SHOW OR USE

The Usage of VR for Complex Space Recognize Research

Abstract. VR technology can represent the space of architecture and urban study in an acceptable way. It’s not only for the visualization of the architecture and urban planning but it also can be used in the essential research of architecture space. After the installation of a big scale VR system for the College of Architecture and Urban Planning in Tongji University, we’d like to introduce an application of VR in the complex space recognition research and bring forward a concept of Pure Space for the architecture research in VR system.

1. VR & Architecture Space

The consideration of form and space plays an important role in architecture and urban study. Although many theories of architecture in China nowadays put much emphasis on culture or even philosophy, and the range of urban study has been enlarged to cover almost every aspect of human life, all these researches will finally be materialized as various forms of buildings, the inner and outer space of such buildings and the urban space formed by them. As a project funded by National Science Foundation, “The Research on the Way-finding Mode and the Safety Design Strategies Based on the Spatial Features in the Complex Environment” (No. 50408038) focuses on architecture space.

Images, animation or models, none of these can express architecture space in an ideal way. The experience of architecture space has a visual point more flexible than that of animation and a sense of scale that a model can’t give. Moreover it’s 4-dimensional, which means the co-action of time and space. Due to the development of IT, VR (Virtual Reality) lights up the future of solving the problem.

It’s ideal to adopt VR in the consideration of form and space in architecture and urban study. First, VR can perfectly display a 3 dimensional geometric form. Through the interaction with a computer, you can observe a building from any angle in any way as you wish. This exchangeable feature shows the four dimensions of architecture naturally. With appropriate display usage the VR image can fully match with the observer’s visual point and angle and make him see a space of the equal proportion to that in reality. In addition to presenting the form and outer space of architecture and urban environment, VR can give more real information by reinforcing the sense reality. For example, combined with GIS, VR is able to provide non-visual information such as owner, investment, ventilation, the quality of the patch,
traffic, population and so on. These data suspending on the relative element complete the info researchers need.

2. VR System for Show

The College of Architecture and Urban Planning, Tongji University has been concerned in the impact of IT on the development of architecture and urban planning since 1980’s and set up the National Modern Technology Laboratory of Urban Planning and Design. It was the only scientific research institution belonged to the National Department of Construction that did researches in the impact of IT on urban planning and design at that time. At the beginning of the 21st century, our college decided to develop a digital system of architecture and urban planning based on VR responding to the fast progressing information technology. Not only will it keep us capable in traditional architectural study, it’ll also be a fundamental study method in this modern information society.

The system construction of VR started in 2002. The aim is to present the design through VR system to the client and to avoid possible misunderstanding resulted from abstract plans, which allows a number of people observing at the same time. Four HP WX8000 PC workstations and six BARCO SIM6 specific projectors finally produce an interactive 3D image which is ten meters wide and three meters high.

The system is soon put into use after set up. The National Olympics Gym for Table-tennis was the first experimental building, which is one of the main gyms for 2008 Beijing Olympics. The helix spheroidal roof was an important part and in order to make sure about scale and measurement, VR can help to compare the roof in different scale at any angle.

The planning of 2010 Shanghai Expo is another practice. The large screen 3D interactive image is superior in representing large scale urban space. A big image is convenient for leaders and designers to view and communicate in “Live”.

However VR is utilized more in presentation of design. In a large scale urban space like the Expo2010, leaders can’t thresh out in a short time through VR. The almost fixed route makes VR closer to 3D animation. The function of VR in space study is neglected to some extent.
3. Use VR in research

“The Research on the Way-finding Mode and the Safety Design Strategies Based on the Spatial Features in the Complex Environment” intend to explore all the aspects that can help people find their way out in a complicated indoor environment thus making safety design strategies to give advice in the design process and safety assessment. This actually belongs to the study of environmental behaviors. A traditional way of collecting information is to give out questionnaires. With a further step in the research, we find that all elements in a complex and compound space formed an obstacle in finding a way out. These elements are hard to analyze quantitatively and qualitatively. So we begin to use VR to assist in research of this way-finding mode.

