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THE APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN MECHANICAL MANUFACTURING AND AUTOMATION

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Abstract. In order to achieve intelligent production and quality control, improve production efficiency and accuracy, the author proposes an application method of artificial intelligence technology in mechanical manufacturing and automation. The author aims to explore the specific application of artificial intelligence technology in the mechanical manufacturing industry and summarize the main advantages of automation technology. By analyzing these advantages, the aim is to provide targeted recommendations for future technological development. Meanwhile, the author aims to provide theoretical support for promoting the application of modern artificial intelligence technology and automation technology in the field of mechanical manufacturing. In the manufacturing process, intelligent production and quality control can be achieved, improving production efficiency and accuracy; In the field of automation, artificial intelligence technology can achieve intelligent control systems and autonomous decision-making, improving the flexibility and adaptability of production lines. Overall, the application of artificial intelligence technology has brought revolutionary changes to mechanical manufacturing, promoting the upgrading and development of the industry.

Key words: Artificial intelligence, Mechanical manufacturing, automation

1. Introduction. With the continuous achievement of various high-tech research, society is moving towards mechanization and intelligence, and artificial intelligence technology has become a focus and focus of people's attention in the context of the new era. Artificial intelligence technology is a representative modern technology that is gradually playing an important role in various industries, especially in today's rapidly changing high-tech era. The future development prospects of artificial intelligence technology are bright, and its practical direction in mechanical design, manufacturing, and automation will also become clearer. In this situation, in-depth research on this topic is needed, Obviously, it has significant practical significance that cannot be ignored [1].

As an important lifeline of national economic development, the manufacturing industry is of great significance for national development and industrial coordinated development. In today's rapidly developing economy, the level of manufacturing directly determines the country's position in the world economy. With the development of information technology, driving industrial development in the direction of intelligence has become the mainstream trend of current development, such as the development of cloud data, big data and other technologies, the manufacturing industry also needs to be rapidly iterated and updated to ensure that its level is in an absolute advantage internationally. Although artificial intelligence technology has become a well-known cutting-edge technology worldwide, there are still doubts about the application and maturity of new technologies in the equipment manufacturing industry due to its wide coverage. How to use artificial intelligence to improve product manufacturing level and quality, optimize manufacturing product structure, is still in a confused state [2,3].

Against the backdrop of rapid development in industrial manufacturing, people have put forward higher requirements for mechanical design and manufacturing technology. Compared with traditional mechanical design and manufacturing technology, the manufacturing technology in the new era has stronger comprehensiveness and digital characteristics, integrating advanced technologies such as automatic control technology, computer technology, and information technology. The production and manufacturing industry is a pillar industry of the national economy, which cannot be separated from the support of advanced mechanical manufacturing technology. In the future, we must keep up with the trend of the times, strengthen the reform and innovation of intelligent mechanical design, manufacturing, and automation technology, provide strong guarantees for the

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development of industrial manufacturing, and promote the country's development towards the goal of becoming a strong industrial and manufacturing country. Based on this situation, the author analyzes the application limitations of artificial intelligence technology in mechanical manufacturing and automation, in order to further reveal the positive impact of artificial intelligence in promoting industrial upgrading and optimizing product structure [4].

2. Research Methods.

2.1. Overview of Artificial Intelligence Technology. At present, China's modernization construction has achieved preliminary results, and artificial intelligence technology has begun to play a role in people's lives. Intelligent cars, intelligent robots, and smart homes are all extension products of artificial intelligence technology. In fact, applying artificial intelligence technology to mechanical design and manufacturing also has certain feasibility, and products will therefore have human thinking and simulation awareness, therefore, it is possible to engage in self-learning, analysis, judgment, and other abilities. As early as the beginning of the last century, toyota motor corporation of Japan proposed the concept of refined production and adapted and analyzed the production needs of multiple varieties and small scales. The proposal of this idea fundamentally reduced the production and labor costs of the company, and was implemented in the design, manufacturing, and management of automotive products. This enabled Japan's automotive industry to quickly surpass the united states and become the world's largest producer, and this precisely reflects the necessity of putting people at the center. Today, as the Fourth Industrial Revolution approaches, artificial intelligence, an extremely special technology, will become the greatest driving force for human centered mechanical design, manufacturing, and automation. In future development, it is crucial to study the practical application of artificial intelligence technology in mechanical design, manufacturing, and automation based on the demand for flexible manufacturing. Artificial intelligence technology is a development achievement of computer technology, and it is also an inseparable part of computer technology in the new era. It has intelligent characteristics and combines human thinking patterns, and can achieve intelligent simulation of mechanical equipment. Common directions of artificial intelligence include speech recognition technology and virtual reality technology, which are composed of different disciplines and therefore have a certain degree of comprehensiveness.

