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Computer-Aided Design AND APPLICATIONS

Application of CAD in Product Packaging Design Based on Green Concept

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Abstract. CAD technology is applied to the design process of product packaging, and the process of product packaging design assisted by various design software is proposed. In order to solve the problems of backward NC programming and low efficiency of complex parts of marine diesel engine in the actual production of enterprises, based on the full investigation and analysis of CADDCAM integration status of diesel engine manufacturing enterprises. This paper puts forward the solution to the phenomenon of plane label after three-dimensional mapping and the problem of data transmission between different software in the process of packaging design. The proposed design avoids unnecessary repetitive labor in traditional product packaging design, makes the design process more reasonable, more efficient and improves the design effect.

Keywords: CAD technology; Product packaging; Structural design.
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1 INTRODUCTION

The rapid development of science and technology has promoted the rapid development of world economy; the mutual penetration of various technologies has promoted the development and progress of packaging industry. CAD / CAM technology is a powerful tool for the design and manufacture of modern packaging containers. It has been widely used in various fields of packaging industry in developed countries [1].

CAD is a comprehensive and integrated system, which integrates information technology and application domain technology. It involves information technology: computing technology, including computer hardware and software; graphics, including graphics algorithm and its implementation, graphics software, graphics equipment data management, engineering database management system, can process text, standards, specifications and other engineering data; numerical analysis, including finite element analysis, simulation, simulation and other

technologies; intelligent technology [2, 3]. It includes knowledge engineering, expert system, artificial intelligence interface, etc.; man-machine interface, such as graphical user interface, multimedia, etc.; network communication, including LAN, Internet, intranet, etc. [4]. The hardware of CAD consists of computer or workstation, large capacity memory, graphic equipment and other external transfer equipment, communication and network equipment. CAD technology has become a key technology for enterprises to improve their innovation ability, product development ability and competitiveness [5]. Users and manufacturers engaged in packaging industry are no longer satisfied with the original CAD software system, they expect more specific functions for the packaging industry CAD software [6].

Using computer to design the shape and decoration of packaging and the structure of cushioning packaging can not only shorten the design period, improve the design efficiency and precision, but also save the input and material resources [7]. The application of CAD technology in the field of packaging industry mainly includes: design the structure of sales packaging container; reasonable selection of packaging materials; prediction of shelf life; calculation of stacking height of goods; reasonable design of storage and transportation stacking arrangement scheme of goods; realization of auxiliary design and scientific evaluation of packaging scheme [8].

The rest of manuscript is organized as Section 2 provides brief information about efficient product packaging using CAD based designs. In Section 3 the advantages of implementing CAD system based developed framework is described. Section 4 provides the information about design process of packaging structure. A suitable example of the packaging structure design is described in Section 5 which is followed by the conclusion of this paper with the potentials of CAD systems in the future described in Section 6.

2 LITERATURE REVIEW

With the continuous development of China's socialist market economy, China's packaging industry has also made remarkable achievements. However, compared with the world packaging power, China's packaging aided design technology started relatively late, the technology content is low, and there is a big gap compared with developed countries. The production methods of some packaging enterprises still rely on manual calculation, manual drawing and manual assembly, with long design cycle and high cost; while some enterprises use computer technology, but most of them use general engineering software (such as Auto CAD) and graphic image processing software for packaging design. Compared with foreign professional software, designers have a heavy workload. It is difficult to improve the design efficiency. At present, some domestic universities, scientific research institutes and software enterprises have made an effective attempt in the research and development of packaging CAD software, and have developed some packaging CAD software with strong functions and certain practicability. The following will make a brief introduction to several domestic self-developed paper packaging CAD software.

Vuki et al. thinks that the tuli-skh CAD software can be used to design dozens of box types, such as disc cover box, disc shake cover box, tube box, special-shaped tube box, etc. At the same time, the software also has the functions of structure design, size calculation, material selection, standard drawing and so on. The user can select the required box type according to the product packaging design requirements and customer requirements, and then input the product size, product arrangement, product weight and other parameters [9]. The software can analyze and calculate according to the parameters input by the user, and finally output the box structure drawings that meet the user's requirements. The design process only takes a few minutes, which greatly improves the design efficiency and shortens the design cycle. Different from tuli-skh paper packaging structure CAD software developed by Tianjin University of science and technology. Huang et al. dialogue type packaging carton CAD system. The system not only provides standard design method, but also provides combination design and free design mode. The combination design method is mainly realized by the box cover, box body and box bottom [10].

