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Handwritten Chinese numeral recognition based on BP neural network

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Abstract: In this paper, based on pybrain library, a handwritten numeral recognition algorithm is realized by establishing BP neural network, and the accuracy and test time of the algorithm are verified by experiments. The experimental results show that after the training, the algorithm only takes 0.07 seconds in the test process of 50 groups of experimental data, and its accuracy is 98%.

1. Introduction

Handwritten digit recognition is a branch of OCR technology. Its research object is how to use machines to automatically recognize the Arabic numerals written by people on paper. It also has important application value and research significance in large scale data statistics, finance, taxation, finance fields and communication links. [1].

After years of research and development, though the recognition ability of machines can't be compared with human's cognitive ability of handwritten digit recognition is a very important problem in the pattern recognition field. Bengio has proved that the deep network model can successfully extract the essential features of handwritten digital images, while Yann Lecun also proposed the Lenet-5111 model, which uses the gradient-based reverse propagation algorithm for global training and tests the accuracy of the model with Mnist data. Next, Mirza proposed CGAN. Later, the CBN-CGAN network was proposed which uses category labels to batch normalize each type of data, so that the network learns more characteristics, so as to improve model robustness [3].

2. The process of recognizing handwritten digital images

In the process of handwritten digital image recognition, the basic steps of pre-processing the picture, extracting features, selecting the database and classifier are usually carried out.

2.1 Picture pre-processing

As shown in figure 1, the image is usually not input directly, but the sample set is preprocessed.

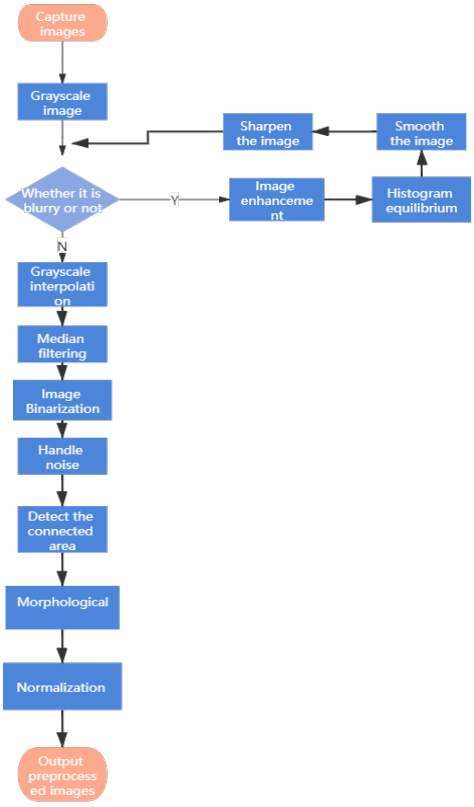

Figure 1: Pre-processing process

2.2 Method of extracting features

Adjust the picture by extracting and balancing the features from the three graphs [4]. Pictures captured by reality cameras are often too bright or too dark to cause local grayscale concentration, so it is necessary to transfer the centralized area to the lower part of the picture by linear interpolation, so that it is evenly distributed.

2.3 The selection of the database

Due to geographical and cultural differences, handwritten numbers can also be written in a very different way, so it is especially important to choose a suitable sample library. Researchers can build their own sample banks or use existing databases such as the NIST or the CEDAR databases which in the United States, and the ETL database or the ITPT database in Japan. This scenario, we select the NIST database.

2.4 Classifier

The final step in handwriting numerical recognition is classifier recognition. There are many traditional recognition methods, but it has the disadvantage of linear regression, which must do cumbersome pre-processing of the picture. At the same time, the separation of feature extraction and training learning process can also lead to low recognition efficiency and accuracy.

This scheme not only concentrates the module functions such as feature extraction and classifier recognition in the same area, but also makes use of the characteristics of weight sharing between layers and layers through local connection, which greatly reduces the number of parameters between layers,

reduces the complexity of the whole network model, and ultimately, it's easier to build network. The overall implementation of the process is shown in Figure 2.