In the stage where artificial intelligence did not yet exist independently of computer technology, the application scope of computer technology was not large. At this time, the social production mode was mostly manual production. Although the concept of artificial intelligence had initially emerged, there was still a long way to go until the popularization and rise of electronic information technology, and network technology began to play a role in production and life, the application fields of artificial intelligence technology are still relatively scarce [5,6].

With the development of network technology and information technology, artificial intelligence technology has begun to truly become known to people and exists on a large scale in production and daily life. As shown in Figure 2.1: Intelligent remote control technology can remotely control the start and stop of production machines. Through video technology and automatic data collection, the situation at the work site is transmitted in real-time to the worker's workbench.

2.2. Application advantages of artificial intelligence technology in mechanical design, manufacturing, and automation.

2.2.1. Improving stability and reliability. In the past mechanical design and manufacturing, once mechanical equipment malfunctions, maintenance personnel must quickly go to the production site and rely on their professional skills and maintenance experience to repair the equipment. Staff need to spend a certain amount of time obtaining fault information. In such a situation, not only will the workload of maintenance personnel be large, but it will also seriously affect production efficiency and quality, and even cannot guarantee that the equipment can continue to operate safely after maintenance. After the application of artificial intelligence technology, once an accident occurs on the production site, monitoring and fault detection can be carried out as soon as possible, which is beneficial for maintenance personnel to quickly handle the problem. With the support of artificial intelligence technology, the internal programs of mechanical equipment can be regularly scanned and repaired on their own in case of problems, improving the safety and reliability of the equipment [7]. In addition, self inspection and repair of the equipment can help extend its service life.

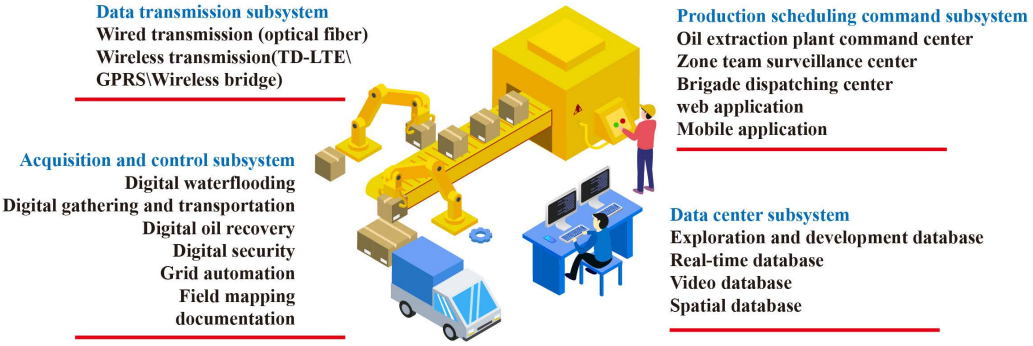

Fig. 2.1: Intelligent Remote Control Technology

2.2.2. Ensuring Quality and Improving Efficiency. After applying artificial intelligence technology, it is possible to continuously improve the production process and optimize various links in the mechanical design and production site, thereby saving production time. The application of artificial intelligence technology in mechanical design and manufacturing can fundamentally improve production efficiency and ensure production quality. The application of artificial intelligence technology in mechanical design and production by enterprises can appropriately reduce the number of employees on the frontline production site, thereby reducing production problems caused by human factors on the production site, and improving per capita output and production efficiency of the enterprise.

