

Discuss the Development of Computer-Aided Industrial Design Technology

Jun YAO¹

¹ First Author, Corresponding Author School of Arts and Design, China University of Mining and Technology
Xuzhou, Jiangsu 221116, China

Abstract

The direction of the development of the industrial design gradually approaches mechanical-electrical integration and informational and electronic products. With an increasing improvement of its technical content, and better social economic conditions, people's consumption concept are getting more and more different. Consumer concerns not just the functionality and quality of the product, more and more people are starting to focus on the appearance of the product, degree of innovation, environmental protection, and so on, which brings a higher degree of difficulty to the industrial technology. It is because the increasing demands of people and the industrial design, many scholars are increasingly concerned about the industrial design in recent years. With the continuous development of computer technology, a wide variety of hardware and software are developed, and a variety of ever-changing technologies are attracting the industrial design talents as well.

Keywords: *Computer-Aided Industrial Design, industrial design technology, CAID*

Computer-aided industrial design (Computer-Aided Industrial Design, CAID) software system is a software system provides automated support for the products of industrial design from the product form, color, decoration, man-machine environment during the product conceptual design stage. It is one of the effective tools to support product innovation design. In recent years, CAID technology has become one of the hot research spots of innovative design and computer-aided technology.

1. Introduction

With the development of information technology and computer network technology, the world economy is undergoing a profound revolution around the "network economy". This revolution has dramatically changed the face of the world economy and the manufacturing environment. The diversification and personalization of consumer's demand have led to the market dynamic variability; manufacturing enterprises are no longer

isolated individual resources, but a member of the social system. Facing the trend of increasing competition and product complexity, enterprises should enhance cooperation and participate in dynamic manufacturing system restructuring, in order to change the tactics of manufacturing companies, and establish a digitized, flexible and agile networked manufacturing mode.

2. Development of Computer-Aided Industrial Design Technology

Currently, the domestic and international CAID's research focuses on the application research of computer-aided modeling technology, human-computer interaction in CAID, smart technology, and emerging technology. And it also introduces the design module of some well-known CAD / CAM / CAPP commercial software industry.

2.1 Computer-Aided Modeling Technology

In the area of CAID technology, computer-aided modeling technology is mainly reflected in the shape of the free-form surface design and sketch design. In the free-form surface design, the product appearance freeform surface design study is an important content of the CAID. And the surface feature design is an important development in the design of free-form surfaces. The surface feature design includes three parts, namely basic surface, mobile features and collision graphics.

2.2 The High-Tech of CAID

Currently, the market began to slip from the emerging technologies in the high-tech of CAID, such as virtual reality, genetic algorithms and so on. But how to use these technologies well in CAID field, this would be carried out with some of the traditional technologies effectively, thereby to approach some CAID related research. The collaborative, parallel design is now one of the main development directions of this technology. As for the

industrial design, the sense of product design is very important, a detailed study of the product functions, principles, shape must be carried out. Many scholars observe on a variety of contents in some parallel environment in different angles of the technology and deep into it to understand and explore. But the starting point of other scholars is from the CSCW perspective, they have carried out a detailed analysis of the collaborative design and studied the use of this design, explored the model of engineering and industrial design work.

2.3 Intelligent Technology of CAID

Currently, the Intelligent CAD has witnessed a considerable degree of development. Integrated Intelligent Design System (I2CAD) provides an integral computer support to the design during the whole process. As it relates to the creative thinking as well as the frequent human-computer interaction, industrial design, in particular, needs auxiliary artificial intelligence technology. In the industrial design process of creative design thinking, the translation of the designer's conception fast into sketch is a fairly complex process behavior, and this process is known as the stage of concept function. Many scholars make researches on the stage of concept function from the designer's creative design thinking, design knowledge representation, and put forward their own views with a combination of sketch design. Design grammar, it is the formal description method by refining and abstracting the elements of shape, color, and shape of the object and its generation principle from the angle of design methodology. It is one of the foundations of intelligent design system. At present, the design grammar of the industrial design community scholars mainly includes the pose grammar, color grammar, shape grammar and modeling conversion grammar.