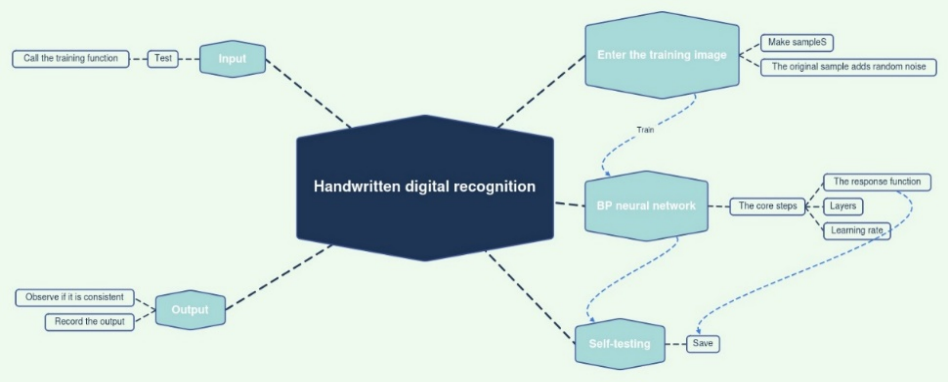

Figure 2: The total process

3. Analysis of experimental

3.1 How to implement the training process

This scheme uses pybrain, the specific implementation process is shown in the figure 3.

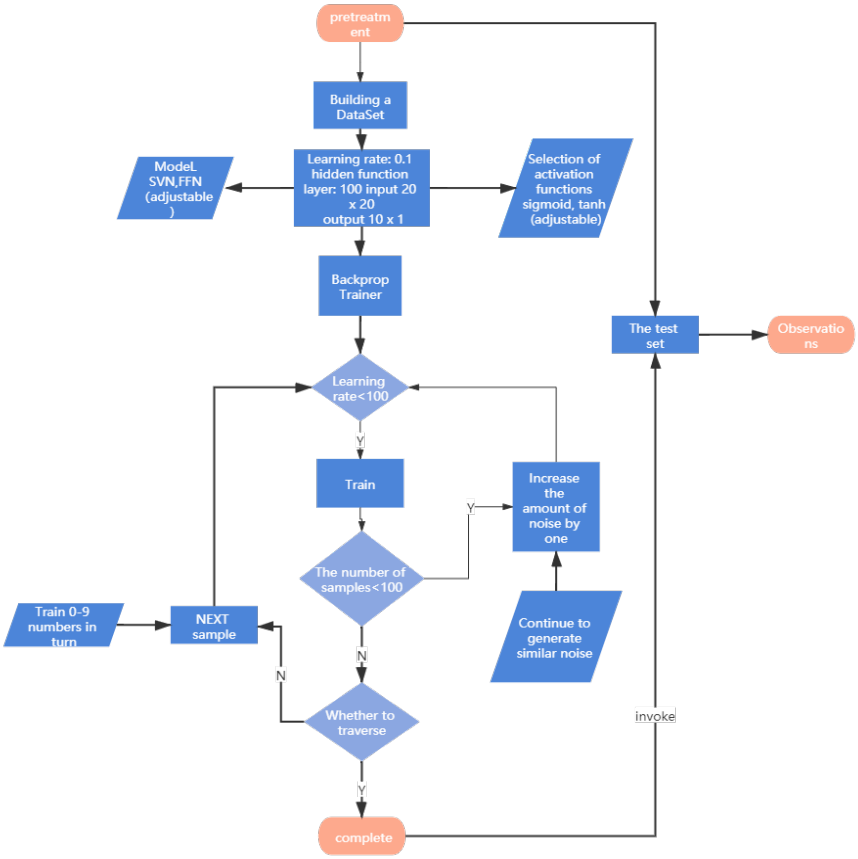

Figure 3: Implement the training process.

The activation function selected in this scheme is Tanh which is more convergent than sigmoid which can reduce the number of iterations in the process.

3.2 Experimental results

As shown in Figure 4, after initializing the learning rate, the learning rate e (the ratio of learning efficiency to time) is getting lower and lower as the training progresses, indicating that efficiency is increasing.

```
getsample start.
Train start.
1   done, e= 1.776437606715067
2   done, e= 0.11176138053071917
3   done, e= 0.03990304149692847
4   done, e= 0.021359640198327902
5   done, e= 0.014449216035408644
6   done, e= 0.011167598140969726
7   done, e= 0.009392840395752214
saving
```

Figure 4: The process of training

Enter the test sample after the training is completed, as shown in Figure 5. The test results are shown in Figure 6.

