VIRTUAL REALITY IN ARCHITECTURAL EDUCATION: DEFINING POSSIBILITIES

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Introduction: virtual reality in architecture

Virtual Reality (VR) is an emergent computer technology for full 3D-simulations, which has a natural application in the architectural work, due that activity involves the complete definition of buildings prior to its construction. Although the profession has a long tradition and expertise in the use of 2D-plans for the design of buildings, the increasing complexity of projects and social participation requires better media of representation. However, the technological promise of Virtual Reality involves many sophisticated software and hardware developments. It is based on techniques of 3D-modelling currently incorporated in the majority of drawing software used in architecture, and also there are several tools for rendering, animation and panoramic views, which provide visual realism. But other capabilities like interactivity and sense of immersion are still complex, expensive and under research. These require stereoscopic helmets, 3D pointers and trackers with complicated configurations and uncomfortable use. Most advanced installations of Virtual-Reality like CAVEs involve much hardware, building space and restrictions for users. Nevertheless, diverse developers are working in Virtual-Reality user-friendly techniques and there are many initial experiences of architectural walk-throughs showing advantages in the communication and development of designs. Then we may expect an increasing use of Virtual Reality in architecture.

Applications of VR in architectural education

Some authors have identified the potentiality of Virtual Reality in architectural education, but there are not many references about specific activities in that theme. A dissertation thesis at Strathclyde [Andrews, 96], reviewing the different techniques and applications of VR in Architecture, mentions educational possibilities through 3D-representations of 2D-abstractions. A paper about the use of the CAVE in architectural teaching [Af Klercker, 98] warns about the high cost of installation for schools of architecture, and defines three ways in education; to improve the visual impact of computer modeling, to interact with clients (?), and to design unusual forms. But according to the usual curriculum of architecture the possibilities could be broader, Virtual Reality technology could be used from basic courses until advanced subjects, in the diverse lines of architectural education; - History and Theory; in the modeling and review of historical cases and schematic concepts. - Technical courses; in the modeling and behavior of structures, review of constructive details, representation of building services and performance, etc. - Design Studios; in the modeling of students' proposals, review of examples of contemporary architecture, etc. There are several reports of use of Virtual Reality in design studios [Achten; 99, Donath; 97; Emdanat; 99, Garcia; 99], although involved in research projects, without evaluation of its pedagogical issues. Also architectural experiences in university VR-laboratories (Clemson, Georgia, Michigan, Mississippi, MIT, Washington), and VR-models of historical buildings and constructive process [Retik; 97].

THE VIRTUAL ENVIRONMENT LABORATORY AT STRATHCLYDE

In 1998 the ABACUS, Research Unit of the Department of Architecture and Building Science of the University of Strathclyde setup the first Scottish visually immersive facility called the "Virtual Environments Laboratory" (VEL). This facility is based on a curved-panoramic screen of 5 by 2 meters, which received a high-resolution computer generated image from three coordinated video-projectors (Fig.1). Those are controlled by a Silicon Graphics engine with specific software that allows interactive walk-through in 3D-models from several CAD formats. The installation includes a place for one operator of computer, video-projectors, sound and 3D-pointer, and space for 14 seats. This Laboratory reaches a high visual quality and immersive perception through the wide field-of-view and fast interactive control. It is without the ergonomic difficulties of helmets, and the high amount of space required by the CAVE, both of which installations are limited to one or very few people. The VEL permits a group of persons enough for a design's team and clients. By the same reason is suitable for education, because it can hold an amount of students that in 2 to 4 sessions complete a course, with a proper cost for universities. The VEL has a database of virtual environments, including a big urban model of Glasgow, part of a major project of urban information called "The Virtual City" [Maver; 99], models of Edinburgh, some design proposals from students and industrial models. Currently it is modelling the Lighthouse of Glasgow (the renewal design for the program Glasgow-1999) and the new Scotland Congress in Edinburgh. On the other hand, it has carried on an interesting experience of collaborative education in architecture using video-conferencing between Strathclyde and the Mackintosh School, over the ATM-Scotland Metropolitan Area Network [Lindsay and Grant; 98]. That activity involved traditional and multimedia lectures, and also traditional and multimedia design reviews, besides a vir-

Figure 1. Virtual Environments Laboratory.

tual visit to an architect's office. Considering several visual and audio installations and diverse pedagogical possibilities.

Examples

As an experimental example of Virtual Reality in the Architectural Education the model of the city of Glasgow was used to review several urban and architectural concepts considered in courses of history. That can be especially important for foreign students lacking the living experience in European cities. The model illustrates the perimetrical growth of a mediaeval city (Fig. 2), the mix of buildings from different historical ages in the urban centre, the distributed organisation of a urban centre with religious, civic and commercial poles, the adaptation to topography, the proportion of historical urban space (Fig. 3), the diversification of streets in uses and dimensions and the density and scale of traditional residential areas. Besides, it reviewed examples of design concepts and technical subjects like an integrated central space and the arrangement of a steel-frame in a student's proposal for a library (Fig. 4).

