



BIM + VR Based Synchronization and Interactive Technology in Interior Design

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Abstract. “Seeing is believing” VR virtual technology and BIM technology three-dimensional display, so that the use of BIM + VR is very complementary, that is, with real visual effects to express the designer’s design intentions, but also to view the real information, breaking the traditional design thinking, to give users a VR immersive experience, the use of modern technology to achieve the sharing of information technology, to facilitate the relevant parties to provide effective data reference, followed by analysis and evaluation and pre-control and use of the whole process, to achieve good design results and improve the efficiency of interior design.

Keywords: BIM · VR · Interior Design · Application

1 Introduction

BIM has penetrated into all fields of design, and changed the traditional construction method in the design method, providing the function of “arbitrary disassembly” for interior design, and the birth of VR has brought people a different perception and interactive experience, the combination of the two enhances the technical level between mutual fields. The combination of BIM + VR helps to avoid design risks in the pre-program review and simulate 3D programs in construction to reduce the accident rate. [3] And interior design is only one aspect of VR and BIM integration, the future use of BIM and VR system platform will have more new space, in this process, whether in the research of equipment and hardware, or in the content filling and interactive function experience, when BIM and VR really integrated with each other, not only the virtual world and the real world without trace switch, but also feel “Only in this mountain” mood experience.

2 Walking into the BIM and VR

BIM, through simulating digital information by core big data technology of buildings, establishes a multi-dimensional, structured data base; with relevant data and information

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of the construction project, conducts the model building; at the three levels of data, technology and collaborative management, provides scientific project management. It has eight characteristics: information completeness, information correlation, information consistency, visualization, coordination, simulation, optimization, and Chartability. [9] VR, as a virtual technology, mainly has the characteristics of multi-perception, existence sense, interaction, autonomy and so on. From the perspective of characteristics, VR can combine BIM in visualization and interactivity, then show the advantages of BIM to the general public in the greatest extent. It is not only reflected in screen, but lets people get a truly realistic indoor experience. VR immersive experience strengthens BIM's concrete and interactive functions, greatly improves the application effect, thus pushes its promotion and application in the design field.

The specific connotation of VR, in simple terms, is the interactive simulation system using information technology to stimulate a virtual world for users. It uses computer to fuse multi-source information and by 3D dynamic view, and lets users perceive the virtual world under the physical behavior. [13] VR can enhance the display effect of architectural and interior design, and can also carry out construction simulation drills in an immersive way to help the construction party understand the construction process. In interactive aspects, interior designers can use the VR to complete the immersive decoration design. VR both enables the experiencers to be personally on the scene, clearly view every part of the engineering structure, and can fully grasp the process method in the construction process, which helps to realize the virtual and realistic crossing.

3 Advantages of BIM + VR in Design

VR, based on the BIM 3D model, enhances visibility, concreteness, and interaction. That is to say, it solves the two long-term pain points in the design: one is the design effect is unknown, the other is the engineering quality is unknown. [12] Unknown design effect refers to that the actual effect is unpredictable, the construction party can not grasp the design schematic diagram, while customer is also difficult to predict the construction situation; to solve the above two pain points, BIM + VR, the synchronous and interactive technology is created. The flow is shown in Fig. 1.

The use of BIM + VR can use VR to enhance the BIM and accelerate its promotion and use. Its design effect is within reach to provide an immersive experience. In addition to solving the biggest two pain points in design, “What you see is not what you get” and “difficult engineering control”, BIM + VR also has the advantages of overall planning, resource integration and concrete construction. [7] The VR is based on a 3D

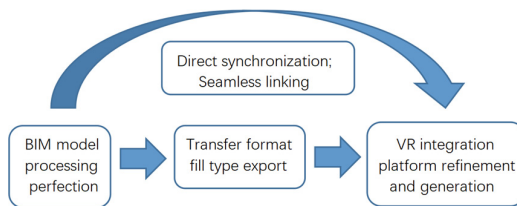


Fig. 1. Specific flow chart of BIM + VR combination in the actual project.

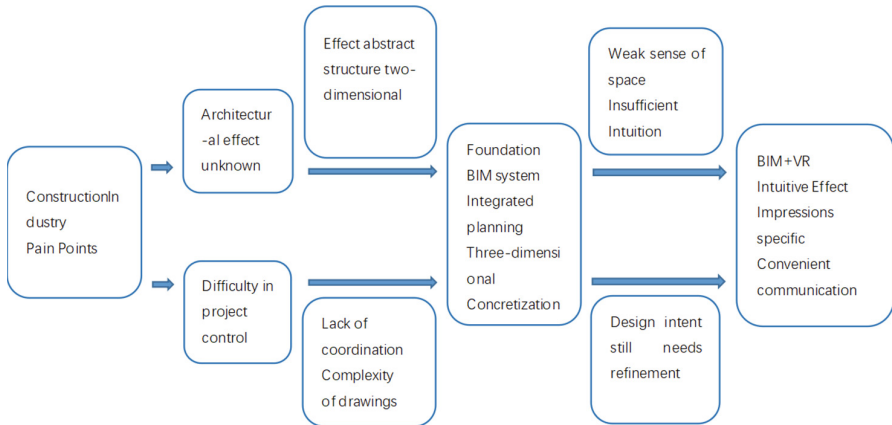


Fig. 2. Construction industry pain point solution path: BIM + VR.

model of the BIM, systematic BIM can also let design more intuitionistic informatization, three-dimensional that visibility and concreteness were strengthened. [8] And through the introduction of a powerful new 3D engine, rendering effect of the picture is greatly improved that achieves the seamless two-way transmission between design and practical effect. From design, construction to operation coordination, designers can integrate information data from various projects and freely create in virtual scene. Solving the pain points of the construction industry is shown in Fig. 2.

