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EMERGING TRENDS IN COMPUTER AIDED DESIGN: focus on virtual reality as a tool in architectural education

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ABSTRACT: *Various efforts in the industry and academia are underway to explore the possible benefits of Virtual Reality (VR) in construction. This paper provides an overview of recent examples of successful adoption of VR technology as applications in construction. The paper also provides an outline of what Virtual Reality (VR) is, and presents a work jointly carried out at the Departments of Architecture and Computer Science of the Federal University of Technology, Akure (FUTA). The aim of the joint research is to investigate the efficiency and effectiveness of virtual reality drawing at all stages of a project, from initial conceptual design through detailed design, planning and preparation, to construction completion. The methodology employed was the critical examination of different building project drawings developed by the use of different computer aided drawing software such as AutoCAD, and comparing them with drawings generated by virtual realty software packages such as Vizx3D modeler. The result obtained shows that VR software provides avenue for easy manipulation of the drawing details thereby increasing the management of the construction process.*

Key words: *computer aided design, construction, virtual reality, architectural education.*

INTRODUCTION

Virtual Reality (VR) proposes to bring to education in general; exciting possibilities which were once considered science fiction and unattainable. It is important to present at the beginning the various definition of virtual reality, to also present an overview of its inception, its current capabilities and future possibilities will also be examined. There is not much data available on the effectiveness of this medium on architectural education due to the "newness" of the technology. Virtual Reality is in itself a relatively new venue for interaction. In order to understand the implications of this technology, one must first understand the concept.

Webster's defines Virtual as "being such in essence or effect though not formally recognized or admitted" and Reality as "the quality or state of being real". This "state" is a computer generated simulation of a real or imagined 3-dimensional environment that is user interactive. The level at which users can interact is dependant upon the available hardware. Currently it is possible for users to immerse themselves in these simulated environments with the use of head gear (HMD's) that feed computer images to screens in front of the eyes and provide surround sound audio which gives the user the added sense of distance and depth in the virtual world. Gloves and full body suits equipped with networks of sensors are capable of transmitting changes in body orientation, thus giving the user the full sense of actually being in the simulated environment and the ability to interact much the same as one does in actual reality.

The term 'Virtual Reality' (VR) can also be refereed to as 'Artificial Reality', 'Cyberspace','Virtual Worlds' and 'Virtual Environments' (Beier, 2006; Chalmers, 1996). More recently, 'Virtual Reality' is used in a variety of ways and often in a confusing and misleading manner. Originally, the term referred to 'Immersive Virtual Reality' whereby the user becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer (Sutherland, 1963; Obe, 2002).

According to Beier (2006), Virtual Reality could also be aptly termed as a 3D computer-generated representation of a

scene or object that aims to give the user a sense that the scene or object exists in reality and obeys the laws of physics. In general, Virtual Reality (VR) is a computer generated experience that submerges the common user to the point in which the user believes that it operates in another world, place or space. It is a special kind of model designed to convince users to a great extent that are not actually within a computer simulated environment. VR representations can address one or more senses: visual, auditory, and tactile.

VR technology is at the infancy stage in its current state' further researches are ongoing. There are now available desktop VR programs that will allow students and teachers easier access to this new frontier. Affordable software programs such as Virtual Walkthrough enable students to create their own virtual worlds without the expense of silicon graphics machines and the assorted hardware expense. These virtual worlds can be interacted with through the click of a mouse and do not require the body gear.

Virtual Reality has been used for years in military, government and industry training programs. Many computer games use in most of today's video games and electronic handsets employ VR to some extent, but little has been done in the aspect of VR applications for education which remain largely unexplored. The advent of the Internet and the WWW allow for wider uses of VR, but first a design platform had to be established and agreed upon in order to bring this venue to the Web. This brings in VRML comes in a worldwide language similar in concept to HTML. VRML is an acronym for Virtual Reality Modeling Language, called VRML is a language that specifies the parameters to create virtual worlds networked together via the Internet and accessed via the Web's hyperlinks. It was conceived at the first annual WWW conference in Geneva, Switzerland (Evans, 1995; Blackburn, et al; 1996).

Neil (1996b) submits that in order to view and interact with a three-dimensional VRML scene, VRML browser programs are needed. Looking at the international scene a wide range of VRML browsers are now available for a variety of different computer platforms and operating systems. Some are still under development and are released as Beta software, which may still contain bugs. Examples of the existing ones are i3D, VRScout, VRweb, WebFX, WebView, WebSpace and WorldView.

