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Recognition and classification of flower species based on artificial intelligence

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Abstract: *The deep learning algorithm draws more and more attention in recent years. It mimics how human recognize images, and the ability of extract abstract features from original input, which greatly improves the efficiency of image processing, makes it popular in fields like image recognition and face recognition. This paper discusses the application of deep learning algorithm by showing how it relates to each field and designs a flower recognition experiment to explore how deep learning algorithm works. The experiment focuses on the best-known CNN model and chooses three kinds of flowers to test its efficiency and the impact of parameters in the model, like learning rate and steps. The experiment also explores the optimization which focuses on the overfitting.*

Keywords: *AI, deep learning algorithm, image recognition*

1. Introduction

With the development of artificial intelligence, there are several applications in our life, varied from biometric technology, remote sensing image recognition, military applications, and etc. However, the most popular application of artificial intelligence is image recognition technology.

Image recognition is a kind of technology that uses computers to process, analyze and understand images, as well as to recognize different patterns of targets and objects. It is a practical application of a deep learning algorithm. The traditional image recognition process is divided into four steps: image acquisition → image preprocessing → feature extraction → image recognition.

The application of artificial intelligence in image recognition technology includes machine vision and CNN convolutional neural networks. Machine vision is mainly used for 3D image understanding and recognition. Additionally, the convolutional neural network imitates the characteristics of each nerve of the human brain, and a neural network is composed of neurons. After machine learning, the training results are used for practical testing.

Image recognition with AI technology is also used in biology. The recognition technologies include face recognition, fingerprint recognition, and palmprint recognition. One of the most common one is the face recognition system, which mainly includes four parts: face image acquisition and detection, face image preprocessing, face recognition, and recognition. First, the preprocessing process mainly includes the following steps: Face image includes light compensation, gray transformation, and etc. Second, the features that can be used in recognition systems are also divided into several process, such as visual features, and pixel statistical features. Finally, the face feature to be recognized is compared with the face feature template, and the identity information of the face is judged according to the similarity degree.

Apart from face recognition, image recognition with AI technology also can be used in analyzing objects, which includes flower identification. In this paper, we are going to talk about how computers interpret specific flower species' pictures according to their special features, which is quite similar to face recognition.

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2. Related work

In recent years, the use of image recognition technology to classify objects has been more and more widely used, and the machine learning algorithm used in the construction of image detection and recognition classifier on various data sets has been continuously improved. The accuracy of deep learning has been constantly improved in numerous works.

In 2016, Yang and Huang did work on machine learning[1], This is the earliest work on machine learning to date. This work used vector machine (SVM) and CNN to classify single waste object. The accuracy of these two methods was 63% (SVM) and 22% (CNN) respectively. This work led to the creation of an open source data set that has since become widely used, which is called TrashNet. Rabano et al., 2018[2] used Google MobileNet[3] learning model for garbage network image processing, and the accuracy rate reached 87.2%.

Rahul Chauhan et al.,2018[4] established a CNN model to evaluate its performance in image recognition and detection data sets. The algorithm was implemented on MNIST and CIFAR-10 datasets, and its performance was evaluated. The accuracy of the MNIST model was 99.6%.

Wang et al.,2020 proposed a convolutional neural network (CNN) model to Distinguish between recyclable and non-recyclable garbage. The model uses transfer learning from a pretrained Resnet-50 CNN to complete feature extraction. They used augmented TrashNet dataset[1] trained a subsequent fully connected layer for classification. This model achieved an overall detection rate of 48.4% in simulation and final classification accuracy of 92.4%.

In 2020, Zhang et al.[5] carried out a study on the image recognition of supermarket goods. They took 166 images of 12 types of items under different light, distance and Angle, and finally formed a data set of 1600 different images. Resize these data sets to 100 * 100. Setting the learning rate of 0.0001 and the batch size of 64, using CNN training method, iterated the algorithm 16,000 times, about 10 epochs, then get the results. Figure 1 are the results

