Development and Realization of Computer Three-dimensional Aided Design System for Industrial Design

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Abstract. With the continuous development of computer technology and industrial design technology, the traditional manual drawing design method has seriously affected the effect of industrial design. The research on computer-aided industrial design system has gradually attracted the attention of experts and scholars. This paper expounds the application characteristics of computer-aided industrial design technology from CAD industrial design technology in detail, and finally designs the computer-aided industrial design system according to the more mature hierarchy method and structure method, and conducts detailed analysis and comparison of specific components.

Keywords: Computer Aided Design, Industrial Design, CAD Industrial Design System

1. Introduction

With the rapid development of computing technology, my country's economic structure has undergone significant changes. The trend of economic integration has become increasingly obvious, the market competition has become increasingly fierce, and the means of people's industrial design have been continuously improved [1-3]. Especially with the development of computer-aided three-dimensional modeling technology, people need to use computer virtual imitation technology to perform 360-degree three-dimensional observation and motion simulation on the internal structure and mechanical motion state of new products, in order to be able to perform the product before it is put into actual production. Observe and solve the problems that may arise in the design in advance, thereby greatly shortening the development cycle and reducing the cost of research and development [4-5].

Industrial products have also changed from traditional manual assembly methods to mechatronics methods, and consumers' buying concepts have also changed, not only limited to the quality of the products, but also focusing on the shape, environmental protection and innovation of the products [6-7]. "Industry" emphasizes that products should have reasonable structural functions and be capable of mechanized mass production. "Design" indicates that products must meet their functional needs while also being combined with humanized and creative artistic creation activities [8-10].

Relying on computer technology, this research builds a three-dimensional computer-aided design system for industrial design, aiming to explore and solve problems in industrial design.
2. Industrial design requirements for 3D auxiliary software

2.1. Powerful modeling function
The ability to efficiently and quickly complete various forms of three-dimensional digital modeling is the most basic requirement of industrial design for three-dimensional computer-aided software. The realization of this requirement requires the design software to provide designers with a concise and clear graphical interface, efficient and comprehensive modeling methods and intelligent design information prompts. After the designer completes the modeling, he can also observe the appearance of the product through the computer screen in all directions, so that the research and development of new products can truly achieve what you see is what you get.

2.2. Rich extended functions
Modern industrial design is no longer simply designing the appearance of the product, but going deep into the internal structure of the product. This requires 3D auxiliary software to provide design modules such as material properties, part assembly, and engineering drawing output while providing product appearance modeling functions.

For example, digital assembly refers to the function of pre-assembly in the design software after all the parts have been modeled, rebuilding each part into a whole product. The provision of digital assembly functions can enable designers to understand the structure, process and technical indicators of each part of the product, and solve the problems that could only be discovered after the product is actually put into production in the virtual three-dimensional design stage. Effectively reduce design risks.

The ability to provide photo-level rendering effects is also one of the requirements of industrial design for computer three-dimensional auxiliary software. Through the rendering of the three-dimensional model, the manufacturer can know the true appearance of the new product in advance, especially the color, material, shape and other aspects of the product have a more intuitive understanding.

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2.3. Easy to learn and use
How to enable students to quickly and conveniently understand various modeling methods and design by inferences on the basis of theoretical skills learning is also a problem that needs to be considered when choosing 3D computer aided software for teaching. This requires the software interface to be concise and clear, and to provide intuitive and clear prompts to beginners, so that students can find and solve the problems in the design under the prompts of the software.

3. System design and application of computer-aided industrial design

3.1. The overall framework of the computer-aided industrial design system
The specific overall framework of computer-aided industrial design is shown in Figure 1 below.
Figure 1. Overall framework of computer-aided industrial design

The focus of its research is not only to explore the internal connections of disciplines such as computer engineering, aesthetics, and sociology, but also to explore new knowledge generated by the mutual influence of interdisciplinary.

The computer application layer provides the corresponding technical support for the computer-aided industrial design system, which mainly includes two parts: design foundation and design method. The basic design module mainly includes a product information model and a unified product information interaction platform. The product information model collects various information related to the product, such as collecting product connotation information, product design information, user demand information, model information, and for related management information, the module will identify each organization information in a framework, and will use the scalability and inheritability of the framework to describe the design process in detail. A unified product information interaction platform will communicate and balance the internal connections between various information. Under the premise of increasing product information, the efficiency and accuracy of information interaction must also be ensured. This research analyzes and finds ideal solutions for information interaction based on ontology theory, integrates and encapsulates information according to the principles of information interaction, and interacts in the form of information components or information types, thereby improving the efficiency of information interaction. The design method layer mainly includes the design methods related to product information. It needs to be emphasized that, unlike the knowledge base layer of mechanical computer-aided industrial design, even the same name may represent different design methods. Of course, the final design effect may also be completely different.

