Literature Survey
A Novel Method For Handwritten Digit Recognition System

ABSTRACT:

Handwriting recognition is one of the compelling research works going on because every individual in this world has their own style of writing. It is the capability of the computer to identify and understand handwritten digits or characters automatically. Because of the progress in the field of science and technology, everything is being digitalized to reduce human effort. Hence, there comes a need for handwritten digit recognition in many real-time applications. MNIST data set is widely used for this recognition process and it has 70000 handwritten digits. We use Artificial neural networks to train these images and build a deep learning model. Web application is created where the user can upload an image of a handwritten digit. this image is analyzed by the model and the detected result is returned on to UI.

LITERATURE SURVEY:

[1]Ayush Purohit , Shardul Singh Chauhan

They designed an early notable attempt in the area of character recognition research. The origin of a great deal of research work in the early sixties was based on an approach known as analysis-by-synthesis method suggested by Eden in 1968. The great importance of Eden's work was that he formally proved that all handwritten characters are formed by a finite number of schematic features, a point that was implicitly included in previous works. This notion was later used in all methods in syntactic (structural) approaches of character recognition. K. Gaurav, Bhatia P. K. Et al, this paper 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. In this, different preprocessing techniques like skew detection and correction, image enhancement techniques of contrast stretching, binarization, noise removal techniques, normalization and segmentation, morphological processing techniques are discussed. It was concluded that using a single technique for preprocessing, it can't completely process the image. However, even after applying all the said techniques might not possible to achieve the full accuracy in a preprocessing system.

[2]Ankit Sharma ,Yogiraj Barole

They designed a Hand writing recognition of characters has been around since the 1980s.The task of handwritten digit recognition, using a classifier, has great importance and use such as – online handwriting recognition on computer tablets, recognize zip codes on mail for postal mail sorting, processing bank check amounts, numeric entries in forms filled up by hand (for example tax forms) and so on. There are different challenges faced while attempting to solve this problem. The handwritten digits are not always of the same size, thickness, or orientation and position relative to the margins. Their goal was to implement a pattern classification method to recognize the handwritten digits provided in the MINIST data set of images of hand written digits (0 to 9). The data set used for their application is composed of 300 training images and 300 testing images, and is a subset of the MNIST data set (originally composed of 60,000 training images and 10,000 testing images). Each image is a 28 x 28 grayscale (0 to 255) labelled representation of an individual digit. The general problem they predicted they would face in this digit classification problem was the similarity between the digits like 1 and 7, 5 and 6, 3 and 8, 9 and 8 etc. Also people write the same digit in many different ways the digit '1' is written as '1', '1', '1' or '1'. Similarly 7 may be written as 7, 7, or 7. Finally the uniqueness and variety in the handwriting of different individuals also influences the formation and appearance of the digit Velappa Ganapathy, and Kok Leong Liew they proposed a method in which first multi-scale neural training with modifications in the input training vectors is adopted to acquire its advantage in training higher resolution character images and then selective thresholding using minimum distance technique is proposed to increase the level of accuracy of character recognition. A simulator program (a GUI) is designed in such a way that the characters can be located on any spot on the blank paper in which the characters are written. The results show that such methods with

moderate level of training epochs can produce accuracies of at least 85% and more for handwritten upper case English characters and numerals [3]. Mathias M.Adankon, Mohamed Cheriet the LS-SVM classifier, like other kernel machines, gives a poor generalization when the hyper parameters are not tuned efficiently. The authors proposed a model selection strategy for the LS-SVM which is a variant of the popular SVM classifier. They formed model selection using the empirical error criterion through the LOO procedure. They applied an algorithm on a handwriting recognition problem, which gave promising results. Compared with the SVM, the sparse LS-SVM classifier, empowered by model selection based on the empirical error criterion and the LOO procedure, achieved higher performance. They conclude from this that the sparse LS-SVM with model selection would be an interesting alternative classifier for the SVM in pattern recognition systems.