Compared with the above two software's, the founder pack system developed by Keshi et al. of Founder Group has friendly, open, interactive and convenient operation interface. There are more

than 500 standard box types and components in the box database of the system, which can meet the needs of product packaging design in tobacco, wine, medicine, food, cosmetics and other industries. In addition, users can use the drawing tools of the software to draw their own boxes, complete the box design and store them in the box library, so as to continuously expand the number of boxes [11].

To sum up, the packaging CAD technology in China is far from that of developed countries, but we have been trying to develop packaging CAD software with more perfect functions, more convenient operation and more-friendly interface. With the increasing strength of science and technology in our country, we should have enough reasons to believe that our packaging CAD technology can overcome the obstacles in its development process and catch up with and surpass the world advanced level.

3 INTRODUCTION OF CAD TECHNOLOGY AND ITS ADVANTAGES

CAD (Computer Aided Design) technology is a kind of theory and method which is based on computer, peripheral equipment and its system software, making use of computer's powerful computing function and high-efficiency graphics processing ability to assist knowledge workers in engineering and product design and analysis, so as to achieve ideal goals or achieve innovative results. CAD technology integrates digital calculation, geometric model processing, graphics, simulation and other functions in one, which can materialize and visualize the abstract and separated design objects, and vividly show the shape, material, color and even the processing process of products through virtual reality technology. Generally speaking, the functions of CAD system include sketch design, part design, assembly design, complex surface design, engineering drawing, engineering analysis, realistic rendering and data exchange interface and so on. However, the CAD software currently seen in the market is basically a software system for drawing design.

The concept of CAD technology originated in 1946. It has experienced the development process of 2D graphic design, interactive graphic design, 3D wireframe model design, 3D solid modeling design, freeform surface modeling design, parametric design, feature modeling design, etc. In recent years, there are many advanced technologies, such as variable quantization technology, virtual product modeling technology and so on [12].

3.1 Advantages of CAD Technology

The development and application level of CAD technology has become an important symbol to measure the industrial modernization of a country, which reflects the comprehensive strength of a country to a certain extent. As an important part of advanced manufacturing technology, it has great advantages in improving product design accuracy and reliability, shortening design time, improving production efficiency and reducing product development cost. Generally speaking, CAD technology has the following advantages:

- The reliability of CAD system can be improved. Because of the high calculation accuracy and easy to optimize the design, designers can complete the design of higher quality by using CAD means on the basis of professional knowledge. Designers can make products intuitively in the computer by using solid modeling. The optimum design method used in CAD is helpful to optimize some process parameters and product structure.
- CAD system can shorten product development cycle and improve production efficiency. Because the CAD system has a strong ability of graphic processing and data processing, the computer can display the design results intuitively, and the designer can make a quick response according to the display of the computer. It is much easier to modify the design on the computer than on the drawing, and the computer can provide the functions of copy and query. It can greatly shorten the production cycle and improve the design efficiency.
- CAD system can greatly reduce the production cost. Because the CAD system can realize the automation of part of the design work and the standardization of the product data, it is convenient to modify the design and save the labor force; on the other hand, the

optimization design of the system can reduce the reject rate, and caddcam technology can shorten the preparation time for production, accelerate the product update, reduce the inventory, and thus reduce the production cost of the enterprise.

- CAD system can improve the management level of enterprises. The design results generated by CAD system are mainly computer data, which are easy to save and retrieve. Under the premise of the establishment of the enterprise intranet, it is easy to realize the overall management and improve the management level of the enterprise by adopting the product data management technology [13].

