



Application Analysis of Virtual Reality Technology in CAD Industrial Design under the Background of Big Data

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Abstract. With the development of economy and the continuous progress of society, computer has become an indispensable part of People's Daily work and life, making People's Daily life more convenient and improving the efficiency of industrial production. Computers are important in all kinds of industries and industrial product design as well. The addition of computers not only saves labor costs and improves customer satisfaction, but also improves product quality and performance to a certain extent and improves work efficiency. It can be seen that in the process of work not only to make detailed product plans, but also to understand the current development and trend of computer-aided industrial product design. The computer is an important device in the industrial design industry. Virtual reality technology effectively integrates information technology, sensing technology and intelligent platform to build a virtual operation scene, and describes the running information of things in the current virtual environment through the docking and mapping of data information. Based on this, this paper takes the classification of virtual reality technology as the breakthrough point, explains the advantages of applying virtual reality technology in industrial design, and studies the application of virtual reality technology in industrial design. This paper discusses the application mode of cad in various stages of industrial design, analyzes the shortcomings existing in the current application process, and puts forward some suggestions for better popularization and application of CAD in industrial design.

Keywords: computer aided design; industrial design; virtual reality technology; big data Environment

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1 INTRODUCTION

Form design is the main application field of computer aided design technology. Since the birth of the first computer, researchers have been committed to the application of this tool in product design, in order to improve the quality and efficiency of designers' work, after more than 30 years of development, remarkable achievements have been made. Up to now, there have been several geometric modeling methods, such as wire frame modeling, surface modeling, solid modeling and feature modeling. Parametric solid modeling based on feature integrated surface modeling has become the basis of modern mainstream CAD system and has been widely used. There are a large number of mature form design software, such as UG, Pro/E, SolidWorks, AutoCAD, etc., which have been widely used in aerospace, aviation, machinery, chemical and other manufacturing industries, greatly improving the level of product design in manufacturing industry [1]. The traditional CAD technology is based on geometric modeling technology, can build a general geometric modeling tool and use quantitative methods to analyze the structure and performance on the basis of the geometric model. However, for a long time, CAD software has paid too much attention to the universality of the system for commercial consideration, and has been loosely combined with specific industries, neglecting the characteristics of the design object itself [2]. In the late 1990s, with the maturity of CAD software, CAD application and technology research began to stagnate. After a period of time, computer aided design application and technology research began to turn to specific industry and process applications, so CAD software began to integrate grinding tools, tools, pipes, sheet metal, scene rendering, lighting and other professional modules. In the aspect of industrial design, the world's large CAD/CAM/CAE software systems, such as Pro/Engineer, EDS Unigraphics, EUCLID, Autodesk, solid-works, etc., all began to provide the system module of early product design, which also belongs to the category of industrial design. Typically, Pro/Engineer includes an industrial design module. This module tool includes a two-dimensional nonparametric makeup layout editor for product design, a two-dimensional parametric model layout for conceptual analysis, and a three-dimensional layout editor for components. Phadnis et al. [3] found that it is not only software functionality that affects the output of designers, but the choice of workflow has a significant impact on the design results. For finding the application method of industrial design in computer aided design. We according to the form design method of industrial design, from the layout of the form, scale, linear, detail studies four aspects, on the basis of the layout design, the proportion design, design a series of form linear design, detail processing tools, build the form of computer aided design system of industrial design. Finally, in VC++6.0 development environment, using COM component technology in SolidWorks modeling platform for system development, programming to achieve part of the shape design tools, and check the integration of the system and the availability of tools. Zheng et al. [4] propose a virtual reality-based computer-aided design system to improve human-computer interaction by applying VR interface and geometric modeling techniques. Jain and Singh [5] believe that CAD can effectively reduce production costs, demonstrate their quality, and help minimize time-to-market.

In the past, the industrial era was marked by large-scale manufacturing, while the information age was characterized by inter-communication. Industrial products are no longer isolated island products limited to their own functions. The concept of interaction between products and products, and between products and people, is being gradually attached importance to. The Internet is in the era of changing with each passing day. When users are using products, manufacturers can use the information collection function of the Internet of Things to convert users' usage habits and behavior patterns into information data. Efficient use of such information can help designers and enterprises dig unexpected innovation and creativity.

