



Application of Computer 3D Modeling Technology in Wheelchair Modeling Design

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Abstract. The application of computer 3D modeling technology in product design improves the efficiency and quality of product modeling design. Clarify the current situation and development trend of the existing computer modeling technology, and practice the appearance design of wheelchairs on the basis of analyzing the current situation of wheelchairs and relevant design principles. Apply computer 3D modeling technology to carry out innovative design of wheelchair appearance, study the application advantages of computer 3D modeling technology in the process of wheelchair modeling design, and clarify the role of computer 3D modeling technology in promoting the product design industry.

Keywords: 3D Modeling Technology · Product Design · Wheelchair Modeling Design

1 Introduction

With the development of 3D modeling technology and modern product design technology, it can jointly improve the characteristics of the industry. Building a modern information environment is the development trend of computer 3D modeling technology. At this stage, the product design industry is facing the current situation of insufficient innovation, poor product adaptability and low design efficiency. By developing naked eye 3D, virtual reality and other technologies and integrating them into computer product 3D modeling, designers can realize group joint development and share design information resources without geographical restrictions, The realization of open design can establish a “wall free design room” and further reshape the discipline of modeling design. Product modeling design is an important part of product design. Appearance modeling is not only the most intuitive visual embodiment of products, but also the first step of product value evaluation. Taking wheelchair modeling design as an example, this paper studies the modeling deduction and presentation of computer 3D modeling technology in product design.

2 Current Situation and Development of Computer Modeling Technology

In the current product design, computer-aided design plays a vital role and can hardly be replaced. Computer aided design shows the advantages of being modifiable, easy to save, strong expressive ability and high degree of numerical control. In the actual modeling design process, it is inseparable from the computer. Computer-aided modeling design also accounts for most of the proportion, such as product modeling plane performance, product modeling three-dimensional rendering performance, product abrasive tool development and so on.

In terms of computer 3D modeling technology, 3dmax and rhinoceros are generally used. Alias can be said to be the top existence of modeling design software. In terms of accuracy and functional comprehensiveness, Rhion and other design software cannot compete with it. 3D software for modeling design mainly focuses on Modeling and rendering. [1] Computer modeling software can be divided into two types: special effects design and industrial production. Modeling is an important part. It has a direct impact on effect performance and manufacturing, while rendering only has an impact on effect performance. Rhino, a modeling software commonly used in modeling design, is easy to learn and use, and the modeling accuracy is also very high, which is very suitable for beginners. Compared with very rendering, keyshot has certain convenience. It can render the material of 3D grass mold, which is widely applicable. The quality of very rendering is high, and it also has certain requirements for the skills of users. Photoshop is an important editing and drawing tool. After the model material is assigned by keyshot, the pictures are described and displayed in detail. In the existing product modeling design process, Rhino, keyshot and Photoshop are commonly used product modeling software. [2]

CAD software includes CATIA, UG, ProE, SolidEdge, Solidworks, inventor and other design software. CATIA, UG and ProE are relatively high-end design software. These design software can directly produce the designed products, and the modeling is more accurate and rigorous. In the process of modeling design, it needs the assistance of a variety of 3D modeling software tools to better complete the modeling design work. [3]

3 Current Situation of Wheelchair Design and Related Design Concepts

The target group of wheelchair design is the elderly and the disabled. At present, China is the most populous country in the world and the country with the largest number of aging population in the world. Providing timely and high-quality medical care and life security for the elderly and physically disabled has become the focus of national attention. At present, there are many kinds of wheelchairs at home and abroad. Facing different use scenarios, wheelchairs can be divided into floor climbing wheelchairs (foot type, planetary wheel type, crawler type, crawler wheel combination type), multi terrain wheelchairs, sports wheelchairs (suitable for disabled athletes), rehabilitation training wheelchairs and other types of wheelchairs. In the design process, the unity of function

and form is formed through product design and modeling design, so as to truly meet the real needs of different people for wheelchairs.[4] At this stage, China's population is aging seriously and the humanistic care for the disabled is gradually improved. China still has a certain development space in the field of wheelchair design [5].