2.4 Key Technologies to Be Solved

(1) Research of modern design methodology. Based on the development direction of the modern industrial design, makes research on the qualitative design process and the design method with the similar accurate method to lay the theoretical foundation of CAID from the design object itself.

(2) Research of innovative design technology. Follow the principles and norms obeyed by the design process of research design thinking process and computer support; explore a wide range of innovative techniques, study innovative design principles, methods and techniques in-depth.

3. Influence of the Computer to Industrial Design

3.1 Influence of the Computer to The Concept And Method Of Industrial Design

Due to the development of computer software, the product has made a great progress in the design of the degrees of freedom. In the traditional design, the expression of hyperboloid and the free-form surface is very troublesome, and it often needs to produce a solid model to express clearly. It is also a difficult thing to change model again into engineering drawing. Therefore, in the design, the designer always avoids the use of free-form surfaces, which makes the design conservative. Today, with the use of computer to generate data model, all these difficulties are gone, and the relationship between design and manufacturing is closer. The use of computers makes us change the design criteria. Traditional design puts high demands on the effect of expression, it often takes that whether the drawing production is sophisticated, the line is light, and the color is uniform as an important criterion of evaluation. However, this criterion loses its meaning due to the computer-precise data and sophisticated output. Meanwhile, we put the evaluation criteria on the evaluation of the merits of the design. Moreover, the Computer-aided design has shortened the product development cycle. On one hand, it increases the efficiency of the work; on the other hand, it eliminates many steps of the traditional design performance. Especially on the program modifications and adjustments, it is very convenient to modify because the computer retains the whole process of design.

3.2 Product Modeling CAID

Traditional mechanical design and manufacturing is cumbersome and difficult to modify because of the use of artificial mapping, it generally only draws view. It is very difficult to draw a perspective view for complex models, designers can only base on its plan to imagine the finished model after the three-dimensional model, which is very difficult to design and production. However, computer-assisted cartography changes all these. For example, a common base, the computer maps out its three-view, the shaft side maps, and cross-sectional view only in 5 min, and computer automatically marks all sizes. when you want to change a size, all views are automatically amended accordingly axis the angle of the side of the map, cross-sectional view of the cutting position can be adjusted and can be displayed to direct three-dimensional effect. Simulating products work environment, rendering module, assigning different materials, designing products

appearance, drawing idea sketches and design effect diagram, mimic motion effects, analyzing movement interference, with this end, we can watch last made to improve efficiency and to avoid losses caused by ill-considered design at the design stage.

3.3 Conceptual Effect Drawing Stage of Modeling Design

In the early stages of the modeling creative design, industrial design promotes hand-painted, for hand-painted is the most natural way for designers to capture the inspiration, as long as there is a piece of paper, a pen, they can record their inspirations at anytime, anywhere. Hand drawing even should be a means of inspiration record because inspiration cannot be controlled. Only accumulating in daily life, will you be able to come in handy in a lot of materials. When you combine these materials with your personal style as well as product design orientation, you can go back to work in front of the computer.

4. Characteristics and Application

4.1 The Main Features

CAID technology has unparalleled advantages than the traditional industrial design, industrial designers can free to express a creative idea to display their talents if master it. It can enhance the quality of the overall product design, strengthen the competitiveness of the product market, and has the following characteristics: high-quality three-dimensional space software system set a three-dimensional solid modeling, static coloring, complex lighting model, and the multimedia animation in one, vivid image. It ensures the high quality of the design through advanced design tools. Flexibility with such high-tech tools for creative design directly on the system, using 3D solid modeling techniques for geometric modeling of objects, such as a color design, material editing, form, texture depicting real-time rotation transformation, rapid real image generate output, many different styles, program evaluation and testing. It can easily be modified until satisfied. The system is to optimize the design.