Discussion

The examples show specific possibilities of VR in architectural education that allow students to review building concepts using three-dimensional visualization, interactive control and group discussion. This method of learning provides a vivid experience that could result in better understanding when compared to lectures or static images. An old oriental quotation said that it remembers 1% of what is heard, 10% of what is seen and 100% of what is experienced. At the same time these examples demonstrate some limitations of the technology. First the model does not show the fine style and decoration of Glasgow's architecture. The large size of the model constrains geometric detail. Also it requires explanations or schemes to clarify some concepts. In any case this kind of application must consider a proper pedagogical planning, guidance of experience and additional material. Those can be incorporated into a multimedia system. However, the examples show an important advantage of this technology;

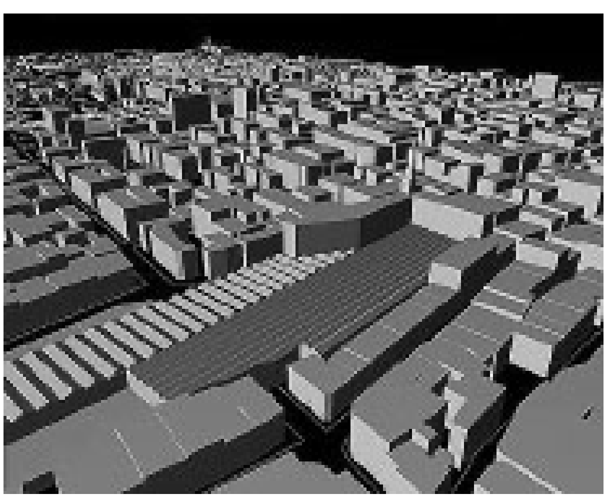

Figure 2. Computer model of a Mediaeval city

Figure 3. Model of Urban Space.

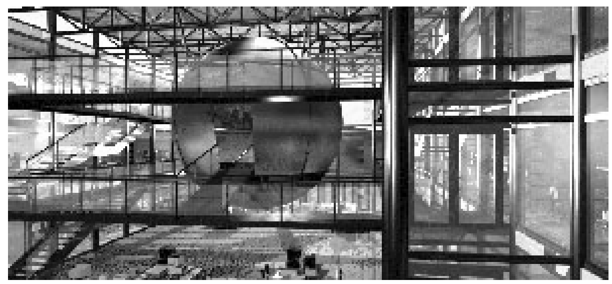

Figure 4. Student Proposal for a Library.

the three-dimensional representations of technical and theoretical concepts facilitate an integrated view of architecture. Traditional teaching methods tend to separate the subjects, but through VR each issue can be directly related to building design. Moreover, those views of shapes and spaces could encourage new creative approaches for design, particularly those based on conceptual or technical concerns. Further research could focus on the testing of the understanding of the concepts described above with a group of students in the VEL, or especially other concepts through models of architecture buildings far from Glasgow to give novel spatial experiences without the need to travel. Also it could be interesting to relate the experiences with video-conferencing, although wide field-of-view and speed of interaction, opens a wide possibility of collaborative teaching with other schools around the world. Additionally the contribution of this way of learning in the integration of subjects and in the creative skills can be evaluated.

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Computer Modeling and the Traditional Methods of Design Process

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Context

To understand the importance of these images one must first have knowledge of the context in which the images were created. Within the educational environment the computer must find its’ way into the traditional methods of design process. In the past the computer has been seen as a production tool, a communication and now a design tool. Computers as design tools within the design process are allowing for further exploration of space and form just as physical modeling and sketches have done in the past.

Ball State University begins its’ mandatory computer purchase for all incoming second year architecture students in the fall of 2000. The introduction of the computer, physically and pedagogically, into the studio environment will have profound effects in the way in which projects are investigated, explored, and presented. Visualization methods must go beyond the traditional means of communication (e.g., sketches, physical models, and analytical drawing) to include the computer within the design process. Integration of the computer into architectural education is nothing new to the upper level students at Ball State University. The focus now is in the second year studios where we are no longer asking when to integrate but how to integrate computers into the studio environment.

Integration of the computer

Beginning this semester, students were introduced to modeling software, Form-Z, in their design communication course, which is run conjunction with the design studio. The studio environment becomes the place of applying this new set of skills learned in the Form Z introduction workshops. Previously students used traditional methods of design inquiry and communication visas vie sketches, perspective drawings, and physical models. Beyond being just a tool for image manipulation and page layout, the computer becomes another tool for inquiry.

Problem statement: *the way station*

The project given was a *way station*, a point of rest or stasis from a journey. Issues for discussion dealt with the relationships between the automobile/pedestrian, interior/exterior and movement/stasis. Students must define for themselves the concept of rest. The rules of engagement were simple, the automobile must enter the site and the boundary for investigation was 30’x50’x15’. The images and text provided display a thorough investigation combining traditional methods of exploration, (e.g., sketching and physical modeling) and computer modeling. The computer was introduced between two series of physical models allowing for a greater knowledge of the project, each model informing the other. It is the understanding of the process of design that becomes the fundamental principal. Integration of the computer need not be a setting aside of the other tools of discovery but an addition to our process of design.

Rest. *Rest does not necessarily mean a ceasing of all activity. Rest is often an activity used to break up the monotony of another activity. Such is the case of the way station. The spaces are designed to provide physical as well as mental rest from the journey. The spaces in this construct are meant to intrigue the occupant. Separation from the vehicle is not required or forced, but is strongly implied by the change in elevation between automobile and pedestrian spaces, the selected views and unique geometry of spaces, and the distinct change in materials.*

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