4 PACKAGING STRUCTURE DESIGN PROCESS

It is impossible to complete the whole design task by a single software in the design process of packaging structure. In the whole design process, graphic design and 3D design are usually carried out separately, and multiple software are used alternately to complete the design task. The design process is shown in Figure 1. The specific process is as follows:

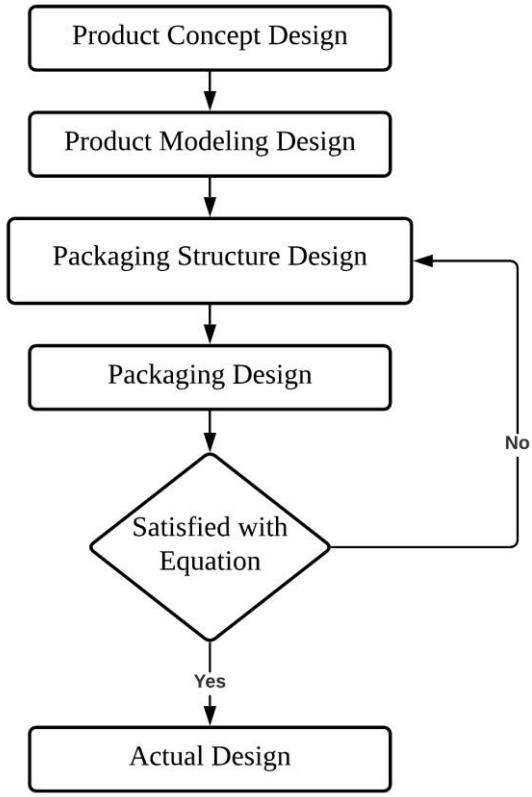

Figure 1: Flow chart of packaging structure CAD.

4.1 Product Concept Design

In the conceptual design stage, designers should have a preliminary idea of the appearance of the product. In this stage, the designer only needs to use the computer to establish the modeling grass model. Usually, hand-painted board is used to connect computer to sketch design intention, and

the software storage format is set as JPEG or GIF format, which is convenient for subsequent calling.

4.2 Product Modeling Design

The product modeling design is based on the sketched drawings of conceptual design. The pictures are loaded through the 3D design software, and the key points are established by tracing points. The boundary curve is constructed by connecting the key points. The curve is adjusted by using the curve handle to get the boundary curve as close as possible to the design sketch. Then the independent surface is generated by using the surface generation tool of the 3D modeling software. Then, the whole appearance surface is constructed by surface merging, and finally the solid modeling design is completed by using the solid tool. The software output tool is stored in IGES or step format to facilitate the exchange of design data with subsequent packaging design engineers.

4.3 Packaging Structure Design

Packaging structure design engineers use IGES or step file to design packaging structure. During the design, we should consider the factors that have great influence on the packaging structure design, such as the packaging circulation environment, the performance of packaging materials, and the product structure strength. After the main structure design of the package is completed, the three-dimensional design drawing is transformed into two-dimensional engineering plan by using the special function of the three-dimensional design software, and stored in the electronic format required by the subsequent processing software. For example, when AutoCAD is needed, the file format is stored in DWG format.

4.4 Packaging Design

On the basis of the structural design drawings received, the packaging artists can carry out the packaging design work. The usual steps are: use Corel DRAW software to read the WMF format vector file processed and stored by AutoCAD, and then design the text and picture. The image processing is processed by the graphics processing software such as Photoshop. After the packaging appearance draft design is completed, the color needs to be processed, and the image is processed into the CMYK color format required by the subsequent printing process. So as to realize the consistency of color output in the whole process from prepress to printing, and then carry out production processing [14, 15].

5 AN EXAMPLE OF PACKAGING STRUCTURE DESIGN BASED ON CAD TECHNOLOGY

The following is an example of packaging structure design of an electronic product to illustrate the specific application of CAD technology in packaging structure design. Design process: (1) sketch of appearance curve; (2) design of product structure; (3) design of packaging structure; (4) structural design of outer packing carton. The three-dimensional CAD modeling software is prooe4.0, and the two-dimensional CAD design software is AutoCAD2004.The specific design effect is as follows (Fig. 2, Fig. 3).

The following problems should be paid attention to when using CAD modeling software to design product packaging structure

5.1 Optimization of Complex Component Modeling Process

For parts with complex structure, such as the packing cushion in this example, the process of feature modeling should be analyzed in detail during 3D modeling, and the most basic modeling commands such as stretch, rotation, mirror image, array, stripper, and fillet and so on should be used for design as much as possible. This can accelerate the modeling speed, save storage space and facilitate subsequent design modification [16, 17].