Other VRML Browsers include but not limited to the following are also available, including AmberGL (Windows NT/95), Fountain (Windows). GLView (Windows NT/95), NAVFlyer (Windows), Virtus Voyager (Macintosh), VRealm (Windows NT/95), WebOOGL (SGL, Sun), and Whurlwind (Macintosh).

BENEFITS OF VIRTUAL REALITY IN ARCHITECTURAL EDUCATION

Education is the development of the total man, which Dewey (1966) views as the process of forming fundamental intellectual and emotional dispositions; that commences at birth and continues till death. The intent of this paper is not to discuss architectural education in general; but to emphasis the need to incorporate into the study of architecture in the various citadel of learning in Nigeria the use of computer aided design packages especially virtual reality presentation mode. The integration of the use of these CAD packages will give needed exposure to the trainee-architect.

One of the ways to achieve this is by the use of graphic based VR method of learning in the architectural schools. The use of VR in architectural education is numerous. According to Pantelidas (1995) it provides motivation to the learner. Sometimes it offers the opportunity to see 'behind the scene' process of design that will create better understanding for the learner. The VR technology affords experience with new technologies through actual use. It involves user interaction and friendly interface and encourages active participation by the students.

USE OF VIRTUAL REALITY IN ART AND DESIGN

The ability to create and explore

the existing/ proposed building and creates room for collaborative design/construction. The diagrams below show step by step approach followed in creating interactive 3D design using the VRML modeler (See Plates 5 8).

ANALYSIS AND RESULT OBTAINED

It is difficult to create a 3D model without having some idea of what it is going to look like and how it is meant to work. If the object already exists then there may arise the need to take some reference photos which are useful not only in the modeling process but can also become the basis of textures that will be applied to the object. If the object is only in based on imagination then rough sketches are the place to start.

The flow diagram (see fig.1) presents a step by step approach to the formulation, generation and simulation of virtual building.

Creating the 3D geometric model

All building elements of the wall were identified and defined as 3D objects. Structural elements (demarking the brick panels), vertical panels of the wall and two standard opening elements, were modeled. In order to provide the virtual simulation of the geometric evolution of a wall in construction, the 3D models were defined as a set of individual objects, each one representing a wall component. The design already exists so it is just a matter of taking a few photos and familiarizing with the operation of the VR software to create the

Plate 1 Approach to FUTA Senate Building.

Plate 2 Back view of FUTA Senate Building

three-dimensional environments on the World-Wide Web presents many interesting opportunities for art and design in higher education, especially in the disciplines of architecture, interior design, landscape and 3D design. These subjects are concerned with the communication of ideas about structures and spaces. Computer modelling is now used widely in these areas, as a tool for understanding the spatial relationships within a 3D design. The importance of VRML (Virtual Reality Modelling Language) is that it enables the models to be viewed by more people (potentially anyone with access to the WWW), on a variety of different computer systems. Hence VRML could be used as the medium for the public exhibition of work. The additional VRML multimedia feature of allowing objects to be hyperlinked to text, sounds, and images, may also make it a useful tool in teaching or research (Neil, 1996a; Burdea and Coiffet, 2003).

COLLABORATIVE EFFORTS AT THE COMPUTER GRAPHICS LABORATORY (CGLAB)

In light of these claims that VR would be useful in education, a research work was carried out at the Computer Graphics Laboratory (CGLab) at the Department of Computer Science, Federal University of Technology, Akure, Nigeria, in collaboration with the Department of Architecture of the same university to explore VR as a learning tool for teaching university undergraduates the building construction process. The overall goal of this project is to determine if and when partially/non-immersive virtual environments improve understanding of complex environmental processes when compared to what can be learned from non-computer-based simulations of the same processes.

Procedure for Data Gathering

The stage of the collaboration effort is still at a dialogue level; however some programme of work was initiated involving joint study between students from the two departments involved. Construction sites were visited, records of drawings and pictures were taken which are later processed using the VR packages.

Data were collected through different means that include

a) Visiting of the site/building: Some buildings were selected for strategic study, in the Campus of the Federal University of Technology, Akure.
b) Photographs were taken at strategic angles to get a proper view of the existing condition of the building.
c) The photographs were simulated as 3D model of the building using VRML (see Plates 1 8).
d) Relevant books, journals and literatures were consulted to get more information.

