Application Status of Intelligent CAD in Mechanical Manufacturing

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Abstract. Machinery manufacturing takes up a very heavy proportion in the national economy, which is the core industry as well as the cornerstone of a country's national economy. Mechanical manufacturing has been slowed down because the manufacturing process is complex. With the development of social economy, and the advent of the era of science and technology, the production manufacturing technology level is increased sharply in order to promote the development of China's industrialization process, gradually in the mechanical manufacturing will be tedious manual production mode transformation to the intelligent technology development, the automation and intelligent technology applications, the application of intelligent CAD is one of them. The application of intelligent CAD technology in machinery manufacturing is conducive to improve the development level of machinery manufacturing industry and it is an important measure for the transformation of industrial production towards digitalization and modernization. This paper analyses the application status of intelligent CAD technology in mechanical manufacturing and discusses its future development trend Introduction.

1. Introduction

With the increasingly wide application of computer, people put forward higher and higher requirements for CAD system. Traditional CAD system can't have the ability of reasoning and decision-making as the design engineer, and it can't meet the requirements of design process automation. Therefore, the research on the theory and application of intelligent CAD came into the society [1].

Intelligent CAD (ICAD) system not only has the numerical calculation and graphics processing ability of traditional CAD system but also has the knowledge processing ability, which can provide intelligent computer support for the whole process of design. Mechanical design has also become intelligent due to the introduction of intelligent technologies such as intelligent CAD systems and expert systems. Intelligent CAD technology has been introduced in the mechanical manufacturing process, and a reasonable expert system has been used to continuously enlarge the intelligent CAD system to meet the requirements of product creative design concepts. Timely access to market demand and scientific and technological information, processing methods integrated into intelligent technology to improve production safety benefits, improve product quality and performance, closer to customer requirements. Therefore, under the impact of the rapid development of information technology, the artificial intelligence system in intelligent CAD can promote the rapid development of mechanical manufacturing industry, and the CAD could achieve particularly ideal economic benefits.
2. Research Status of Intelligent Cad Technology

2.1. Overview of Intelligent Cad Technology
Intelligent CAD technology is a new technology that developed rapidly in recent decades. This system contains two special systems of expert system and artificial neural network, as shown in Figure 1[2]. The Intelligent CAD system is to strengthen the application of artificial intelligence technology in all aspects of the design process, especially the combination of expert system technology, artificial neural network image thinking technology based on logical thinking, to further improve the intelligence level of the system [3, 4].

The expert system is a computer program system that utilizes the knowledge research of human experts through comparing several experiences, and solves the problems generated in the production process with constantly updated domain knowledge. This expert system is different from the traditional computer operation process. The point is that the expert system adding artificial intelligence during the operation process and proposing different solutions according to different problems generated during the work process, and reminding the designer about how to proceed according to the change of the work.

Another important system in intelligent CAD is the artificial neural network, which contains a large number of artificial neurons in the artificial neural network, which can provide more flexible adjustment variables for mechanical manufacturing, and has holographic memory capabilities, including computer self-organization ability. Moreover, compared with the expert system, the artificial neural network has much better adaptability and fault tolerance, and also has certain self-organization ability.

![Intelligent CAD system structure](image.png)

**Figure 1. Intelligent CAD system structure**

2.2. Research Status of Intelligent Cad Technology at Home and Abroad
The intelligent work of CAD began in the mid-1970s. The earliest international research unit of intelligent CAD is CMU (Carnegie Mellon University) in the United States. The famous AI scholar HASimom and CAD scholar Eastman led a group of doctoral students in the mid-1970s to study the residential space synthesis and achieved initial results. Since then, spatial integration has been a classic problem in the field of intelligent CAD, which has been studied by researchers in various countries till now. Researchers from the University of Sydney, the University of Edinburgh in the UK and the University of Tokyo in Japan have made great achievements in the field of intelligent CAD.

In China, the institute of computing, Chinese Academy of sciences, Tsinghua university, Tongji university, Shanghai Jiaotong university, the national university of defense technology, zhejiang university and other institutions in the field of intelligent CAD has made a lot of outstanding research work. As early as 1982, the institute of artificial intelligence of Zhejiang university successfully
developed an intelligent CAD practical system "intelligent simulated color plane pattern creation system", and then carried out the research on the intelligent CAD system and theory of architecture, carpet and other fields. [5]

After entering the 21st century, with the growing maturity of intelligent CAD technology, commercial intelligent CAD technology companies have emerged. For example, Shanghai Heying Electromechanical Technology Co., LTD. has introduced intelligent CAD systems suitable for industries such as clothing, automobile, aviation, luggage, shoes and hats, and furniture. In 2013, Guangzhou Weizhao Information Technology Co., LTD. developed CAD software suitable for mobile phones.

### 2.3. Development Trend of Intelligent Cad

The intelligent CAD system has been widely used in various fields, but with the Integrated Circuit of the nano, of complicated mechanical structure model, etc., require the development of intelligent CAD itself continuously, can be found through research, the trend of the development of intelligent CAD for the following four aspects: Integrated, Internet, Interactive and Standard. [5, 6]

#### 2.3.1. Integrated

In the early days when CAD system was put forward, CAD and its derivative computer-aided manufacturing (CAM), computer-aided process design (CAPP), computer-aided engineering (CAE), computer integrated manufacturing system (CIMS) and virtual manufacturing (VM) were all independently applied. Although there is many software that bring together these systems, they can be called to some extent. But this simple combination of several systems cannot be called integration. The integration of meaning should include the integration of functions between different systems, the integration of information, the integration of processes and the integration of dynamic alliance enterprises. If these systems are integrated together, different intelligent systems can complement each other.