In the process of wheelchair design, it is necessary to strictly abide by the product design principles, do a good job in crowd audience research, master the market gap and product pain points, study the size of wheelchair on the basis of ergonomics, and rationalize the height, sitting depth and width of wheelchair according to human body data, so as to meet the comfort needs of users for wheelchair; In terms of structure, meet the mechanical design principle to meet the functional requirements, rationalize the structural design of wheelchair, effectively integrate traditional machinery and intelligent components, improve the intellectualization and multifunction of wheelchair design, and realize the use requirements of different people in different occasions. In the process of modeling design, follow the law of formal beauty and modular design method to meet the aesthetic needs of the audience, and meet the users comfort and psychological satisfaction to the greatest extent in the process of using wheelchair; The wheelchair is divided into modules according to different functions, and the modeling design is carried out in the way of regional modules, which can effectively improve the design efficiency. In the process of use, some modules can be replaced to facilitate the maintenance of the wheelchair. [5] Under the background of the new era, the design of wheelchairs gradually tends to be multifunctional and intelligent. In the design process, the applicability of people and environment and the durability of wheelchairs are considered.

4 Application Advantages of Computer 3D Modeling Technology in Modeling Design

The application of computer 3D modeling technology in modeling design can effectively improve the design accuracy and simplify the design work. In the process of product modeling design, computer 3D modeling technology, as an auxiliary tool, can build the product design model through 3D modeling software such as "rhino" and "3DMAX".[6] The appearance and size of the 3D model can be reflected in the model, which is convenient for scheme modification and redesign in the modeling design process. Various numerical contents in the design can be obtained through calculation, Moreover, the data is very accurate, which significantly improves the efficiency of modeling design [7].

The rational application of modern computer-aided technology in modeling design can further improve the design quality, and then improve the quality and production efficiency of modeling products. In addition to the influence of product design on peoples appearance, it will also have a direct physiological and psychological effect on people in the process of use. Computer modeling technology is used to consider and design man-machine as a whole, so as to make products closely cooperate with human functions and further improve production efficiency.

Computer 3D modeling technology can further stimulate designers; innovative inspiration and show designers; personality. According to the traditional way of design, manually drawing product renderings and making models is not only a long cycle, but also

difficult to modify. Therefore, there is little room for choice, which limits the designers design inspiration. Using the computer three-dimensional modeling technology, the speed of generating the model is very fast. A variety of alternative modeling schemes can be generated in a short time, which can show the designers design ideas of different styles, and it is very easy to modify according to the users requirements. In the design process, we can also observe the product shape from different angles and determine the best scheme. This new technology is a useful tool to induce designers; creative thinking and improve their creative ability.

5 Application and Practice of Computer 3D Modeling Technology in WheelChair Modeling Design

This design mainly focuses on the wheelchair design research for the elderly. In the early stage of product design, it is necessary to analyze the audience, clarify the market demand, find the product pain points, and rationalize the existing products. Taking practicability as the starting point, on the basis of ergonomics, according to the human sitting posture size data (as shown in Table 1), the functional size of wheelchair is designed to realize the rationalization of design (Liu, Cui, 2020)[8]. For example, the sitting depth data is used to clarify the sitting depth of the wheelchair and avoid the suspension fatigue of the lower leg when sitting down; According to the human body data of sitting height, it is clear that the wheelchair should be sitting height reasonably, which can effectively reduce and limit the pressure of leg socket muscles; It is also necessary to determine the size of the wheelchair base according to the hip, hip width and other data of the elderly, so as to ensure that most of the elderly can use it, minimize the pressure on the hip and tailbone of the elderly, improve comfort, and have a more comfortable space for the elderly to move.

Design hand drawing performance is the main means of traditional modeling design, which can effectively integrate computer 3D modeling technology into product modeling design. In the stage of modeling, designers can follow a variety of methods of 3D modeling or hand drawing, and the final design scheme can be based on a variety of principles of hand drawing, The wheelchair modeling design scheme is simulated and presented, and then the value of wheelchair appearance modeling is evaluated. As shown in Fig. 1, it is the preliminary model of wheelchair modelling.

The application of computer 3D modeling technology can better present the design scheme with accurate data, and can comprehensively evaluate the wheelchair design, so as to find the shortcomings and deficiencies of the existing wheelchair modeling design scheme, promote the rationalization of the modeling design, and seek the optimal solution of the product modeling design. [9] In the traditional manual hand-painted modeling design process, if the existing scheme problems are found, the hand-painted design needs to be re designed, which consumes a lot of design time. Using computer 3D modeling technology, the model can be modified and redesigned directly. The wheelchair appearance can be modified according to the modular design, and the design scheme can be adjusted intuitively, which can effectively improve the design efficiency and product quality.