4 Application of BIM + VR in Interior Design

BIM's interior design can realize virtual reality rendering through VR and can be displayed in roaming animation form which make us know the structure, environment, materials, light, tone, and the overall style of the interior design more intuitively and clearly. Highly visual to keep the design within reach, what you see is what you get, the combination of both is more intuitive and concrete.

4.1 Interior 3D Design

BIM technology through digital means, the establishment of a virtual building, through the virtual building will provide a complete and contains logical relationships of the building information base, BIM based on three-dimensional data platform, the use of parameters will be flat drawings to play a larger editing space, improve the efficiency of modeling, prompting data integration and transfer of this goal to be achieved. [15] In interior design, BIM uses information modeling (containing all the geometric dimensions, spatial relationships, piping structural functions and performance and other information involved in interior design projects) to plan construction of the interior design costs in general, using three-dimensional models to determine whether the spatial relationship between the shape and structural components fit together, and whether pipes such as water and electricity pass smoothly between structural beams and columns, from

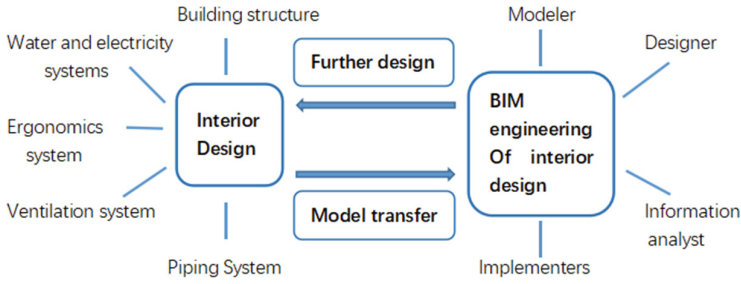


Fig. 3. Interior design and interior design BIM engineering interaction diagram.

design, construction to operation Coordination, the information data of various projects are integrated, the project process is predicted in advance to reduce errors and facilitate timely modification of the program, and in the actual construction of the project, if contradictory points are found, the constructed spatial relationship can be checked and confirmed through the dynamic demonstration of BIM technology, which brings convenience to the later maintenance and repair. [5] As shown in Fig. 3.

4.2 Indoor Sight Line Design

Different indoor environments have different requirements for interior sight lines. For example, when designing a commercial building, designer is under industry standards, strictly selects materials, comprehensively considers things to ensure designed works meeting the needs of users and rational using the materials.

Comparative analysis by the BIM technique makes several expected designs more specific and choose the best one, thus ensures high efficiency. Therefore, whether home interior design or commercial design, BIM provides technical support and application strength, and gradually replaces traditional technology. [1] Users then enjoy a scientific and reasonable indoor environment. This is especially true for places emphasizing visual effects, designer finds the corresponding viewpoint and fully considers the indoor environment, through comparison, finds out the gap then chooses the best visual effect and makes the most scientific and effective assessment of the line of sight, so as to improve the indoor sight line effect. [6] Take a theater as an example, the designer mainly references to sight line design and comprehensively considers basic parameters of the theater design, the slope of the ground rise and so on. While studying the plane form and functional relationship of the audience hall, designers also draws simulated line of sight by mannequin then uses BIM to compare the viewing effect of each audience seat and test it. Finally, designer makes reasonable adjustments to the seat spacing distance, visual height difference, minimum visual distance and the direction of the seat to ensure that every audience can experience the best viewing effect when watching the play. [11] For general hotels, it is necessary to take into account both the construction of landscape decoration and the formation of a reasonable natural transition relationship between the hotel interior space and the external architecture and landscape, which can, to a certain extent, enhance the harmony between the interior environment and nature and give users a relaxing experience visually and spiritually.

4.3 Indoor Lighting Design

Green interior design concept, not only effectively reduce the waste of resources, but also can bring people more visual beauty, different commercial buildings, its indoor lighting requirements are also different, designers need to consider the whole picture, combined with the characteristics of the place, the use of BIM technology to simulate the lighting effect, and according to the specific conditions of the three-dimensional space, design the focus of lighting and concentration area, the key indoor lighting area and decorative Lighting area for reasonable layout, so that the organic integration, so as to achieve the maximum optimization of indoor lighting design. [10] Let the design effect meet both customer needs and aesthetic definition. In order to be able to enhance the design effect to the optimal, VR technology is used for dynamic monitoring, experience in the specific implementation process will be more specific performance of several preconceived plans, and from which the best plan is selected to ensure the best effect of interior vision design.

