The Application of Artificial Intelligence in Mechanical Manufacture Industry

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Abstract. Artificial intelligence (AI) technology, as one of the most advanced science and technology in the current society, has been applied more and more widely to production and life, and especially in manufacture industry. This paper studies the application of artificial intelligence in mechanical manufacture industry. Firstly, it briefly introduces the definition and development of artificial intelligence and that of mechanical manufacture industry. Secondly, it analyzes the advantages of AI. Lastly, it illustrates how artificial intelligence technology is applied in mechanical manufacture mainly from the aspects of fault diagnosis, quality inspection, improving the safety of working places and other aspects as well.

1. Introduction
Artificial intelligence technology is playing an increasingly important role in people's lives as it is more and more widely used in people’s daily life, such as the common use of smart dishwashers, smart sweepers, which are the products of the interfusion of artificial intelligence and mechanical manufacture industry. In fact, artificial intelligence technology has been extensively applied in mechanical manufacture industry, which not only guarantees the accuracy of manufacturing, but also improves the efficiency of the work and guarantees the safety of working places.

It can be said that the emergence of artificial intelligence has led to great changes in the entire manufacture industry. With no exception, manufacture industry also needs to rely on AI technology to achieve automation and intelligent development and to better meet the requirements of manufacture industry in the new era of 4.0 industrial revolution.

2. Artificial intelligence and mechanical manufacture industry

2.1. Definition and development of artificial intelligence
As a branch of computer science technology, artificial intelligence is currently the most representative technology in this field. It tries to understand the essence of intelligence and produce similar intelligent machines by simulating, extending and expanding human intelligence. Artificial intelligence is a comprehensive, practical technology and studies various techniques including virtual reality technology, emulation technique, speech recognition technology.

The embryonic stage of artificial intelligence, to be precise, is the stage of computer technology, because computer technology has just appeared at this time and is applied only in some limited fields. At this stage, mechanical manufacture is mainly manual. Artificial intelligence technology has just begun to appear and not yet been able to play a great role in manufacture industry. Then, with the rapid development of electronic information technology, people have begun to get access to network
in work and life. At this developing stage, people have got to know about artificial intelligence and gradually realized its significance. In 2012, deep neural network technology was applied in the field of image recognition. Since then, a variety of new networks have sprung up. The application of deep learning algorithms has made a breakthrough in speech, image, semantic recognition technology and many artificial intelligence innovations have mushroomed. Currently, artificial intelligence is stepping into the stage of popularization. Artificial intelligence technology is gaining popularity in various fields, especially in mechanical manufacture industry.

Speaking from the viewpoint of technology, AI has experienced three stages of development: computational intelligence, perceptual intelligence and cognitive intelligence. At the computational stage, machines can compute and convey information like human being. Then AI comes into perceptual intelligence, machines can identify vision, speech and language and can take actions based on their judgments. Now it is in the stage of cognitive intelligence, machines can think and act like human being, such as pilotless automobile, autonomous robots, and etc.

2.2. Development of mechanical manufacture industry

Globally speaking, mechanical manufacture industry has experienced four stages of development. The first stage is machine manufacturing age. In the late 18th century, Industrial Revolution characterized by the invention of steam engine and machine tool brought manufacture industry into the age in which machines replaced manual manufacture. From the beginning of 1900s to 1960s, the second industrial revolution happened, and manufacture industry stepped into the stage of electrification and automation. Streamline and volume-produce emerged in this stage. Based on the upgrading of industry 2.0, electric information technology was applied in mechanical manufacture industry and electric information era has come. At this stage, machines have gradually replaced human being and micro-electric technology, computer science, automation technology have been widely applied in mechanical manufacture industry. Mechanical manufacture was developing into integration. Now mechanical manufacture has stepped into the age of intelligence. From the beginning of 21st century, the fourth industrial revolution is integrating internet, big data, cloud computing, internet of things, artificial intelligence into mechanical manufacture industry.

3. Advantages of artificial intelligence in manufacture industry

3.1. Effective and accurate information processing

Effective and accurate information processing guarantees the security and stability of mechanical manufacture and automation. Mechanical automation relies greatly on electronic information transmission system to transmit information, and it is very easy to have problems in the process of information transmitting, especially when you input or output a lot of information, some unpredictable errors may occur and result in serious adverse effects. The main reason for this problem is the instability in the mechanical electronic system itself, so, it is necessary to apply artificial intelligence technology when the information is being processed. Artificial intelligence technology can monitor the stability of electronic information system in the process of information transmission very accurately to ensure the security and accuracy of information input or output. Therefore, artificial intelligence can better information processing, and plays a significant role in mechanical manufacture and automation.