#### 2.3.2. Internet

With the development of the Internet, various technologies and systems have a networked development trend. After networking, various systems work together. For example, after intelligent CAD is networked, the knowledge base between different intelligent CAD systems and the database can be shared, and the intelligence of CAD will be improved to a new level. If after the network intelligent CAD of connection, multiple mechanical structural model designers can collaborate to design, so the shortcomings of designers can be complemented under this situation. In addition to intelligent CAD for collaborative design, you can also use network to build a corporate alliance, and the response to the market through the demand relationship on the Internet can be more rapid.

#### 2.3.3. Interactive

Because the intelligent CAD system is oriented to the object is human, so the human-computer interaction is also a trend of the development of intelligent CAD in the future. In the current intelligent CAD system, human-computer interaction is also carried out with a simple mouse and keyboard input, display and printer output, such a single form of human-computer interaction, low efficiency. Consequently, If the human-computer interaction become more friendly, efficient and diversified, the intelligent CAD will also be increased accordingly. Some users without CAD professional knowledge, also can carry on some simple design, the designer and professional model to use, will be more simple and convenient.

#### 2.3.4. Standard

At present, there are many companies in developing CAD software. The most widely used is AutoCAD software developed by Autodesk in the United States. In the field of intelligent CAD software, most of them are highly targeted software, such as clothing and specific mechanical component models. Furthermore, there is no clear international standard between these different types of intelligent CAD software. So, the non-uniformity of drawing standards has become an important issue and we have to figure out some useful approaches to meet the needs of the future development of intelligent CAD. Therefore, the establishment of international CAD drawing standards has become an urgent need for the development of intelligent CAD.
3. Application of Intelligent Cad Technology in Machinery Manufacturing Industry

The model of the internal components in the process of mechanical manufacturing contains various information of different parts. First, the model can help strengthen the connection between various parts and components and play a better role in the process of interaction. Also, the internal information of the model can be integrated during the operation of the intelligent CAD, and then the information is stored in the internal engineering data of the computer software. In the process of mechanical manufacturing, the designer can utilize the intelligent CAD to obtain the accurate model parameters and operate in several different models. In the end, the technology can choose the best one that meets the standard mechanical components of the model to ensure that meet the requirements for producing the parts. [10, 11]

3.1. IBM DB2 System

In mechanical engineering, the application of intelligent CAD technology can be established quickly in order to help technicians master the interaction of information between mechanical parts, and through a reasonable set of parameters to optimize the design of mechanical parts to achieve the optimal design goals of mechanical products. At present, in the process of establishing the mechanical design of the model, most people will choose entry model parameters IBM DB2 system that uses data classification technology and accommodate the large amount of data with a variety of data processing procedures to ensure comprehensive data and authenticity.

IBM DB2 system can achieve parametric model of parts and ensure the accuracy of the models’ characteristic parameters. Moreover, designers can import the design parameter in the surface of the software and use the software that called the SolidWork to make some judgements for these components in order to obtain the best design for the mechanism. The effective application called IBM DB2 systems in the mechanical manufacturing industry have effectively improved the actual utilization efficiency of system data and promoted the high integrity of mechanical data. Then, these applications laid a solid foundation for the stability of mechanical manufacturing procedures in various mechanical manufacturing. In fact, these systems have a huge impact on today’s society.

3.2. BR Technology

The BR technology that uses the real examples to make some analyze is a core technology applied to the intelligent CAD technology system in mechanical manufacturing. It can store the relevant parameters and instance models of the mechanical design model. Thus, it directly establishes a database to store the model design parameters. In the process of mechanical manufacturing, due to the variety and different type of models, the data has the characteristics of diversity and complexity, and it is difficult to achieve effective integration and rational utilization. With the support of SolidWorks software, the BR technology can directly build their databases through the existing model and update the model parameters in the design process. Furthermore, the BR technology can promote the preparation of parts models in the system, and has high recycle value, and promotes the optimal allocation of resources.

3.3. Virtual Reality Technology

Virtual reality technology has been used in intelligent CAD technology. In the process of mechanical design and manufacturing, designers can use virtual reality technology in the virtual world to create new products. They can check the authenticity of simulated objects from multiple perspectives, and find problems involved in structural design early. Virtual technology is also an important sign of the application of intelligent CAD technology in mechanical manufacturing. It can virtually simulate the testing, simulation and processing of models and other technical means, timely find problems, and effectively reduce production costs.

4. Conclusion

With the in-depth development of the CAD system, users have put forward higher requirements for the intellectualization of the system, and the application of intelligent CAD system design will be an inevitable trend of technical development. The application of artificial intelligence technology in the
CAD system in the field of mechanical manufacturing can help designers establish three-dimensional mechanical models and carry out a simulation of the mechanical operation state, therefore, these softwares can optimize design parameters and optimize the mechanical structure and achieve the purpose of improving mechanical product performance.

In general, the application of intelligent CAD technology in mechanical manufacturing makes mechanical production step into an intelligent and automatic control field, which greatly promotes the development and progress of mechanical manufacturing industry. With the development of network technology, concept design and work together with technical team, the use of intelligent CAD technology for mechanical design and manufacturing can be realized in the true sense of the digital design and manufacture. Intelligent CAD technology has in-depth to all aspects of mechanical manufacturing, will become a development trend of machinery and equipment manufacturing.

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