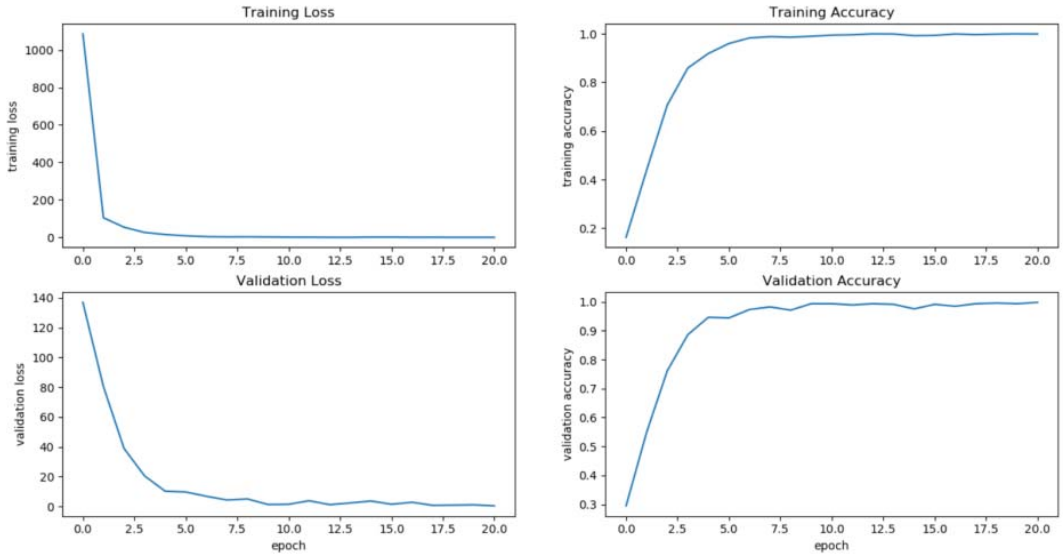

Fig. 1 Training by Huang et al

Then they selected 10 categories of items from the Caltech 101 database to run our algorithm, The best training accuracy is around 0.991, while the best validation accuracy is around 0.836. Figure 2 are the results.

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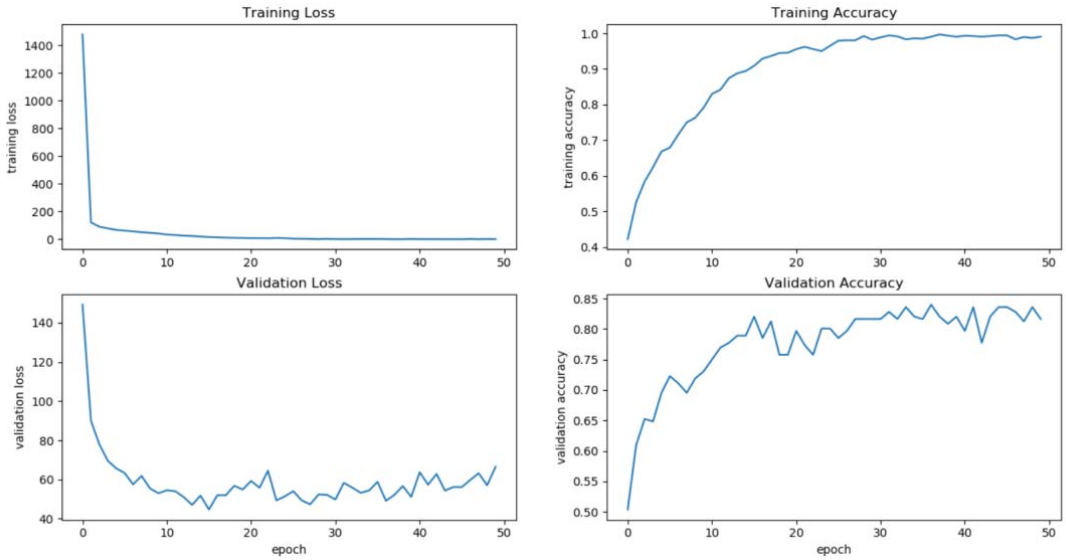

Fig. 2 Training results of Caltech 101

3. Research Method

3.1 32x32 Peony, Rose, and Morning glory Dataset

This dataset was firstly downloaded from Baidu Picture by web crawler with keywords "flower name+ photography", since the images are supposed to be a blooming flower with a closed shot, which shows clear architecture and avoid advertisement like rose perfume. 3,000 images are downloaded with 1,000 images per category. For each category 125 images are selected without unrelated details like faces, hands, etc. Then they were flipped upside-down and applied Gaussian Noise so that there would still be 1000 images per category. The images are collected together, resized to 32x32, and rotated by 45 ° per times until it reaches 7000 per category. The training set and testing set are divided randomly at the ratio 4:1.

