

Explore the Application of Machine Learning in Image Recognition and Detection

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Abstract. With the rapid development of computer technology, the application of image recognition technology and machine learning technology in society has become more and more proven. Through consulting a large number of data and literature, this paper probes into the development status of image recognition technology and its future development trend and shortcomings. This paper concludes that there is a certain advanced technology development at present, and machine learning and image recognition are slowly being applied in many fields. For example, it has applications in the fields of medical pathology examination, unmanned supermarkets, autonomous driving and intelligent monitoring. However, some problems are related to low precision, insufficient intelligence, and privacy, which need to be solved in future development and application. In the future, the application of machine learning in image recognition has great space for development and a large market. This article can help others learn the relevant knowledge and suggest some directions and trends to solve the problem.

Keywords: Artificial intelligence; machine learning; unmanned supermarket; image recognition.

1. Introduction

With the rapid development of science and technology, artificial intelligence (AI) and computer technology have been significantly advanced. Among them, the development of machine learning technology is particularly prominent and has become a hot field of research and application. Machine learning is a branch of AI that emphasizes that computers gain experience in processing data and use rules to make predictions about unknown data. Machine learning has applications in many fields, such as predicting future trends based on past data, forming video and speech for an individual based on his language habits, and image recognition [1].

By building mathematical models and using large-scale data for training and optimization, machine learning can automatically extract useful features from complex image data and perform efficient classification and recognition.

At present, image recognition technology, as a core component of computer vision, is widely used in medical diagnosis, automatic driving, intelligent monitoring, industrial manufacturing, and many other fields. In medicine, through convolutional neural networks, lesions can be identified by computer: the model of lesions is recorded by a large number of records and examples, and the model is searched in the application; In geology, image recognition and modeling can be completed by AI; In daily life, the surveillance video on the road and the billing system in the parking lot can recognize the license plate number and complete the payment. In recent years, the application of machine learning in image recognition and detection has made remarkable progress. ImageNet is one of computer vision's most influential large-scale image classification competitions. Since 2012, deep learning models have repeatedly broken records for classification accuracy in the ImageNet Competition. The success of classic models such as AlexNet, VGG, GoogLeNet and ResNet in the ImageNet competition marks the rise of deep learning in image recognition. Earlier, AlphaGo's achievements were obvious to all [2]. AlphaGo is a Go AI developed by Google DeepMind. AlphaGo can recognize the board state in the Go image and play high-level games through a combination of deep learning and reinforcement learning techniques. He defeated professional Go players from China and Japan. In addition, the recent medical image analysis system developed by Google Health, IBM



Watson and other companies use deep learning technology to analyze medical images such as X-rays, CT and MRI to assist doctors in disease diagnosis. For example, Google Health has developed a breast cancer screening system that automatically identifies potential cancer lesions on mammograms, improving early diagnosis [3, 4].

The present study is intended to provide an exhaustive review of the cutting-edge research advancements in the domain of machine learning as applied to image recognition and detection. The author will structure an exploration of the applications and evolution of machine learning within contemporary contexts. Initially, the paper delineates machine learning methodologies' conceptual underpinnings and categorization. Subsequently, it delineates the array of algorithms associated with machine learning and highlights their distinct attributes. Ultimately, an illustrative case study is employed to synthesize the utility and benefits of machine learning in everyday situations.

2. Fundamentals of Machine Learning and Image Recognition

2.1. Basic Concepts of Machine Learning

Machine learning constitutes an interdisciplinary field predominantly grounded in mathematics and computer science. It encompasses a comprehensive understanding of probability theory, statistical analysis, approximation algorithms, and intricate computational procedures. The underlying premise of machine learning is to endow computers with a learning capacity, enabling them to assimilate knowledge from pre-existing instances. This process facilitates the resolution of novel, analogous challenges, serving as the foundational underpinning for the advancement of artificial intelligence. Widely employed algorithms include [5].

2.2. Deep Learning

As a new research direction in machine learning, deep learning has important characteristics such as high efficiency and wide scope of application, which makes it widely used in speech and image recognition processing, machine translation and personalized service, making machine learning closer to artificial intelligence. Deep learning is the learning of the intrinsic laws and layers of representation of sample data, and the information gained during these learning processes is of great help in the interpretation of data such as words, images, and sounds. At the same time, the ultimate goal of deep learning is to enable robots to analyze and process problems like humans so that machines can mimic human activities such as hearing and thinking. It solves many complex pattern recognition problems and greatly progresses in artificial intelligence-related technologies.