2.2.3. Easy maintenance and adjustment. Applying mechanical design, manufacturing, and automation can fully debug production data to meet the demands of different customer orders for mechanical design and production, ensuring the diversity of products produced by the enterprise. The application of artificial intelligence technology in mechanical design and manufacturing can achieve quality self inspection and online detection of mechanical equipment, timely discover problems in equipment operation, and develop the best solution to ensure product production quality [8,9]. Once there is a problem with the operation of the system, it can also be automatically stopped by the automation technology protection measures of artificial intelligence technology, avoiding the contact of production site workers with faulty equipment, ensuring the personal safety of workers, and ensuring the stable operation of the equipment.

2.2.4. Convenient operation. The application of artificial intelligence technology in mechanical design, production and manufacturing can achieve mass production, and the products produced have strong composite characteristics. Artificial intelligence technology can not only change the production mode of machine equipment, but also achieve automated adjustment of equipment programs, meet the production needs of different products and the application of different scenarios in enterprise production sites, promoting diversified development of enterprise production. In practical applications, artificial intelligence technology can automate the control and adjustment of production information, not only optimizing the operation process, but also operating equipment through program settings. Production personnel only need to activate the button to ensure the safe and smooth operation of the equipment.

3. Application Practice of Artificial Intelligence Technology in Mechanical Manufacturing and Automation.

3.1. Application in Mechanical Design. In today's rapidly developing modern society, there are significant differences between traditional design ideas and modern design ideas, and they exhibit significant differences on multiple levels. Especially in the field of modern mechanical design, this difference is particularly evident, involving design, manufacturing, and sales perspectives. Firstly, from a design perspective, traditional design patterns often focus on experience and manual skills, while modern design ideas tend to rely more on advanced technologies such as computer-aided design (CAD) and computer-aided engineering (CAE). Modern design emphasizes efficiency, accuracy, and sustainability. Through simulation and other technical means,

product performance can be more accurately predicted and design solutions can be optimized. Secondly, from a manufacturing perspective, traditional manufacturing methods may rely more on manual operations and traditional processes, while modern mechanical design places more emphasis on automated production and digital manufacturing. Advanced manufacturing technologies such as CNC machining, 3D printing, and intelligent manufacturing systems can improve production efficiency, reduce costs, and flexibly respond to changes in market demand [10]. Moreover, from the perspective of sales, traditional sales models may pay more attention to interpersonal relationships and traditional channels, while modern sales are more inclined to use digital platforms such as the Internet and social media for promotion and sales. Through big data analysis and intelligent marketing systems, we can more accurately grasp consumer needs, provide personalized products and services, and enhance competitiveness. Therefore, with the continuous pursuit of efficiency and innovation in modern society, traditional design ideas have gradually shown limitations in the field of mechanical engineering. In order to meet the needs of the market, it is necessary to fully combine the actual situation, reasonably apply artificial intelligence technology, and promote the development of mechanical engineering towards digitalization and intelligence. By introducing modern artificial intelligence technology, more development opportunities can be created to compensate for the shortcomings of traditional design and promote the healthy development of the industry [11].

3.2. Application in fault diagnosis. In mechanical design, manufacturing, and automation processes, complex tasks and a large amount of data processing are often involved. For example, in demonstration and modeling tasks, a large amount of professional calculations and derivations are required, and traditional manual calculations often have problems of large errors and long time consumption, which is not conducive to the efficient completion of tasks. Therefore, the rational use of artificial intelligence technology has become a necessary choice to achieve automatic data aggregation and accurate classification, ensure the accuracy of the final calculation results, and thus avoid failures in subsequent operations. Specifically, mechanical monitoring data can be transferred into the system through human-machine interfaces, and then intelligent algorithms such as inference machines can be used to provide guidance and guidance. The inference machine can analyze mechanical monitoring data and obtain preliminary diagnostic results based on preset rules and logical inference processes. Then, through the operation of the thinking mechanism, further inference and analysis are carried out on the preliminary diagnostic results, and accurate diagnostic conclusions are ultimately drawn. Meanwhile, with the help of case analysis techniques, historical cases and similar data can be compared to verify and strengthen the reliability of diagnostic results [12].

