A PLACE WHERE PEOPLE ARE FREE TO MOVE:

Exploring dynamic texture mapping in computer graphic systems

CHENG-YUAN LIN
National Chiao Tung University, Taiwan
gage@arch.nctu.edu.tw

Abstract. Recent studies, both collaborative design system and scenario scripting, attempt to explore further CG media. Corbusier pointed out that good architecture is a place where people can walk unrestrainedly and feel free in spirit. However, it is apparent that the human figures are still in animation, whereas they are free to move in the real world. The human figure always plays an important role in the development of design media. The objective of this paper is to develop a new design method using CG media and to study the process of dynamic human texture mapping within the CG. This research conducted a design experiment using computer as the sole design medium. The results show that the new design method not only altered the behavior of the designer, but also impacted design thinking cognition.

1. Introduction

Many studies has been undertaken in respect to the importance of design media, which evolved from text, drafting, modeling, to applications of recent digital technology (Hewitt, 1985; Koch, 1997; Goldschmidt, 1999). Different media cause different impacts to various stages of the design process (Krawczyk, 1997; Maher, 1999). In particular, research topics focusing on the involvement of computers in the design thinking process have become more and more mature, to gradually form a new way of design methods (Liu, 1996). Therefore, multimedia design has especially become a popular topic of research (Lin, 1999; Dave, 2000), containing three main directions: computer graphics (CG); the Internet; and virtual reality (VR). Researchers were interested in studying how these media might aid the designer significantly in the concept stage of design and communication (Madazo, 2000; Haymaker, 2000). Within these three directions, CG

technology has developed to an extent, thanks to it's ability of accurate and realistic simulation (Lin, 2001; Huang et al., 2001). However, due to limitations in bandwidth, applications of Internet technology in architectural design including collaborative design and database processing systems are still limited (Murray, 1997; Jozen et al., 2000). Moreover, the facility of VR simulator such as VR Cave is still over-expensive therefore the cost prohibits the development of this research (Knight and Brown, 1999; Fukuda, 2001).

Based on the ability of producing accurate and realistic representation, CG technology has increasingly enhanced the potential for interaction between human and design. In the book Architectural Principles in the Age of Humanism, it was emphasized that the perceptions of experience in space change as soon as human bodies move (Wittkower, 1971). In addition, Le Corbusier pointed out that good architecture is a place where people can walk unrestrainedly and feel free in spirit (Jenger, 1987). However, recent studies, both applying CG technology to collaborative design system for citizen participation (Sasada, 2000) and combining the use of animation and scenario scripting (Huang, 2001), attempt to explore further CG media. However, it is apparent that the human figures are still in animation, whereas they are free to move in the real world. The human figure always plays an important role in the development of design media. Evolved from the sketches, plans, elevations, image processing, animation, and virtual reality, the purpose of the appearance of human figure is to emphasize representation of human existence, in order to convey a more vivid description of design concepts and even the interaction between human and space (Panofsky, 1960). The objective of this paper is to develop a new design method using CG media and to study the process of dynamic human texture mapping within the CG.

2. Experiencing and Exploring Space

In order to examine the differences between traditional and dynamic texture mapping, this research conducted a design experiment using computer as the sole design medium. This research consists of four steps. First of all, computers were used to produce two identical digital sites, applying dynamic texture mapping methods in one scene and traditional one to another. Second, two designers were chosen as the subjects on an equal basis of their knowledge and expertise in respect to computer operation in 3D environments. Then show the animation of site introduction with dynamic human texture mapping to one subject, and without dynamic human texture mapping to another. In the third step, the subjects were asked to produce a simple design in each given site. The aim was to examine and

record differences arising from design cognition. Finally, an analysis of the experimental data was discussed including various comparisons of the two data types.

In order to emphasis the importance of human movement, we conducted an experiment of remodel design. The task of the experiment is to renew an old museum, which has many problems of original design such as the height of interior is over high, the distance of circulation is too long, and the exhibitive rooms are bad for use as well as the quality of lighting. Therefore the theme of the design task is how to improve the visiting circulation and the relation between users and exhibitions. Museum design has a great requirement of function, so the design task was divided into three parts, including the arrangement of circulation, the concept of entry hall, and the detail of an exhibitive room design (Figure 1). The design condition is very flexible, and the subjects can remove or add the wall freely.
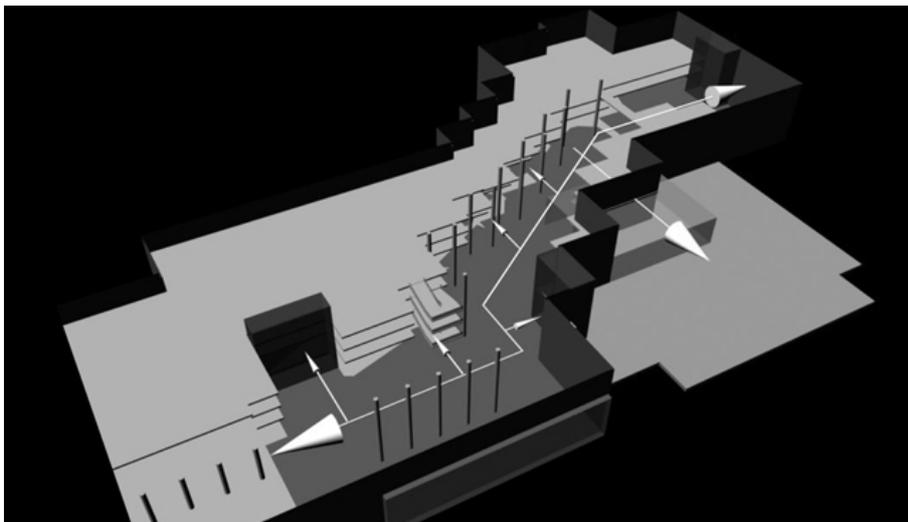

Figure 1. Circulation arrangement of site by subject.

