

Research on the Application of VR Technology in Interior Design

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Abstract—With the rapid development of VR technology in interior design, an interactive dynamic design can be made as per the interior design requirement from the perspective of virtual space by applying this advanced emerging technology. In the process of interior design, this technology presents technical characteristics different from traditional design and has more advantages than the traditional one so that the entire interior design scheme can be presented more intuitively and flexibly, the final effect can be precisely presented, and the immersive feeling created by it is more conducive to the expression of the design.

Keywords—VR; interior design; technical characteristics; user experience

I. INTRODUCTION

As interior space is an important space for people's living activities, people have higher and higher requirements and expectations for interior design. With the popularization and application of various design software, the expected planning and effects of creating an entire indoor space have been fully mature, however the medium through which this design effect is delivered to the user is the designer. The designer can create applicable drawing picture through his/her own design for the space on the basis of user's needs, and added it with applicable description and expression and then deliver it to the user. The entire design process may not be able to be intuitively and comprehensively presented to the user. But by applying VR technology in interior design, it is available to well solve the problems appeared in traditional design. VR technology is a combination of various technologies. It uses computer technology and simulation technology to simulate the real space, and use sensing technology to deliver the result to user so that the user can more intuitively enjoy the design process and have an all-round perception of the spatial design effect. Through the recognition of VR technology, this paper analyzes the main features of the technology and explores the application of this technology in the interior space of building as per the interior design demand.

II. CONCEPT AND DEVELOPMENT OF VR TECHNOLOGY

A. The Concept of VR Technology

Virtual Reality technology, also called VR technology, was formally put forward by American Jarn Lanier. As a key

direction of simulation technology, VR technology is an integration of many technologies such as simulation technology, computer graphics, multimedia technology, sensor technology and network technology, and is a comprehensive frontier subject field. VR technology mainly includes simulation environment, perception, natural skills and sensing equipment and so on. Wherein, the simulation environment is a dynamic three-dimensional shape built by computer; perception means that VR technology has the perceptual technology that is associated with human body, and can convey information and make users perceive from multiple dimensions such as sight, smell, and hearing. Natural skills mean that people control and transmit information by rotating body and shaking arms. The information is received by computer which further processes the information to form it into data, give real-time response to user's input, and then respectively feedback the residual data information to the user's five sense organs. Sensing equipment refers to a three-dimensional interactive device.

Nowadays, technology has been gradually penetrated into people's lives. Computer technology has even largely served people's lives. The use of Internet makes the link between people become closer and closer, and information technology also becomes more advanced and perfect. As a combination of new technologies such as computer technology and network technology, VR technology has been widely used in all walks of life, and architectural interior design, as one of the industries that apply this technology the most, perfectly applies computer system to get the design idea and 2D drawings transformed into real building spaces, and get abstract things detailed, so that the designers and customers can also achieve effective interaction and communication.

B. Development of VR Technology

VR technology was firstly put into use in the United States in 1960s, and was mainly used in the US military astronauts and aircraft pilot simulation training; and later the technology was gradually improved and popularized. The generation of VR technology can be roughly divided into four stages. The first stage is before 1963: the simulation of voice shape dynamics is the beginning of gestating VR technology. The second stage is 1963-1972, during which period VR technology was in the embryonic stage. The third stage is 1973-1989, during which period concept and theory of VR began to form. The fourth stage is 1990-2004, during

which period the theory of VR technology has been perfected and successfully applied into applicable industry.

