Research on the Application of Artificial Intelligence in the Field of Mechanical Automation

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Abstract. As a branch of computer science, artificial intelligence involves disciplines such as computer science, psychology, philosophy, and linguistics. It can simulate certain human thinking processes and social behaviors. In the past 20 years, the application of artificial intelligence has penetrated into many areas of life and production, including economics, space technology, active control, computer planning, and mechanical manufacturing. It has produced huge economic benefits in production practices and pushed human society forward by a huge step. With the increasing research and development of artificial intelligence technology, its application in mechanical engineering has become more and more extensive. Through its high-end technology and intelligent algorithms, it can effectively and accurately solve various problems in the process of mechanical automation experimental research and production use. This article will analyze and research the application of artificial intelligence in the field of mechanical automation.

1. Introduction
With the development of modern science technology and information technology, in modern engineering construction, the trend of mechanical automation is continuously strengthened. Traditional machinery is increasingly unable to meet the needs of modern engineering construction. For example, improving the precision of the mechanical automation control system can precisely control the production process of fine parts and reduce the precision errors of them. It is of decisive significance for engineering quality, production efficiency or economic benefits. The application of artificial intelligence in mechanical automation production can organically and efficiently integrate information technology, machinery production technology and testing technology so as to help machinery manufacturing companies produce better products quickly and efficiently, and improve their economic benefits.

2. The development status and existing problems of our country's mechanical automation field
At present, there is still a big gap of mechanical automation development between our country and developed countries. This gap is manifested in the following aspects:

(1) Regarding the production management of mechanical automation, most enterprises in our country still adopt traditional and backward production management mode. The management mode of intelligent equipment such as computers has not been fully implemented. In addition, some companies blindly introduced automated production management technology but failed to form the infrastructure construction that matched the technology, leading to the formation of a management model that separates humans from machines. While, the industrialized developed countries have realized computer scientific, integrated, and high-intelligence management, and have mastered a series of advanced
manufacturing technologies such as artificial intelligence, computer-aided technology, and flexible manufacturing systems.

(2) As far as mechanical automation production is concerned, our country’s mechanical automation production technology is still in the stage of automatic production with relatively low degree of electronic automation and rigid automation in terms of application scope, practical level, construction effect, etc. While the industrialized developed countries have developed more mature automated production technology, getting rid of the shortcomings of high dependence and poor applicability of early automation, and have generally realized intelligence, flexibility and integration, and can feed back information based on the use of existing machinery, and then improve product performance to produce better products.

(3) As far as the talent cultivating mechanism for mechanical automation production is concerned, most of them stay at the stage where textbook teaching is the mainstay and practical teaching is supplemented. The main theoretical teaching causes students to lack own initiative and innovativeness, and single and theoretical talents account for the majority. In addition, in terms of mechanical design, technological level, application technology and other aspects, our country's innovation level is low, and the speed of automatic production machinery replacement is far behind the level of developed countries. At the same time, we failed to master the core production technology of mechanical automation, and most of our technology stayed at the level of primary processing of products.

(4) Automated production technology still has some other problems in our country's mechanical engineering manufacturing, such as the low technical content of automated production equipment, the lack of automated production equipment, the lack of compound talents with both theory and practice, insufficient external environment for mechanical automation research and other issues.

3. Application of artificial intelligence in the field of mechanical automation

Artificial intelligence is a new technological science that studies and develops theories, methods, technologies and application systems used to simulate, extend and expand human intelligence. It is called the "container" of human intelligence.

Automation refers to the process in which a machine or device is automatically operated or controlled according to a predetermined program or instruction without human intervention. And mechanical automation is a process in which a machine or device realizes different motion modes of the machine through automatic control.

