# Designing the Digital Environment

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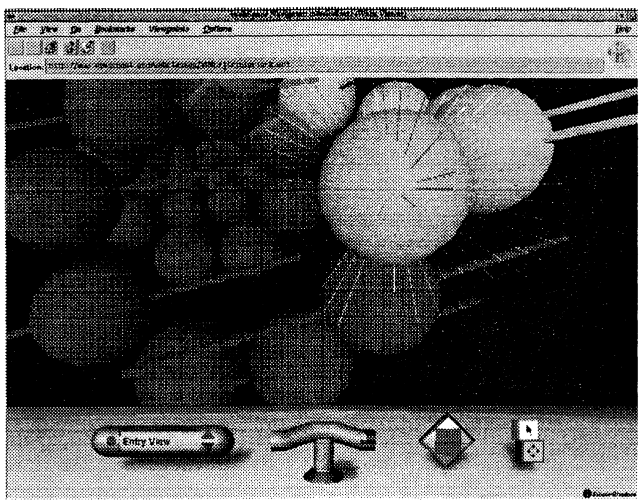


Image A: A virtual environment based on RNA clusters which plays on the use of scale, and contains clusters within clusters, by Ji Yoon.

## ARCHITECTURE AND VIRTUAL SPACE

This article presents the development of a course taught in the spring semester of 1996 at Parsons School of Design, with joint support from the departments of Architecture and Digital Design. The course utilized recently developed technology to create and share computer generated simulated environments over computer networks. This technology, VRML or Virtual Reality Modeling Language, allows a computer user to interact with these environments, to enter, explore and move through them as one would any built project, experiencing a variety of phenomena while traversing three dimensional space. What is most amazing about VRML is that it is a cross platform, open standard scripting language, so that these experiences are available to anyone and everyone who has a personal computer, a modem and a phone connection to the Internet.

While professional and academic institutions have long used CAD and 3D modeling technology for architectural presentations, it must be understood that VRML is not simply visualization, but actual immersion. While VRML environments do not exist physically, they utilize many of the same criteria and principles which we use to describe physical space.

For architects and industrial designers, VRML expands our ability to present and preview work, not only to coworkers, clients, and consultants, but to an ever expanding audience of participants in the digital realm of the Internet. It obviously introduces new methods of visualization, but also places designers in a unique position to design a new kind of environment, one which may be simultaneously inhabited by individuals who may be hundreds if not thousands of miles apart.

The course was developed in response to the challenge of VRML, initially revisiting fundamental issues of computer based visualization, although our ultimate goal was to determine if VRML, and the World Wide Web, are appropriate to the field of architecture. We questioned whether these medium are useful to our methods of practice and education, and to our profession in general. The course initiated questions in regard to the "place" where architects are engaging practice, most prominently, is it valid for architects to design and build in cyberspace?

## THE FUTURE OF DIGITAL SPACE: PERSONAL COMPUTERS AND THE INTERNET

The course referred to developments relating to the technology for its program. The rapid expansion of the Internet, and specifically the World Wide Web, as it has evolved from a document retrieval system to a communication medium, has broadened the reach of individuals, businesses and academic institutions, and increased their ability to interact with each other. Simultaneously, an increase in computational power on personal computers caused by the introduction of 32 bit processors, now allows desktop PCs to perform highly complex mathematical calculations. These developments occurred over the last few years, but their joint potential was only made apparent in the spring of 1995, with the release of the first VRML specification. VRML is a scripting language which allows three dimensional polygon based models, with colors, lights and interactivity to be easily and efficiently generated as ASCII (common word processor) text. In addition, because VRML is text based, models can be authored in any word processor, exist in very small data sizes, and transmit quickly and efficiently over the Internet.

The increase in processor power that allows PCs to handle VRML models also points to an impending change to the current visual working environment, or user interface, of the personal computer. The user interface is dictated by the power of the computer's processor. It was the arrival of 8-bit processors in the late 1970's, and resultant research at Xerox's famous Palo Alto Research Center, which led to the Macintosh operating system's (OS) Graphical User Interface or GUI, and in turn to the Microsoft Windows. This allowed PCs to leave a text based interface of computer programmers for today's "desktop" paradigm filled with "files" and "folders." The recent migration to 32-bit processors allows for GUIs which add movement and a limited amount of three dimensionality to the desktop paradigm.

The next generation PC processor is always the current generation Workstation processor, which today is 64-bit, and easily capable of generating complex three dimensional space while simultaneously calculating light, color, textures and other types of interactivity. Small versions of these 64-bit processors are already used in inexpensive computer game machines such as those made by Sony, Nintendo and Sega. Manufacturers have recently released graphics sub-processors for PCs which specifically accelerate 3D graphics. The end result of these developments will be the ability to utilize a GUI which replaces the "desktop" paradigm with one of the entire office. In the near future computer users will enter an environment in their PC and work within that environment, using spatial interfaces rather than the current graphical ones. The benefit of a "place" metaphor for a GUI over the "page" metaphor, especially for the World Wide Web, is that people see and think in three dimensions, therefore it should be much easier to find a document or a website in a physical location than it is in a complex of hierarchical directories, subdirectories, folders and files.

If we assume that the design of virtual three dimensional space is within the province of architecture then the obvious question presented by these technological developments is what will these new three dimensional spaces be?

