Development Status and Trend of Indoor VR Technology Design Under the Background of Big Data

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Abstract. With the development of economy and society, virtual reality technology has been paid more and more attention and gradually applied to all walks of life. Due to its interactive, immersive and real-time nature, virtual reality has a broad prospect in the field of architecture, especially in interior decoration and design. The use of virtual reality interior design allows designers and users to experience effect of what they see is what they get, but also allows users to feel as if they are in the design of the virtual scene, immersive mood. The purpose of this paper is to study the development status and trend of indoor VR technology design under the background of big data. After reviewing the development background of virtual reality technology and its application status in interior design, this paper introduces the technology related to big data, studies the global lighting rendering technology, and then analyzes the interior design system based on big data and VR technology. The experimental results show that the interior design system designed in this paper is accurate. By comparing the detection results of the digital model with the real results, the error of the digital model is not more than 0.5.

Keywords: Big Data, VR Technology, Interior Design, Development Status, Trend Exploration

1. Introduction

With the development of computer technology, multimedia technology, artificial intelligence, computer graphics and network technology, the development of virtual technology has gradually shifted from the simplest software virtual reality to the desktop virtual reality system[1-2]. It will be an important technology and tool to promote the development of the future world[3]. The emergence of
virtual reality, certainly for the innovation of art and technology of combining the architectural design field opens up a new train of thought, it broke the previous architecture design "from the plane, elevation, section and 3 d model" the performance of the model, the designer can at any time "into" own design scene space, from the perspective of arbitrary observation and review their own design, immersive experience space, scale, ambient light, and even the change of the voice, which makes the design more perfect[4-5].

It is a new attempt to use virtual reality to carry out virtual indoor roaming, so as to evaluate the interior design effect. Its purpose is to enable people to conduct an immersive and all-round inspection of the future residence in a virtual three-dimensional environment with dynamic and interactive ways in the planning and design stage. The application of virtual interior system in housing sales will become a powerful tool for developers[6-7]. Compared with the sand table model, it can be a full-size model of the actual house, and the structure of the house can be viewed with the mouse, which is convenient for users to choose houses [8]. Compared with the sample room, it has the characteristics of short time and saving money. Convenient and natural interaction makes people have a stronger sense of reality[9].These advantages make such a system have a broad market prospect in the application of human-device interaction, and also open a new horizon for the application of virtual reality technology in the construction industry and real estate industry[10]. It has obvious practical significance to study this subject.

After reviewing the development background of virtual reality technology and its application status in interior design, this paper introduces the technology related to big data, studies the global lighting rendering technology, and then analyzes the interior design system based on big data and VR technology. The experimental results show that the interior design system designed in this paper is accurate.

2. Analysis of Interior Design System

2.1. Big Data Technology

Big data processing is a powerful software analysis tool and platform that uses specific analysis algorithms to capture and find the potential value of big data generated in different application scenarios, such as the correlation between data and the business logic behind the data.

2.2. Global Lighting Rendering Technology

Assumes that the light intensity of known incident point P, decided to point P of the reflected light intensity is the material of point P, material can be seen as objects for incident light reaction parameters, based on the physical realistic graphics generation, widely described as the reflection
property of the material the BRDF, point P of the BRDF has two parameters, direction of incident light and reflected light \( \omega_i \) and \( \omega_o \):

\[
f(\omega_i, \omega_o) = \frac{dL_o(\omega_o)}{L_i(\omega_i) \cos \theta_i d\omega_i}
\]  

(1)

BRDF tells us how much of the incident light energy from the direction \( \omega_i \) is reflected in the direction \( \omega_o \). We express the light energy radiation of point P in the direction \( \omega \) as \( L(p, \omega) \), then the total reflected light of point P in the direction \( \omega_o \) can be expressed as:

\[
L(p, \omega_o) = L_i(p, \omega_o) + \int L_i(p, \omega_i) f_i(\omega_i, p, \omega_o) \cos \theta_i d\omega_i
\]  

(2)

2.3. Analysis of Interior Design System

(1) Modification of model materials

Simplified model number of faces. Prototype in this paper, we study the indoor model refers to the ready-made Max precision model, the model of integral mainly includes 840000 face, because made by surface rendering and render show plane height, number of surface height does not affect the rendering of the single frame rendering, but based on the real-time rendering of virtual reality technology as the core, more than the interior space small scene in front of the number, will increase the burden of hardware. So, be about to undertake thin body to the face number of original model.

Modify the model UV. In order to correctly display the texture, map coordinate UV should be formulated for each original model so that no overlapping UV is set in each model. The original UV should be kept and new map channel 2 should be set for the model. In this channel, uVW is used to carry out the command to flatten the UV.

