Mechanical Automation Design and Manufacturing Based on Artificial Intelligence Technology

Tianrong Han¹*, Yeqin Xu¹

¹Nanchang Institute of Technology, Nanchang 330044, Jiangxi, China

*Corresponding author E-mail: hantr241@nit.edu.cn

Abstract. The development of mechanical design and manufacturing and automation engineering is not only an effective support to realize the goal of China's industrial power and improve the gross national product, but also can improve the people's living standards and provide the production basis for the current social development. The development of artificial intelligence can promote the degree of mechanical automation. In order to better distinguish the influence of artificial intelligence technology on mechanical design and manufacturing, we selected 30 students from mechanical college and equally divided them into two groups. Group A students used traditional mechanical design and manufacturing method to carry out experiments, while group B used artificial intelligence on this basis be able to design and manufacture machinery. With the development of experiment time and progress, we found that there was a big difference between the two groups of students. The experimental results show that when the mechanical manufacturing reaches 30%, the waste rate of group A is 0.4%, and the waste rate of group B is 0.2%, saving 0.2%. When the manufacturing progress reaches 50% and 70%, the waste of resources in group B is 0.3% less than that in group A and 1% in group A and 1% in group B, saving 0.5%. Thus, the use of artificial intelligence technology can not only improve the manufacturing efficiency of mechanical manufacturers, but also reduce the waste of resources, which has a profound impact on the rapid development of mechanical design and manufacturing.

Keywords: Artificial Intelligence Technology, Mechanical Manufacturing, Degree of Automation, Resource Waste

1. Introduction
Humans integrate their ideas and creativity through design[1-2]. Especially in the process of modern engineering, computer technology not only involves the design, development, construction and other processes, but also involves all levels of marketing, after-sales and after-sales service. It seems that the traditional planning methods in the past can not meet the needs of modern society[3-4]. Therefore, in order to solve this problem, artificial intelligence system has gradually attracted the attention of
engineering circles. All kinds of artificial intelligence technology make the difference tendency of mechanical design method, and also can minimize the short board which may be caused by the personal restriction of human experts in the design process[5-6].

The introduction of artificial intelligence system in mechanical engineering can effectively increase production capacity and further improve product quality[7-8]. Due to the application of artificial intelligence, automatic control and automatic processing can be realized in the process of mechanical engineering. Therefore, the artificial intelligence system can accurately control the mechanical process, reduce the interference to the external environment, and improve the production efficiency and work quality. In addition to the precise control of the whole production process, artificial intelligence can also automatically analyze and adapt to the different needs of people's products. The times and society require to improve its mechanical design, construction and automation technology, and the key to improve the technical level is to explore the technical core of mechanical design and its construction and automation. Only when people pay enough attention to basic technology, its mechanical design, construction and automation technology will not be stopped and eliminated as time goes by like traditional mechanical engineering[9-10].

In this paper, the control experiment method is used to study the mechanical automation design and manufacturing under artificial intelligence. We divide 30 students into two groups. One group uses traditional methods for mechanical manufacturing, and the other group uses artificial intelligence technology for experiment. Except for the different methods used in the experiment, other data are completely the same, including the experimental time, experimental resources and experimental ring Environment, etc. The experimental results show that the application of artificial intelligence technology in mechanical automation design and manufacturing can effectively improve the manufacturing efficiency and reduce the waste rate of resources.

2. Artificial Intelligence Technology and Mechanical Automation

2.1 Artificial Intelligence Technology

The development of artificial intelligence technology has different stages. From the early stage of development, due to the Internet technology has not yet developed, industrial enterprises must also use manual production to develop. In the middle, the Internet has been very popular, but due to the low level of technology, artificial intelligence is only used in a few fields, the application effect is not optimistic. Finally, in the mature stage of development, the level of electronic information technology in China is constantly improving, and artificial intelligence technology has been applied in various fields.

The theory of artificial neural network is a typical mathematical model of algorithm, and its function is supported by artificial neural network. Artificial neuron is mainly responsible for activating the neural network simulating human brain. Its purpose is to use this network to process a series of information, so as to store data effectively. This article uses destination spacing points to create tracking functions. Let the position vector of the target trajectory at k time be SK, and the position vector difference between K + 1 time and K time, that is, the displacement vector of adjacent time is:

$$\vec{S}_K = S_{K+1} - S_{K}$$

It can be found that there are differences in the SK mode and direction variation law of different models, so the feature vector of trajectory can be generated by using Sk. Assuming that the length of the trajectory segment, i.e. the number of position points, is m, i = 1,2,..., M-1, then the eigenvector of the module is:

$$F_s = [f_{s_1}, f_{s_2}, \cdots f_{s_{m-1}} ]$$
Let $i = 1, 2, ..., m-2$, $\theta K$ be the direction angle of $SK$, then we can get the characteristic vector of the displacement vector direction change.

