# LITERATURE SURVEY

Multi-digit Handwritten Sindhi Numeral Recognition Using Some Neural Network International Nuclear Information System (INIS)

Chandio et al (2017): A multi-digit handwritten Sindhi numeral recognition system using SOM Neural Network is presented in the research paper. Handwritten digit recognition is one of the challenging tasks and many researches have been carried out for many years. Notable work has been done to recognize isolated handwritten characters as well as digits in many languages such as English, Arabic, Devanagari, Chinese, Urdu and Pashto. However, the literature reviewed does not show any notable work done for Sindhi numeral recognition. Recognizing Sindhi numerals is a difficult task due to different writing styles and different font sizes. Therefore, SOM (Self-Organizing Map), a NN (Neural Network) method is used, which can recognize digits with different writing styles and different font sizes. Only one sample is needed to train the network for each pair of multidigit digits. A database consisting of 4000 samples of multi-digit digits consisting of only two digits from 10 to 50 and other corresponding numbers were collected by 50 users, and the experimental results of the proposed method show that an accuracy of 86.89% is achieved.

An Adaptive Deep Q-Learning Strategy for Handwritten Digit Recognition.

Qiao, Junfei et al (2018): Handwritten digit recognition is a challenging problem in recent years. Although many deep learning-based classification algorithms are being studied for handwritten digit recognition, the recognition accuracy and running time still need to be further improved. An adaptive deep Q-learning strategy is proposed to improve accuracy and reduce runtime for handwritten digit recognition. The adaptive deep Q-learning strategy combines deep learning feature extraction and reinforcement learning decision making to form a Q-learning adaptive deep belief network (Q-ADBN). First, Q-ADBN extracts the features of the original images using an adaptive deep autoencoder (ADAE), and the extracted features are considered as the current states of the Q-learning algorithm. Second, Q-ADBN adopts the Q-function (reward signal) during the recognition of the current states, and the final recognition of handwritten digits is realized by maximizing the Q-function using the Q-learning algorithm. Finally, experimental results from the well-known MNIST dataset show that the proposed Q-ADBN outperforms other similar methods in terms of accuracy and running time.

Handwritten digit recognition using neural computers.

Caflin et al (2009): A theoretical framework for neural networks used to classify handwritten digits is also presented. The classification task is performed using a convolutional neural network (CNN. A CNN is a special type of multilayer neural network that is trained with an optimized version of the back-propagation algorithm. A CNN is designed to recognize visual patterns directly from pixel images with minimal preprocessing, capable of recognizing patterns with extreme variability (such as handwritten characters and with resistance to deformations and simple geometric transformations. The main contributions of this paper relate to original methods to increase the efficiency of the learning algorithm by pre-processing images before the learning process and a method to increase accuracy and performance for real-time applications, by removing useless background information. By combining these strategies, we obtained an accuracy of 96.76%, using NIST (National Institute of Standards and Technology database).

A Study of Moment Based Functions for Handwritten Digit Recognition as a training set.

Pawan Kumar Singh et al ( 2016): Handwritten numerals do not have the same size, thickness, style and orientation, so these challenges must be faced when solving this problem. Much work has been done for various non-Indian scripts, especially in the case of Latin, but research is limited in the case of Indian scripts. The paper presents a fixed-script handwritten digit recognition system for identifying digits written in five popular scripts of the Indian subcontinent, namely Indo-Arabic, Bangla, Devanagari, Roman and Telugu. For each numerical sample, a 130-element feature set, which is essentially a combination of six different types of moments, namely geometric moment, moment invariant, affine moment invariant, Legendre moment, Zernike moment, and complex moment, was estimated. Finally, the technique is evaluated on the CMATER and MNIST databases using multiple classifiers, and after performing statistical significance tests, it is observed that the Multilayer Perceptron (MLP) classifier outperforms the others. Satisfactory recognition accuracy is achieved for all five mentioned scripts.