Application of Virtual Reality Technology in Industrial Creative Product Design

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Abstract. Using virtual technology, customers can use a variety of sensing systems and natural environment to interact. This paper firstly explains the application of virtual reality technology in product design, and discusses the role and design approach of virtual reality technology in product design, and discusses the application prospect of virtual reality technology for readers’ reference.

Keywords: Virtual Reality, Industrial Creativity, Product Design, Three-Dimensional

1. Introduction
Virtual technology emerged in the 1940s. With the continuous development of virtual technology, it has been widely used in many fields such as manufacturing, military industry, medicine, aerospace, and architecture. Combined with the actual application of virtual technology, the following virtual technology, and related products to explain.

2. Application of virtual reality technology in product design
With the continuous development of science, human society has entered a new century. A variety of new technologies emerge in an endless stream, and the integration and development of various disciplines gives rise to many new disciplines and technologies [1-3]. Product design is such a discipline. Each new technology will bring new development and change to the way and way of product design. Virtual Reality (VR) is based on computer-supported simulation technology [4-6]. Virtual environment, Virtual process and Virtual products are formed through unified modeling for design, processing, assembly, and maintenance, etc. The application of virtual technology in product design will reflect its many advantages and bring new ideas and ways to the design industry.

Virtual reality technology is combined with people's imagination and electronics and a comprehensive technology, is a highly realistic simulation of people in the natural environment dynamic behavior such as audio-visual man-machine interface technology, which USES the multimedia computer simulation technology constitute a kind of special environment, the user can through a variety of sensing system natural interaction with the environment. The basic characteristics of virtual reality include Immersion, Interaction, and Imagination. Compared with other computer systems system can provide real-time interactive operation, three-dimensional visual space, and multi-channel human-computer interface. In recent years, virtual reality technology has been more and more applied to scientific research, and has been gradually considered as an important tool for scientific
exploration. The application of virtual technology in product development and design, known as virtual design, virtual design is based on virtual reality technology, it is mechanical products as the object of the design means. Essence, virtual design is the whole process of products from concept design to be put into use on the computer virtual realization structure of virtual environment, the goal is not only the physical form of the product and manufacturing process simulation and visualization, and the product performance, behavior and function and the implementation plan in all stages of product realization prediction, evaluation and optimization. There are many aspects in the application of virtual design, and more and more people pay attention to it because of its advantages. Here's how virtual design works at this stage.

1) Virtual prototype visualization and replacement of physical prototype. For example, in 1992, NASA established a digital model of the space shuttle and a virtual wind tunnel to observe the streamline distribution of the aircraft and verify the rationality of the aircraft appearance design.

2) Immersive design environment. Virtual environment and design are interlinked. By establishing 3d digital model, designers use virtual reality equipment to direct and manipulate the model in the virtual environment. In each stage of product development, the virtual product prototype structure, function, performance, processing technology, assembly, production organization and other aspects of simulation under the virtual environment, to ensure reliable and efficient design.

3) Virtual assembly. The product is often not a single part, the assembly interference of multi-part products is a common mistake. In traditional design methods, this error is not discovered until the final assembly of the product. By using virtual design, interference can be detected early or even completely avoided. With the assembly simulation software, the designer can test the virtual prototype and analyze the stress and deformation. If the design does not meet the standards, you can easily change the model and regenerate it.

2.1. Improve the intuitiveness and authenticity of design
Virtual design system is different from computer aided design system. Computer-aided design (CAD), which is widely used now, has not fundamentally and ideally changed the original way of design, but has replaced pen and paper with a monitor, mouse, and keyboard. The designers in the virtual design system do not have to be constrained by these external devices, but can freely exert their imagination and creativity in the virtual space through the virtual devices.

2.2. Shorten the design process and improve the design efficiency
After applying virtual design to the process, the original prototype trial production can be eliminated, and the experiment (trial) of the product is completed virtually, to shorten the product design cycle and improve efficiency. Many major international manufacturers, such as General Motors, Boeing, and British Airways, are rushing to introduce virtual technologies into their designs. Boeing's 777 aircraft was designed using virtual design technology, with development cycles reduced to five years from the usual eight.

