COLLABORATION SUPPORT SYSTEM FOR NIGHTSCAPE DESIGN BASED ON VR TECHNOLOGY

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Abstract. This paper reports the collaboration support system for nightscape design based on virtual reality (VR) technology. 3D-CAD is converted into lighting simulation software. The schematic design and detail design of the Tokushima Shinmachi riverside promenade have been done using this system.

1. Introduction

In this paper, the public design for a night-time slot (from evening till daybreak), when people depend on artificial lighting is defined as “Nightscape Design”. Nightscape design is a kind of a social activity. So it is very important to collaborate with many participants who are not only professional people such as planners, designers and engineers but also non-professional people such as clients, neighbors, and visitors. Though this process consists of planning, schematic design, detail design, construction, and completion, actually there is no ideal nightscape design process which keep from planning to completion with a consistent concept in Japan. Both the social system and existing design tool cause this problem. Until now as the setting up of nightscape simulation circumstance and simulation take many days, the designer could not use this simulation system in design stage except in the last presentation stage just before construction. But both hardware and software for nightscape simulation have been developed during these years.

The developed collaboration support system is based on VR and network technology. It is used in real design projects as we need to evaluate this system, and to present this new design process and tools to the public is a much better way compare to traditional design process and tools. In CAADRIA 2000, we reported collaboration support system based on VR technology. This time we improve the system and apply the system to the nightscape design of the Shinmachi riverside promenade in Tokushima city.
This paper is organized as follows: Section 2 describes the developed system. Using this system in real design project has been represented in section 3. And section 4 concludes with the result.

2. Collaboration Support System for Nightscape Design

2.1. OVERVIEW

In collaboration circumstance which include communication and decision-making among design participants, the system with which they can share the design image in an intuitive way and allow real time their feedback is needed. To realize this, we develop two system based on VR technology: the semi-spherical screen VR system and the desktop VR system (Fukuda et al, 2000). The former consists of semi-spherical screen which is 6.8 meters in its diameter, six projectors, graphics computer, LCD shuttering stereo glasses, and I.R. emitter. The latter is developed on personal computer. The software consists of a VRML browser such as Cosmo Player and Java applet on a Web browser.

2.2. SYSTEM FLOW

The operating systems used to run the software for creating VR data are Windows 95/98/NT/ME/2000. Figure 1 explains the system flow. Participants can create 3-D data including geometry, coloring, and texture mapping in any modeling tool (in our case it is FormZ). Then we simulate lighting effects (in our case it is Inspire or Lightscape). As both VR systems share 3-D modeler and Lighting simulator, they can be used efficiently.

2.3. SYSTEM IMPROVEMENT

We develop the software to convert 3D-CAD data into lighting simulation data. It can keep not only 3-D geometry data but also layer name, color, texture mapping, and their name. When we use this system not only as presentation but as design, repeated trial and error is happened. Inspire is a good lighting simulation software (Andrei, B.K. et al, 1996) but when we convert 3D-CAD data into lighting simulation data, the only 3-D geometry data is kept until now. This software saved us a lot of time and labor, but with new converter design participants can use Inspire in the design review stage. And we establish the way for VR experience with lighting simulation of Inspire and Lightscape. The created VR data size after lighting simulation of Inspire is less than that of Lightscape because of Inspire’s shaded texture technology (Integra, Inc., 1999)
which is able to mix illumination maps with textures for some VRML browsers such as Cosmoplayer.

![System flow](image)

Figure 1. System flow (bold line: nightscape simulation flow).

3. Application of the System to the Real Design Project

We are applying this system to some real projects. One of them is the schematic nightscape design of the Shinmachi riverside promenade which is about 2.2 kilometers in length in the center of the Tokushima city.

3.1 DESIGN PROCESS

The planning and schematic design is gone with workshop style from August 1999 to February 2000 (Figure 2). Workshops is held 10 times. A total of 343 participants who are not only professional people such as architects and
lighting designers but also non-professional people such as clients and neighbors take part. In workshops, participants carry out a field survey, lighting experimentation, discussion, and planning (Figure 3). Then, in the schematic design, lighting designer designs three alternatives: a) the relief and safety promenade, b) the elegant and interesting promenade, c) the promenade with temporary structures for events. Our desktop VR system is expected that participants can understand lighting effect and review these plans concretely and clearly. We create VRML data and develop design interface for comparing alternatives (Figure 4).

Figure 2. Design process

Figure 3. Photograph of workshop: discussion (left) and lighting experimentation (right).
At the last stage of the workshop, symposium was held twice (Figure 5), participants can review alternatives with design interface of Java applet and walkthrough operation. With this system, they can understand lighting effect and alternatives more concretely and clearly.

During this workshop, our system is recognized by the entrepreneur, Tokushima prefectural government. After this workshop, the government described that design alternative should be also reviewed with VR simulation in the detail design specifications. In the detail design stage, design alternative was reviewed with VR simulation (Figure 6). After design and construction, one area named “Aibahama” was completed in December 2000 (Figure 7).

Since fiscal 2000, Ministry of Land, Infrastructure and Transport in Japan establishes the prize for the best Public Involvement of the year to improve the accountability of public enterprise. We receive the joyful news that this process is awarded a grand prize of this year (Figure 8).
Figure 5. Photograph of the second symposium: lighting designer explains three alternatives with VR system.

Figure 6. VR image of the detail design.
Figure 7. Photograph of completion.

Figure 8. Article of a grand prize awarded to the best Public Involvement of the year.
4. Results and Conclusion

With this system, participants can design the nightscape from the schematic design to detail design. They can walk-through in the world and review from the viewpoint they want to see. The workshop reached a consensus on the nightscape design with the aid of our system. It must be impossible to share concrete image and design like this if they use the traditional design process and tools.

But some problems also happen. When we simulate to detail level, many polygons and textures create (over than 300,000 polygons) and the frame rate of walkthrough is sometimes less than 1 frame per second (fps). When the frame rate is less than 1 fps, a walkthrough operation of the 3-D virtual space does not go the way users want.

After this project, to create more photo-realistic nightscape image, three functions are added to Inspire: 1) “BLOOM” is a effect of fusion of distant light sources. 2) “CORONA” is a effect of star like emanation in radial direction for strong light source. 3) “EXPOSURE” is a elongated stripe like reflection of a source light in the water with small waves.

![Figure 9. CG of photo-realistic nightscape image: created by previous system (right) and by new system with BLOOM, CORONA and EXPOSURE functions (left).](image)

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References


