COLLABORATION SUPPORT SYSTEM FOR CITY PLANS OR COMMUNITY DESIGNS BASED ON VR/CG TECHNOLOGY

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Abstract. This paper reports the collaboration support system for city plans or community designs based on virtual reality (VR) or computer graphics (CG) technology. This time we report to elaborate the extended potable VR equipment and expression method with CG to allow for the realistic viewing of night scenes, and apply to real projects.

1. Introduction

A process of a city plan or a community design that includes both daytime design and nighttime design is a kind of a social activity. It is very important to collaborate with many participants who are not only professional people such as planners, designers, engineers and administrators but also non-professional people such as clients and citizens. We have developed a “VR/CG-based Collaboration Support System”. This system is capable of providing a dynamic virtual experience to a city plan or a community design allowing many people to examine it at a time through VR scenery. It can also be effectively used as a design or communication medium and substantially improve design/review efficiency. Once a 3D virtual space is constructed based on design drawings, participants can select portable VR equipment reported in CAADRIA’98 or dome-screened VR equipment reported in CAADRIA2000 according to their purpose to experience and evaluate the design. We also elaborated expression method with VR to allow for the realistic viewing of night scenes reported in CAADRIA2001.
And we have also applied and evaluated our latest system to real projects. This system also allows people to have a spatial feeling by virtual walking around, compare multiple plans, and make design changes interactively and easily. In this paper, we report to elaborate the extended potable VR equipment and expression method with CG to allow for the realistic viewing of night scenes, and apply the latest system to real projects.

2. System Improvement

We elaborate the extended potable VR equipment and expression method with CG to allow for the realistic viewing of night scenes.

2.1. EXTENDED PORTABLE VR SYSTEM

The portable VR system is based on PC (Windows 95/98/NT/Me/2000). Its software circumstance consists of a VRML (Virtual Reality Modeling Language) browser (Cosmo Player 2.1x) and a JAVA applet on a Web browser (Netscape Navigator 4.06~4.78 or Internet Explorer 4.x~5.5). The following explains the main functions for the portable VR system:

1) Project participants walk-through and bird's-eye view in a 3D virtual space. Their position and orientation in a 3D virtual space represent on a 2D map in real time. If they set position and orientation by dragging mouse on a 2D map, the viewpoint of a 3D virtual space is represented in real time. A field of view is also changed. When they set wide-angle, they review all the world. When they set narrow-angle, they review near sense of their depth perception.

2) They compare multiple plans, daytime design and nighttime design interactively and concretely.

3) They review to translate and rotate a design element, and create a new plan loading a new design element such as a tree or a illuminator from 3D database.

4) They change a texture or a color of a design element such as pavement or building façade interactively.

5) They measure a scale of a element in a 3D virtual space.

This time we develop the device driver software to connect the potable VR equipment with a VR in/out device. One of a VR in/out device is named “Window-VR system”. This consists of a 17” display with touch screen, handgrip buttons emulate joystick buttons, 3 degree of freedom orientation tracking. The display is hung in the air. Project participants grasp the handgrip buttons of both sides of the display and use touch screen, operate a 3D virtual space more friendly and sensuously than with mouse. With this
device driver software, a driving simulator system also be applied. The following explains the specification of the software:

1) A design participant rotate or tilt the display with handgrip buttons or operate joystick where they want to review.
2) Numerical values of its position or orientation are acquired from 3 degree of freedom orientation tracking if the display is rotated or tilted or from the joystick if the joystick is operated.
3) Acquired values are translated a VRML spatial frame of reference. Then the new viewpoint data is calculated.
4) The new viewpoint data is represented on a 3D virtual space via VRML EAI (External Authoring Interface).

Figure 1. Connecting the potable VR equipment with the VR in/out device (ex. WindowVR)

2.2. EXPRESSION METHOD WITH CG TO ALLOW FOR THE REALISTIC VIEWING OF NIGHT SCENES

An actual distant night scene produces an impression of bustle with a mass of illuminators. On the other hand, when a night scene is represented by CG, an emission part of an illuminator by painting over with emissive color is usually represented. With this method a distant night scene of CG is represented as dark as pitch because of resolution. To get rid of the difference between actuality and CG, to represent a distant night scene is usually re-touched. But there are a lot of trouble to re-touch and it is difficult to repeat trial and error. To solve this problem and simulate more photo-realistic night scene image, three functions are developed on the
lighting simulation software named “Inspire”. The following explains the functions:

1) “BLOOM” determines that bloom glare (bright spot around a bright pixel - such as that in which a light source is located) is simulated.

