Indoor Intelligent Decoration System based on BIM+VR Technology

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Abstract. In the interior decoration industry, disputes between design and actual effects, waste of materials, and poor construction quality often occur. In order to improve customer satisfaction, reduce waste of construction resources, and realize smart decoration in the interior decoration industry, BIM+VR technology has begun to take the stage. BIM+VR interior decoration technology is the use of BIM technology to build a three-dimensional model to realize the three-dimensional visual display of the decoration design plan. Users can really feel the effect of interior decoration through VR technology, and modify the unsatisfactory parts of the design before construction, which can more accurately meet the needs of users. And finally achieve the smart decoration function.

1. Introduction
With the improvement of the quality of life of the people, people pay more and more attention to the health, comfort, beauty and intelligence of the living environment and many other factors. People's requirements for interior decoration are getting higher and higher. Therefore, interior decoration work is becoming more and more important, and its difficulty is getting bigger and bigger. The fresh vitality of VR technology has attracted the attention of many people. BIM technology has gradually been widely used in the construction industry of our country. With the development of the Internet and artificial intelligence technology, various construction industries will be closely integrated with artificial intelligence technology to form a new type of digital construction industry. Driven by the trend of this industry, the integration of BIM technology and VR technology will become the new development direction of the interior decoration industry.

2. Formatting the title, authors and affiliations

2.1. Decoration industry and market situation
The In recent years, the construction speed and development level of my country's urbanization have gradually accelerated, and the scale of cities has also continued to expand. The increase in buildings has produced more decoration projects. For consumers with decorative needs, affected by work, life and other schedules, it is difficult for them to spend a lot of time on the market to select furniture, select decorative materials, and understand the market situation in the industry. They will not understand the gap between the designer's design and the actual decoration effect. Moreover, it is
difficult for consumers in general to combine the design drawings with the actual building, so the results obtained according to the design are often difficult to achieve the desired effect [1].

There are mainly three existing BIM decoration modes. The first is for the designer to come up with several sets of uniform decoration schemes for customers to choose. The second is to provide customers with different ranges of materials according to different decorative parts, and customers can choose combinations according to their own needs. The third is to jointly determine the design plan after communication between the client and the designer. This mode requires a professional design team, and the price is high, and it is difficult to promote on a large scale. The virtual reality technology is called VR technology. The existing VR decoration technology uses a computer to form a virtual reality, and the user feels the entire environment from the first perspective. A set of high-performance VR equipment is expensive, which leads to high experience cost and extremely low penetration rate. As an emerging industry, currently only a few merchants use it as a means of attracting customers, they have not really combined it with products, and the development of supporting resources is still in its infancy[1][2].

Our country's current BIM technology and VR decoration technology can only complete a simple visual experience, cannot produce further interaction and management, and lack of communication bridges with smart buildings and smart homes [3].

3. BIM+VR interior decoration system

3.1. System introduction
It is mainly based on the relatively mature BIM technology and VR decoration technology, and integrates the structural thinking of Internet + BIM to realize the BIM + VR decoration platform of three-dimensional real scene. The main content of technical realization includes design platform, BIM parameter model, VR panoramic preview, product information parameter platform. BIM+VR interior decoration technology has all the functions that can be perceived in the real world, such as vision, hearing, and feeling. It is an intelligent decoration system that integrates design, layout, procurement, cost control, and quality control [4].

3.2. System advantages
This system can make the communication between customers and designers more interactive. Users and designers can quickly understand each other's opinions and ideas. It has real scene simulation, allowing customers to experience the environment in their "home" in advance. Reduce the time and effort of customers on site inspection and selection of products. It is easier for designers to find creative inspiration in the three-dimensional space. And the design company directly cooperates with various product vendors to ensure that the material prices are more affordable and the quality is more guaranteed.

4. System functions

4.1. Visual function
BIM technology can restore the architectural model, and then combine the designer's design plan to restore the real scene in the design. Everyone's height is different, and the position of the eyes to observe the environment is also different. The existing VR technology only provides the visual simulation route that the customer has designed. There are also certain differences between virtual colors and actual objects, and customers cannot achieve the real experience of entering the room during the experience. Use BIM rendering technology to enhance the rendering of the interior details of the room, such as furniture, wallpaper, lighting, floor, etc., to accurately achieve the authenticity of the visual effects of the rendered objects in all directions. And import the design rendering results into the VR equipment, so that customers can truly experience the actual effect of decoration, and achieve what you see is what you get [5].
4.2. Sound function
In real life, people can clearly determine the source of the sound, and the sound is more realistic. Different objects have different impact sounds, such as the sound of opening doors of different materials, the sound of walking on the floor of different materials, and the sound of opening drawers. We can use VR technology to truly bring the experience into the experience by recording the sound effects of the various decorative equipment designed.