Methodology

The methodology employed was the critical examination of different building project drawings developed by the use of different computer aided drawing software such as AutoCAD, and comparing them with drawings generated by virtual realty software packages such as Vizx3D modeler. Some design propositions were explored through the development of a specific example of virtual architecture. Traditional media were used to develop the design included pencil and pastel sketches, and ink drawings. Electronic media were also used, including Video capture of different view of the real building with a digital camera, computer-aided design for three-dimensional models, as well as still-frame and real-time rendering of those models with animation and virtual reality technology. Vizx3D, which is a VRML modeler, was used for the 3D design of the project. It was after completion exported in VRML format for onward rendering by any of the VRML browsers (e.g. Octaga and Cosmo Player).

Further Works

The collaborative effort includes a proposal to develop a World Wide Web site to record the development of the project. This will enabled the on-line publication of the project for real time interaction with the models of

To program an animated presentation the nodes or actions needed are picked from the nodes window and put into the simulation tree. Here, those nodes are associated with the blocks to be affected by the programmed animation.

The following figures represent the layout of the plan of the building within Vizx3D modeler.

The Virtual Building Tour

Here, the builder/client can walkthrough and interact with the design at real time to point out errors. It is possible to navigate through the entire design without any restriction, that is, one could walkthrough, look, slide, examine, rotate, straighten, create viewpoint nodes, take snapshots. The pictures presented below offer various snapshot of real time navigation through the finished virtual building. This could be with a stand alone VRML browser or integrated Web browsers.

Plates 5 8 show the virtual tour of the building within Vizx3D modeler.