VR technique available now isn’t capable of representing the real world completely. An artificial image can be easily distinguished from a real scene thanks to the acute observing ability of human eyes. And, visual changes caused by motion are hard to realize through the existing VR system. Doubts about the adoption of VR in the research of environmental behaviors have been raised recently in other countries. Our system probably is facing the same problem. First of all, even professional projection system worthy of millions of RMB is not able to provide images that can compete with real scene in color, light and contrast. The workstation isn’t strong enough in calculation due to the limited funds, so the reaction speed is low. The delay of image transition can’t be avoided even use a SGI workstation when the space is too complicated. 3D models and pictures are necessary if we want the VR scene to be close to reality. People experience a space in motion in reality and by walking if indoors. 3D Trackball and digital glove can’t adapt to the visual change caused by walking. As a result, VR is impossible to imitate a real scene.

Figure 1. Tongji’s large VR System
To solve a contradictory problem resulted from the complexity of real scenes and the limitation of VR; we started to seek a ‘purified’ ideal space. It’s like doing a scientific experiment, you put the object under control, simplify and purify the natural process, remove all accidental factors and disturbance, so that the responsive characters show in a pure way. We look up a great number of documents home and abroad, find the independent factors that will affect people while they’re finding their way and design experiments according to these factors to see how they influence the way-finding mode. For example, the width, height and angle of an exit and the distance to it all have influences on people’s behaviors. We can develop a space with exits of certain height and width from certain angle in certain distance and learn about people’s choices.

It’s difficult to build an area and keep changing its exits in reality. So is to find somewhere with exits of different sizes in various location. Even if there were such space existing, there would be other aspects that could affect the setting. For instance, illumination and texture lead to directions. Under this circumstance, VR has the advantage.

It’s easy to build a space model via VR and change its exits and other conditions. In a virtual world the dilemma of imitating a real one lies in the details while in a purified space this dilemma turns out to eliminate the disturbance. Illumination is well-distributed without any appearance of light and texture is uniform without any sense of direction. Nothing will present unless you set it. An ideal pure space like this comes out of VR.

VR also offers functions impossible in a real world. For example, we need to know what signs are actually seen by people when they’re finding
their way. Usually people just take a glance at the road signs and get the information subconsciously, it’s hard to know accurately which signs they notice by doing a questionnaire or interviews. In a modeling space of virtual reality, this problem is solved by changing the texture interactively. We have all signs in a vague pattern and the content of the sign won’t appear until it’s triggered (e.g. when click the mouse or touch a key). And at the same time, every action happened in the virtual setting is recorded, also the time, speed, trails, pauses etc., these data base the analysis.

4. A PC Based Lower-Cost CAVE

As we can see, VR is unique in fundamental study of architecture. It’s more than just a show of design. What needs pointed out is that a VR system aimed at merely presenting design needn’t be large or expensive, some simple systems based on one PC can basically satisfy. In our college, the large-size VR system is in pursuit of Expo so we set up a small one similar to CAVE (Cave Automatic Virtual Environment).

This CAVE is based on a regular personal computer with an Intel Pentium IV processor and a Matrox Parhelia three-channel video card which connects three monitors thus displaying three successive images. By setting the procedure, monitors can display show scenes from left, middle and right respectively. To cut down the cost we use narrow-framed monitors to form a three-sided CAVE. And cut a small hole outside the CAVE to fix the visual point. This VR system of satisfying effect costs less than 20,000 RMB, which is quite worthwhile.

Figure 3. The low-cost Mini CAVE
5. Conclusion

There have been significant advances in VR. Since the study object of architecture is space, VR will be applied more in space study as an effective way of expression with the development of IT. What introduced above are only practical examples in our research project. Hope VR will be widely utilized in more researches.

References

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