4.2 The Application of High-Tech Research in CAID

Currently, these emerging technologies of virtual reality, neural networks, genetic algorithms and parallel design, collaborative design method are the hot spots of the majority of scholars. The introduction of these technologies into CAID field, combination of traditional optimization design, fuzzy technology, intelligent

technology to CAID study also gradually win the attention of scholars.

Parallel design, collaborative design is one of the trends of modern design. In the field of industrial design, especially product design, it is necessary to study the parallel and collaborative design mechanism of product features, principle, and layout. From Concurrent engineering point of view, some scholars have explored deeply into the parallel design process and design environment for concurrent engineering design technology.

4.3 Positioning and Its Implementation

Analysis through in-depth investigation of a number of factories, refrigerators, machine tools, and other typical product development process, various design techniques can be seen in the application of the entire product development process and the role of various designers. Based on accurate position, they can develop CAID system development strategy and implementation method. Computer-aided industrial design (CAIDS) is developed in accordance with the CAID technical principles and methods of computer-aided design software system. It is shown in Fig.1.

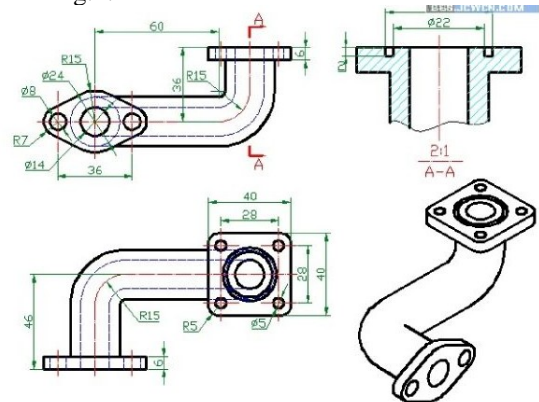


Fig. 1 Computer-aided design software system

It should be in accordance with the thinking of system engineering, completely take industrial design theory and methods as guidance for the smart innovative product development and design system. it first does form design and human-computer design in the machine; then imports the product model into design platform, including design of color, decoration, material, etc.; at last, it comes to the conclusion of the product modeling program modeling program expression including renderings of product modeling, design, evaluation, and engineering geometric model. The product designed through the system has the features of good shape and beautiful color, pleasant, high quality, efficient, animation and others.

4.4 Application Examples

It can effectively form a product family or a different design for the evaluation and selection. Currently it mainly uses algorithms include adaptive neural network and morphological differences in residual algorithm to control the generation of the new design, and the method of adaptive neural network is applied boarder. Figure 2 is its calculation model.

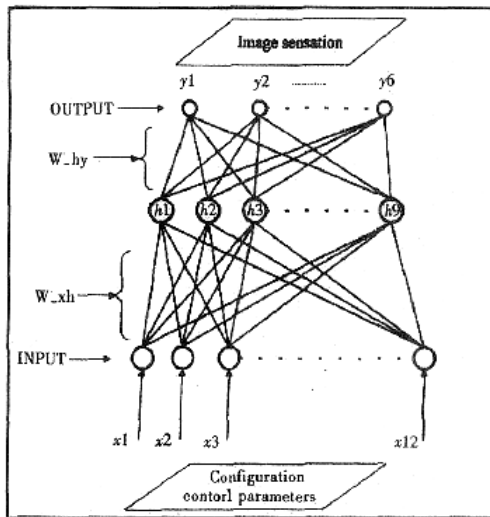


Fig. 2 Calculation mode

5. Developing trends of CAID

From perspective of industrial design, with the further development of CAD, artificial intelligence, multimedia, virtual reality technology, there must be a deeper understanding of the design process and a new level of design thinking of design mind. CAID will make industrial design develop in the direction of diversification, optimization, integration, make human-computer interaction more natural, innovative design more advanced and effective. From the entire product design and manufacturing trends, parallel design, collaborative design, intelligent design, virtual design, agile design, full life cycle design, all these design approaches represent the development direction of modern product design patterns. With the further development of the technology, on the basis of the information, product design patterns will inevitably develop in the direction of digital, integrated, networked, and intelligent computer-aided. Industrial design trends must be consistent with the above trends, and eventually establish a unified design support model. The industrial designers and engineering designers should gradually converge toward unification.