A common model for deep learning is convolutional neural networks. The research on convolutional neural networks began in the 1980s and 1990s, and the time delay network and LeNet-5 were the earliest convolutional neural networks. In the 21st century, convolutional neural networks have been developed rapidly and applied to computer vision, natural language processing and other fields. Convolutional neural networks mimic the construction of biological visual mechanisms and can carry out supervised and unsupervised learning. The convolution kernel parameter sharing within the hidden layer and the sparsity of interlayer connections enable the convolutional neural network to learn grid-like topology features, such as pixels and audio, with a stable effect and no additional feature requirements on the data with a small amount of computation.

In addition, artificial neural network algorithm is a commonly used deep learning algorithm. An artificial neural network is like a computer simulation of a human neural network, consisting of individual neural units connected, each of which has a numerical input and output in the form of either a real number or a linear combination function. It has to be learned by a learning principle before it can work. When the network makes a mistake, it learns to make it less likely to make the same mistake.

2.3. Development of image recognition detection

Since Turing built a learning machine in 1950, machine learning has flourished since 2000, a trend that stems from the growing social demand that machine learning has many advantages over traditional methods. At the same time, this greatly improves the accuracy of recognition: trained computers can react quickly to targets, no matter how big or small, strong or weak. In this way, enterprises are eager to increase work efficiency through machine learning technology, improve operating income, solve the problems caused by rising labor prices, and improve user experience. This is also the trend of The Times because even though technology is still in the early stages of development, it shows huge development potential, which may greatly improve the economic development line in the future and help the country's development.

With the continuous progress of machine learning technology, it is widely used in various fields, one of which is image recognition technology. Image recognition technology is an important application of artificial intelligence. It refers to object recognition technology on images to identify various targets and objects of different modes. From a simple perspective, image recognition technology is based on machine learning. In this process, the computer learns the features of a particular pattern through basic pixel recognition, such as the fact that the letter "Y" is made up of three line segments with one end point intersecting simultaneously. In the process of scanning, the computer recognizes the pattern based on features. Image recognition is used in many fields, such as medicine, intelligent driving, intelligent surveillance, and unmanned supermarkets.

3. Specific Applications

3.1. Medical image recognition

In medicine, image recognition is playing an increasingly important role. Vascular segmentation is the extraction and reconstruction of the blood vessels around the organ, so that physicians can have a clearer and direct understanding of the blood vessels around the organ, and help them to plan a better path before implementing invasive treatment to avoid vascular damage (references have been saved). Specifically, angiography of chest muscles and computed tomography in thoracic MRI images can be achieved by using three-position convolutional neural networks, while segmentation of coronary arteries can be achieved. Combining the machine learning method with the shape model can greatly increase the segmentation accuracy.

However, this algorithm still has some flaws. First of all, the algorithm still has the problem of not being accurate enough for small blood vessels. At the same time, the requirement of computer hardware is also high because of the large calculation amount.

3.2. Automatic Driving

Autonomous driving systems (ADS) mainly involve three areas: environmental perception, decision planning, and control execution. Among them, the application of image recognition in environment perception and decision planning is the most important. Environment perception is the process of obtaining the vehicle's external environment by using Lidar, millimeter-wave radar, ultrasonic radar and high-definition camera. Decision planning is the process of judging and planning for the next wave based on the results of environmental perception. Specifically, before leaving the factory, the on-board computer will use convolutional neural network algorithms to model traffic facilities and objects such as zebra crossings, traffic lights, and pedestrians. In the application, the computer will match and detect the data from the sensor and the existing data, and judge the next action based on the results.

Again, this algorithm has several drawbacks. First of all, the accuracy of target recognition is insufficient. Specifically, problems such as insufficient ability to identify small obstacles and identifying vehicles and people in advertisements as obstacles frequently occur

3.3. Intelligent Monitoring

In recent years, more and more surveillance cameras have been replaced with intelligent surveillance equipment above the road. Different kinds of smart probes are implanted into the model through a convolutional neural network. Some of the surveillance cameras that check the seat belts are implanted with models of different types, colors and forms of the seat belts. When used, the computer processes the photos taken by the high-speed camera and looks for objects similar to the seat belt models. At the same time, such cameras can also recognize the license plate, they will find the location of the license plate through a similar algorithm, and then recognize the letters and numbers on the above, if there is a violation of the law, they can be punished according to the identification results.