3. Analysis and Results

3.1. THE CONVENTIONAL DESIGN

In examples taken from the design of sites in respect to conventional design, it can be seen that the design first made use of a corridor as a means of dividing the lengthwise space in half; and this being completed, proceeded

to carefully organize a system of circulation, a system that involved the use of ingenious methods to join the various parts into a single entity. From the means used to design this edifice, as expressed in its form, we can identify it as being modernist in it inherent spatial tendencies. And in considering the over-all mass of the building, it can be seen that the sense of grandeur that characterizes its over-all atmosphere, has been successfully replicated. Moreover, in regard to the vertical spaces, and the over-all sense of scale of the interior of the building, that is a building intended to embody a form representative of a mythical palace of art, the majesty and elegance of the feeling of the design as a whole has been successfully expressed (Figure 2).

3.2. DESIGN WITH DYNAMIC TEXTURE MAPPING

In respect to the use of dynamic human texture mapping for site design in respect to the design of the middle interior spaces of a public building, or public hall, the means by which the various exhibition spaces were connected together in respect to their left right-axis, and in particular, the fluency and coherence of the system of circulation, was the aspect of design given most emphasis. Thus, the localized interior spaces were designed in a manner that related well to the exterior constructions on the site, as well as serving the multi-level function of the park and museum. The structural elements of the design included a system of outwardly radiating spaces, and in this regard the design enables the user to become aware of the sense in which the works of art and the viewer are able to coexist in a single space. Of particular importance is the degree of transparency built into the design, so that in this way the user is able to both experience a sense of inter-reaction with the design as a whole and with other users of the design (Figure 3). Moreover, the means of displaying art works was designed in a manner demonstrating a careful and systematic attention to detail.
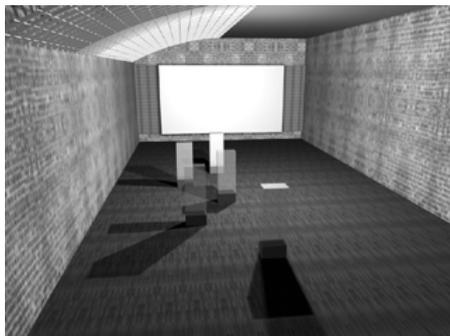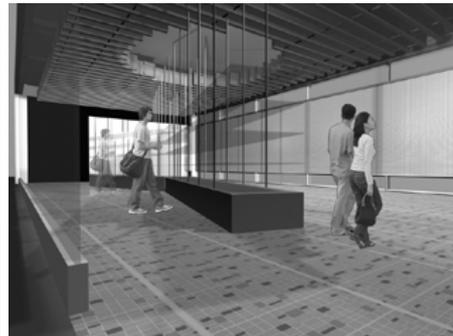

Figure 2. Exhibitive design of subject A. *Figure 3.* Exhibitive design of subject B.

4. The Impact of Human Movement

In arranging the circulation, the subject who was introduced the site without dynamic human texture mapping (subject A) focused on the appropriateness of relations within the over-all system of circulation, whilst the another subject (subject B), in organizing the over-system of spatial relationships, dealt with circulation as it existed in respect to people. As regards the interior space, a used art design as a basis for analysis; and subject B also made use of art design in this respect, but additionally, focused on the inter-relationships of users, as well as the relationship of the cognitive process of the users and the works of art on display. Subject B was able to supply a sense of space that as well as being lively, displayed a fairly high degree of richness and freshness of design. In regard to the scale of the design as perceived by its users, subject A had no problems in arriving at a design built with a system of scales well suited to the visual judgment of the user, whilst subject B was more successful in respect to scale as it exists in relation to the activities and movements of the user. In regarding the relationship of people and culture as seen from a wider perspective, subject B showed an ability in its management of space, to allow for a careful consideration of human possibility, and in meeting the needs of users generally, and in this way was better able to obtain a sense of intimacy between people and architectural space (Figure 4), whereas subject A focused more on the dynamics of inter-relationships, thus creating a sense of over-all design.
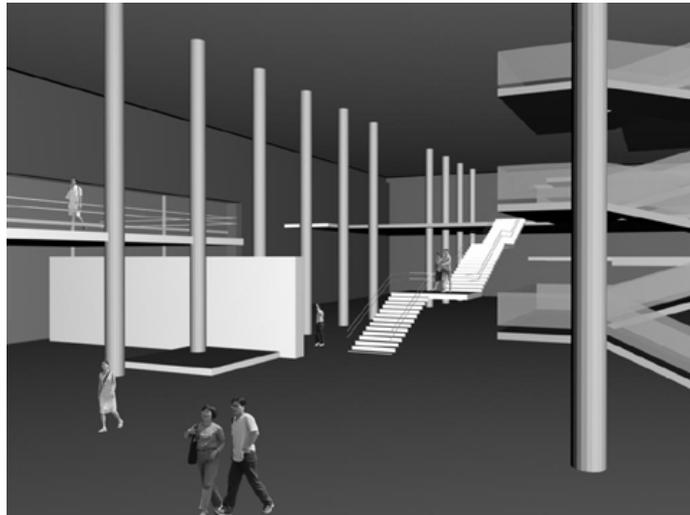

Figure 4. A careful consideration of human possibility.

5. Discussion

The research shows that the new design method not only altered the behavior of the designer, but also impacted design thinking cognition. Operating in an environment that can simulate human movement, designers are able to draw on a much richer source of visual data to organize spatial patterns, manipulate design situations, and produce design concepts. Future research, based on above findings, would involve applications of the dynamic texture mapping technology to the standardized 3D software currently available.

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