

Garbage Classification Based on Convolutional Layer Neural Network

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Abstract

Human resources in the rapid development of science and technology under the background of The Times more and more do not occupy the dominant position in the market, but it is obvious that the development of society at the same time with more and more waste generation. In this paper, efficiency simulation and success rate simulation are carried out through the self-learning of computer programs, and advantages and disadvantages of computer garbage classification are analyzed. The known popular neural network and residual network algorithms are used to provide a good foundation for computer autonomous learning. The existing pictures, such as garbage plastic bottles and garbage paper, are used for computer training. Then, different pictures of the same type are used for testing, and attempts and adjustments are made in different training intervals. Finally, it was found that the training peak was basically reached when the computer self-learning reached nearly 400 pictures, and the accuracy rate was 10.7%, which was much higher than that of training 200 pictures. And far more efficient than artificial waste classification.

Keywords

Garbage classification; Residual network; Neural network; Autonomous learning.

1. Introduction

Growing up to society and economy and science and technology circle, directional guidance in the form of social consciousness to the society decided the affordability of artificial intelligence and strong handling ability fast enough to dominate the market, this is the case in different areas provides a lot of convenience for people, including but not limited to intelligence service, data statistics, etc. Garbage sorting, which seems to be very simple, even slightly lower level work, is the key issue that every central city needs to focus on. With the continuous improvement of people's living standard, more and more garbage is produced. However, the garbage disposal capacity and the economic cost used are limited. How to classify and treat recyclable garbage and non-recyclable garbage has become a seemingly simple problem, but it is actually becoming more and more serious. At present, the main waste treatment methods in China include sanitary landfill, waste incineration, composting, and recycling. But incineration is still the most commonly used [1], and there is no avoiding the fact that only a small amount of recyclable waste is recycled. People want to collect as much garbage as possible on the basis of computer recognition. While everyone is confident about technology, most cities are still using simple partial recycling, including but not limited to using electromagnets for metal recycling, sorting bins and so on. It can be seen that even under the design premise of a large number of people concerned, there are still few so-called high-tech garbage recycling treatment methods in China. Therefore, on the basis of trying to use the computer autonomous learning, this paper makes continuous simulation attempts, simplifies the process of program operation to the greatest extent by using the algorithm optimization brought by the residual network, and makes statistical analysis of the data obtained from the experiment to find the optimal balance point and the problems existing in the current computer autonomous learning.

2. Urban waste classification and treatment measures

Shanghai has issued a mandatory garbage classification policy, which classifies garbage into dry garbage, wet garbage, recyclable garbage, and toxic and hazardous garbage. And the classification can be promoted, and even mandatory use of garbage cans[2]. In the human resource analysis, we also took into account the manpower deployment and funding of mandatory waste classification.

As the current most popular across the country can be classified garbage can generally include recyclable waste, kitchen waste, hazardous waste and other waste for the computer can only be classified as two types, recyclable garbage and recycle, for other kinds of rubbish, such as kitchen waste, hazardous waste, computer intelligent recognition is generally not be considered, So in the whole process of garbage disposal problem above

Computer processing does not take into account subsequent waste disposal problems. As for manual waste classification, efficiency and financial issues also need to be considered.

3. Residual network

In 2015, He Kaiming et al. [3] proposed the residual network model, which has been widely used. In the process of deep learning, the increase in the number of network layers will often bring about several problems to varying degrees, including but not limited to the consumption of computer resources. The model is easy to overfit; Generation of gradient vanishing/gradient explosion problem [4]. And the residual network can solve this problem effectively to a certain extent. It can help us maximize the efficiency when carrying out computer autonomous learning and reduce the error in coefficient evaluation to a certain extent.

Residual network neural network, as a typical model of convolutional neural network, follows the design principles and structure of traditional convolutional neural network, and is also composed of convolutional layer, pooling layer and classification layer. The main difference from traditional convolutional neural networks is that RESNET introduces a cross-layer connection between output and input, Introducing a cross-layer connection between each convolution layer is equivalent to disassembling the network into the structure of residual blocks. The previous input-output function of the network is changed into the difference function of input-output of each residual unit. Such a structure makes the number of layers of the network designed deep and easier to learn.

In this program, the residual network algorithm, as the core algorithm in the code, can play an important role in simplifying the operation time in the calculation and storage of the image information identified during training. For the program, the saving speed of the residual network can effectively achieve the computer to grasp the known information quickly in a short time.

4. Simulation algorithm design

4.1. Convolutional layer neural network

The input layer. The input layer is the input of the whole neural network. In the image processing convolutional neural network, it generally represents the pixel matrix of an image. For example, a black and white image has a depth of 1, while in RGB color mode, the image has a depth of 3. Starting from the input layer, the convolutional neural network transforms the 3D matrix of the upper layer into the 3D matrix of the next layer into the 3D matrix of the next layer through different neural network structures, until the final full connection layer.