But the flaws are obvious. There is still a significant chance of error in computer recognition. If the driver is wearing black clothing, the black seat belt is not easy to identify. Similarly, there have been cases where drivers who are drinking water have been identified as talking on the phone. As an assistant to law enforcement, intelligent surveillance should avoid such problems as much as possible.

3.4. Unmanned Supermarket

With the development and application of image recognition and artificial intelligence in other fields, it is also gradually applied in everyone's life.

Now many supermarkets have introduced unmanned supermarket systems. Its main purpose is to more efficiently deal with problems that can occur in supermarkets, such as checkout lines. However, most similar concepts are applied in convenience store level supermarkets, which are far from the supermarket level we expect.

Its operation model is as follows: First, the customer's identity and account information are determined through APP or social software before entering the store; Second, in the goods storage area, through high-definition cameras and face capture system to perceive the goods, in this process, the image recognition system will identify the customer's face information, product information, and through radio frequency identification technology (RFID) to monitor the goods; Third, payment is made through a specific machine.

However, such immature technology has many drawbacks. First, these unmanned supermarkets are not strong enough to deal with theft and cannot manage behavior that may harm other customers. Unmanned supermarkets can not solve such problems through certain methods, which also determines that it cannot be applied in large-scale supermarkets for the time being. Second, the management of goods in the current supermarket makes it unable to handle large goods, there is no supervision, and the processing capacity of supermarket equipment for large and heavy objects is weak, and may even cause accidents. Third, the customer's personal information may be leaked, which is very important.

4. Suggestions

4.1. Development Prospects

First of all, from a technical level, image recognition requires a high-speed computer, but if you want to really integrate it into life, the algorithm should be simplified, the amount of computation should be reduced, and this technology should be affordable for everyone. Second, for the protection of privacy, there are several ways to alleviate the problem

The State should improve relevant laws to regulate the behavior of obtaining personal information through image recognition, avoid improper use, avoid privacy disclosure after legitimate use, and avoid the sale of personal information. In order to achieve this goal, relevant illegal acts should be dealt with severely, scientific and technological development should be followed up, and loopholes should be filled in a timely manner.

Companies should use image recognition groups to protect customers' privacy, strictly manage their own, employee behavior, and end personal information trading. At the same time, personal rights should be limited to ensure the credibility of those who access personal information, to protect customers' safety.

As individuals, we should improve the awareness of personal privacy, the information around the need to be vigilant, choose the authority of large companies. At the same time, if you encounter relevant problems, you should seek legal aid and asylum in a timely manner.

In the future, image recognition can be developed in more directions, such as building a fugitive tracking system, efficiently combating crimes, assisting athletes to develop their potential, or as a good assistant to explore celestial bodies in the universe. In this process, the promotion of image recognition corresponding artificial intelligence algorithm should be strengthened, and supplemented by various effective means.

In addition, in terms of machine learning, the experience accumulation of the machine should be strengthened so that it can learn the data by itself and update it by itself.

4.2. Development Challenges

In the future, image recognition may face the following challenges: First, low-quality images tend to contain less information, which may lead to reduced recognition accuracy; Second, as confusing information grows, the system's ability to process it may be inadequate. In addition, as the scope of image recognition applications expands and the problem's difficulty increases, the amount of data will grow significantly. In the face of the growing amount of data, image recognition and the processing power of artificial intelligence may be challenged. Finally, in terms of modeling accuracy and variables, when the shape and color of the target object change greatly, whether image recognition can maintain or even improve the judgment accuracy will become an important issue.

5. Conclusion

Machine learning and image recognition are rapidly developing and widely used in many fields. Its relatively mature technology and simple algorithm have become one of its main advantages. Both technologies have been specialized in many applications, including enhanced recognition of specific objects and image processing. In the field of image recognition, the focus of this paper, the recognition and processing of specific objects occupies an important position, and this technology is applied to including but not limited to unmanned supermarkets, medical recognition and unmanned driving. Such technology is becoming more common and facilitates people's lives. In the future development process, the user's privacy issues need to be paid attention to, which is an important part of the development of artificial intelligence and image recognition.

With the further improvement of computing power and the continuous emergence of new technologies, image recognition technology is expected to achieve breakthroughs in more fields and bring more intelligent and convenient applications. The combination of general artificial intelligence and image recognition will further promote the development of image recognition technology, making its application in cross-domain tasks more extensive and flexible. In short, image recognition technology has become an important part of modern artificial intelligence, and its development prospects are broad. Through continuous technological innovation and application exploration, image recognition technology will continue to change our way of life and promote the intelligent process of society.

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