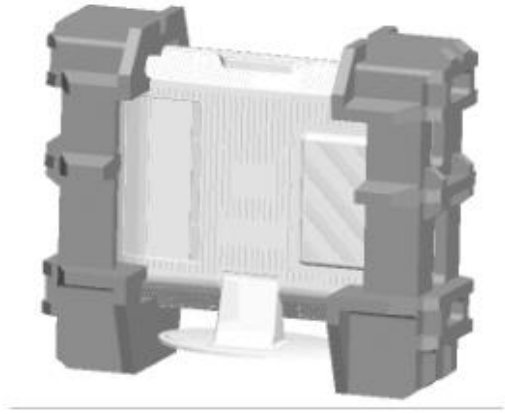

Figure 2: Three-dimensional diagram of packaging structure.

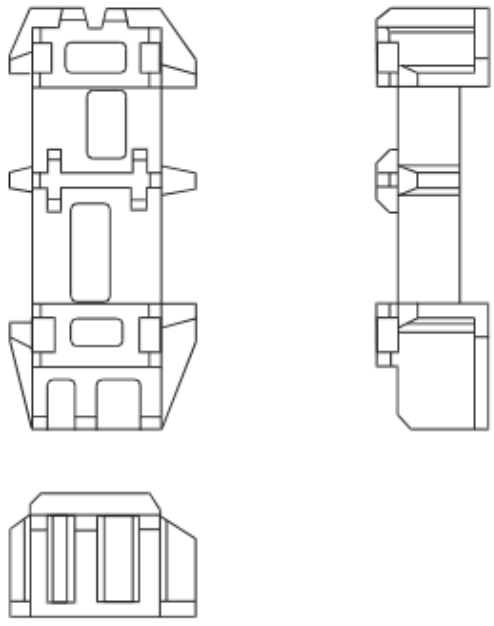

Figure 3: Three views of cushion structure plan.

5.2 Use Part Simplification Function to Simplify Parts

In order to simplify the assembly process of the product, it is not necessary to simplify the assembly process of the product, so as to simplify the assembly process of the product. In this example, before the assembly of the product and packing pad, the internal circuit board and display module of the electronic product which do not affect the packaging and assembly effect are simplified, and the running speed of the three-dimensional modeling software is improved.

5.3 Effective Use of View Manager

Due to the complexity of the three-dimensional structure of packaging liner, the designer's sense of space is easy to be confused with product portfolio design. The effective use of view manager of 3D modeling software can make up for the above problems. In this example, in the assembly design of product and package, the view manager tool of prooe software is used to establish five view display states of product, left liner, right pad, left pad and right pad (as shown in Figure 4), which respectively represent the combination relationship of product and packaging liner, and the display effect is intuitive and concise, Designers can switch flexibly to obtain ideal display effect and improve design efficiency [18, 19].

5.4 Effective Use of 3D Computing Function

The powerful operation function of CAD modeling software can easily switch between entity display and wireframe display.

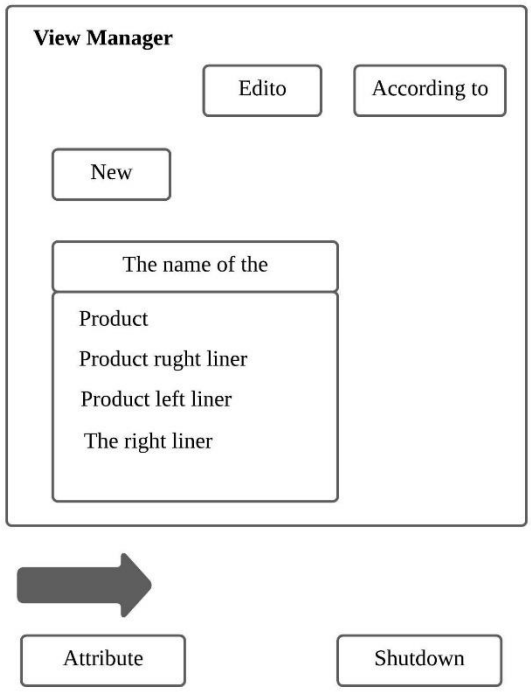

Figure 3: Example of view management.

In different states, designers can complete corresponding operations respectively, such as stretching and removing in solid state, while grasping surface boundary and curve grabbing in wireframe state are easy to realize. It can also use transparent storage function for large assembly space. Reasonable use of 3D computing function makes the application of modeling tools more flexible and convenient.

