

Introducing Virtual Reality CAVE into Non-geometrically Curved Space Design

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Abstract. Digital models can make visible non-geometrically curved space, and in this way so doing realize the artistic/abstract conceptions of the designer. However, the question as to whether or not geometrically curved space can actually serve as the original design concept remains an unanswered question. This research aims to explore the relationship between virtual reality CAVE and the design of non-geometrically curved interior space. In this paper we make use of the PC-based virtual reality CAVE system — which is aimed at the design of large-scale interior space. It is possible that VR CAVE provides solutions to the problems inherent in non-geometrically curved space design.

Keywords. virtual reality; CAVE; non-geometrically curved space.

Background

Formerly, in which before computers have not yet were well developed well, there have been there had been some researches regarding that explored architectural representation using conventional media. For ancient architects, the design process was described abstractly by text (Hewitt, 1985); the architectural design process evolved from unselfconscious to conscious ways methods. Until the appearance of two dimensional (2D) drawings, these drawings designs could only express abstract visual thinking and visually conceptualized vocabulary (Goldschmidt, 1999). Then, with the widespread use of physical models in during the Renaissance, the form and space of architecture was given much better precision and accuracy (Millon, 1994). Researchers continued their attempts to identify the nature of different design media (Koch, 1997).

Different media cause different impacts to on the various stages of the design process

(Krawczyk, 1997; Maher, 1999). The work done by Mitchell (1997) concerning the growing importance of computer technology in architectural design has gradually come to be assimilated into the already considerable amount of literature dealing with design theory and the various design media. The use of the computer media as an aid in design serves as an important drafting and analytical tool for the many architects. The most representative members of this group are Frank O. Gehry and Peter Eisenman (Gehry, 1976). Based on their recent work, the most outstanding feature is the non-geometrically curved space design. In 1995, computer modeling was getting becoming increasingly sophisticated; making it possible to express there comes more and more non-geometrically curved spaces, that formerly would have been beyond our imagination or our ability to realize, leading to the forming the creation of virtual architecture and virtual space (Lin, 1999; Bai and Liu 2001). Because the this form method of architecture becomes allows for more and more freedom of expression, its biggest stimulation impact

is the visual impact. It also affects the form of interior space but earlier most designers could only have had a few limited spatial experiences of those non-geometrically curved interior spaces (Liu, 2002).

In addition, multimedia design has also become an especially popular topic of research (Dave 2000; Madazo 2000; Haymaker 2000). Of these media, virtual reality (VR) greatly enhances the user's psychological engagement and allows interfaces radically different from traditional computer aided design (CAD) to be developed and evaluated (Bellemann 2001; Fukuda 2001). Ivan Sutherland first used a VR system for architectural implications in the 1960's (Cruz-Neira, 1998). when Wwe began to considered the full potential of VR technology for possible applications in the practice of architecture (Baker 2000; Dam 2000).

Research Problem

As can be seen from the this very brief history of the design media, the use of physical models eradicated some of the limitations of 2D drawings; and in the same way digital models can make it possible to express abstract design concepts to which the physical models is unable to give expression (Lin, 2002). New design media methods have been able to tackle design problems that conventional media were unable to solve, and at the same time, the new design media has greatly influenced architectural form (Liu and Eisenman 2001). For example, digital models can make visible non-geometrically curved space, and in this wayso doing realize the artistic/abstract conceptions of the designer. However, the question as to whether or not geometrically curved space can actually serve as the original design concept remains an unanswered question.

Methodology

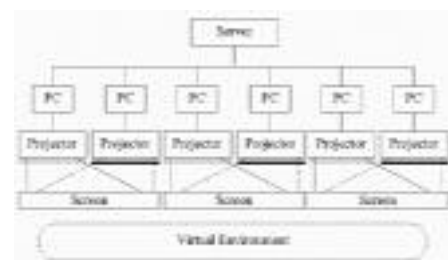
This study — which includes an experiment and questionnaires — examined an array of design media, including 2D drawings, three dimensional (3D) physical models, 3D digital models and computer renderings, to determine whether or not they are able to serve as fully accurate representations of non-geometrically curved space. A series of statistical analyseis established that such models were in fact unable to do this. Thus, the study established that digital models and computer renderings could n't not give complete expression to the designer's concept. As is shown by the history of the design media, when conventional media methods are unable to tackle design problems, the only solution is to make use of new design technology. Recently, the use of virtual reality has gradually been increasing in respectas an aid to design (Paranandi and Sarawgi 2002). However most of these applications focus on conventional design simulation, and seldom make use of this technology to deal with the issue of the non-geometrically curved space (Sasada, 2002). This study examines the issue of whether or not virtual reality (CAVE) has the potential to overcome the limitations of computer renderings in respect to non-geometrically curved space and thus give full expression to the conceptions of the designer (Figure 1).

This research aims to explore the relationship between virtual reality CAVE and the design of non-geometrically curved interior space. Architects dealing with non-geometrically curved space design often pay a good deal of attention to outer form, and neglect the "feel" of interior space. Often, even the designer himself has no clear conception of the shape of the interior design before construction is completed. Assuming the ability of virtual reality to visualize form in a vivid way, this research is aimed at

Figure 1. CAVE Automatic Virtual Environment.

measuring the effectiveness of the design of non-geometrically curved space, and examines the relationship between design imagination and design methods. In this paper we make use of the PC-based virtual reality CAVE system (Figure 2) — which is aimed at the design of large-scale interior space (Li et al., 2001). It is possible that VR CAVE provides solutions to the problems inherent in non-geometrically curved space design. With the VR CAVE system, we experiment with non-geometrically curved interior spatial experiences, experiences with which not even designers are familiar. The example used to illustrate the problem of non-geometrically curved space is a privately owned museum in Taiwan. In respect to architectural form, computers have proved to be a more effective means of measuring curvature and space, and are thus able to provide a greater degree of accuracy. However, in respect to the design of non-geometrically curved space, there exist some differences between the renderings of images as generated on the computer monitor and those as generated by VR CAVE — that is in respect to the design of non-geometrically curved space. Every stage of the design process makes use of the VR CAVE system, and it provides a simulated representation of each design stage. All of these design processes of design have been

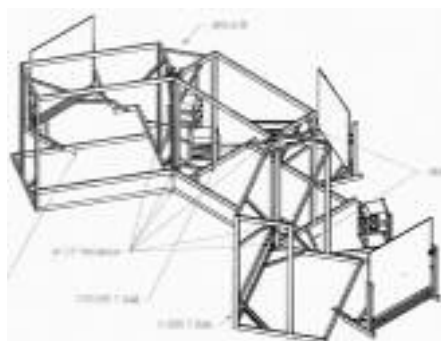
recorded, and a conclusion has been reached based on the an analysis of the fully formulated data.



Concluding Remarks

It is possible that the use of a computer monitor — to render images made by computer models — is not appropriate in respect to certain types of measurements and spaces. The VR system provided effective simulations in this respect, and, moreover, offered architects a natural interface through which to navigate. It was able to affect spatial judgments and generally acted to make substantial changes in the computer-generated environment. The designers who have worked with VR CAVE have been able to perceive experience these effects at first hand. The study addresses the problems concerning the limitations of digital models and computer rendering, and, moreover, explores the possibility of an alternative design process in respect to non-geometrically curved space design through the use of VR CAVE technology. Thus, virtual reality media realizes the possibility of the design of binary space, and in this way provides human beings with a source of enormous future potential. In addition to freeing the imagination and mental processes, virtual space offers a visually accurate depiction of actual physical space.

Figure 2. PC-based virtual reality CAVE system.



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