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Application of Deep Learning Technology in Image Processing

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Abstract

Deep learning is a unique technology derived from machine learning, which learns the inherent laws of the information obtained, which has a great impact on image processing, voice recognition and other fields. The ultimate goal of deep learning is to enable computers to imitate human learning and recognize numbers, sounds, images and other information. Moreover, deep learning has achieved significant results in image processing. Starting from the aspect of image processing, this paper discusses the application methods of deep learning in the field of image processing and the development process of models.

Keywords

Deep Learning; Image Processing; Development Process of Models.

1. Introduction

Digital image processing technology was born in the 1920s. Image processing, as the name suggests, is the use of computers to study the collected images through deep learning algorithms to obtain the desired results. Image processing technology can be divided into three parts: image compression, image enhancement and image restoration, image matching, description and recognition. Image compression refers to purging unused data and optimizing the original sample. Image enhancement refers to the enhancement of valuable information in an image to improve the visibility of the image. Image restoration refers to the repair of images that have been damaged due to external reasons, making the images clearer. Image matching refers to finding images that are highly similar to the target image. Image description refers to the analysis of the nature of the image and the relationship between organizations. Image recognition refers to the use of electronic information technology to process images to identify targets in different situations, mainly used in the process of transporting goods. Digital processing is closely related to other neighborhoods, and the development of electronic information technology, the development of the financial field, and the needs of military medicine and agriculture are the reasons for the rapid development of image processing technology.Nowadays, deep learning technology is widely used in image processing neighborhoods. Most of the deep learning algorithms are the main means of image processing. The ultimate goal of deep learning is to create a multi-layered network on which computers can learn on their own to derive connections between data, extract more practical and accurate data, and make the data more expressive. Therefore, deep learning algorithms have been widely used in the field of image processing, and the application of deep learning in image processing will be a research topic for a long time in the future. This article will first introduce deep learning briefly, then discuss the main applications of deep learning in image processing, and finally briefly summarize this article.

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2. Organization of the Text

2.1 Deep Learning

Deep learning can be divided into supervised learning and unsupervised learning according to the labeling of data. If there is a label, it is supervised learning; otherwise, it is unsupervised learning. The algorithms used in supervised learning mainly include linear regression, neural networks, decision trees, support vector machines, etc.; the algorithms used in unsupervised learning mainly include PCA, anomaly detection method, and Herbi learning method. Supervised learning is mainly used to classify the data, while determining the nature of the data, and will not reduce the dimensionality of the input data; unsupervised learning is mainly used to cluster the acquired data, and the nature of the data will be analyzed after clustering, and the input data will be processed for dimensionality reduction.[5].

The development of deep learning has gone through three stages: origin, development and outbreak. First, the origin stage. Mainly the proposal of neural network models and perceptrons. Second, the stage of development. Invented the Hopfield neural network, proposed the BP algorithm and other simple machine learning algorithms represented by the support vector machine. Third, the outbreak phase. In 2006, Jeffrey Hinton and others formally proposed the concept of deep learning, solving the problem of gradient disappearance. In 2016, the robot studied by Google defeated the Go master Lee Sedol, and then competed with other masters, all of which won. Robots born on deep learning technology surpass humans. In 2017, deep learning achieved important results in other aspects such as medical, military, and financial.

2.2 The Application of Deep Learning Technology in Image Processing is Divided into Three Aspects: Image Transformation, Image Recognition and Image Restoration.

2.2.1 Image Transformations

Image transformation is to facilitate the processing of the acquired image, the original image is transferred to other spaces through Fourier transformation, scaling, replication, denoising and other technologies, using the nature of space to process the image, and finally converted to the original space to achieve the desired effect. Image transformations can be divided into geometric transformations, scale transformations, and spatial and frequency domain transformations. Among them, deep learning technology is mainly applied to the transformation of space and frequency domain. When processing the image, it will encounter an image that occupies a large amount of memory, at this time in the space for processing, the calculation work will be very heavy, the use of deep learning technology such as Fourier transform, Walsh transformation, etc. to transform the image from the spatial domain to the frequency domain, greatly reducing the difficulty of calculation, and the processing effect will be better.

2.2.2 Image Recognition

Image recognition refers to the use of computers to analyze and process the acquired images to identify targets in different states. The process of image recognition is mainly divided into three steps: first, the image is preprocessed, then the effective data of the image is extracted, and finally the computer learns a classification function or classification model to classify the image. The main algorithms used in image recognition are:Deep learning algorithms such as deep-first search, Bayesian classification, pattern matching, and more. These algorithms improve the accuracy of recognition and reduce the loss caused by large computational volumes.

Application of deep learning in image recognition: The CIFAR-10 dataset provided on the kaggle platform is an example to build a convolutional neural network to recognize images:

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```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 32, 32, 32)        896
_________________________________________________________________
activation_1 (Activation)    (None, 32, 32, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 30, 30, 32)        9248
_________________________________________________________________
activation_2 (Activation)    (None, 30, 30, 32)        0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 15, 15, 32)        0
_________________________________________________________________
dropout_1 (Dropout)          (None, 15, 15, 32)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 15, 15, 64)        18496
_________________________________________________________________
activation_3 (Activation)    (None, 15, 15, 64)        0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 13, 13, 64)        36928
_________________________________________________________________
activation_4 (Activation)    (None, 13, 13, 64)        0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 6, 6, 64)          0
_________________________________________________________________
dropout_2 (Dropout)          (None, 6, 6, 64)          0
_________________________________________________________________
flatten_2 (Flatten)          (None, 2304)              0
_________________________________________________________________
dense_4 (Dense)              (None, 512)               1180160
```

Figure 1. Train the model with a convolutional neural network[6]

