employment of the notes. automatic written digit recognition is wide used these days – from recognizing nothing codes (postal codes) on mail envelopes to recognizing the amounts written on bank checks. during this paper we have a tendency to incline to introduce Associate in Nursing rule, referred to as Back propagation, to acknowledge written notes and so we'll amend it by the utilization of neural networks. As a short outline, during this paper, we have a tendency to solely think about the case of written digits; but, this rule will be utilized to acknowledge alphabetical figures and words. we have a tendency to initiated our learning method with pictures in size of 40×40-pixel figures, however the method was perceptibly stalled in speed and extended in time, we have a tendency to obligatory Associate in Nursing inevitable shift on size of the photographs, reducing them to a grid of 20×20 peal grayscale sq. pictures. These pictures will currently be understood as a 20×20 matrix to that recognition method are going to be applied. we'll discuss this procedure any within the following sections. Casting a perfunctory retrospective look at the previous achievements during this space not on the far side the last 3 decades. However, it's useful to summarize the past makes an attempt. several researchers have admitted the classical pattern recognition ways that are supported pre-processing the image so as to extract options and so feed the Neural Network with these options.

2. LITERATURE REVIEW

An early notable try within the space of range recognition analysis is by Grimsdale in 1959. The origin of a good deal of analysis add the first sixties was supported associate approach called analysis-by-synthesis technique urged by Eden in

1968. the nice importance of Eden's work was that he formally tested that everyone written characters and ranges area unit fashioned by a finite number of schematic options, a degree that was implicitly enclosed in previous works. This notion was later employed in all ways in syntactical (structural) approaches of character and range recognition.

K. Gaurav, Bhatia P. K. this paper deals with the varied pre-processing techniques concerned within the range recognition with completely different quite pictures range from a straightforward written type based mostly documents and documents containing coloured and complicated background and varied intensities. In this, completely different pre-processing techniques like skew detection and correction, image improvement techniques of distinction stretching, binarization, noise removal techniques, standardization and segmentation, morphological process techniques area unit mentioned. it had been all over that employing a single technique for pre-processing, we tend to can't utterly method the image. However, even once applying all the aforementioned techniques may not attainable to realize the complete accuracy in an exceedingly pre-processing system.

L. A. Brakensiek, J. Rottland, A. Kosmala, J. Rigoll during this paper a system for off-line cursive handwriting recognition is delineate that is predicated on Hidden Andre Mark-off Models (HMM) victimization separate and hybrid modelling techniques. Handwriting recognition experiments employing a separate and 2 completely different hybrid approaches, that carries with it a separate and semi-continuous structure, area unit compared. A segmentation free approach is taken into account to develop the system. it's found that the popularity rate performance are often improved of a hybrid modelling technique for HMMs, that depends on a neural vector quantizer (hybrid MMI), compared to separate and hybrid HMMs, supported tired mixture structure (hybrid - TP), which can be caused by a relative tiny information set.

R. Bajaj, L. Dey, S. Chaudhari used 3 completely different styles of options, namely, the density options, moment options and descriptive part options for classification of script Numerals. They projected multi classifier connectionist design for increasing the popularity dependableness and that they obtained eighty nine.6% accuracy for written script numerals.

Renata F. P. Neves have projected SVM based mostly offline written digit recognition. Authors claim that SVM outperforms the multi-layer perceptron classifier. Experiment is administered on bureau SD19 normal data-set. Advantage of MLP is that it's able to phase non-linearly divisible categories. However, MLP will simply be a districtity|a vicinity|a part|a section} of local minimum, wherever the coaching can stop assumptive it's achieved associate best purpose within the error surface. Another hindrance is shaping the simplest spec to resolve the matter, considering {the range|the amount|the quantity} of layers and also the number of perceptron in every hidden layer. due to these disadvantages, a digit recognizer victimization the MLP structure might not manufacture the specified low error rate