4.3. Tactile function
In the virtual system, we can see door handles, sofas, tables, walls, but when we grab these things, our hands do not really touch the objects. The operation of opening and closing the door is only realized by using the options that have been set in the video. When we want to open the door, touch the curtains, or the table, our hands will pass through the virtual objects and cannot feel the real decorative effect. In this regard, we can use data gloves, sensing cushions, etc., to access the touch data of various objects, and set up contacts inside the gloves and cushions to simulate the touch of real objects. VR is not a simple head display. At present, some companies have developed gloves and finger clips that can simulate the sense of touch, which can accurately experience the touch feeling of various objects in the virtual environment.

4.4. Voice interaction function
Voice recognition is also very important in the entire system. It is mainly to enable the virtual environment to understand what people are saying, and to realize real-time communication and interaction with people like smart furniture. We have entered the era of artificial intelligence, and artificial intelligence technology can be used to train and recognize voices, to conduct self-learning on users' voices, and to achieve barrier-free communication between humans and machines. This approach not only reduces the work of sales staff, but also enriches the user experience.

4.5. User-designed functions
The designer uses BIM to design according to customer needs and house types, and draws three-dimensional design effects. Then connect it with VR technology equipment, allowing customers to experience the decoration effect in all directions in advance. Before the design is finalized, users can make changes to unsatisfactory locations, such as the color and pattern of the wallpaper, the material of the floor, the style of the sofa, the size of the furniture, etc.

The real size, material, color, style, price, etc. of all decorative furniture and equipment entered in this system are for customers to choose. Customers can use the corresponding selection device to independently select the material and color of the bed, sofa, floor and other parameters in a virtual environment. At the same time, through the voice interaction function, you can understand the prices and characteristics of different furniture, so that customers can have more choices to achieve their ideal decorative effects. The designer's design style does not meet the needs of all users, and different apartment types use the same design plan to achieve different effects. Therefore, the combination of diversified design styles and architecture can bring more visual experience to users.

4.6. Price budget function
When the customer changes the design content, the price list will also change. According to the design plan selected by the customer, the price list of furniture and decoration costs and the total cost of each room can be output immediately. The system can recommend the best match according to the decoration style selected by the customer, such as the most affordable match and the most space-saving match. After the customer determines the final decoration plan, he can enter the payment electronic payment system to confirm the order and make payment.
4.7. Design model storage function
This function is used independently by the designer. The decoration design of each style of his design is stored in this platform. When designing, the designer only needs to modify the imported design template in the new building model. This method can effectively reduce the designer's workload and increase design efficiency. In this part of the function, each designer will have his own independent account and password, which can effectively protect the designer's design plan and intellectual property rights.

4.8. Engineering quantity budget function
The engineering quantity of the system engineering is completed by professional budgeters according to the engineering drawings, or estimated by the relatively experienced construction personnel. In this way, the calculation method is prone to inaccurate engineering quantity calculations, which will cause material waste. BIM technology can quickly count the amount of construction materials and simulate the construction process, saving manpower and material resources, and improving work efficiency [6].

5. System operation process
The implementation process of the installation system based on BIM and VR is different from the ordinary decoration process. The system flow chart of the BIM+VR decoration system is shown in Figure 1.

6. Technical disadvantages of hardware facilities
At present, all VR devices on the Chinese market mainly include 3D scanners, head-mounted displays, etc. Users are prone to dizziness and fatigue when using them; this will reduce customer experience. In addition, the current VR hardware requires a long cable to connect to the host computer, display device, and interactive device. People will walk back and forth during the VR experience, and it is easy to trip over.
7. Conclusion

The research purpose of this project is to realize the interconnection of BIM and VR, so that the model has richer connotation and expressive power. Through reasonable analysis of construction materials and engineering quantities, time can be saved more effectively, quality and cost can be controlled, and decoration efficiency and effect can be improved. The purpose is to achieve what you design is what you see, and to achieve smart decoration in the interior decoration industry. BIM+VR technology has brought new development and opportunities to the decoration industry, and has taken new steps for the "digitalization" of China's construction industry. Although VR technology at home and abroad is relatively mature, there are still many shortcomings in smart technology, product quality, core technology, etc. Therefore, in the future development, further research and innovation of smart decoration are needed.

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