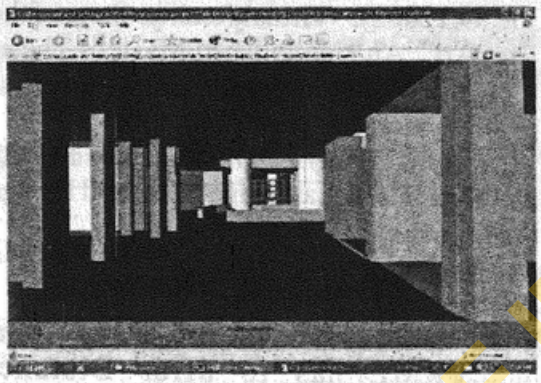


Plate 5. Front view

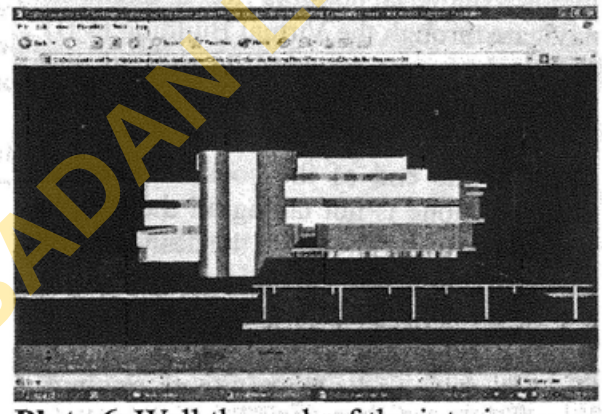


Plate 6. Walkthrough of the interior

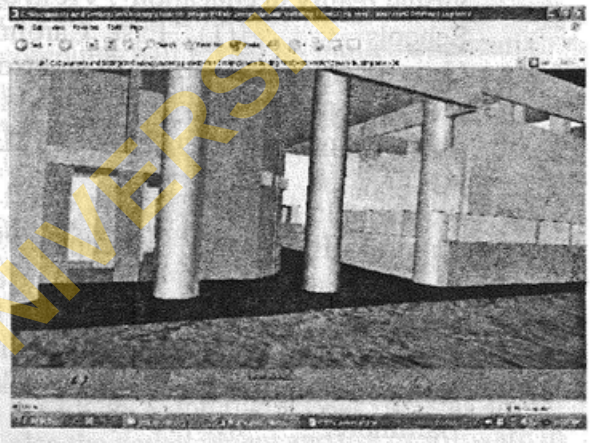


Plate 7. Walkthrough of the interior

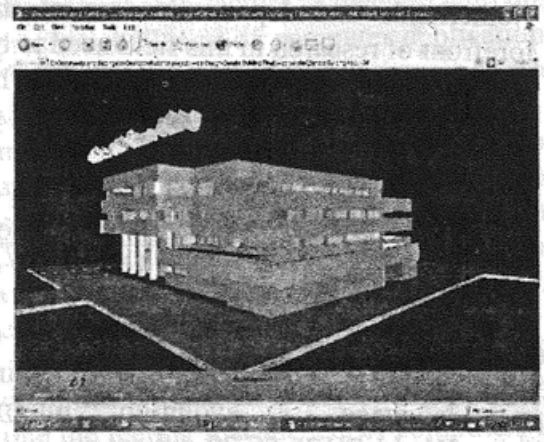
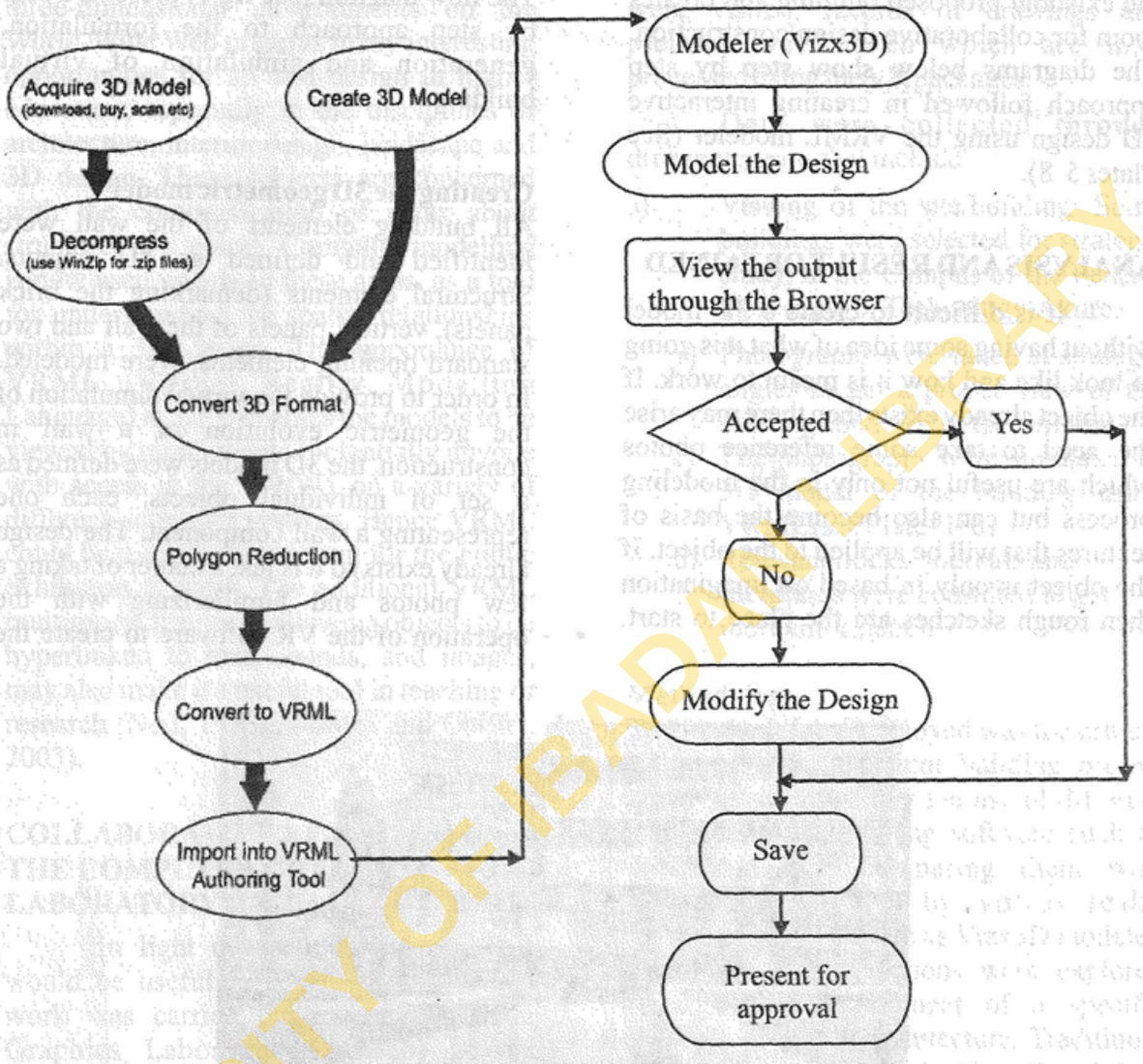


Plate 8. External view



Structural elements of the Design

Foundations, columns and beams, were considered as structural elements. The concrete blocks are defined as *box* graphic elements (available in the AutoCAD system). The VR system should allow the manipulation of the elements of the wall model according to the plane prescribed for carrying out the construction. Supporting that, a range of nodes or functions is available in the system to build up convenient virtual animations. When the wall model is inserted into the virtual system, the drawing blocks of the model are visualized in the central window.