2 CAD COMPUTER AIDED TECHNOLOGY

It refers to the combination of facilities in the overall computer system, and the use of combination technology to design industrial products. In the overall design process, the computer needs to constantly analyze the content of the design, after the optimization of the results, industrial designers will be optimized after the content of the industrial design applied to the whole production line, so as to improve the overall development efficiency of industrial design [6]. Therefore, CAD technology as the computer aided design of the most important performance software, integration of many aspects of the design concept and analysis of the factors, with a more powerful comprehensive performance, which provides risk protection for the efficient development of the overall industrial products. At present, CAD technology is more traditional, because in the content of industrial design, CAD mode is mainly to simulate the quantity, so the field of CAD technology application is narrow. More advanced CAID technology emerges at the right moment [7]. The application of CAID technology to the overall industrial design concept can provide more advanced and efficient design for industrial design by using computer technology, so as to improve the feasibility of the overall industrial production.

CAID refers to the use of technology to carry out industrial design work through some CAID software, which is actually a derivative of CAD. Computer-aided industrial design is an extended application of technology. It combines various technologies and multimedia technologies of virtual reality technology and computer-aided design. Computer-aided industrial design gives computers and humans a variety of comprehensive advantages and strong alliances. Further promote the development of the industrial design industry to the end. Then the computational steps of computer-aided design in industrial design are often extremely complicated. The average operation step diagram is shown in Figure 1, which has also become a problem that hinders development.

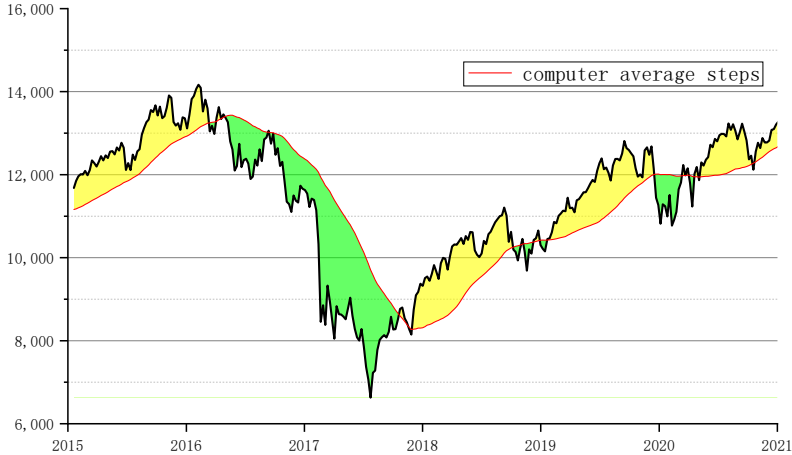


Figure 1: Computer operation steps diagram.

Under the background of Internet, concurrent engineering has been greatly developed. Through the application of concurrent engineering, the quality of the final product of the whole industrial design can be improved to a new level, and the development cycle of the whole product can be shortened, thus the cost of the whole design process can be further reduced. But it is important to note that when using concurrent engineering, industrial designers should start from the whole production process, constantly increase the intensity of consideration of design details, but also

and other departments institutions to establish a relatively closely linked, to keep the trust as the foundation of communication mechanism, in such an environment, It can make the design of the whole industrial design products become more perfect, reduce the number of rework, thus improving the overall development efficiency of the product, and then improve the economic benefits of the whole enterprise, and ultimately promote the further development of the enterprise.

The development of virtual simulation technology in computer aided industrial design has opened up a new field in practical application. Moreover, virtual simulation technology is also a hot technology in China. There are not only relevant majors specialized in design in colleges and universities, but also many enterprises are carrying out relevant research, which has attracted great attention from the public. Virtual simulation technology is a significant invention of computer-aided industrial design. It can simulate the specific effect of the design model in various industrial products under various environments. It can also be more specific and standardized to present the whole design and production process, thus forming more mature design products than before.