Table 1. data of human sitting posture.

	Male (18–60 years old)							Female (18–55 years old)						
	1	5	10	50	90	95	99	1	5	10	50	90	95	99
Sit high	836	858	870	908	947	958	979	789	809	819	855	891	901	920
eye height	729	749	761	798	836	847	868	678	695	704	739	773	783	803
Sitting shoulder height	539	557	566	598	631	641	659	504	518	526	556	585	594	609
Sitting elbow height	214	228	235	263	291	298	312	201	215	223	251	277	284	299
Sitting thigh thickness	103	112	116	130	146	151	160	107	113	117	130	146	151	160
Sitting knee height	441	456	461	493	523	532	549	410	424	431	458	485	493	507
Leg heightening	372	383	389	413	439	448	463	331	342	350	382	399	405	417
Sitting deep	407	421	429	457	486	494	510	388	401	408	433	461	469	485

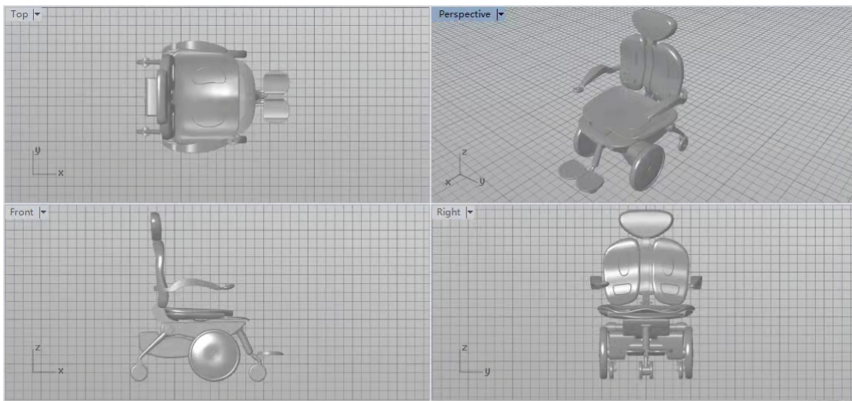


Fig. 1. 3D model of wheelchair modeling design scheme.

Define the grass mold scheme of wheelchair modeling design, and apply computer 3D Modeling Technology (keyshot material rendering software) to endow the wheelchair with materials and color selection. It can also intuitively adjust the appearance and modeling of the wheelchair, and improve the material performance of the wheelchair through material science. [10] For example, the overall skeleton of the wheelchair is made of stainless steel to increase the rigidity of the wheelchair, the silicone with appropriate thickness is used above the base to increase the comfort, the backrest is made of cotton material to improve the air permeability, and the material and color are controlled at the same time. As shown in Fig. 2, through the computer 3D modeling technology,



Fig. 2. Wheelchair color scheme.



Fig 3. Multi angle display of wheelchair.

we can intuitively observe the color matching of wheelchairs and visually meet the psychological needs of the elderly. Realize the organic unity of function and form, and lay the design foundation for wheelchair production and processing.

Taking the red scheme as an example, after clarifying the wheelchair appearance design scheme, the details and functions of the wheelchair design scheme can be displayed through keyshot rendering, video production and Photoshop Image processing. Figure 3 shows the multi angle view of the wheelchair, and Fig. 4 shows the functional diagram of the backrest, which helps the audience and the manufacturer understand the functions of various parts of the wheelchair, and realizes the effective design of the appearance of the wheelchair through computer 3D modeling technology.



Fig 4. Functional diagram of backrest.

6 Conclusion

Under the background of the information age, taking wheelchair modeling design as an example, in the product design process, the simulation presentation of product modeling, color and material is realized through computer 3D modeling technology. Compared with traditional design methods, the application of calculation auxiliary tools can simplify the design process, save design time and promote the divergence of designers; design thinking, Effectively improve the efficiency of product design. The application of computer 3D modeling technology has changed the way of traditional product design and is the main method of modern product design. The application of computer-aided design can not only greatly improve the design accuracy of products and simulate product modeling, but also shorten the design and development cycle of products, Promote the efficient development of product design industry.

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