2.2 Mechanical Automation

Mechanical automation is a relatively broad concept. It is mainly composed of many elements in all mechanical systems, and is aware of the actions that all systems will complete. As a result, the purpose of mechanical systems is to effectively replace manual functions. Mechanical automation has been widely used in product design, production management and process implementation. It can not only obtain more benefits, but also provide convenience for machinery production and construction, relieve the pressure of employees and promote the development of machinery industry. However, in this operation process, there are still many problems in the mechanical automation system, mainly in the fault, seriously affecting the normal operation of the system. The application of artificial intelligence in mechanical automation can detect system error timely and accurately, and the automation system can run normally with the use of machine.

(1) The significance of mechanical automation

The level of machine automation represents the level of machine manufacturing capacity of a country. As an advanced technology, the application of automation technology in mechanical engineering industry can not only effectively improve the company's production efficiency, but also improve the company's efficiency and mechanical engineering quality. Compared with manual operation, automation technology is safer and more efficient. Therefore, in order to promote the development of China's mechanical engineering industry, it is necessary to apply automation technology.

(2) The role of mechanical automation

Firstly, automation technology has the function of automatic information processing and automatic control in the application process. Sensors integrated into the mechanical system ensure that industrial machines strictly apply production forecasts based on high accuracy. At the same time, in the automatic production of the machine, the production process of the machine will not be affected by the subjective factors of the machine operator.

Secondly, in the industrial production, the monitoring, automatic alarm, protection, diagnosis and other corresponding functions of mechanical automation technology are applied to realize unmanned operation.

Finally, in China's industrial production, technical personnel in the installation and commissioning of mechanical automation products, according to the specific needs of the industrial production process and the changes in the field production environment, they can immediately change the mechanical automation control program to control the automatic operation in mechanical production.

3. Research Methods and Design

3.1 Experimental Personnel and Experimental Methods

(1) Experimenter

We ranked the third year undergraduate students of Mechanical College of our city according to their usual performance and experimental experience, and selected 30 students with similar comprehensive scores, and divided them into two groups on average. Among them, 15 students in group a used
traditional methods for mechanical design and manufacturing, and 15 students in group B used artificial intelligence technology for mechanical design and manufacturing.

(2) Experimental methods
In this paper, two groups of students in the same time and the same environment require labs1000 test box to complete the design and debugging of the temperature control system of an industrial incubator model. After the end of the experiment, the manufacturing speed, resource utilization and waste of the two groups of students are compared.

3.2 Experimental Requirements

(1) System hardware requirements
According to the system principle, the corresponding hardware system is designed with PC based adam5510m intelligent module as CPU and the matching I / O interface module, accessories and PC.

(2) Control function requirements of incubator
Through the real-time measurement of the temperature in the box and the control of the cement resistance heater and fan, the temperature in the box is kept in the appropriate range.

When the temperature exceeds the control range of 32 ℃ - 35 ℃, the corresponding alarm lamp will be on. Thermocouple is used to measure the temperature in the box in real time. The temperature is heated by the cement resistance, and the temperature in the box is reduced by the operation of the fan. The real-time temperature information, cement resistance and fan running status and other information in the box shall be displayed on the screen in real time. The time period of temperature measurement is no more than 1.5 s.

4. Analysis and Discussion of Research Results
Virtualization is an important feature of network technology. The practical application of network technology in mechanical design, construction and automation can lead to product design and production process. For example, in the design of mechanical equipment, the current mechanical engineering technology, manufacturing and automation mainly use two-dimensional and three-dimensional CAD technology. The application of high-tech simulation technology, to a large extent, can control the control equipment after the early design conversion connection and engineering scheme modification, and can control the production cost of the company and improve the work efficiency. In addition, the implementation of network technology can also carry out virtual monitoring of product production and personnel management. The so-called virtual monitoring is actually remote monitoring, because network information technology can carry out comprehensive and comprehensive remote monitoring and monitoring system for the mechanical manufacturing process through the corresponding network information technology, without the need for supervisors to continue to patrol and monitor in the laboratory, which helps to reduce the labor cost of enterprises.

In this paper, the artificial intelligence technology is applied to the mechanical automation design and manufacturing of artificial intelligence technology, and its application effect is explored.

4.1 Manufacturing Speed Analysis
The traditional mechanical design and construction can not meet the actual needs to a certain extent. Therefore, the level of mechanical automation in China will be improved again in the future. From a technical point of view, mechanical automation not only includes mechanical and electronic technology, but also effectively integrates other advanced industries. With the continuous development of information technology, artificial intelligence and other advanced technologies, mechanical automation will gradually improve the technical structure, product structure and production management methods, and gradually improve the level of mechanical automation. In this experiment,
the mechanical manufacturing speed of group A and group B is shown in Figure 1 and Table 1.