Computer-aided modeling design is similar to CAD modeling in computer design, which can effectively and comprehensively show the overall characteristics of industrial design products. In a general sense, industrial design products refer to sketch design and free surface design, the two kinds of design is the main representative of computer aided modeling technology design, can be more intuitive and concise to the public to show the whole characteristics of the product, so as to attract people's interest. Computer-aided modeling technology can reconstruct sketches on the computer and simulate specific design results by using human-computer interaction technology. The design of free-form surface needs to make use of the surface features of the form, that is, basic surface, intersecting figure and moving feature. These are the factors that must be paid attention to when industrial design products are put into the market.

3 COMPUTER AIDED DESIGN TECHNOLOGY IN INDUSTRIAL DESIGN

CAD technology is a collection of computer application technology combined with specific professional knowledge. CAD technology research in the content mainly includes two parts, one is the combination of specific professional knowledge and technology of computer application research, the other part is the study of computer aided design, the two parts are interrelated, inseparable.

3.1 Surface Cutting Square Method based on Surface Cutting Scheme Library

When the designer matches a plane segmentation scheme, the designer can know all the segmentation schemes in the next step through the tree structure in the scheme library. Designers can choose the appropriate segmentation scheme, further segmentation, and so on, and finally complete the segmentation of the target surface.

(1) the method of comparison grid

In the traditional painting process, at the beginning of the design, the designer should plan the paper, such as folding the paper, drawing grids on the paper and so on. Designers do this in order to determine the rough position of modeling elements in the drawing, so that the layout of the picture can be focused, proportional, etc. Unfortunately, in current CAD software, sketch background does not have the function of proportional grid. As for the CAD software modeling environment is common now. Square grid background, only for the convenience of size and positioning, it is very useful for technical structural expression design, but for the aesthetic design of the form of little significance. The design and arrangement of technical structural modeling elements are shown in Figure 2. The form design of industrial design emphasizes the artistry of form, and the computer-aided form surface segmentation of industrial design should provide the function of background grid.

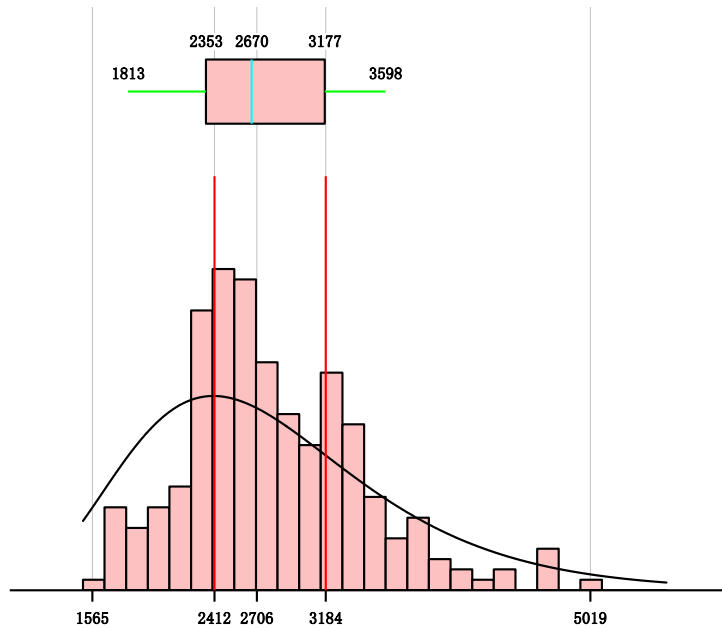


Figure 2: The order in which style elements are arranged and combined.