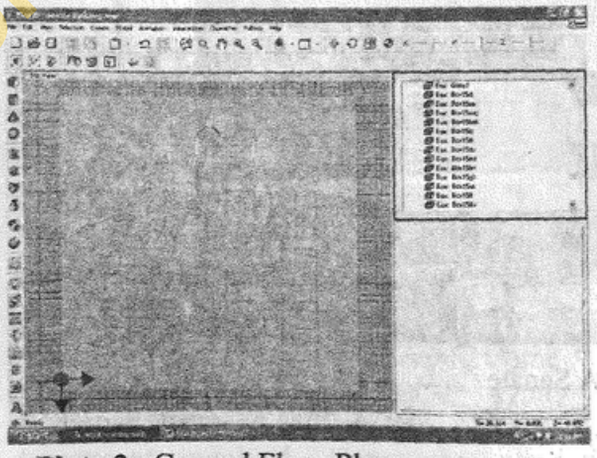


Plate 3. Ground Floor Plan

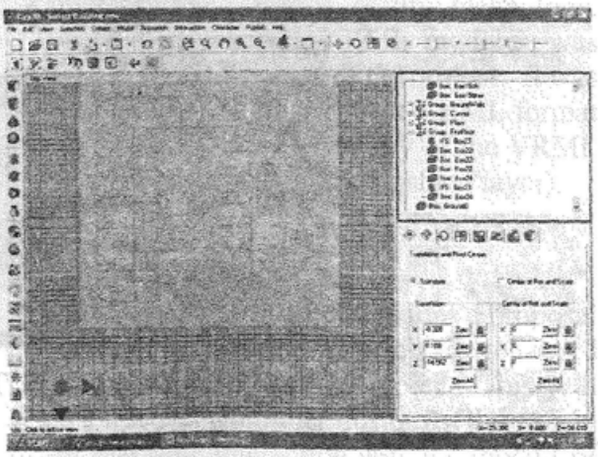


Plate 4. First Floor Plan

CONCLUSION

Despite the AutoCAD designs, some limitations are still been experienced in the sense that clients may not be able to make some modifications themselves and instantly visualize the effect of the modifications. Virtual Reality System (VRS) came as a solution to these problems that AutoCAD could not solve. Virtual Reality has the characteristics of being inclusive, interactive, and happening in real time. Using the VRS, the clients can see and have a taste of the structure even before a block of the building is laid. Being interactive, it is possible for a client to navigate through the Virtual Building (VB) and make real-time modification of the structure until he or she is satisfied. In this case, if the structure is not acceptable to the client at the end of the construction, the designer alone is not taking all the blame, because both the client and the designer as a matter of fact, took part in the design. The use of virtual reality should be encouraged in the Nigerian architectural schools through the broadening of the curriculum. Collaboration with architectural schools in the developed world should be looked into; with a bid to forming exchanges with them. Countries like the United States, China, Netherlands and Japan who are at the forefront of research in this field need to be contacted and persuaded into assisting the up and coming architects.

REFERENCES

Beier, K.P. (2006): Virtual Reality: A Short Introduction, Michigan, University of Michigan.

Blackburn, D., Henderson, R., & Welz, G. (1996): "Virtual reality modeling language evolution". Internet World, 7(12), 65-70.

Burdea, G. & Coiffet, P. (2003): Virtual Reality Technology, Second Edition, John Wesley & Sons.

Chalmers, J. (1996): Virtual education, [Online]. Available at: http://www.musenet.org/~bkort/EdMud.html
Accessed 29 August 2005

Dewey, J. (1966): Democracy and Education. New York: Free Press.

Evans, C. (1995): WWW-VRML benefits [Online]. Available at: http://freenet.msp.mn.us/people/drwool/icde/0038.html
Accessed 12 May

Obe, O. (2002): "Virtual Reality State of the Art", An Unpublished Master's Thesis to Department of Computer Science. University of Lagos

Neil, A. (1996a): "The Virtual Reality Modelling Language in Art and Design Higher Education". : N.Ashdown@mmu.ac.uk
Accessed 29 August 2005

Neil, R. (1996b): "Virtual Reality: What VRML has to offer Distance Education". www.mindspring.com/~rigole/vr.htm
accessed 7 July 2006

Pantelidas, V. (1995): "Reasons to use virtual reality in education". VR in the Schools 1(1), East Carolina University: V.R and Education Laboratory Press. http://eastnet.educ.ecu.edu/vr/vr1n1a.txt
Accessed 15 August 2005

Sutherland, I. E. (1963): Sketchpad: "A Man-Machine Graphical Communication System", In Proceedings of the Spring Joint Computer Conference, Spartan Books, Baltimore, MD, 70 79