(2) Making texture materials

The raw Max model material is rendered using the VRay rendering plug-in, which has a faster rendering speed. In order to retain its powerful rendering effect and apply it to virtual reality technology, VRay light information is rendered as map, so that the map light effect is good.
3. Experimental Design of Interior Design System

3.1. Data Acquisition

In order to facilitate the development of the interior design system analyzed in this paper, the following experiments are carried out under normal conditions. The 100m² common dwelling houses were selected as the experimental objects, and the landscape reconstruction detection experiment was carried out for the washing machine, bed, refrigerator, water heater and TV. Set $X_{idx}, Y_{idx}$ and $Z_{idx}$ as the exponential components in the direction of $X, Y$ and $Z$ of the interior space; $T_{idx}$ is the sum of the three exponential components. Parameter Settings are shown in Table 1.

| Name of furniture       | power | $X_{idx}$ | $Y_{idx}$ | $Z_{idx}$ | $T_{idx}$ |
|-------------------------|-------|-----------|-----------|-----------|-----------|
| Refrigerator           | 200   | 1.04      | 1.33      | 0.99      | 3.36      |
| Bed                    | 0     | 0.07      | 0.41      | 0.33      | 0.80      |
| Washing machine        | 500   | 2.00      | 2.41      | 1.98      | 6.39      |
| TV                     | 150   | 0.91      | 0.82      | 1.03      | 2.76      |
| Water heater           | 1500  | 5.44      | 5.36      | 6.02      | 16.82     |

3.2. Experimental Environment

In this paper, OpenCasCade, based on BREP, was used as the CAD core of the 3D modeler. For the
purpose of research, Blender was selected as the animation output software in this paper. Blender is an open source, cross-platform 3D modeling and animation software that supports different geometry primitives. Qt is a cross-platform C++ graphical user interface library.

4. Analysis of Experimental Results of Interior Design System

4.1. Discussion and Analysis of Experimental Results

The experiment consists of two parts. The locations of the above five furniture and electrical appliances are found in this space. The general model and the digital model are used to observe the five Spaces.

Table 2. Experimental results

| Name of furniture | Digital model | Common model | Real results |
|-------------------|---------------|--------------|-------------|
| Refrigerator      | 3.5           | 6.2          | 3.36        |
| Bed               | 1             | 3.5          | 0.80        |
| Washing machine   | 6.5           | 9.22         | 6.39        |
| TV                | 2.93          | 5.09         | 2.76        |
| Water heater      | 17.3          | 20.97        | 16.82       |
By comparing the results of the two: The results of the indoor space reconstruction detection based on the common model have a large error compared with the real results, and the error will be enlarged in the process of increasing Tidx index. The interior space reconstructed by the digital model has little error compared with the real result. As the Tidx index increases, so does the error. It can be seen that the system designed in this paper can simulate the scene dynamically and reconstruct the 3d graphics of the complex scene.

4.2. Trend Analysis of Interior VR Technology Design Development in the Context of Big Data

(1) Sharing of interior design

In the era of big data, information transmission technology has made great progress, and network coverage is rapidly spreading. How to obtain data information is no longer the first issue for designers to consider. On the contrary, how to cope with the collection, integration, optimization and application of data information in the era of big data has become a major challenge for designers. The essence of the so-called big data is also the aggregation of a sub-data. In this huge data network, each designer is a network node, they are not only the user of data information, but also the provider of data information. In the face of such trend, interior design industry practitioners must through the establishment of effective information sharing platform, makes the different regions, different culture, the designer can hold their data collection information rapidly and effectively output to the corresponding network platform, and careful screening, optimized integration, make indoor design more full and accurate data. The establishment of database of interior design industry will not only bring direct benefits to designers as individuals, but also bring huge public benefits to interior design industry.
(2) Human culture of interior design

For many years, the concept of interior design is people-oriented, which requires that the human culture of interior design must be adhered to under the background of big data. The so-called human culture of interior design, on the one hand, is that interior design must be reflected in the design process for the customer's own personality and spiritual pursuit. On the other hand, interior design is also required to be able to combine regional culture or national culture organically. Interior design of human culture, its fundamental goal is to meet people for the living environment health environmental protection, friendly and natural requirements, so as to achieve the harmony and unity of home environment and human environment. Under the background of big data, designers can understand the humanistic factors in customers' long-term life in the database, so as to deeply analyze and understand the humanistic needs of customers in their interior design.

(3) Ecological interior design

The ecologicalization of interior design will become the mainstream under the background of big data society when the country and the public pay more and more attention to ecological and environmental protection. On the one hand, since the 16th National Congress, the Chinese government has put forward the strategic thought of sustainable development. On the other hand, when the household environment that coexists harmoniously between man and nature is pursued, people become thirsty for the ecology of interior design: beg gradually prominent. To solve this problem, designers should make proper use of big data. For example, when the preliminary design scheme is completed, computer modeling technology can be used to simulate the energy consumption level, pollution data simulation and design cost numerical simulation of the interior design scheme. Based on this, the preliminary scheme can be further modified and improved to achieve the ecological goal of the design scheme.

5. Conclusion

Modern information technology has changed the ways and methods of traditional design. The rapid development and widespread application of VR technology and big data have injected fresh blood into the interior design industry. How to combine the two technologies reasonably and effectively is the problem and challenge that interior design will face in the future. The application of information technology in data age can collect the data in real time and analyze the data to obtain its intrinsic value. First of all, interior design data is helpful for designers to master the range of various environmental indexes in the space so as to realize the optimal configuration of construction materials and the presentation of space effect. Secondly, it helps to improve the work efficiency of each stage. On the basis of clear data and quantitative analysis, the work of each stage is greatly simplified and optimized,
and the monitoring of the project can be relied on in each stage. Finally, it is beneficial to promote the development of interior design. The storage of project data is helpful to guide the future design from both right and wrong aspects. The data of interior design will promote the change of design method.

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