3. METHODOLOGY

3.1 Flowchart

3.1.1 Training

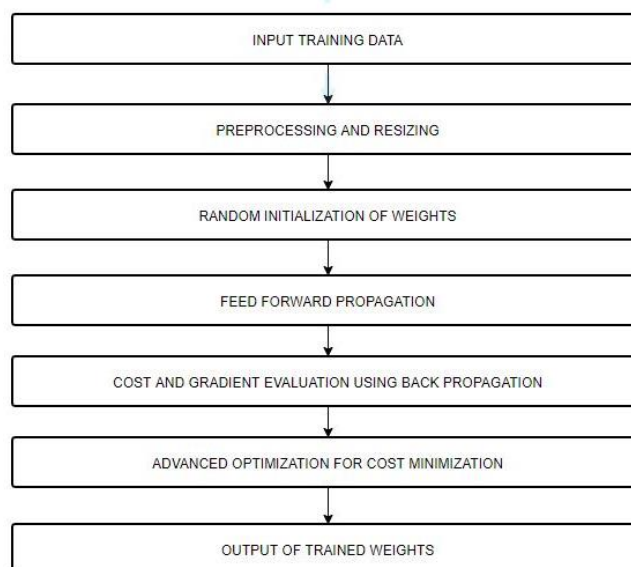


Fig.3.1. Flowchart of Input

In this project we implement number script recognition using neural networks, for this to be implemented firstly we collect huge data-set of number scripts of individual number digits from 0-9 where 500 images of each of digit is present in data-set. However, the images in data-set ae already preprocessed and each of dimension 20x20 and they are present in data-set as 5000x400 dimension matrix because each image is reshaped from 20x20 to 1x400 and are labeled accordingly using a corresponding vector of 5000x1. Now we give those data-set set model which will train on the data-set. Here the model is constructed using neural networks which is implemented by sigmoid activation functions and Back-propagation algorithm, the neural network we used has total of three layers in which one is input layer of 400 units, hidden layer of 25 units and a output layer of 10 units since we are implementing multi class classification using neural networks to predict digits from 0-9 so we have 10 units in output layer, in the

input layer 400 units correspond to 400 pixels of input image. In the neural network we find the multiply the input layer with weights such that the multiplication leads to 25 hidden units in the network and we term this weights as 'theta1' then we again multiply hidden units with certain weights such that the multiplication leads to 10 output units and we term this weights as 'theta2'. First we initialize the random weights to theta1 and theta2 and compute cost function to check the error in the output by comparing with the actual output. Now we minimize the error by choosing weights of theta1 and theta2 such that on new input the output is predicted correctly, to minimize the cost function we use gradients of cost function which is similar to differentiation. Here to compute gradients accurately we use back propagation algorithm where all the units in the network are computed by feed forward propagation and then error in each layer's units is computed and except the input layer. Now the gradients are computed by multiplying computed error vector of the layer to previous layer units. Now these gradients along with cost function are supplied given as input to some advanced optimization algorithms in this project we use 'fminunc', the main purpose of these algorithms is to minimize the cost function by choosing weights of theta 1 and theta 2 by iterating through a loop and simultaneously updating weights and computing cost function for that corresponding weights the iteration of loop is stopped when the cost is not changing as iteration is progressing. Finally after minimizing the cost the optimization algorithm returns the theta 1 and theta2 weights now we multiply new unseen image pixels which are reshaped with theta1 and then the result of pixels x theta1 with theta2 which results in a 1x10 dimensioned vector here we predict the number as index value of maximum value of 1x10 vector.