Up to now, VR has been widely known to all. The main reason is that it can use computer to create a virtual space similar to the real environment, and allows users to participate in the simulation environment. This is also the lack of other technologies. Due to the popularity and development of this technology, all walks of life have begun to introduce this new technology for experiencing. For example, in the game industry, the game system developed by using VR technology enables the user to experience the game process more personally, which increases the user experience and operability. Nowadays, many large-scale entertainment facilities have adopted VR technology to create new entertainment facilities through artificial intelligence, virtual scenes, etc., allowing users to experience different entertainment items. In addition to entertainment experience industry, even medical technology also requires the participation of VR; VR technology can be used to simulate the structure of human body, so that medical care personnel or educators can recognize human body more intuitively and clearly; it also facilitates the development of medical industry. In architectural interior design industry, the role of VR technology is even greater. Through the simulation of interior scenes and the creation of interior decoration, this virtual scene space can be intuitively transmitted to users, and users can also feel immersive in the design effect of the entire indoor space and switch over various scenes and orientations as per their needs; the final effect is more dynamic and immersive than ordinary CAD drawings and 3D design sketch, and the design and planning efficiency of designer can also be greatly improved.

III. INTERIOR DESIGN AND VR TECHNOLOGY

A. *The Relationship Between Interior Design and VR Technology*

With the rapid development of VR technology in recent years, this technology has been applied to architectural interior design. Interior design is for the purpose of meeting people's space needs and pursuing functionally reasonable, comfortable and elegant interior environment; in the interior design process, it is needed to understand user needs, design sketches, construction drawings, etc., and more importantly, to show the final design to the user in order to meet user's psychological needs for interior space. The application of VR technology in interior design is concentrated in its immersive and interactive features which is conducive to comprehensive display of the interior design.

Nowadays, more and more interior designers want to develop virtual reality technology in interior design more maturely, so that it can not only conducive to the design process of designer but also refine the design, enrich the expression method of interior design, and diversify the performance forms of interior design. The process of interior design also becomes more expressive because of VR technology. A real design effect is achieved through the simulation design and rendering of the entire space. Therefore, once VR technology can be well used in interior

design, it can not only effectively meet user needs, correctly convey the designer's design intent, but also achieve the design effect faster and reduce the time spent in the design process. Moreover, the use of VR technology in interior design can also accelerate the promotion of this new technology.

B. *Performance of Main Features of VR Technology in Interior Design*

The technical characteristics of VR technology mainly include four aspects: multi-perception, immersion, interactivity and conception. Among them, immersion, interactivity and conception are relatively significant in interior practice. VR technology can simulate the corresponding space, and render a highly realistic space environment by modeling so that people can immerse in the whole environment to experience the interior space design.

1) *The immersion of VR technology*: In interior design, VR technology relies on the computer system to generate the simulated spatial effect; eventually, people can experience the true feeling brought about by this spatial effect, just like being in this simulation space. The simulated lighting, scenes and decorations in interior space all give users a realistic feeling in vision, auditory sense and tactile sense.

2) *The interactivity of VR technology*: Interaction means that users can manipulate and change the objects created in a virtual environment. When using VR technology, user can directly experience the object in the interior space, such as the size, material and volume and weight of the object, and realize a realistic interaction with the details in the interior design.

3) *The conception of VR technology*: Design thinking and creativity are extremely important in the process of interior design, and VR technology can help the designer to realize his creative thinking very well, previously conceive the required environment, design as per the personal understanding of space, and obtain new inspiration that are not available in graphic design. This way can not only facilitate playing user's ability, but also is a process of learning and re-creation.

IV. APPLICATION OF VR TECHNOLOGY IN INTERIOR DESIGN

A. *Significance of the Application*

The mature development of computer technology is the main reason for the emergence of VR technology. The emergence of computer greatly facilitates people's lives. More and more industries rely on technology; and followed by, VR technology has also been applied in many fields of the society. However, the sector that applies this technology the most is architectural decoration. As people's requirements for interior space design are upgraded from ordinary aesthetics to spiritual level, the requirements for design are also constantly upgrading. This is also one of the reasons for the application of VR technology in interior design. VR technology perfectly gets traditional abstract

thinking and 2D engineering drawings transformed into real buildings and architectural spaces by virtue of computer, and get abstract things detailed so that designers and customers can achieve efficient interaction and communication, the designer can more realistically convey the design of the space to user, and the user can also feel the all-round effect and experience of being right in the space through the VR technology. VR technology not only benefits the interior design process and effects, but also enables VR to be better developed and perfected.