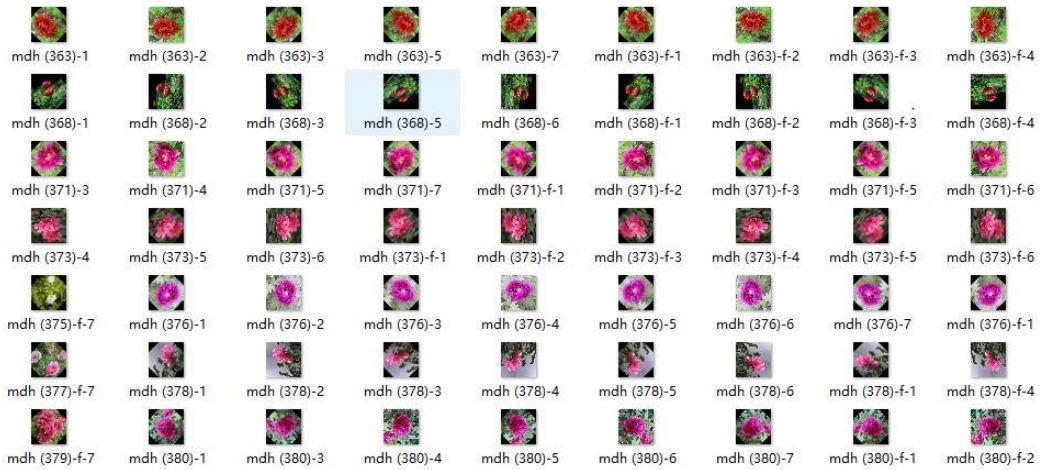

Figure 3 32x32 Peony, Rose, and Morning glory Dataset

3.2 CNN Model

CNN (Convolutional neural networks) is a deep learning algorithm that simulates the process of how visual cortex works with images to automatically extract features. It takes input images and use convolutional layers with kernels to compute the features.

The computation is defined as following:

$$N = (W - F + 2P)/S + 1$$

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N: size of Output

W: size of Input

F: size of Convolution Kernels

P: size of Padding

S: length of Stride

In this project, the CNN model is designed as four convolutional layers with two pooling layers, and two fully connected layers.

```
Input - > conv1 -> conv2 -> maxpooling -> conv3 ->conv4 -> maxpooling -> Fc1 -> Fc2 ->output
32*32     32*32    32*32      16*16       16*16   16*16      8*8         8*8

Input -> {[Conv*N] ->Maxpooling} * M -> [Fc * T] -> Output
 N = 2    M = 2    T = 2
```

Convolutional layers use kernel to compute weighted summation and then get the feature maps. The kernel slides through the input with certain steps and then compute the convolved feature.

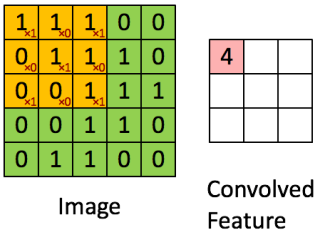

Figure 4 Pooling performs

Pooling is a way that lessen the parameters to simplify the NN, reduce the cost of training and improves the Receptive Field. It also guarantees the invariance of operations like translation and rotation. The way pooling performs is similar to the convolutional kernel, but it doesn't compute the weighted summation neither slide overlappingly. In this project, the pooling method is max pooling, which means instead of weighted summation, it takes the max value in the matrix. Since the pooling kernel doesn't slide overlappingly, padding is necessary in order to keep the size of feature maps same as the size of inputs. 0s are added around the border so that there would be enough information to add more layers without noise. In the output layer, SoftMax is used to compute the probability of each category and make decisions.[6]

3.3 Optimization

The main problem here is overfitting which describes the situation that the training is so well that the model tries to find the connection between the training set and the testing set rather than the future that represented by the training set. In other words, it would be flower to flower but not flower to the category.

The simplest way to reduce the overfitting is Dropout. The images in dataset are dropped at a certain probability. When the probability comes to 0.5, the structure of the network would be greatly changed.

Another way applied is the Adam (Adaptive Moment Estimation), which is a gradient descent algorithm that use momentum and adaptive learning rate to accelerate the convergence. It also requires less RAM while training.

4. Result

The training data was divided into batches with size 64 which means only 64 images would be taken for each iteration step. And for every 50 steps, the accuracy and loss would be recorded.

The test set was divided into batched with size 500. And the average accuracy was 80.125%.