(2) Face cutting method based on face cutting case library

Surface segmentation plays an important role in the designer's form composition design. It is easy to obtain better artistic effect of facade layout with application surface partition design form. The method of dividing characteristic rectangular surface can obtain the artistic effect of combining dynamic and static, and coordinating with each other, so that the division of the body can proceed according to certain ratio law, and the ratio beauty of the shape can be obtained. However, due to the numerous rectangular surface segmentation schemes, the designers have to find the corresponding scheme diagram from the numerous schemes, which brings great inconvenience to the designers. The successive matching technology based on the surface segmentation scheme library can dynamically guide designers to design facades. The facade segmentation of the form is a process of gradual refinement. Before performing face segmentation, it is assumed that the designer defines the facade and elements in the facade. Firstly, the feature of the target plane is abstracted to simplify the elements in the target plane. Secondly, the contour rectangle of the target plane is determined and transformed into a feature rectangle. Finally, the target plane is segmented according to the matching scheme in the plane segmentation scheme library, and the process is shown in Figure 3.

3.2 The Calculation Method of Form and State Ratio

On the premise that the shape layout and shape elements are basically determined, the designer should plan and adjust the overall proportion of the shape (refine the design), so that the size relations of the shape as a whole, part and each other are coordinated and consistent. There are fixed proportion factor composing method, similar rectangle composing method and mixed proportion composing method.

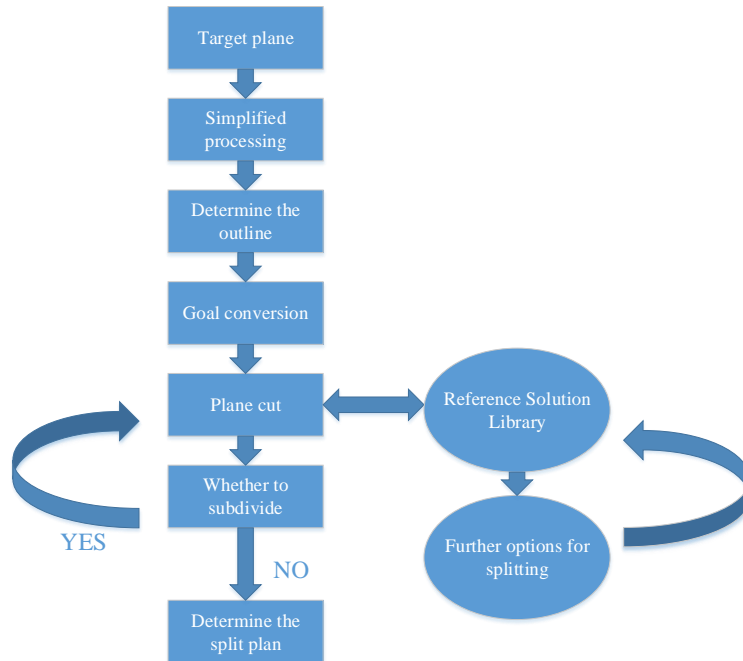


Figure 3: Plane segmentation method.

(1) Factor construction method of fixed ratio

Fixed form scale factor method is the concrete application of steps: first, according to the design intent, select product overall profile size and more critical level of the outline of size size or vertical size set: then, choose close to priority than the relationship between size of fixed scaling factor, as a basic scale factor to determine the relations of the product ratio; Finally, the proportion sequence is determined according to the basic size, and the size of the product form is adjusted according to the proportion sequence. By discovering the regularity of proportion in a collection of dimensions, designers can establish relationships between shapes and dimensions.

This approach requires the designer to be able to find patterns (construct scaling factors) from a "pile" of dimensions of the form, and this requirement often exceeds the ability of most designers to abstract numerical dimensions. With the help of computer, designers can apply this method to design form proportion more conveniently. In practical application, this method can be applied flexibly. The input of form size can only consider vertical or horizontal size, or only carry out proportional design for partial size. If the main tone of the product form is horizontal line segmentation, then only the vertical size of the form can be considered; If the product form is dominated by vertical line segmentation, then only the horizontal dimension of the form can be considered.

(2) Phase similarity rectangular construction method

The specific application steps of the similar rectangle formation method are as follows: First, the general outline of the product form and the outline of the main components are divided into rectangular areas to obtain a series of rectangles; Secondly, according to the obtained series of rectangles, the rectangles are matched to select the majority of similar rectangles, whose diagonals are parallel or vertical to each other. Finally, adjust the shape size according to the similar rectangle. Under the condition of traditional manual design, the similar rectangle formation method also requires the designer to find out the size rule in the graph, that is, find out the similar rectangle. Application computer designers can easily find patterns in graphics.