Convolution layer. As the name suggests, the convolutional layer is the most important part of a convolutional neural network. Different from the traditional full connection layer, each node in the convolutional layer

The input is just a little piece of the neural network at the next level, and this little piece is 3 by 3 or 5 by 5. The convolutional layer tries to take each piece of the neural network deeper

To obtain features with a higher degree of abstraction. In general, the matrix of nodes processed through the convolution layer gets deeper,

Pooling layer. The pooling layer neural network does not change the depth of the three dimensional matrix, but it can reduce the size of the matrix. The pooling operation can be thought of as one with higher resolution

The image is converted to a lower resolution image. Through pooling layer, the number of nodes in the final full connection layer can be further reduced, so as to reduce the parameters in the whole neural network

The purpose of number.

Full connection layer. After multiple rounds of convolutional layer and pooling layer processing, the final classification result is usually given by 1 or 2 full connection layers at the end of the convolutional neural network. After several rounds of processing of convolution layer and pooling layer, it can be considered that the information in the image has been abstracted into features with higher information content. We can regard the convolutional layer and the pooling layer as the process of automatic image feature extraction. After the feature extraction is completed, the full connection layer is still needed to complete the classification task.

4.2. Autonomous learning under neural networks

Neural network algorithm can play a great role in promoting the solution of autonomous learning problems. It is composed of a large number of tunable connection weights of neurons, and is characterized by large-scale parallel processing, distributed information storage, and good self-organization and self-learning ability [6]. This paper mainly introduces the use of residual network algorithm, including the definition of data sets, including transformation, data loading, Dataloader definition; Define the optimizer; Define the loss function; The change rate of computer learning.

When the computer is running, it will first carry out training mode, including starting to record the last gradient (which needs to be used to update the weight), entering the residual network, getting the probability of image output and calling forward propagation function, recording the size of loss function and recording accuracy.

5. Artificial garbage disposal

In the selection of manual waste treatment methods, the comparison method selected in this paper is from Shanghai Jiming Environmental Protection Engineering Co., Ltd. : fully closed, mechanized, no manual sorting equipment, zero pollution collection of the garbage on the same day, harmless treatment on the same day, resource out of the product on the same day (LJ five chemical comprehensive treatment technology). The technology has been successfully used in Guangdong, Chongqing, Yunnan, Xinjiang, Shanxi, Liaoning and other waste treatment plants, and has achieved good economic benefits, environmental benefits and ecological benefits, and to the greatest extent to realize the recycling and industrialization of waste treatment.

6. Computer module processing process

During the operation of the computer, Python is used to program the computer and PyTorch library is used to enable the computer to achieve autonomous learning under human control.

PyTorch is a Python-based continuable computing package that provides two advanced features: 1. Strong GPU-accelerated tensor computing (such as NumPy). 2. Deep neural network including automatic derivation system.

6.1. Autonomous training of computers

During the training process of the computer, the computer mainly recorded the middle pixel points of the picture and the feature points contained in the picture. In the system, we artificially classified several major garbage, including cardboard, glass, metal, newspaper, plastic and cigarette butts.

Considering the limited running capacity of the GPU of the small portable computer, we gave priority to the training of recycling items with high value. In the statistical analysis, it was shown that waste paper (including but not limited to cardboard and newspaper) accounted for 90% of all recyclable garbage [7]. So we give priority to the cardboard type of waste for training. As shown in the table below:

Table 1: sample diagram of waste paper recyclable waste

Cardboard class	
Newspaper class	

In the first learning time easy to exist the following problems, the computer running speed is slow; Therefore, in the stage of code debugging, we adopted a custom method to quantify and control the autonomous learning, so that every time the machine completes learning, it can display the real-time memory allocation and floating point number calculation of the computer. But do this in no way to know in how much time to learn the computer to achieve the best condition of image analysis (that is, complete garbage sorting), so in the first phase of the trial run at the same time joined the real-time test system can in time after learning the picture complete a computer simulation of identification test, In other words, we manually add 400 known test pictures to the code to test the efficiency and accuracy of the computer, and randomly select 10 pictures for testing each time, because it is known that the 400 pictures tested are all valid pictures and there is waste paper in the pictures and should be recognized by the machine. Therefore, the computer recognition accuracy after each learning can be basically judged only by considering how many of the 10 pictures can be evaluated by the machine as target pictures.

6.2. Computer debugging and testing results

However, another obvious problem is that it is impossible to draw the output results on a per-unit basis, so in the end, I chose to learn 10 pictures each time as the basis, and made iterative calculation with the support of residual network neural algorithm, and randomly selected 30 out of 400 detection pictures each time as the detection standard. Stop learning and display the current optimal learning quantity when the detection success rate decreases after 10 consecutive learning.



Figure 1: Comparison of success rate and efficiency of computer simulation

7. Conclusion

At the time of artificial garbage classification problems mainly include the long time consuming, money use is more, the scarce of human resources and so on, so use computer assisted garbage classification identification can effectively solve the problem of efficiency and cost, human resources can be used more in the computer can't do a more detailed classification, but the computer's development prospects are very bright, The rapid development in just a few decades has brought more expectations to the future life. When more accurate algorithms and more rigorous equipment are widely available, the computer will bring more help to the human society. At present, convolutional layer neural network can play a better role in this aspect.

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