4.4 Indoor Livable Design

Livability design is an important factor in interior design to meet consumers' needs, especially the circulation of indoor air, surrounding noise and the overall color of the room will have a certain impact on consumers' living experience. When doing the indoor green and livable design, designer under the overall design ideas, reasonably selects materials, uses suitable construction technology, decorates properly. With the help of BIM, indoor livable design model is constructed through the following factors: 1. Indoor natural ventilation conditions. 2. Reasonable choice of green decorative materials. 3. Reasonable collocation of indoor home furnishing and soft decoration. 4. Reasonable construction technology. Designer considers all these factors then make the overall layout. Unifying indoor air pressure, temperature, and the overall livable environment, designer uses BIM specifically analyzed volatile organic matter content of interior decoration materials so as to complete the calculation of specific values, to reduce the use of contaminated interior decoration materials. [14] For indoor green plants and soft decoration, designer firstly calculates the actual level of green plants absorbing pollutants, predicts the purification effect of indoor soft decoration and tries to maximize the increase of indoor air purification. For the noise pollution, the specific source should be analyzed, so as to improve noise reduction. Meanwhile, The relationship between sound intensity and quantity should also be found to achieve the best indoor sound insulation. [2] BIM has shown a lot of excellence in livable design, for example, indoor daylighting and ventilation outlet treatment, indoor lighting lights placed, kitchen toilet covers an area of reasonable distribution, etc. It maximize the green channel of the indoor environment. The following cases further explain the application of BIM + VR in interior design. As shown in Fig. 4 and Fig. 5.

Figure 4 is one project utilizes VR device to experience BIM refined decoration model room. BIM + VR allows the home owners experience home in advance. In VR, they can feel the comfortable decoration of houses, warm indoor atmosphere and clean and tidy layout of kitchen and bathroom. They can also take elevator, look the scenery from top and experience other virtual scenes.

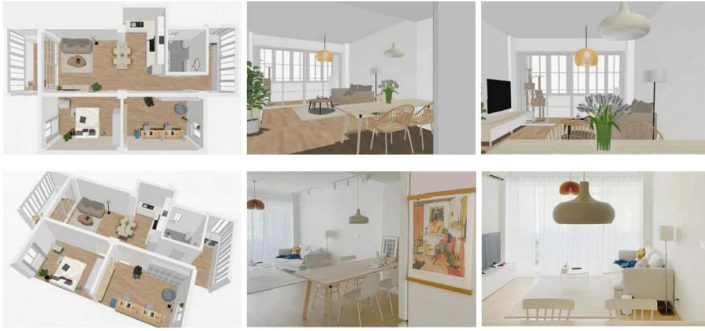


Fig. 4. Using VR equipment for BIM finishing model room browsing experience.

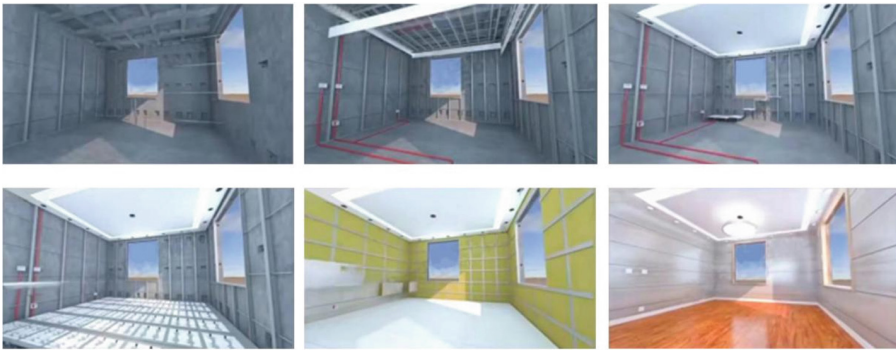


Fig. 5. Using VR equipment can visually read the BIM model related information display chart.

Figure 5 is using VR make reading of size information of plumbing pipe in BIM model and below in Fig. 5 is using VR equipment to read the net height data of the components in the BIM model for visual analysis. Through the existing BIM model, the basic format of the model is converted and extracted, and a certain degree of geometry lightening and effect processing is carried out, discarding the attributes and information of the BIM model itself, and the processed model only has the appearance of the form, which is used as the model for the subsequent development of VR experience, optimizing the appearance effect, plus specific animation interaction, without the real-time reading and analysis of BIM data. It is a perfect interpretation of the synchronization and interactive technology of BIM + VR in interior design, which fully demonstrates the intuitiveness and interactive function.

5 Conclusions

The BIM + VR can be effectively applied to the interior design and has the intuitive effect to improving the display and visibility of it. Rationally using BIM and VR can effectively improve the interior design effect, greatly meet the needs of customers and realize the real experience of interior design thus to improve the satisfaction of demanders. [4] The

application of BIM + VR synchronization and interactive technology in interior design is only a beginning. In the future, it is the long-term path of BIM + VR to use it building virtual cities, creating more new space for cities, promoting the formation and change of super-large cities, and assisting the construction of smart cities.

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