3.3 Setting of Chamfering Angle and Method of Pipe Management

Morphological details are characterized by a large number of design elements and a single change, such as edges and corners, small surface transition, etc. Therefore, detailed design should be combined with certain management methods. In this section, the fillet Angle is taken as the research object to discuss the computer aided fineness calculation method, which is also suitable for other fineness elements in the form. The fillet modification flow chart is shown in Figure 4.

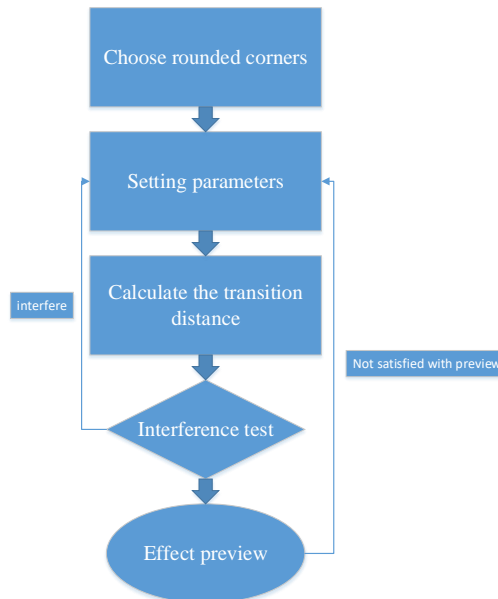


Figure 4: Fillet modification flow chart.

(1) Group management method of round Angle

Fillet, as the name implies, turns the included Angle of two straight lines into an arc tangent to the two straight lines. There are often a large number of fillets in the product form. These fillet factors have a single change and high repetition rate, so it is necessary to carry out unified management. The computer features can be used to manage the fillet in the form in a unified manner. The fillet management involves the following functions: (1) The rounded corners used for retrieval; (2) Establishing, merging and dissolving groups; (3) The rounded corner value can be set in groups. If interference occurs, the system will return interference information.

(2) The mold paste setting method of large rounded Angle and small national Angle

Large rounded corner and small rounded corner are a kind of fuzzy volume contrast relation, that is, the comparison between the volume of the rounded corner part and the volume of the surface of the rounded corner. In many cases, designers set the size of the rounded corner, often pay attention to the modeling effect of the rounded corner (such as the effect of large rounded corner, small rounded corner, etc.), rather than the specific value of the rounded corner. The volume feeling of large and small rounded corners can be quantified by the volume ratio. The volume of fillet corner is represented by the area reduced by the fillet transition, and the volume of the surface of fillet corner is represented by the area formed by the edge tangent to the fillet corner. Assuming that the two sides of the rounded corner transition are perpendicular to each other, the volume ratio can be expressed by the formula:

$$K = [(1 - \frac{\pi}{4})R_1 \times R_2] / [mn - (1 - \frac{\pi}{4})R_1 \times R_2] \quad (1)$$

Where, R_1 and R_2 represent the radius of the arc, and m and n represent the side length of the surface where the arc is located (assumed to be a rectangular surface).

With the help of computer, designers do not need to care about the specific value of fillet when choosing the type of fillet transition. The computer can automatically obtain the specific value through the corresponding algorithm of fillet transition, and realize the corresponding fillet transition attribute setting.

4 THE DEFICIENCY AND DEVELOPMENT DIRECTION OF CAD APPLICATION IN INDUSTRIAL DESIGN

Although computer aided design software has made unprecedented progress in the rapid development of computer technology today, but at the same time it also has a lot of deficiencies, to our designers to bring some confusion. Austin et al. [8] detail the problem and solution procedures in computer-aided design. Among them, the most prominent is the optimal range of various aspects in the design process. The optimal design range is shown in Figure 5.

