Research on Method and Application of Architecture Visual Design based on BIM + VR

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Abstract. The traditional architectural design method leads to the application of building information model in the operation and maintenance management stage, so the collaborative design function of building information model is difficult to play, resulting in the waste of BIM model data information. The VR visualization technology based on the BIM model deeply digs the data resources of BIM model, such as geometric dimension, material attribute, etc. through free roaming and real-time rendering in BIM model, through the immersive experience of BIM model in a design stage, the owner and the resident can communicate their opinions and suggestions with the architect in the form of feedback from their own perspectives, so as to achieve the real sense of collaborative design. Based on the above principles, taking 1-yard 20 project as an example, this paper introduces the visual collaborative design method of VR technology based on the BIM model in detail, and analyzes the existing problems of this technology. Finally, in view of the problems existing in the application of this technology, the future development of this technology is prospected.

Keywords: Visual Design Method, VR, BIM

1. Introduction
The rapid development of modern science and technology constantly affects the field of architectural design, and promotes the renewal of design tools and methods[1]. However, in terms of the whole architectural design process and design results, there are still many problems, mainly in the following aspects. In the architecture design based on BIM Technology, digital data information is the core[2]. The deep application of these data information needs the cooperation of different disciplines and departments[3]. Collaborative communication between different disciplines can only appear in the construction and operation management stage at most, which greatly reduces the efficiency of...
collaborative work of different units. Up to now, after the completion of architectural design, most of its effect display is mainly display from different perspectives, and only fixed path or perspective display can be carried out in three-dimensional display[4]. This simple visual impact is difficult to really attract the user's feeling, and it will also cause the omission of information table, which leads to the deviation between the actual architectural effect and the user's expectation.

2. BIM + VR technology

BIM (building information modeling), which is the combination of building model digitization and information, basically includes all the information of building project, including geometric information and non geometric material properties, volume and other information[5]. Therefore, before the construction of the construction project, the BIM model can be used to preview the information after the completion of the whole project. Based on this model, construction simulation, and subsequent model analysis can be carried out[6]. The core of BIM is that model information can be used in the full cycle, and the essential requirement is collaborative design. However, at this stage, BIM can only rely on designers to design passively, but can not actively accept the suggestions of users and managers. Therefore, the collaborative advantage of BIM Technology is difficult to play.

VR (virtual reality) technology is to put users in a virtual building environment to obtain user experience based on the target environment. Based on VR technology, users can enjoy the most real building projects in advance. Immersion, interaction and imagination based on the target building are three important characteristics of VR technology.

3. Development of BIM + VR

The whole development process of BIM + VR is similar to that of VR game, in which BIM provides basic 3D materials, which is equivalent to the game universe development in game development, while all 3D engines and rendering engines used in VR development are engine systems often used in 3D games. Therefore, the development model of BIM + VR in this paper follows the 7-layer waterfall development model used in game development. As shown in Figure 1.

![Figure 1. Development Model of BIM + VR](image-url)
The development model starts from the copywriting planning, writes the basic code on the basis of various 3D engine development tools such as particle engine, physical engine, optical engine, etc., and then jointly debugs the code and the model, and finally realizes the BIM + VR system on the VR equipment. The final debugging and system packaging go online. Different from game development, BIM + VR system does not need to develop cool fighting engine part, nor do it need to develop character attributes and integral attributes, but it focuses more on VR reality and restoration degree, to ensure that the modeling of BIM part can restore the real state of the real estate to the maximum extent. During BIM development, the whole building is still in the planning state, and there is no physical object as a reference. All the development work needs to be carried out on the architectural construction design drawings, so the BIM development process needs the full participation of the architectural engineer. However, construction engineers lack project experience in VR development, and the communication between VR engineers and BIM engineers becomes the key to affect the quality of BIM + VR system development.

Based on the results of architectural design and virtual environment rendering, VR video can be output and virtual browsing function of model cloud can be realized. Based on different application of building model, different interaction scenes can be designed by VR technology. For example, in order to prevent the occurrence of safety accidents in the process of construction and operation and maintenance, the simulation experience and emergency rescue of safety accidents can be carried out by combining the whole body action to catch electric shock and other accident disasters, so as to realize a more real simulation of safety accidents and reduce the occurrence of disaster losses; the rendering of construction interaction scene can facilitate the construction personnel to have doubts about the drawings at the moment. Review and consultation: in the drawing stage after the completion of architectural design, SketchUp model can also be exported to Revit through Mars plug-in for further inspection and modification, and finally 2D drawing can be realized to guide the construction.

4. Summary
Because BIM model integrates all information of construction project, construction simulation and model analysis can be carried out based on this model. VR technology enables participants to roam in virtual reality and realize real-time human-computer interaction based on human feelings. Therefore, VR technology based on the BIM model takes the real feelings of people as the starting point of design, and the way of collaborative design as the core of the whole design process. On the basis of BIM information model, it realizes the design participation of many parties in the whole life cycle of the building, improves the design efficiency, and maximizes the expression of the architect's design intent. In the early stage of design, it can realize the collaborative communication between the designer, the owner and the public, bring the owner and the public into the design process of the building model, and achieve the optimal design of the building project. VR collaborative design based on the BIM model has more advantages than traditional architectural design methods, but at present, due to the existence of various problems, it restricts the development of BIM + VR technology in the field of architecture, so the research of this technology in the field of architecture only stays on the stage of architectural design.
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