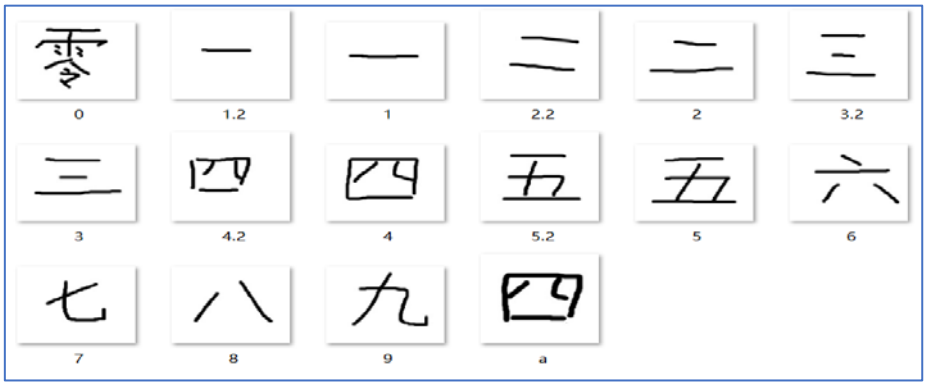

Figure 5: Test samples

```
Train end.
saving
done
Get test samples start.
Test start.
Result  [0,  1,  1,  2,  2,  3,  3,  4,  4,  5,  5,  6,  7,  8,  9,  4]
```

Figure 6: Test results

3.3 Analysis of experimental results

By comparing the output and input, As in Table 1.

Table 1: The duration of training and testing

Duration of training /s	The duration of the test /s		
	NUM	TIME/s	Accuracy
Time 0:01:21.010024	10	0:00:00.031914	100%
	20	0:00:03.525202	100%
	50	0:00:07.353611	98%

4. Conclusion

On the whole, this programme not only avoids the complicated steps of manually extracting features, but also compresses the training time into less than two minutes. At the same time, it changes the original high demand for hardware into simple use known functions. In short, not only does the progamme solve the problems of traditional methods, but it is also superior to the traditional neural network in accuracy, recognition, learning efficiency and versatility.

References

[1] Ren Dan, Chen Xuefeng. Principles and Applications of Handwritten Digital Recognition (J.Computer Age, 2007 (03): 17-18 s. 21.

[2] Chen Hongyu. Research and implementation of handwritten digital recognition technology based on KNN algorithm.

[3] Mei Wei; Liao Wei; Yu Wanling. Research on Handwritten Digital Recognition Technology Based on the Lennet Neural Network. New Technology New Process, 2020, (06): 51-53.

[4] Ellie Wang; Xue Dong; Wu Haihai; Wang Minhui. Condition-generated anti-network handwritten digital recognition . . . liquid crystal and display, 2020, (12): 1284-1290.

[5] Liu Chenyu. Research and Design of Handwritten Digital Recognition Based on Convolutional Neural Networks. Chengdu University of Technology, 2018.

[6] Gao Guangdong. Handwritten digital recognition application based on convolutional neural network.

[7] Through the city, Yang Yunfeng. Comparison of the accuracy of handwritten digital recognition based on four algorithms. New Industrialization, 2020, 10 (07): 1-3.

[8] Tang Xiaowu. The design and implementation of a handwritten digital classifier based on KNN algorithm.

[9] Song Xiaoru, Wu Xue, Gao Hao, Chen Chaobo. Handwritten Digital Recognition Simulation Research based on Deep Neural Networks . . . Science and Technology and Engineering, 2019, 19 (05): 193-196.

[10] Yu Shengxin, Xia Chengxuan, Tang Zexuan, Ding Zhao, Yang Chen. Based on improved handwriting digital recognition of the Inception convolutional neural network. Computer Applications and Software, 2019, 36 (12): 143-149.

[11] Lan Jia, Hongxia Miao, Bensheng Qi. Studying on Improved Spiking Neural Network in Handwritten Digital Recognition [J]. IOP Conference Series: Earth and Environmental Science, 2019, 252(2):

[12] Ma Yichao, Zhao Yunji, Zhang Xinliang. CNN Handwritten Digital Recognition Algorithm based on PCA Initial Convolution Cores (J Computer Engineering and Applications, 2019, 55 (13): 134-139.