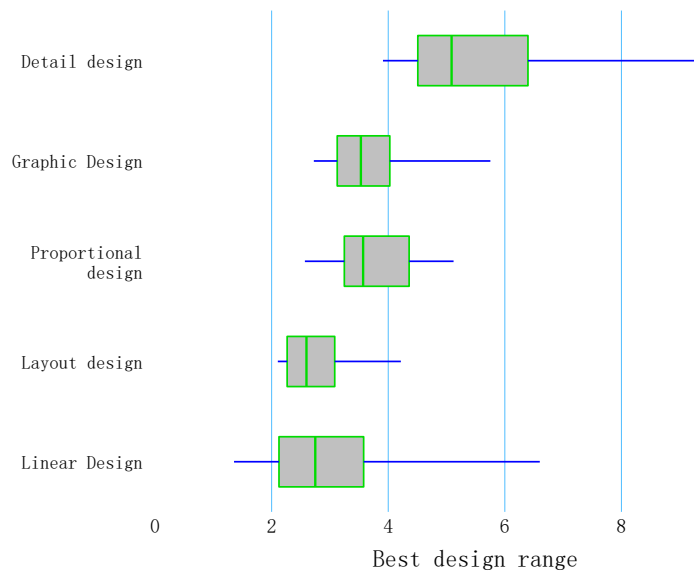


Figure 5: Optimum design range of each element.

(1) Most different versions of the same software are incompatible with each other. Due to the rapid development of computer technology, the computer aided design software version upgrade cycles are getting shorter, and between different versions of the same kind of design software are often not compatible, causing low version of the software can't open the high version of the software the processed data, individual high version of the software can't open the low version of the software of data; Although the data processed by different versions of the same software can be opened between each other, the data cannot be correctly displayed during transmission. Even if the data processed by the software of a higher version is opened by the software of a lower version, the edited data will also change.

(2) Two different applications cannot directly share or exchange data. As there are many kinds of computer-aided design software, the old and new designers in the enterprise use different design software, and there is no good information interface between different design software, it is

difficult to ensure the complete and accurate transmission of data information, so that the design communication and data sharing within the enterprise cannot be well realized.

(3) The network information sharing degree is low and the information feedback speed is slow. A strong visual error occurs in traditional CAD software, as shown in Figure 6. Therefore, it cannot provide the effect of dynamically displaying rounded corner transitions. The computer aided tools in the enterprise are often discrete and isolated systems, and the product data is stored in different computer systems. Some departments do not have an effective network communication environment, unable to carry out effective information sharing and transmission among the design, process and manufacturing departments. The main way for enterprises to transmit information is through written documents. As a result, the design department cannot collect feedback information from the process and manufacturing department in time.

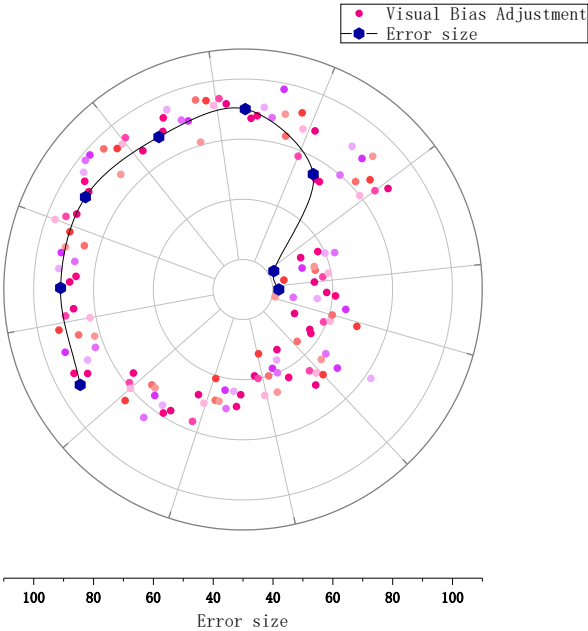


Figure 6: Visual Error Display Diagram.