[3]Stefan Knerr, Léon Personnaz, Gérard Dreyfus

It is shown that neural network classifiers with single-layer training can be applied efficiently to complex real-world classification problems such as the recognition of handwritten digits. The STEPNET procedure, which decomposes the problem into simpler subproblems which can be solved by linear separators, is introduced. Provided appropriate data representations and learning rules are used, performance comparable to that obtained by more complex networks can be achieved. Results from two different databases are presented: an European database comprising 8700 isolated digits and a zip code database from the US Postal Service comprising 9000 segmented digits. A hardware implementation of the classifier is briefly described.

[4]Fabien Bauer, Ching Y Suen, Gérard Bloch

They mainly focuses on the problems of feature extraction and the recognition of handwritten digits. A trainable feature extractor based on the LeNet5 convolutional neural network architecture is introduced to solve the first problem in a black box scheme without prior knowledge on the data. The classification task is performed by support vector machines to enhance the generalization ability of LeNet5. In order to increase the recognition rate, new training samples are generated by affine transformations and elastic distortions. Experiments are performed on the well-known MNIST database to validate the method and the results show that the system can outperform both SVMs and LeNet5 while providing performances comparable to the best performance on this database.

[5]E Tuba, M Tuba, D Simian

Handwritten digit recognition is an important but difficult practical problem. This is a classification problem for which support vector machines are very successfully used. Determining optimal support vector machine is another hard optimization problem that involves tuning of the soft margin and kernel function parameters. For this optimization they adjusted recent swarm intelligence bat algorithm. They intentionally used weak set of features, four histogram projections, to prove that even under unfavorable conditions of their algorithm.

[6]Cheng-Lin Liu, Kazuki Nakashima, Hiroshi Sako, Hiromichi Fujisawa

This paper presents the results of handwritten digit recognition on well known image databases using state-of the-art feature extraction and classification techniques. The tested databases are CENPARMI, CEDAR, and MNIST. On the test data set of each database, 80 recognition accuracies are given by combining eight classifiers with ten feature vectors. The features include chaincode feature, gradient feature, profile structure feature, and peripheral direction contributivity. The gradient feature is extracted from either binary image or gray-scale image. The classifiers include the k-nearest neighbor classifier, three neural classifiers, a learning vector quantization classifier, a discriminative learning quadratic discriminant function. (DLQDF) classifier, and two support vector classifiers (SVCS).

[7]Dan Claudiu Cireşan, Ueli Meier, Luca Maria Gambardella, Jürgen Schmidhuber

They designed a Good old online backpropagation for plain multilayer perceptrons yields a very low 0.35% error rate on the MNIST handwritten digits benchmark. All they need to achieve this best result so far are many hidden layers, many neurons per layer, numerous deformed training images to avoid overfitting, and graphics cards to greatly speed up learning.

[8]Martijn van Breukelen, Robert PW Duin, David MJ Tax, JE Den Hartog Kybernetika

Classifiers can be combined to reduce classification errors. They did experiments on a data set consisting of different sets of features of handwritten digits. Different types of classifiers were trained on these feature sets. The performances of these classifiers and combination rules were tested. The best results were acquired with the denote, median and product combination rules. The product was best for combining linear classifiers, the median for -NN classifiers. Training a classifier on all features did not result in less errors.

[9]Chandio, A.A. Jalbani, A.H.; Awan, S.A.

In this research paper they designed a multi-digit Sindhi handwritten numerals recognition system using SOM Neural Network is presented. Handwritten digits recognition is one of the challenging tasks and a lot of research is being carried out since many years. A remarkable work has been done for recognition of isolated handwritten characters as well as digits in many languages like English, Arabic, Devanagari, Chinese, Urdu and Pashto. However, the literature reviewed does not show any remarkable work done for Sindhi numerals recognition. The recognition of Sindhi digits is a difficult task due to the various writing styles and different font sizes. Therefore, SOM (Self-Organizing Map), a NN (Neural Network) method is used which can recognize digits with various writing styles and different font sizes. Only one sample is required to train the network for each pair of multi-digit numerals. A database consisting of 4000 samples of multi-digits consisting only two digits from 10-50 and other matching numerals have been collected by 50 users and the experimental results of proposed method show that an accuracy of 86.89% is achieved.