2) “CORONA” determines that corona glare (bright spot with rays emanating from a bright pixel) is simulated.

3) “EXPOSURE” effect control for photo-like rendering. Zero means ordinary rendering which assumes infinitesimal time. Values other than zero make sense only if exposure textures are present in the scene. In photo, especially night ones, the exposure time must be quite long which results effectively in superimposing reflection from undulation waves on water surface that, in turn, is available with exposure texture. The value of exposure time for rendering should be agreed with time interval (end time) defined for exposure texture.

![Figure 2. Comparison of a photo(Left) and existing CG(Right).](image)

![Figure 3. New expression method of CG (Left: eye effect; Right: camera effect)](image)
4. Application of the System to the Real Projects

To evaluate our latest system, we apply this to multiple real projects.

4.1. STREET OF STORES RENEWAL ENTERPRISE

This project is a street of stores renewal enterprise of the U city government. This street is located one of the center of commerce in U city. But in recent years commerce of this area become hollow. As you know this problem is not only this area, but also many areas in Japan. From 1960’s until now, residential areas are developed in the suburbs of a center of cities. Public and private facilities also move to the suburbs. Less people live in the center of the city. And a center area of cities don’t correspond to the progress of motorization. Stores of a center of cities tend to be defeated by suburban supermarkets.

For revitalization of this street we continuously support this enterprise with our VR system for about two years from April 2000. Participants is composed of the U city government, planners, the chamber of commerce, the association of town center management and inhabitants. The VR system is used not only on study meetings among professionals per a week but also on study meetings among both professionals and citizens per a month. This is useful for simulating the plans and sharing the concrete design images with participants. There are four steps in the process:

Step1) We make the 3D virtual space of the actual world based on ground plans and photos of building facades.
Step2) We simulate putting up electric wires in the ground and removing existing electric light or telegraph poles and arcades of the street in the 3D virtual space.
Step3) We make the 3D virtual space of four road alignments: 1) straight alignment, 2) curve alignment (two patterns) and 3) branch alignment. Project participants compare plans and agree on the direction of curve alignment. They review from driver’s and pedestrian’s continuous viewpoint. Then multiple kinds of curve alignments are reviewed.
Step4) We make the 3D virtual space of a landscape design. Participants compare multiple design alternatives of gardening spaces, symbol trees, benches, illuminators, bollards and pavements interactively. In the near future, building facades is designed with VR system.

4.2. BALLPARK RENEWAL PROJECT (NIGHT SCENE DESIGN)

This project is the H ballpark renewal project. The architect creates the concept of the ballpark like MLB (Major League Baseball) ballparks. One of its characteristics is that its form is not linear symmetry. The site of this
Step 1: the actual world

Step 2: simulation of putting up electric wires in the ground and removing poles and arcades

Step 3: comparison of four road alignments

Step 4: comparison of landscape design

Figure 4. Street of stores renewal enterprise.
project is along the Shinkansen line. The architect designs the low stands behind the left fielder that passengers of the Shinkansen can watch and enjoy the baseball game. Baseball games are usually held at night for about 65 days a year. And also for the rest about 300 days when there are no games, this stadium is placed as landmark of this city. The architect collaborates with the lighting designer to design both 65 days design and 300 days design of its night scene. The lighting designer design but at the first stage he doesn’t have a enough presentation tool, only the re-touched CG. Project participants can’t share his design image. We support and simulate high minutely with “BLOOM” and “CORONA” functions and at last they can share the concrete image.
5. Results and Conclusion

With this system, participants’ design and review city plans or community designs in the real projects. These features are not provided by conventional model, perspective or CG. Also, it is needless to say that these projects are good examples of collaboration. In the future, we make effort to create more realistic VR image.

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References