Industrial design is the basis of the overall development of industrial products. It is necessary to take into account the resources and costs required by the development process of industrial products and other factors affecting the final economic benefits in the whole process of industrial design, so as to fundamentally realize the new development of industrial design. With the rapid development of modern computer technology, computer aided technology and other emerging technology gradually integrated in an open and common environment of rapid development. The core idea of this design concept is that industrial products should continue to develop and innovate in research and development and design, so as to reduce the waste of raw materials, improve the quality of the overall product, and make the most ergonomic optimal design. In the above various human-computer interaction technology and virtual simulation technology and other continuous development, computer-aided industrial design technology has also crossed a new level, in the vibrant development of new opportunities [9].

Paritala et al. [10] believe that digital computer-aided design is necessary and driving force, and industrial design must transform into intelligent manufacturing, and propose the future development of computer-aided design. First of all, in fact, industrial design and engineering

design of the core is consistent, because the consistency of the common, designers must fully meet the demand of people, on the basis of man-machine integration through the use of highly sophisticated computer system, combination and the concept of green design and environment, design quality of industrial products. Secondly, in the process of accelerating the market circulation of industrial products, designers should implement the concept of environmental protection and science and technology of green environmental protection. In the process of accelerating the development of new energy and new technology equipment, through the application of computer-aided design technology, we can meet the overall design requirements and quality, and further improve the overall value in a new sense. Finally, in order to achieve innovative design results, designers should always keep a cool head, constantly enrich their design knowledge, exercise an innovative thinking mode, and constantly apply more advanced design concepts to computer-aided design to produce more advanced design results.

Industrial products not only need to be designed, but also need to be sent to production and processing. In this process, at present, if computer aided technology is adopted, part of the human-computer interaction function can be realized. However, due to the late development of the technology, the specific level of science and technology is insufficient, in the process of human-computer interaction, often due to a variety of artificial or objective reasons, resulting in computer crash and other situations, this problem is very common at present. This situation not only limits the designers' fluent and fast operation of the computer, but also slows down the expected production schedule of industrial products to a certain extent and drags down the overall production efficiency. Figure 7 shows the error fitting curve.

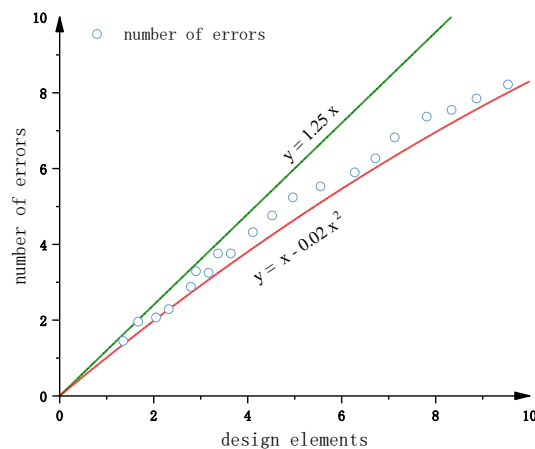


Figure 7: Error occurred fitting curve.

When we consider more elements, the number of errors also increases with a straight line. But in the future, through the continuous introduction and development of virtual reality related technologies, many model systems used for simulation can be further upgraded. By combining the traditional human-computer interaction mode, more efficient interaction results can be achieved, so as to help the overall industrial design process.

5 CONCLUSION

Computer-aided design as an important means and carrier of industrial product design throughout the whole life cycle of the product, digital

The industrial design makes every link of product design more efficient and rigorous. Especially the three-dimensional product digital management, so that the information transmission between design and engineering production is more accurate, the design intention has been well conveyed, but also for the later publicity prepared, shorten the time and cycle of product development. However, we should be more sober to realize that no matter how powerful the development of computer-aided technology, in the final analysis, it is only an auxiliary means of industrial design, and can never replace the leading work of people. Only by combining the leading factors of human with the computer aided system can the computer aided design play a better role in industrial design.

The development and design of industrial products are also constantly improving, which means that we need to constantly improve the appearance and performance of industrial products, prolong the life cycle and use cycle of products, to meet the diversified needs of today's customers. The application of artificial intelligence technology and high and new technology into the design of industrial products can not only promote the quality of computer-aided industrial design, but also promote industrial industry to the new industry. It will also attract more professionals to participate in computer-aided industrial design research, which can promote the sustainable development of industrial design.

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