```
_________________________________________________________________
activation_2 (Activation)    (None, 30, 30, 32)        0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 15, 15, 32)        0
_________________________________________________________________
dropout_1 (Dropout)          (None, 15, 15, 32)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 15, 15, 64)        18496
_________________________________________________________________
activation_3 (Activation)    (None, 15, 15, 64)        0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 13, 13, 64)        36928
_________________________________________________________________
activation_4 (Activation)    (None, 13, 13, 64)        0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 6, 6, 64)          0
_________________________________________________________________
dropout_2 (Dropout)          (None, 6, 6, 64)          0
_________________________________________________________________
flatten_2 (Flatten)          (None, 2304)              0
_________________________________________________________________
dense_4 (Dense)              (None, 512)               1180160
_________________________________________________________________
activation_5 (Activation)    (None, 512)               0
_________________________________________________________________
dropout_3 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_5 (Dense)              (None, 10)                5130
_________________________________________________________________
activation_6 (Activation)    (None, 10)                0
=================================================================
Total params: 1,250,858
Trainable params: 1,250,858
Non-trainable params: 0
```

Figure 2. Train the model with a convolutional neural network[6]

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The total parameter amount is 1250858, and the parameter amount of training is 1250858, and all participate in the training. Set the number of training rounds to 5 and the sample size of a training to 32, train the image set, and obtain the loss and accuracy of each round.

```
Train on 50000 samples, validate on 10000 samples
Epoch 1/5
50000/50000 [==============================] - 129s 3ms/step - loss: 1.5443
- accuracy: 0.4330 - val_loss: 1.1527 - val_accuracy: 0.5902
Epoch 2/5
50000/50000 [==============================] - 129s 3ms/step - loss: 1.1544
- accuracy: 0.5895 - val_loss: 0.9461 - val_accuracy: 0.6628
Epoch 3/5
50000/50000 [==============================] - 128s 3ms/step - loss: 0.9998
- accuracy: 0.6466 - val_loss: 0.8800 - val_accuracy: 0.6906
Epoch 4/5
50000/50000 [==============================] - 129s 3ms/step - loss: 0.9018
- accuracy: 0.6821 - val_loss: 0.8019 - val_accuracy: 0.7165
Epoch 5/5
50000/50000 [==============================] - 128s 3ms/step - loss: 0.8503
- accuracy: 0.7019 - val_loss: 0.7838 - val_accuracy: 0.7290
Test loss: 0.7838050316810607
Test accuracy: 0.7289999723434448
```

Figure 3. Calculate the loss and accuracy of each round[6]

After 5 iterations of the image recognition of the created convolutional neural network, the recognition accuracy of the image has reached more than 70%.

Although there is a learning phenomenon in the recognition process and the accuracy of recognition is not high, deep learning technology is more practical than traditional methods to recognize images, and the recognition efficiency is high and the ability to adapt to new samples is stronger. For over-learning problems, we can solve them by using fewer network parameters and the number of images, and the improvement of accuracy can be achieved by means of model training.

2.2.3 Image Generation

Image generation refers to the process of acquiring the characteristics of the original image from the sample set, and then integrating them to produce an image that achieves the desired effect. The image generation models established by deep learning technology are: deep confidence network, variational autoencoder, and generative adversarial network. As an algorithm for neural networks in deep learning, deep confidence networks can be used for both labeled and unlabeled data learning. Its function is to classify the collected data. A deep confidence network is a multidimensional distribution of sample data and sample labels that allows the entire model to reach the maximum percentage of training for the data by constantly discovering the values of neuronal weights. Variational autoencoders are models built by deep learning techniques. It is an autoencoder that does not produce over-learning problems during training and can generate data during data compression. Generative adversarial networks are a major research model in the field of image generation, and compared with other algorithms, generative adversarial networks are easy to calculate and produce better images. Generative adversarial networks set up generators and discriminators, generators are mainly used to obtain the distribution of data, discriminators are mainly used to determine whether the input data is from a sample or from a generator, through the game between them, to achieve Nash equilibrium, so as to get the optimal two models.[4].

There are many applications for image generation, such as the use of generative adversarial networks to generate anime images.

GANs are constantly trained on the generator so that data that is highly similar to the original sample can be produced. At each step, the discriminator adjusts to the given data and the data generated

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during training, and then uses convolutional neural networks and generators to produce a series of images.

The generator generates the following image:

Figure 4. The generator generates the picture[7]

3. Conclusion

The first part of this article provides a brief introduction to the classification and development of deep learning. The second part discusses the application of deep learning algorithms in image processing technology, which is divided into three aspects: image transformation, image generation, and image recognition. Image transformation is the most basic technology in image processing; image recognition is an important research neighborhood of image processing, which can greatly improve the accuracy of recognition and improve the speed of recognition, mainly used in biomedical image recognition, military public security and other neighborhoods. Finally, the process, algorithm and application of image generation are briefly explained.

With the rapid development of information technology, computer applications are related to all aspects of people's work and life. At the same time, image processing technology is also growing, and the application is in the fields of military, medical, and artificial intelligence. Therefore, we must make full use of this technology to enhance the strength of the country and make the people's lives richer and happier.

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