2.3. Reduce design cost and improve product competitiveness
In today's increasingly fierce commodity competition, for any manufacturer, reducing product cost is undoubtedly one of the issues that should be considered first. In the past product design, it took a lot of manpower, material resources and financial resources to make the physical model and prototype alone, and the experiment of the product was even more time-consuming and laborious. When Boeing designed the cabin of the 707, it paid $500,000 to complete a 1:1 cabin model. The model was used to "simulate flight" for ergonomic analysis tests of the cabin seats and food service compartment. Virtual technology can be used for virtual product modeling, physical simulation, and dynamic simulation of product performance, testing product performance and reliability, etc., to reduce cost and improve efficiency.
3. The way of applying virtual technology to industrial design

3.1. Appearance design of the product
The virtual reality technology is adopted in the shape design, and the modeling data can be modified, evaluated, and determined at any time, which can be directly used in the design, simulation, and processing of stamping die, and even used in advertising and publicity. In other products (such as aircraft, construction and decoration, home appliances, cosmetics packaging, etc.) in the appearance design also has a great advantage.

3.2. Product layout design
In the layout design of complex products, virtual reality technology can be intuitively designed to avoid possible interference and other unreasonable problems. For example, in a complex pipeline design, virtual technology allows the designer to "go in" and arrange the pipeline and check for possible interference.

3.3. Motion and dynamics simulation of the product
The product design must solve the motion coordination relation, the motion range design, the possible motion interference inspection, the product dynamics performance, the strength, the stiffness and so on. For example, the operation coordination and coordination of each link in the production line are relatively complex, and the use of simulation technology (as shown in FIG. 1 after the computational fluid dynamics simulation design) can be intuitively configured and designed to ensure the coordination of work.

![Figure 1. Computational fluid Dynamics simulation design.](image)

3.4. Advertising language tour of the product
The product advertisement produced by virtual reality or 3D animation technology has a realistic effect, which can not only show the appearance of the product, but also show the internal structure, assembly, and maintenance process, use method, working process, working performance and so on. In particular, the use of the network for product introduction, vivid, intuitive, advertising effect is very good. Online roaming technology enables people to roam in cities, factories, workshops, machines and even between drawings and parts, to obtain information intuitively and conveniently. Virtual products also provide convenience for online shopping.
4. Application prospect of virtual design

There are still many problems to be solved in the development of virtual design. The first is the problem of data exchange. Nowadays, CAD system is widely used in manufacturing industry, but the data of virtual design system cannot be transmitted directly with CAD, which is also the obstacle that restricts the application of virtual technology in many enterprises. The second problem is hardware. The current virtual design hardware needs to be improved, such as the resolution of the helmet display, the sensitivity of the feedback system, etc. And the transmission speed of the network, the reduction of data and so on, are restricting the development of virtual design. At present, the manufacturing industry has presented three major trends of globalization, networking, and virtualization. Despite its youth, virtual reality is still seen as the future of human-computer interface. The application of virtual technology in industrial design can realize the complete digitization of products, because virtual products are computer models with all the information and functions of products close to reality. It can be predicted that in the future industrial design, with the development of technology, virtual technology and its application will be more and more extensive, virtual Quasi - technology will also play a greater advantage.

5. Conclusion

To sum up, although virtual design has been widely used in various industries, there are still many problems to be solved in the process of application. For example, the main existing problems are that the data of the design system cannot be transmitted directly with CAD and the virtual design hardware needs to be improved. With the continuous development of science and technology, digital design can be realized by using virtual design in the process of industrial product design, and virtual technology will be more widely used.

References

[1] Luo Ye. Application of virtual reality technology in foreign iron and steel industry [J]. Mechanical manufacturing, 2019,58 (03): 1-3
[2] Hou Yueying. Application prospect of virtual reality technology in industrial design [J]. Digital world, 2019 (07): 128
[3] Huang Ying, Tang Danfeng, liming. Application of virtual reality technology in industrial design [J]. Management and technology of small and medium-sized enterprises (next issue), 2019 (04): 179-180.
[4] Yang Shuai. Research on the application of virtual reality technology in the course of industrial design history [D]. Tianjin Vocational and Technical Normal University, 2019
[5] Ding Lijing. Research on Model Application of Virtual Reality Technology in Industrial Design [J]. Journal of Normal University, 2015,37 (05): 66-68 + 82
[6] Zeng Zhu. Application of virtual reality technology in industrial design [J]. Popular literature and art, 2018 (02): 60