4. RESULTS

Output

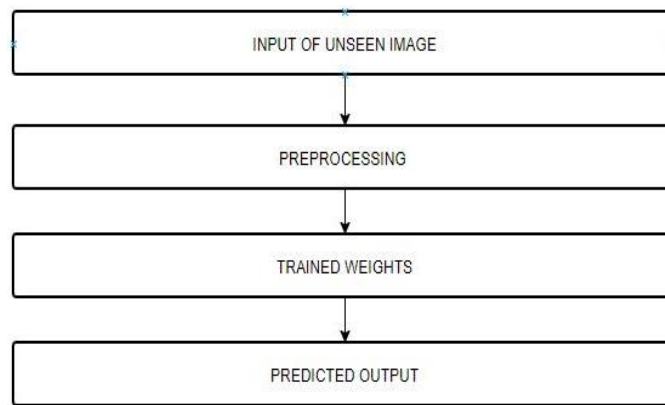
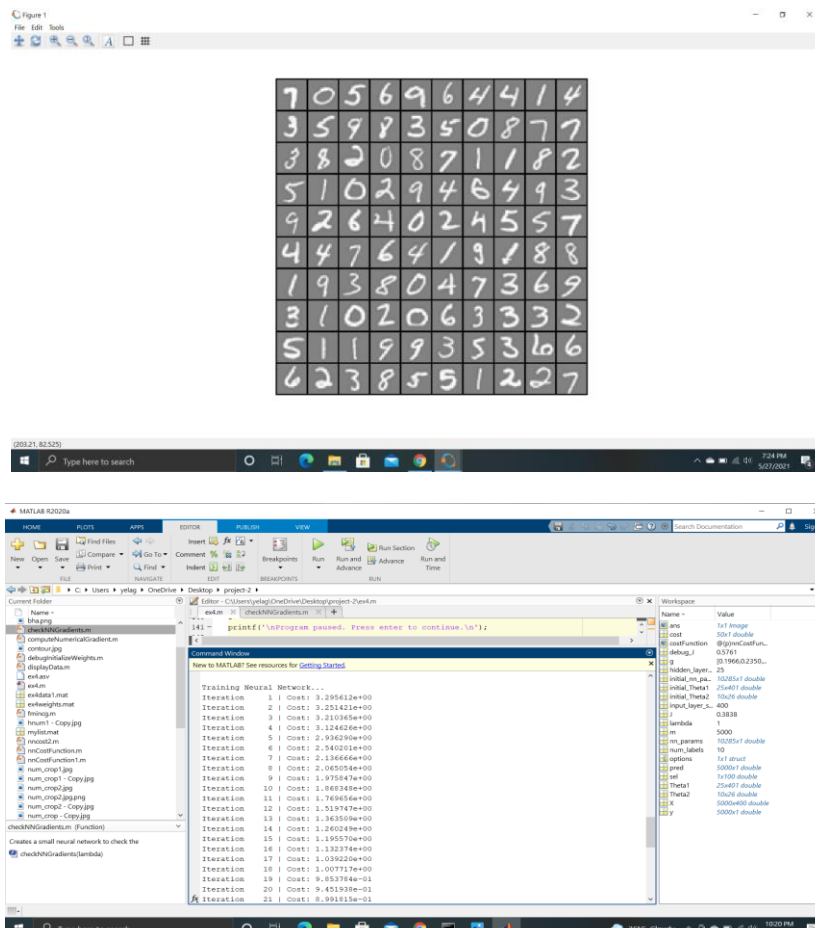


Fig. 4.1. Flowchart of Output

Input training data:



5. CONCLUSION

This study attempted to recognize the handwritten digits by using tools from Machine Learning to train the classifier. Also, the use of techniques in Computer Vision was explored to investigate the effect of selection image preprocessing, feature extraction and classifiers on the overall accuracy. The data-set used for the experiment is MNIST data-set originally constituted of 60,000 training, and 10,000 testing images which are 28 x 28 grayscale (0-255) labeled and bitmap format. It is a brilliant database for machine learning and characters recognition methods while taking minimal efforts in preprocessing and formatting. According to the literature analysis of the field of character recognition, there are some research studies which have made some achievements. For instance, Hochuli et al. (2018) used the CNN classifier to perform experiments on two public databases consisting of Touching Pairs data-set and NIST SD19, as well as highlighting the proposed method by achieving a 97% recognition accuracy. Compared with other research, this study focused on exploring which image preprocessing and feature extraction techniques based on OCR can work for improving the accuracy of classification models by more than 99%. In the initial experiment, the CNN algorithm won with a recognition accuracy of 98.75%, followed by K-NN with 96.68%. Two experimental results were analyzed and evaluated by a series of tools such as confusion matrices, k-fold cross-validation, error rates, and classification reports. Each modification produced changes in the results mostly improved accuracy and widely varying performance times. The original objective of this study was could the handwritten digit recognition accuracy is improved by image preprocessing and feature extraction, and it was confirmed to say yes.

In this paper, we present an effective handwritten digit image recognition method based on Neural Networks. Different from most traditional handwritten digit image recognition methods which focus on basic visual features, our approach extract specific structure, distribution and projection features from pre-processed images, which are conducive for handwritten digit image representation. Besides, our method is applicable to a variety of images in different writing style, rather than images in one predefined database. Extensive comparing experiments on the MNIST database validate the effectiveness and superiority of our method. Future work mainly includes further study on deep learning and optimizing algorithm

6. REFERENCES

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