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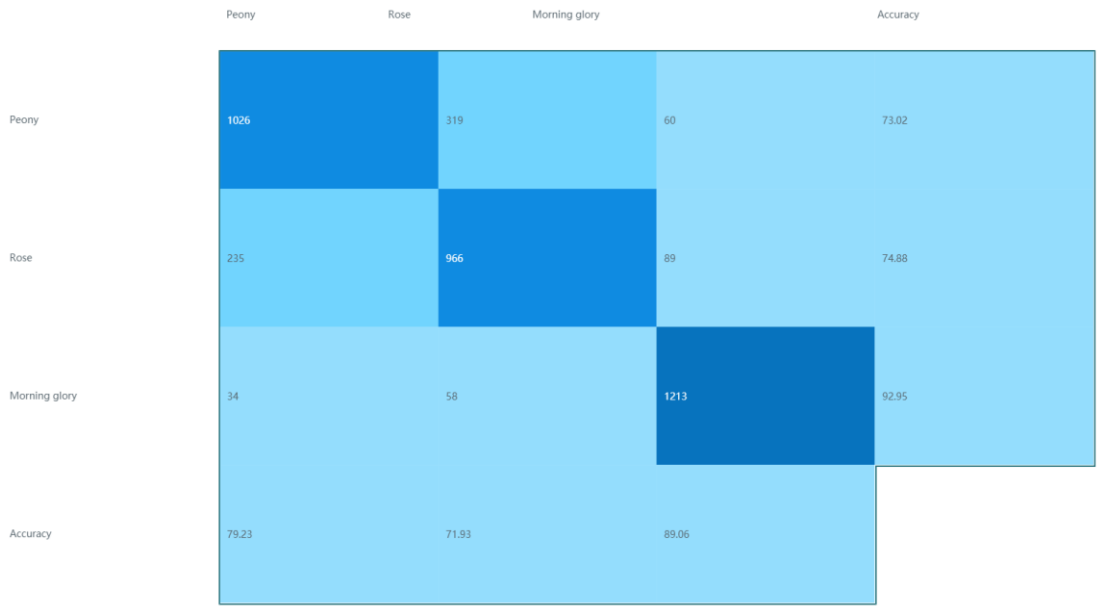

Figure 5 Confusion matrix

From the confusion matrix, it is clear that the morning glory is the most distinguish one which reaches 92.95%. Rose and Peony may have some features in common, like petals or stamen.

5. Conclusion

With the progress of artificial intelligence and deep learning technology in recent years, the technology of using image recognition to distinguish different objects has become mature and gradually used in various fields. Biometric technology is one of the most widely used in people's life, such as fingerprint or face payment. This paper mainly focuses on the application of artificial intelligence and deep learning in flower recognition through depth learning algorithms, collect and filter preliminary processed images, CNN convolution, and pooling through web crawlers. By using two methods for optimization, it is finally analyzed that morning glory is the most easily recognized and has the highest success rate.[7]

References

[1] Yang, Mindy and Thung, Gary, "Classification of trash for recyclability status," arXiv preprint, 2016.
[2] S. Rabano, M. Cabatuan, E. Sybingco, E. Dadios, and E. Calilung, "Common garbage classification using mobilenet," pp. 1–4, 11 2018.
[3] Google, "MobileNets: Open-Source Models for Efficient On-Device Vision," Research Blog. [Online]. Available:https://research.googleblog.com/2017/06/mobilenetsopen-sourcemodelsfor.html. [Accessed: 08-Dec-2017].
[4] Chauhan, Rahul & Ghanshala, Kamal & Joshi, R.. (2018). Convolutional Neural Network (CNN) for Image Detection and Recognition.
278-282. 10.1109/ICSCCC.2018.8703316.
[5] Zhang, Xiaomin & Lu, Hang & Xu, Qianhao & Peng, Xushan & Li, Yongping & Liu, Li & Dai, Zhengwu & Zhang, Weicong. (2020). Image Recognition of Supermarket Shopping Robot Based on CNN. 1363-1368. 10.1109/ICAICA50127.2020.9181936.
[6] Chongyuan Zhang; Afef Marzougui; Sindhuja Sankaran,High-resolution satellite imagery applications in crop phenotyping: An overview [J]Computers and Electronics in AgricultureVolume 2020,175.
[7] Fetter Karl C; Eberhardt Sven; Barclay Rich S; Wing Scott; Keller Stephen R,StomataCounter: a neural network for automatic stomata identification and counting,[J]New PhytologistVolume 223, Issue 3. 2019. PP 1671-1681