Figure 4 presents the proposed design for analysis phase. The methodology which is followed during this work utilizes CAD system. This article mainly focuses on the procedural design for the protective packaging using CAD system. The packaging analysis and its development is categorized in two levels, initial analysis and package development stage. The initial analysis is the study of recent advances using CAD system and based on this design is validated and adopted for package development. Level 2 is responsible for in the development phase which consist of analysis,

synthesis, simulation, detailing, and testing stages. Decision tree analysis the product size and dimensions are synthesized. The synthesized parameters are further used for the simulation of product design. Simulation results validated for meeting the detailing requirements and at last the product design is tested for its validity.

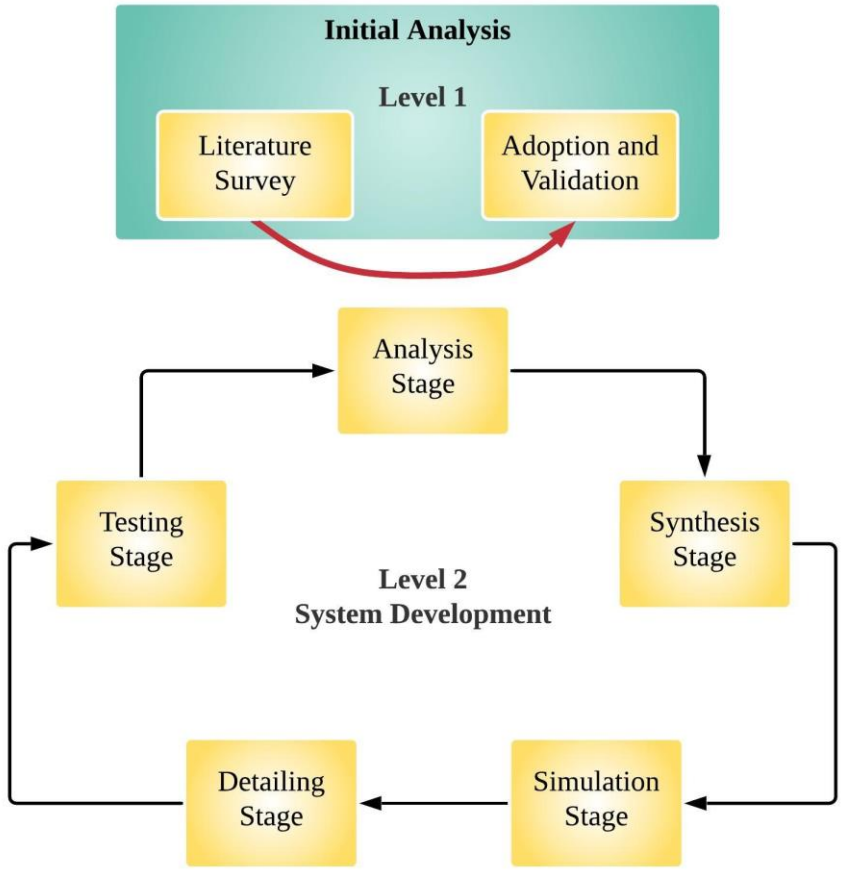

Figure 4: Working flow of packaging system development.

Figure 5: Simulation results of design cycle.

It is of today's demand for designing environmentally friendly products using modern designs. Figure 5 presents the simulation results of design cycle which reduces the cost and it helps in in estimating the mistakes early e which allows more exploration of design goals and ultimately leads for better products production. CAD tools provides the power to meet the requirements of demands therefore engineer use simulation early for development new design to bring the innovation.

6 CONCLUSION

With the deepening and popularization of CAD technology in the packaging industry, the demand for paper packaging CAD software has not only stayed in the simple graphic design function, but also applied the packaging design knowledge to CAD to make it more professional and meet the needs of all kinds of people and enterprises. In addition, in order to further improve and improve the CAD system, as well as to provide effective help for the development of other product packaging design systems, it is necessary to realize the efficient integration of CAD system information and the integration of digital management from design to manufacturing process in combination with the process flow of products. At the same time, with the development trend of network intelligent CAD system software, the system can provide better operation platform and network interaction function for product packaging structure design system.

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