Table 1. Comparison of manufacturing speed between the 2 groups

|       | First day | The forth day | The seventh day | Tenth day | Fifteenth day | Twentieth day |
|-------|-----------|---------------|-----------------|-----------|---------------|---------------|
| A     | 3%        | 10%           | 26%             | 55%       | 78%           | 100%          |
| B     | 3%        | 14%           | 37%             | 69%       | 100%          | 100%          |

Figure 1. Machine manufacturing speed of two groups of students A and B

From the data trend change and comparison in Table 1 and Figure 1, it is obvious that the application of artificial intelligence technology in mechanical manufacturing can greatly improve the speed of mechanical manufacturing. Among them, on the first day of the experiment, the mechanical manufacturing progress of the two groups was exactly the same, which was 3%. However, from the fourth day, the progress of the two groups began to differ. At this time, the progress of group A was 10%, and that of group B was 14%. On the seventh day of the experiment, the progress of group A was 26% and that of group B was 37%. By the tenth day, the progress of group A was 55%, and that of group B was 69%, which was 14% higher than that of group A. On the 15th day, group B had finished all the work, group A had 78% progress, and group A had finished all the work on the 20th day. Therefore, we can know that the use of artificial intelligence technology, in this experiment, can save mechanical manufacturers about five days of time.

4.2 Analysis of Resource Waste Degree

In order to realize China's dream of becoming a big country of production and production, mechanical design and construction engineering and its automation technology play an important role. In our country, automatic mechanical equipment has penetrated into all aspects of human life, and is an important basis for the development of current industrial production. On the one hand, the application and development of mechanical design and construction and its automation technology have greatly improved the efficiency of China's social production, and provided a solid foundation for China's economic and technological development. On the other hand, it is not conducive to China's energy saving construction and the implementation of energy saving technology. Therefore, we compare the degree of resource waste between the two groups, and the results are shown in Table 2 and Figure 2.
Table 2. comparison of waste degree of resources by two groups of students with the change of manufacturing progress

| Speed of progress | 30%   | 50%   | 100%  |
|-------------------|-------|-------|-------|
| A                 | 0.40% | 0.90% | 1.50% |
| B                 | 0.20% | 0.60% | 1%    |

Figure 2. Comparison of resource waste between the two groups

It can be seen from the data analysis in Table 2 and Figure 2 that, we can see that when the machinery manufacturing reaches 30%, the resource waste rate of group A is 0.4%, and the resource waste rate of group B is 0.2%, saving 0.2%. When the manufacturing progress reaches 50% and 70%, the waste of resources in group B is 0.3% less than that of group A, 0.9% and 1.1% in group A and 0.6% and 0.9% in group B respectively. At the end of the experiment, 1.5% of group A and 1.5% of group B were saved. Therefore, the use of artificial intelligence technology has a great help for resource saving.

5. Conclusions

From the global development trend, mechanical automation in most countries, including China, is still in automatic operation. To a certain extent, the industrial structure of our country is relatively low, and there is a certain gap in quantity. The quality and overall use of automation products are compared with those of developed countries. From the perspective of China's manufacturing machinery industry, most companies have limited capital investment in automation production equipment, or the automation level of automation equipment must be further improved. However, under the general trend, China's machinery industry will have greater development space in terms of automation, informatization and informatization. In this paper, 30 students are selected from the Mechanical College of our city, and they are divided into two groups for experimental comparison. One group uses traditional methods for experiment, and the other group uses artificial intelligence technology for experiment. The results show that artificial intelligence technology can further improve the speed of mechanical manufacturing and save the resources of mechanical manufacturing. On the other hand, mechanical design, construction and automation also provide a platform and opportunity for artificial intelligence technology, which promotes and develops each other.

References
[1] Hutson M. Artificial intelligence faces reproducibility crisis[J]. ence, 2018, 359(6377):725-726.
[2] Liu R, Yang B, Zio E, et al. Artificial intelligence for fault diagnosis of rotating machinery: A review[J]. Mechanical Systems & Signal Processing, 2018, 108(AUG.):33-47.
[3] Uestuenkaya T. Artificial Intelligence: Friend or Foe to Fashion in Consideration of the Functionality Doctrine?[J]. European intellectual property review, 2020, 42(1):13-18.
[4] Rahman A, Pasaribu E, Nugraha Y, et al. Industry 4.0 and Society 5.0 through Lens of Condition Based Maintenance (CBM) and Machine Learning of Artificial Intelligence (MLAI)[J]. IOP Conference Series: Materials ence and Engineering, 2020, 852(1):012022 (6pp).
[5] Kumar M J. National Centre on Artificial Intelligence: India on the Move[J]. IETE Technical Review, 2019, 36(2):107-108.
[6] Miao Z. Investigation on human rights ethics in artificial intelligence researches with library literature analysis method[J]. The Electronic Library, 2019, 37(5):914-926.
[7] Jing L, Ruyu X, Anling S. Analysis on Research Frontiers and Hotspots of "Artificial Intelligence Plus Education" in China --Visualization Research Based on Citespace V[J]. IOP Conference Series: Materials ence and Engineering, 2019, 569(5):052073 (4pp).
[8] Upadhyay A K, Khandelwal K. Artificial intelligence-based training learning from application[J]. Development & Learning in Organizations, 2019, 33(2):20-23.
[9] Ranjitha M, Nathan K, Joseph L. Artificial Intelligence Algorithms and Techniques in the computation of Player-Adaptive Games[J]. Journal of Physics: Conference Series, 2020, 1427(1):012006 (11pp).
[10] Lakshman S A, Ebenezer D. Application of principles of a Artificial Intelligence in Mechanical Engineering[J]. IOP Conference Series: Materials ence and Engineering, 2020, 912(3):032075 (7pp).