5.1 Functional Components and Data Modeling Platform Interactive Mode

When the design system uses a COM component technology to the development of various functional modules, the data between the functional components and modeling platform interactive mode select and transplanted directly determines the design of the system performance.

The mode C is the tool interface independent, be a separate component. The purpose of this development model to facilitate the expansion of the tool interface updates. Because of close interaction interface with the user, in some cases, the possibility of change of the interface is relatively large. When the tool interface needs to be changed, according to the mode C development tools components only need to change the code to interface components. C / S mode software are more suitable for with mode C development components. Of course, these three development modes have their pros and cons. Mode C enhanced maintainability, due to excessive interface calls and reduce the operating efficiency of the tool.

5.2 Concepts and the Way Influence of Computer To Industrial Design

The impact of the development of computer software, computer industrial design concepts and have made great progress on the way to make the product design in degrees of freedom. The traditional design of hyperboloid, the expression of the free-form surface is very troublesome, and often need to produce a solid model to express clearly. Model again into engineering drawing, is a difficult thing. Therefore, in the design, designers always avoid the use of free-form surfaces, which makes the design has become conservative. Today, the use of computer generated data model, all these difficulties are gone, and the closer relationship between design and manufacturing. The use of computers make us changed the design criteria. Traditional design with high demands on the effect of expression, often drawing production whether sophisticated, the lines whether light quite, and the color is uniform as an important criterion of evaluation. Computer-precise data, sophisticated output effect; this criterion loses its meaning. While the evaluation criteria on the evaluation of the merits of the design. Computer-aided design to shorten the product development cycle. On one hand, promote the efficiency of the work; on other hand, eliminating the need for many of the traditional design performance steps. Program modifications and adjustments, because the computer retains the whole process of design, modify it very convenient. In this way, than the traditional design in the development of a new

product should be shortened from one-third to one-half of the cycle, and some can even shorten the cycle multiplied

5.3 Internet to Influence the Industrial Design

Today the momentums Internet (Internet) connectivity worlds also expand the presence of art and design space toward the broader digitization of the art design. Not connected to the Internet, the art design is still subject to geographical and time constraints, and with the Internet, information can travel at the speed of light, art and design works taken around the world. People either own creation of electronic files in the network, the existing work of art can also be converted to digital images on the network around the world who are interested to browse in the world of digital-based can also communicate with others their own point of view or order their favorite works.

5.4 Features and Advantages of Virtual Building Design Method

Based "virtual building" intelligent building components of the multi-angle, providing a fully 3D environment. Virtual Building smart objects, all the building components are parameterized contains special properties of building components, such as dimensions, materials, performance, cost and other comprehensive information intelligent three-dimensional objects.

5.5 Design Functional Requirements of The System

Focused thesis considered from the perspective of the application of industrial design, form design method to analyze the design system, and does not involve other aspects. The papers from the form layout, proportion, linear, detail four aspects to consider the form of the computer-aided design system functional requirements of industrial design:

Provide layout design support, in particular the application of surface segmentation technology, auxiliary designer morphology facade.

Provide morphology proportion design support, provides the proportion of information in a timely manner for the designer, assisted designers tune. Whole, the design has the priority ratio between the forms of graphics, auxiliary designer overall ratio proportional relation.

To provide a form of linear design support, especially to generate characteristic curve, the organization of free curve function, such as the number of free-form curve adjusted mutual the congeners curve relationship or proportion curve relationship.

6. Design of Computer-Aided Morphological System

Industrial design form of the computer-aided design system (referred to as the design of the system, the same below) should include the five aspects of domain knowledge, design goals, the designers, the design process and the resources available. On the basis of analysis of the morphological design requirements of computer-aided industrial design, selection modeling platform and systems development techniques, and modeling platform to build a computer-aided morphological design system. It is shown in Fig.3.