3.3. Application in Mechanical Manufacturing System Control. With the support of specific hardware devices, the interaction between the execution and identification programs of artificial intelligence nodes can achieve accurate control of feedback information, thereby ensuring the scientific nature of mechanical operation processes. This interaction enables different system software to work together more effectively, thereby achieving precise control goals throughout the entire mechanical manufacturing process. Specifically, indicators θ_1 and θ_2 can be set, which represent various parameters and requirements in the mechanical manufacturing process, such as production efficiency, quality standards, etc. At the same time, the final accuracy indicators for mechanical component manufacturing can also be set it represents the accuracy and quality level of the product. Through artificial intelligence technology, the final ideal values of these indicators can be calculated, as well as the corresponding final accuracy indicators for mechanical component manufacturing idealized calculation results [13,14]. Tables 3.1 and 3.2 can display the specific values of these indicators and calculation results, further demonstrating the specific effects of artificial intelligence technology in mechanical manufacturing.

According to the analysis of Table 3.1 and Table 3.2, it can be observed that the mean corresponding to indicator θ_1 is relatively low, while the mean level corresponding to indicator θ_2 is relatively high. In this case, it will lead to fluctuations in the physical values of θ_1 and θ_2 . This fluctuation may be due to various factors in the production process, such as changes in material quality and process parameters. Figures 3.1, 3.2, and 3.3 show the changing trends of θ_1 and θ_2 over time, as well as the related mechanical component manufacturing accuracy indicators μ fluctuation situation of. Due to numerical fluctuations in θ_1 and θ_2, the manufacturing accuracy of mechanical components is affected μ there will also be corresponding fluctuations. This fluctuation may have an impact on product quality and production efficiency, therefore corresponding measures need to be taken to stabilize the production process and reduce the impact of fluctuations [15].

Table 3.1: Ideal Values for Manufacturing Accuracy Indicators of Mechanical Components

Experimental period /min	θ_1 Value	θ_2 Value	μ Calculation result/%
10	0.50	0.64	43.4
20	0.43	0.64	3.0
30	0.45	0.64	3.1
40	0.53	0.72	4.2
50	0.50	0.72	4.0
60	0.50	0.72	4.0
70	0.50	0.68	3.6
80	0.57	0.64	4.0
90	0.45	0.72	3.5

Table 3.2: Experimental values of manufacturing accuracy indicators for mechanical components

Experimental period /min	μ Calculation result/%	
	experimental group	control group
10	4.1	1.3
20	4.5	2.0
30	4.7	1.6
40	5.7	1.5
50	3.3	1.0
60	5.0	1.5
70	5.0	1.7
80	4.3	1.1
90	4.2	1.4

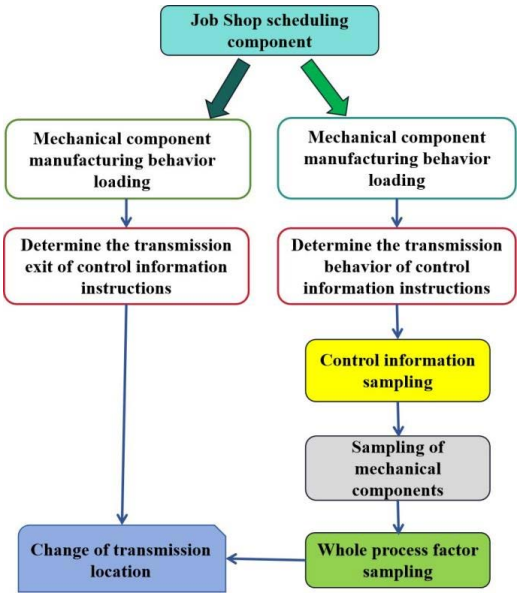

Fig. 3.1: Behavior pattern of Job Shop scheduling control host

By using artificial intelligence technology for intervention, indicators can be effectively improved θ_1 and θ_2 corresponding numerical results. Artificial intelligence technology can analyze a large amount of data and

