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

Ben Zhang
Associate Professor Department of environmental art design, Hubei institute of fine arts 430060, China

*Corresponding author e-mail: ytiaogou@163.com

Abstract. BIM is not only a 3D model, it provides information about the physical and functional components of the structure to support its construction and management throughout its life cycle. VR is not only to provide immersive simulation, it can also be called an integrated collaborative design platform, which will completely change how architects use BIM Technology. The application of R technology in the field of architecture and BIM system will further visualize the causes and results of architectural design. Multi disciplines can also start to intervene from the beginning of design, integrate various factors in the design process for consideration, maximize the expression of design intent, and enable users to experience it personally.

Keywords: Visual Design Method, Application of Architecture, BIM + VR

1. Introduction
After the 1990s, digital design thinking and digital technology gradually penetrated into urban planning, urban design and architectural design virtual, urban and architectural history research, virtual construction and other aspects. At present, the fields of architecture, engineering and construction (AEC) are gradually changing from the past information exchange form based on two-dimensional drawing (CAD, etc.) to the processing form based on three-dimensional model[1]. The concept of building information model (BIM) is just to make the architect's design content change from 2D drawing to 3D model embedded with a lot of information to express the building in detail. In turn, it opens up a new possibility of using real-time visualization and virtual reality (VR) as a tool for communication and understanding in the design process[2].

2. Analysis of the Practical Problems of BIM + VR
At present, although the pace of China's construction market has slowed down, the overall construction volume is still quite huge, especially with the construction of infrastructure such as subway in the second and third tier cities, in the face of numerous construction and construction projects, how to more efficiently promote the transformation of the construction industry in the field of...
architectural design becomes particularly important[3]. However, in the current application process, there are still some problems:

1. The traditional way of architectural effect display is usually through plan, effect drawing or animation, which can only display the fixed angle and path, resulting in the omission of architectural design information expression, the understanding deviation between the architect and Party A, and then the error between the architectural design and the actual effect after completion [4].

2. Facing the problem of data information cooperation and interaction in digital design. The advantage of Bim in the field of architectural design is collaborative design [5]. However, it is often used in the construction and operation and maintenance management stage after the completion of architectural design, and the means of implementation and the population covered are also limited. The lack of visualization degree and scope leads to the low efficiency of multi-party cooperation (the inaccuracy of information transmission and the deviation of understanding), which leads to the error between the architectural design and the actual effect after completion. A complete construction project from the beginning of design, to the final delivery of construction, and then to the final operation and management, are facing different disciplines, different groups of docking and coordination work [6]. However, the processing of this process is often affected by the different professional background, knowledge structure and understanding ability of the communicator and the receiver. In the process of docking between designer and Party A, it is still possible to cause deviation of understanding and reality through 2D drawings, renderings and animations; in the process of docking between designer and structural engineer, it is also possible to cause error between architectural design and construction drawing design due to the limitation of 2D CAD drawings and insufficient model accuracy; in the process of construction, especially for large and complex buildings Design, one-day problems, the loss of human and material resources are very huge.

3. The evaluation system of the whole architectural design field focuses on the results, and pays less attention to the process evaluation. In the process of architectural design, architects and structural engineers mainly use professional drawings for docking, while architects and party a mainly use renderings for docking. Due to different professional backgrounds, Party A has limited participation in the process of architectural design, which is basically a split process. Its mode is: design completion → report to Party a → redesign. As the main users, the time for the public to participate in the construction activities is often before the beginning and after the end (preliminary research, later use and evaluation).

3. Overall Architecture Design of BIM + VR System
BIM + VR is the integration of BIM Technology and the latest VR technology in the construction industry. The general idea of bimvr is to carry BIM model and its data based on VR engine technology, and to use the characteristics of VR engine to realize various BIM applications. Compared with the traditional model engine to carry BIM model, bimvr can make use of VR engine to realize a more realistic visualization mode and easily connect VR devices. At the same time, based on some physical characteristics and network interaction characteristics of VR engine, bimvr can realize collision detection, light environment analysis, sunlight analysis, distributed system and other functions, greatly improving the application ability of BIM model. As shown in Figure 1.
Figure 1. Overall Architecture Design of BIM + VR System

4. Development and Design of BIM + VI
The system development of BIM + VI mainly involves the following hardware and software: SketchUp, Rhino, 3DMAX, Smart+, Google Cardboard and other VR glasses, mobile phones and other handheld devices.

Students choose SketchUp, 3DMAX, rhino and other modeling software to build the model, then upload the model file to the smart + platform with one click, and further adjust the environment parameters such as light and material to complete the VR display scheme. In the process of design, you can wear VR glasses to do immersive experience, experience the relationship between architecture and environment, people and space, space and time; from which you can feel the reality of
architecture, which greatly improves the efficiency and quality of architectural design. The collaboration mode is mainly through: students share QR code to teachers and other participants after design, and interact face-to-face or through written records.

![Diagram of Spatial Composition, Virtual Space, Space Imagination, Interaction Design, Constant Feedback, Time, Space Resolution, Structure, Function, Material, Scene, Feeling]

**Figure 2. Development and Design of BIM + VI System**

1) Phase 1 (week 1): virtual pre preparation. A theoretical knowledge: in this stage, combining with traditional theoretical teaching methods, students are guided to establish the concept of space elements and composition methods, and experience master architecture as a case in VR. B investigate the site and build a virtual scene. All participants went to the site for site investigation, recorded important design factors such as terrain height difference, and considered natural factors such as light and wind. Then, virtual scene was constructed in groups, combined with terrain and real scene. C clear design logic. In the virtual scene, experience the site environment again from the perspective of the first person and "God", and gradually clarify their own design logic combined with the theoretical knowledge learned before.

2) Stage 2 (the second and third weeks): virtual interaction design, which includes a large number of modeling (modification), virtual roaming experience, constant feedback and interaction between teachers and students observers. During the design period, the students constantly consider the model, and through the smart + platform, they can Virtual Roam the phased scheme and sublimate themselves. In the weekly design class, students can explain the scheme in the virtual roaming, and teachers can conduct all-round immersive virtual roaming experience in the design scheme, which means to discuss and communicate with students online if they find deficiencies; observers (other students and teachers) can conduct virtual experience and comment on the scheme from different positions through shared links. In this stage, students can start from the virtual scene, to the building block, space scale, to node space and construction mode, to material performance, and gradually deepen the design concept and details from concept to part.

3) Stage three (fourth week): virtual performance. This achievement mainly shows the way of drawing, virtual roaming and animation. The renderings, design nodes and construction details can be generated by virtual roaming screenshots. The horizontal and vertical sections can also be processed by model making software (such as Su, rhino) to export drawing files and screenshots VR roaming as the base map for performance. In the on-site display stage, visitors and grading teachers can not only
read each architectural design through drawings, but also experience the QR code shared by each architectural design, experience each architectural design through Google cardboard, and experience the space, time and artistic conception of the building from multiple perspectives.

5. Summary
After architectural design and virtual construction, VR video can be output, cloud browsing, etc., and website and public account can be launched simultaneously. The project quality management can be based on the scene model system, assessment and scoring system and other subsystems, aiming at all kinds of standard construction technology, it can be extracted from various technical documents and national standards, and design VR interaction process that meets the actual needs. The virtual experience scene established by VR technology, combined with the whole body motion capture, body feeling, electric shock and other force feedback wearable equipment, can be used to experience various VR construction safety accidents and preview construction difficulties in advance. At the same time, the visualization platform can let the construction personnel review and feedback in time when they have questions about the drawings.

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