The user demand design mainly solves how To integrate users into the circular design, we must also consider the establishment of the user's use model and the specificity and targeting of the use requirements; the conceptual design will plan the visual initial design according to the use function, operating principle, shape, color, and internal structure of the product. Program. The problem that the design application layer urgently needs to solve is how to design the interface according to the user's demand design, detailed design and conceptual design.

3.2. Specific case analysis of computer-aided industrial design system

Using computer technology to carry out auxiliary management design, and thus establish a management platform based on technical communication, which is more conducive to stimulating the creativity of designers and improving work efficiency. Figure 2 shows the integrated management and decision support system, and Figure 3 shows the overall framework diagram of a design company's auxiliary design platform.

Figure 1: Overall framework of computer-aided industrial design

- Design application layer
  - Demand analysis
  - Concept Design
  - Detailed design
  - Redesign

- Computer application layer
  - Demand design
  - Innovative design
  - Virtual design
  - Smart design
  - basics of design
  - Product Information Model
  - Product information interaction platform

- Design methodology
  - Design methodology
  - basic knowledge
  - Design symbol
  - Design Psychology
  - Computer Graphics
  - AI
Figure 2. Integrated management and decision support system

Figure 3. The overall framework diagram of a design company's auxiliary design platform

The following will specifically introduce the functions of each module in the above figure:

1. Customer Consultation Center: The work functions of this center mainly include customer database, customer demand analysis and customer communication mechanism, and strive to provide customers with better system management services.

2. Design a collaborative operation center: as the core part of the entire management system, it is mainly responsible for the coordination function between various modules.

3. Resource Integration Center: This center mainly includes design supply chain management system, system resource management system, design data management system and human resource management system, etc., which provides a data foundation for the normal operation of the entire system.

4. Creative Integration Center: It mainly includes the establishment of the creative knowledge base, the induction and summary of the creative, the management and analysis of the creative, the comparison and inspection of the creative, etc. The center provides a strong core competitiveness for the entire design system.

5. Design project management system: The system's work functions are mainly divided into management and assignment of project work, listing and statistical project work, executive decision-making and assessment work, etc., so as to ensure the normal operation of the project work of the entire system.

4. Innovation of computer aided industrial design system

4.1. Support for conceptual design of industrial products
At this stage, the auxiliary support of computer-aided industrial design technology for innovative design is mainly focused on innovative design methods. For example, the more common reverse engineering design methods and genetic algorithms all rely on computer processing capabilities to
help solve the problems encountered in the design process. Issues such as test result analysis and massive data processing. Obviously, computer-aided industrial technology can make designers' innovative design schemes a reality. Specifically, the designer's innovative design will be expressed through two-dimensional or three-dimensional graphics, but the later modification and maintenance are not very convenient, and the auxiliary design system based on the design sketch design can help the designer get away from the repetitive manual drawing. Labor can express innovative design very conveniently.

4.2. The design expression of the transition from two-dimensional images to three-dimensional images is more effective

Computer-aided industrial design technology has developed from a single two-dimensional image processing method to a three-dimensional image processing method. For example, the current 3D printing technology is one of the representatives. Two-dimensional image processing technology is mainly used in the field of two-dimensional vision. Designers can use two-dimensional processing software to manufacture and design various images, posters and advertisements. It is precisely because of the relatively low cost that the application field of two-dimensional processing methods is very wide. The technical content of 3D image processing is higher. Although the design cost is relatively high, its visual impact is stronger and the degree of visualization is better.

For the editing of different types of 3D image databases, different collected data can be processed:

1) Numerical type

\[ \mu_a\left(C_i^{(l)}\right) = N(C_i)/n, l = 1, 2, 3, \ldots, i = 1, 2, 3, \ldots \]  \hspace{1cm} (1)

2) Class attributes

The membership function of the class attribute is shown in formula (2):

\[ \mu_a\left(C_i^{(l)}\right) = N(C_i)/n, l = 1, 2, 3, \ldots, i = 1, 2, 3, \ldots \]  \hspace{1cm} (2)

4.3. The design process is more interactive and intelligent

Modern industrial design has long been separated from the traditional manual design method, but it has put forward higher requirements for the design structure, aesthetic angle, interactive information and the integration of design resources. At present, computer-aided industrial design technology mainly uses the comparison and reasoning functions of knowledge bases and specialized systems to realize intelligent design systems based on genetic algorithms and fuzzy theory. This processing method is very suitable for the screening and optimization of fuzzy information in industrial design. deal with.

4.4. Designed products are more humane

Today's industrial products must not only meet the normal functional needs of users, but also meet the aesthetic needs of users, which requires designers to pay more attention to the appearance, material, overall structure, and color matching of the product. Designers can even use computer-aided industrial design technology to perform analogy, analysis, screening, and sorting of the above-mentioned elements in various aspects, so as to achieve the ideal product design plan.

5. Conclusion

Industrial design is a discipline that combines technology with art, science and aesthetics. By using three-dimensional auxiliary software, it is convenient for designers to express their creative thinking quickly and comprehensively. This article explores the design scheme of computer-aided industrial design system to improve the work efficiency and practical effect of industrial design.

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