3.1. The application of artificial intelligence in the automated production of mechanical design and manufacturing

In Fig.1, artificial intelligence is applied to the machining process of mechanical parts. The movement trajectory and processing sequence of the cutter and the workpiece are completely controlled by the program and digital signals. The workpiece can be automatically processed according to the preset program. It is not affected by human factors and has high processing accuracy and stable quality. Also, artificial intelligence is particularly effective in improving precision in precision machining and parts processing applications with complex structures. Moreover, artificial intelligence welding technology has been widely used in production practice, which has played a key role in improving welding quality and welding efficiency. At the same time, it has reduced the number of labor and production costs for enterprises, and also provided a strong guarantee for improving the working environment of workers.
3.2. The application of artificial intelligence in the mechanical assembly process

In large-scale mechanical production, such as the production of automobile manufacturers, there are almost no assembly workers on the automated assembly line. The assembly process of automobiles is almost all completed by production robots. It effectively guarantees the stability of the assembly quality and performance of the car, and lays the foundation for the safe travel of human beings.

At the same time, artificial intelligence can also have detection functions when used in the assembly process. The intelligent error-proofing system shown in Fig.2 is used to check the installation of fasteners on a product. For example, during assembly, it can prevent the operator from missing screws or parts, and prevent missing one of the processes. The working principle of the error-proofing system is to set the process through the touch screen, guide the work sequence through the display screen and alarm when an error occurs. It can also be linked with the equipment, and automatically stop the operation of the equipment when an error occurs, thereby effectively preventing errors and avoiding the production of unqualified products. The application of this type of equipment can greatly reduce the workload of the inspectors, reduce their work intensity, improve the production efficiency, shorten the manufacturing cycle, and reduce the production cost[1], thereby improving the economic benefit of the enterprise.

3.3. Artificial intelligence replacing manual mechanical operations

The application of artificial intelligence in mechanical automation operations can replace humans in operating in harsh, complex, and inaccessible environments, such as using robots to replace humans for operations in toxic environments, subsea operations, space operations, and so on. The sampling work of our country's "Chang'e-5" on the moon was done automatically by artificial intelligence.

4. Problems that may arise in the application of artificial intelligence in the automatic production process of machinery

In the process of mechanical automation application, changes in the production environment, adjustments in production scale, and changes in related materials and resources often lead to problems
of unstable connection and untimely control of automation information in the areas of ordering, allocation and control. These changes eventually lead to unexpected errors in the input and output of the relevant systematic information, resulting in instability of control of the relevant mechanical information, which is a common problem in mechanical automation production. Especially in the mechanical automation production of precision processing equipment, due to the fine manufacturing process, a little carelessness will lead to engineering errors\(^2\), resulting in undesirable consequences. This is because the production engineering of precision equipment often has large and complex algorithms. Therefore, automation technology and related systems have some algorithm problems in specific process processing which is hard to overcome. These problems need to be handled and calculated manually, which invisibly increases the workload\(^3\), reduces the actual work efficiency of automated mechanical engineering, and increases production costs and reduces economic benefits.

Meanwhile, the application of artificial intelligence technology can effectively strengthen the monitoring of error information in related information systems. Then, in the process of automation control, we can find out the instability in more detail, and finally realize accurate process monitoring, so as to ensure the accuracy of relevant information input and output throughout the process, so that artificial intelligence can be better used in mechanical automation\(^4\).

5. Measures to solve the problem of mechanical automatic production of artificial intelligence
Firstly, institutions of higher learning should focus on cultivating dual-skilled talents with artificial intelligence research theoretical knowledge and practical ability, so as to serve the future artificial intelligence machinery automation production.

Secondly, the information management of artificial intelligence should be adapted to the mechanical automation production equipment, so that artificial intelligence automatic production becomes the backbone of enterprise development, and artificial intelligence and production practice are organically integrated, which is to serve the flexible, automated and green development of machinery production.

Last but not the least, improve the production capacity of automated machinery production equipment to meet the needs of artificial intelligence production.

6. Conclusions
Artificial intelligence mechanical automation has become an inevitable trend in product design and production. In its development process, we must focus on cultivating information management talents and intelligent design and manufacturing talents that are compatible with this process. At the same time, mechanical automation production equipment must meet the needs of intelligent production, so as to enable artificial intelligence automated production to replace manual operations, which can effectively ensure the stability of product accuracy, improve labor efficiency, reduce production costs, and contribute to the development of human society.

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