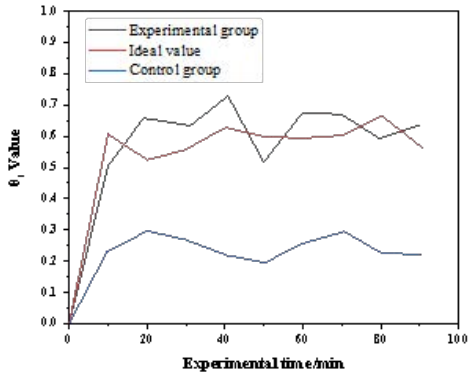

Fig. 3.2: θ_1 experimental values of indicators

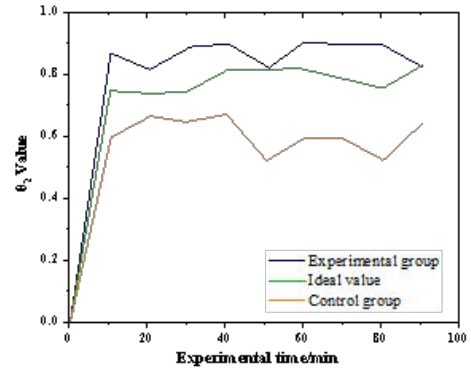

Fig. 3.3: θ_2 experimental values of indicators

make intelligent predictions and decisions based on previous experience and regularity, thereby optimizing various parameters and control strategies in the production process. With the intervention of artificial intelligence technology, intelligent adjustment and optimization of various factors in the production process can be achieved, thereby improving the indicators θ_1 and θ_2 corresponding numerical results are at a relatively high level [16,17]. This optimization can promote the final accuracy of mechanical component manufacturing, improve the quality level and production efficiency of products. Meanwhile, with the intervention of artificial intelligence technology, indicators μ numerical results of the calculation will also continue to increase. This is because artificial intelligence technology can achieve precise control and optimized management of the production process, effectively reducing errors and fluctuations in the production process, thereby improving the accuracy indicators of mechanical component manufacturing μ calculation result of. Therefore, using artificial intelligence technology for intervention can elevate various indicators in the mechanical manufacturing process, thereby improving product quality and production efficiency. This proves that with the intervention of artificial intelligence technology, the control accuracy has been improved more accurately [18].

3.4. Application in Fault Diagnosis. Mechanical design, manufacturing, and automation processes are indeed very complex and require processing a large amount of data. In this process, the modeling and argumentation stages require a large amount of calculations and derivations, using many complex formulas. If

these calculations are completely dependent on manual processing, errors are prone to occur and it will consume a lot of time and effort, which may directly affect the efficiency and quality of the entire production process. Therefore, it is necessary to actively introduce artificial intelligence technology. Through artificial intelligence technology, information can be automatically classified and summarized, improving computational accuracy and reducing the likelihood of errors and failures in subsequent stages. Meanwhile, artificial intelligence can also be used to effectively evaluate and diagnose mechanical faults. This process can be completed through the following steps:

1. The mechanical monitoring data information is transmitted to the system through the human-machine interface.
2. The inference machine is based on a forward inference mechanism and pre-set rules to obtain diagnostic results and provide expert opinions.
3. Based on the search results of similar historical cases, calculate and analyze their similarity with the current situation to support the accuracy and effectiveness of mechanical fault diagnosis.

This method combines the powerful computing and reasoning capabilities of artificial intelligence, as well as the empirical knowledge of historical cases, to improve the efficiency and accuracy of mechanical fault diagnosis, thereby ensuring the smooth progress of the production process [19,20].

4. Conclusion. With the development of the times and social progress, the productivity of modern society has been greatly improved, mainly due to the promotion of various new production technologies. Among them, artificial intelligence technology, as a key technology with multiple advantages such as data processing and transmission, plays a very important role in the field of mechanical design, manufacturing, and automation. Nowadays, artificial intelligence technology is closely integrated with mechanical manufacturing and automation technology, promoting each other. The introduction of artificial intelligence technology has made mechanical manufacturing and automation processes more intelligent and efficient. Through artificial intelligence technology, rapid analysis and processing of large amounts of data can be achieved, thereby optimizing production processes, improving production efficiency, reducing costs, and making the production process more flexible and controllable. Artificial intelligence technology has a wide range of applications in various fields, such as in the manufacturing industry, which can be used to achieve intelligent manufacturing, intelligent warehousing, etc. In the field of transportation, artificial intelligence technology can be used to achieve intelligent traffic control, unmanned driving, and so on. These applications not only inject development momentum into different industries, but also provide good auxiliary effects for many industries, helping enterprises improve competitiveness and adapt to changes in market demand.

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