3.2. Powerful data storage and calculation

Artificial intelligence technology improves the precision of mechanical manufacturing and automation. The most representative application of artificial intelligence technology in mechanical manufacture and automation is the neural network system. In fact, the system is an electronic information system built by imitating the human nervous system, and its main feature is its large amount of storage and the absolute accuracy of the data. Specifically, the neural network system analyzes some data by simulating the structure of neurons, and then uses the results of the analysis to obtain the participating values. From the structural point of view, the structure of neurons is very close and stable, thus making
the whole neural network system more intelligent. Therefore, even if it is necessary to process huge amounts of information data, neuronal systems can be accurate and precise, and the relevant data in the process of mechanical manufacture and automation can rely on neural network systems for effective calculation and storage. Furthermore, the application of deep learning algorithm in artificial intelligence has promoted mechanical manufacturing and automation to a new level, bringing more diversified innovation and practice to the manufacturing industry.

4. Application of artificial intelligence in mechanical manufacture industry

With the progress and development of science and technology, artificial intelligence technology is being increasingly applied to mechanical manufacture and automation. Artificial intelligence technology builds production model through computer simulation system and makes comprehensive data analysis to make relevant precautionary measures in case of emergency, which guarantees the orderly production system, reduces the possible capital loss of manufacturing enterprises, and also greatly improves the production efficiency and accuracy of manufacturing.

The application of artificial intelligence technology in mechanical manufacture industry is mainly reflected in the following aspects:

4.1. Fault diagnosis
The process of mechanical design, manufacturing and automation is relatively complex, and a large amount of data calculation is required in this process. For example, a large number of formulas are needed in the process of modeling and demonstration to calculate and deduce, and if the process is completely dependent on manual calculation, on the one hand, it is easy to calculate wrongly, on the other hand, it also takes a lot of time and effort, which is not conducive to the entire production process. Luckily, artificial intelligence can automatically classify and categorize information to improve the accuracy of calculation, and therefore, the subsequent errors or failures can be effectively avoided.

In addition, artificial intelligence can also diagnose mechanical failure. In the method of fault diagnosis based on Expert System Theory, firstly, the data being monitored by machines are input into the system through the human-machine interface. Then the reasoning machine obtains the corresponding diagnostic results through forward inference engine and puts forward expert opinions. Finally, the most similar cases in history are obtained by intelligent searching, and the similarity is calculated based on the historical cases to diagnose mechanical faults.

This advantage of artificial intelligence technology can also be reflected in the maintenance of equipment. Artificial intelligence in equipment maintenance is mainly predictive maintenance, which is done by collecting the actual operation data of parts of the equipment and then comparing them with that of the intelligent training model, timely warning and reminding related personnel to maintain. This technology not only improves the safety of the production system, but also effectively reduces the downtime, and improves production efficiency as well.

4.2. Quality inspection
The traditional manual detection, on the one hand, due to the differences between different people, makes the inspection standard difficult to be completely the same. On the other hand, even the same person may have inconsistent test standard at different time and with different physical or mental state. Moreover, especially when faced with product inspection of rapid mass production, it is almost impossible for manual detection to do the full inspection. However, based on deep learning machine vision technology, artificial intelligence detection makes quality inspection standards more unified, stable, and faster detection.

4.3. Improving the safety of working places
Safety has always been a hot issue in traditional manufacture industry due to its frequent occurrence of unsafe problems in manufacturing process. Thanks to AI, there problems can be avoided to the
greatest degree. AI can recognize the safety status of working places with its unique cognitive function, it will warn the workers to leave the spot or take other necessary actions in case of emergency. Moreover, AI system can also set up visiting limitations of workers to identify the entry of the unpermitted people, and with its image recognition technology, AI can assess whether the workers on the spot are conforming to the safety regulations, for example, if they are wearing necessary safety equipment, such as safety helmet, safety goggles. Thus, the safety situation in manufacture industry will be much improved with the help of AI system.

In addition to the above aspects, artificial intelligence is also greatly helpful in product development, manufacturing and rear services. Relying on its powerful data storage and effective information processing, artificial intelligence can help its clients find their desirable products and thus shorten the time for products design. Also, in products manufacturing procedure, artificial intelligence can help bring about most accurate products. Similarly, in products rear service, artificial intelligence can help provide far-distance equipment maintenance when in need, such as spare parts management, routine or predictive equipment maintenance, fault warning and diagnosis, products upgrading, and etc.

5. Conclusion
With the rapid development of science and technology, there are great changes in people’s lives and social production. Due to the fast pace of life and the coming of 4.0 industrial revolution, artificial intelligence has gaining its popularity and are being applied widely to mechanical manufacture and automation. Its powerful data storage and computation and its effective and precise information processing bring great benefits to manufacturing field. It is helpful to promote work efficiency and quality control, spare more valuable work for human being to do, provide much safer working places, diagnose faults and offer predictive maintenance, and develop more intelligent supply chains as well. Artificial intelligence promotes the development of mechanical manufacture, and vice versa. On the one hand, the manufacturing industry is experiencing the fourth industrial revolution, and the arrival of 5G and the application of artificial intelligence will accelerate the transformation of manufacturing. On the other hand, mechanical manufacture and automation also provide a platform and opportunity for the innovation of artificial intelligence technology. However, no matter how fast technology develops and how many changes occur in manufacture industry, "people" will always be the core of the field.

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