[10]Qiao, Junfei , Wang, Gongming; Li, Wenjing; Chen, Min

They designed on Handwritten digits recognition is a challenging problem in recent years. Although many deep learning-based classification algorithms are studied for handwritten digits recognition, the recognition accuracy and running time still need to be further improved. In this paper, an adaptive deep Q-learning strategy is proposed

to improve accuracy and shorten running time for handwritten digit recognition. The adaptive deep Q-learning strategy combines the feature-extracting capability of deep learning and the decision-making of reinforcement learning to form an adaptive Q-learning deep belief network (Q-ADBN). First, Q-ADBN extracts the features of original images using an adaptive deep auto-encoder (ADAE), and the extracted features are considered as the current states of Q-learning algorithm. Second, Q-ADBN receives Q-function (reward signal) during recognition of the current states, and the final handwritten digits recognition is implemented by maximizing the Q-function using Q-learning algorithm. Finally, experimental results from the well-known MNIST dataset show that the proposed Q-ADBN has a superiority to other similar methods in terms of accuracy and running time.

[11]Pawan Kumar Singh

They Designed on the Full Text Available Handwritten digit recognition plays a significant role in many user authentication applications in the modern world. As the handwritten digits are not of the same size, thickness, style, and orientation, therefore, these challenges are to be faced to resolve this problem. A lot of work has been done for various non-Indic scripts particularly, in case of Roman, but, in case of Indic scripts, the research is limited. This paper presents a script invariant handwritten digit recognition system for identifying digits written in five popular scripts of Indian subcontinent, namely, Indo-Arabic, Bangla, Devanagari, Roman, and Telugu. A 130-element feature set which is basically a combination of six different types of moments, namely, geometric moment, moment invariant, affine moment invariant, Legendre moment, Zernike moment, and complex moment, has been estimated for each digit sample. Finally, the technique is evaluated on CMATER and MNIST databases using multiple classifiers and, after performing statistical significance tests, it is observed that Multilayer Perceptron (MLP classifier outperforms the others. Satisfactory recognition accuracies are attained for all the five mentioned scripts.

[12]Hansen, Lars Kai; Liisberg, Christian; Salamon, P.

The designed on the Neural network ensembles are applied to handwritten digit recognition. The individual networks of the ensemble are combinations of sparse look-up tables (LUTs) with random receptive fields. It is shown that the consensus of

a group of networks outperforms the best individual of the ensemble. It is further shown that it is possible to estimate the ensemble performance as well as the learning curve on a medium-size database. In addition the authors present preliminary analysis of experiments on a large database and show that state-of-the-art performance can be obtained using the ensemble approach by optimizing the receptive fields. It is concluded that it is possible to improve performance significantly by introducing moderate-size ensembles; in particular, a 20-25% improvement has been found. The ensemble random LUTs, when trained on a medium-size database, reach a performance (without rejects).

[13]Chang Liu

They designed on the Full Text Available To overcome the shortcomings of traditional dimensionality reduction algorithms, incremental tensor principal component analysis (ITPCA based on updated-SVD technique algorithm is proposed in this paper. This paper proves the relationship between PCA, 2DPCA, MPCA, and the graph embedding framework theoretically and derives the incremental learning procedure to add single sample and multiple samples in detail. The experiments on handwritten digit recognition have demonstrated that ITPCA has achieved better recognition performance than that of vector-based principal component analysis (PCA, incremental principal component analysis (IPCA, and multilinear principal component analysis (MPCA algorithms. At the same time, ITPCA also has lower time and space complexity.

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