B. Technical Analysis of VR Technology in Interior Design

1) *Virtual modeling technology*: In interior design process, the most common and most basic technology among virtual technologies is virtual modeling technology. This technology uses 3D software to design the interior space, designs the modeling in virtual space as per user's requirement, and conducts 3D stretching or composition for the interior space on the basis of modeling technology to show a more three-dimensional entire space design structure.

2) *Scene rendering technology*: After the interior virtual model is built up, the VR technology can be used to further render the model to make the interior scenes, decorations and the like more realistic. If there is no scene rendering technology, the whole room may be in a simple model state, and there may be no way to achieve a sense of reality in the visual effect but by rendering.

3) *Immersive experience technology*: Immersive virtual reality requires high-tech equipment, including data gloves, trackers, helmets, and more. After using those devices, users can completely immerse themselves in the virtual space. By using immersive technology, user can immerse themselves in virtual reality created scenes, and truly feel the real interior space instead of the mere two-dimensional images.

C. Advantages of VR Technology in Interior Design

The design elements of interior design mainly include space, color, light and shadow, and furnishings. Those factors need to be taken into consideration when making interior design. Traditional interior design process is that designer firstly get to know about user's demand for interior space, add his own ideas to plan and design the space on the basis of user's needs, then use hand-drawn or drawing software to draw applicable drawings, and finally conduct interior decoration as per the 2D drawings. This method is very helpful to improve the designer's professional ability and design thinking, but it also has relative limitations. It is difficult for users to feel the same about the design; whereas, VR technology can solve the shortcomings and defects of traditional interior design method.

VR technology is conducive to enhance the "communication and interaction" between designer and user. User no longer needs to know about the design through 2D images, but can have a personal experience in a 3D environment, which is beneficial to speed up the implementation of the design program. The use of VR technology can reduce unnecessary losses in the design

process. The final effect produced by this technology is not much different from the real decoration effect, which can ensure the user satisfaction after completion of construction. In interior design project, the interior style can be switched over at will by using VR technology, which is conducive to the designer's design thinking, and can also get materials, lights and the like used in the virtual space to achieve the most realistic effect; compared to 2D images, this mode of expression is more realistic and reliable.

V. DEVELOPMENT PROSPECTS OF VR TECHNOLOGY IN INTERIOR DESIGN

With the development of construction industry, no matter for residential space or commercial space, people raise higher and higher requirements for interior design, and the professional competence of designers need to be continuously enriched. Hence, the application of VR technology in interior design undoubtedly can give people a new design experience. The application of VR technology in interior design has become a hot trend, because the expression of 2D drawings is relatively limited, while the virtual 3D model for interior space has the same dimensions as the actual effect, and can render the real scene and show a dynamic 3D real space. VR technology allows designers to experience their own design works in an immersive way, and check and correct the design details. For example, by quickly changing applicable parameters, it is available to change the interior materials, colors, and various items. Compared with traditional 3D rendering, VR technology can change scenes faster and more accurately, and can quickly make comparison and application of different design concepts, different material effects, and different lighting colors.

In many real estate industries today, VR technology is used as a new type of marketing tool in addition to being used for making interior design and planning. In traditional indoor model, the interior space effect can only be externally experienced, while VR technology can make people immerse in the space of the model, change the scene and design as per user's demand, and revise the design as required by user, hence to attract users. The process of interior design has also been transformed from static two-dimensional to dynamic three-dimensional mode; through this technology, designer can have more design inspiration and sources. Those are irreplaceable by traditional interior design techniques.

VI. CONCLUSION

With the continuous maturing and development of VR technology, this technology also has an important impact on interior design. The use of VR technology has great value in the design and planning of interior space, and is conducive to completion of the entire interior design. This unique and true space display method makes interior design more scientific and perfect. In actual application, there are still many problems. This is why it is needed to make continuous exploration on the use of this technology in interior design. Only through continuous improvement can it be available to get interior design perfectly combined with virtual reality and achieve better development.

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