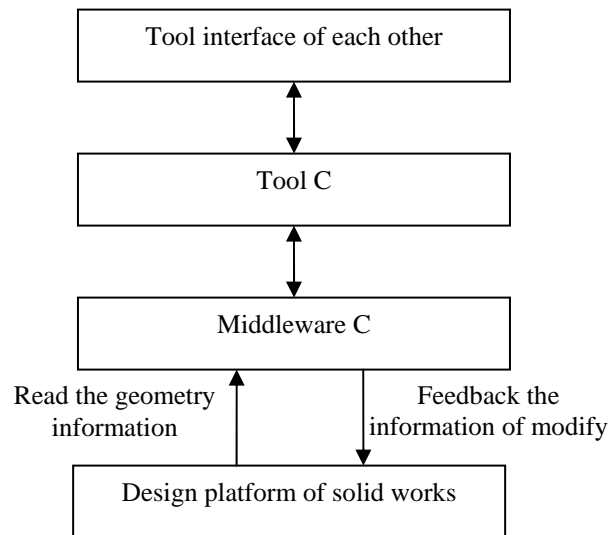


Fig.3 Mode C

7. Conclusions

Collaborative industrial design system, based on the design of the product, we have to borrow the morphology typical electromechanical products shape our self-developed auxiliary design system design, color design and evaluation module, they are integrated into a collaborative environment, thus saving the development cycle of the system, and to avoid unnecessary duplication of development. Has been analyzed in the previous section of this paper characteristics of VRML This graphic file formats, pointed out that the hierarchical tree structure is particularly suitable for the organization and storage of industrial design products, so choose VRML to build the cooperative industrial design process product model, coupled with interactive features on Java3D and call the relationship between them, so Here take a look at how

they are down collaborative environment industrial design activities.

Product designs in collaborative environment include three part of designed by the client, concurrency control, server-side storage. Concurrency control is responsible for conflict resolution, which is at the same time a product model can only be a designer calls. Because the server side is the use of a relational database for program storage, so the database record locking can solve the problem of access to the conflict.

References

- [1] Rajesh Kumar Goutam, Sanjay Kumar Dwivedi, "Search Engines Comparison on the Basis of Session Duration and Click Hits", International Journal of Computer Science Issues, Vol. 8, No. 2, 2011, pp:179-183.
- [2]WANG Hai-bo, "Computer Aided Industrial Design", Journal of Anhui University of Technology, No.2, 2005, pp:23-26.
- [3]Johannes Behrisch, Mariano Ramirez, Damien Giurco, "Representation of Ecodesign Practice: International Comparison of Industrial Design Consultancies", Sustainability, Vol.3, No.10, 2011, pp: 1778-1791.
- [4] G.L. Hu, X. Zhu, "Comprehensive evaluation of population, resources, environment and economic system of Xinjiang: Based on the principal component analysis", Ecological Economy, No. 6, 2009, pp. 67-69.
- [5] S. Li, W. Qiu, and Q.L. Zhao, "Quantitative relationship between environmental quality and economic development of Heilongjiang province", Journal of Harbin Institute of Technology, Vol.38, No. 11, 2006, pp.1986-1988.
- [6] Elmira Moghaddami Khalilzad, Sanam Hosseini, "Recovery of Faulty Cluster Head Sensors by Using Genetic Algorithm (RFGA) ", International Journal of Computer Science Issues, Vol.9, No. 4, 2012, pp: 141-145.
- [7] Gert Pasman, Ingrid Mulder, "Bringing the Everyday Life into Engineering Education", International Journal of Advanced Corporate Learning, Vol. 4, No.1, 2011, pp: 25-31.

Jun Yao Male, Han nationality, born in September 1979, Jiangsu people, Art and Design Institute of China University of Mining and Technology, associate professor, Postgraduate, master degree; research direction for industrial design. University Road 1 Art and Design College of China University of Mining and Technology, Xuzhou City, Jiangsu province.