## A CLASS IN THE DIGITAL ENVIRONMENT

The design of simulated three dimensional environments, in which the user immerses him/herself is ultimately the design of a community—with areas of work, recreation, education and communication—and therefore relates to the normative process of public planning and design. The difference with traditional architecture is that in VR we discuss architectural form in relation to its programming scripts and its size in kilobytes.

In creating this course there were issues to address which had nothing to do with the perceived problems of whether or not it is valid for an architecture class to study building in cyberspace over building in real space. For example, could students, with basically word processor computing skills, and only one semester of computer modeling, handle the complexities of working in an abstract computer. Although scripting is taken for granted in computer programming classes, none of our students had any experience looking under the hood of a computer application. The success of the course depended on both the student's feeling comfortable with the abstraction of modeling in a text based medium as well as their previous training in studio, that is, on their use of drawing and model building to conceive in three dimensions.

During the first class we established the working methodology, we gave students the full VRML specification, and had them begin to script. They started out by making basic objects which are a pre-formed part of the VRML language, such as "cube," "sphere," and "cone." As they began compositing the objects it became immediately clear that it wasn't yet time to throw out the pencils and trace, these would be the tools they would need to map the coordinates of their objects in three dimensional space.

The course was taught as a research course, therefore the interaction of teachers and students was a collaborative one in which the students were expected to bring new ideas and information to the class each week, while the teachers provided the structure in which the class would work. As a reference text we used the *VRML Sourcebook* by members of the San Diego Super Computer Center, although we found that the greatest reference was the experimentation and ingenuity of our own students.

An Internet site was established for the class on the school's server, and each week work was uploaded to the site for review by all the students. Once on our server, this work

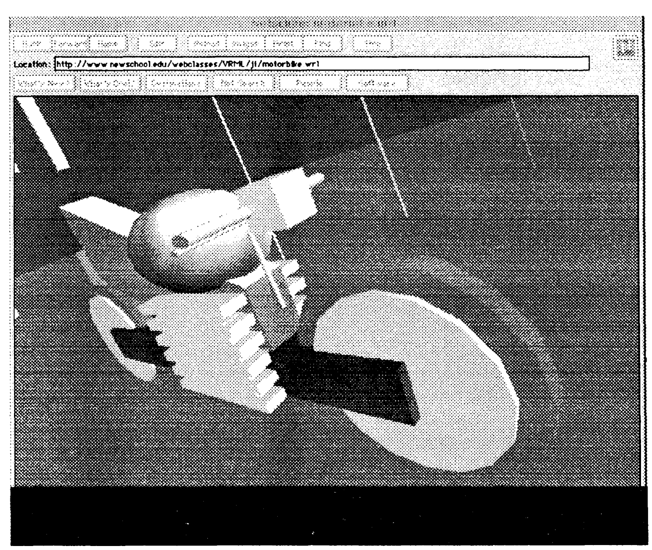


Image B: The first assignment was to create a personal domestic object; above is Ji Yoon's virtual motorcycle.

was as immediately accessible to anyone on Internet, and we received feedback from visitors throughout the semester.

The first homework assigned the students was to create both a homepage for themselves in HTML and a domestic object of their choice in VRML, using pre-formed objects and simple scripting for coordinate mapping and colors. We had taught HTML for the final project in the student's previous computer visualization class, although the *Bare Bones* guide was also supplied as a reference text. The response on the part of the students was interesting, there was a tongue in cheek relationship between the webpages and the domestic objects that expressed both humor and their enthusiasm for the project. The objects ranged from toasters to a fairly complex motorcycle. The success of the first assignment allayed our fears about the students not being able to script.

As teachers our initial hurdle turned out to be as it often is with computer based teaching, technical. Although this course was only offered a year ago, existing VRML browsers at that time were all in either alpha or beta stages of development. However we were able to find at least one working browser for each of the three platforms we worked on. Authoring was done in text editors on Macintosh PowerPCs and IBM-compatible Pentium PCs, viewing was done using freeware VR browsers on those platforms while the final presentations were done on Silicon Graphics workstations using SGI's "WebSpace" browser. (Today VRML 1.0 browsing capability is built into both the Netscape Navigator and Microsoft Internet Explorer web browsers, and VRML 2.0 can be explored using Silicon Graphics Cosmo Player on SGI and Windows NT computers.)

Each week the students were also given a series of readings on related subjects which ranged from the relationship of technology to aesthetics, such as Robin Evan's writings on Mies van der Rohe, to more theoretical essays such as Paul Virilio's articles on "fractal space," a space which is at once both local and global. Through group discussions and critiques, the students identified conceptual differences between virtual space and the real world. For example, there were lengthy debates about the validity of building stairs in an environment which one locomotes by "surfing." There was also discussion about the use of "structural" objects in an environment which has no gravity. Certain compromises were made to keep the environments from being totally alien to visitors, but this also became part of developing an appropriate design language for this new medium. We challenged the students to imagine how Henri Labrouste felt when he first began designing with slender steel members. During these discussions students also defined specific personal programs and identified areas of research having to do with either structure, circulation, or communication technology in the digital environment.

All projects were authored in ASCII text, there was no use of modeling software in the generation of any of the works, which helped also to guide students in creating spatial environments which were functionally appropriate. The use of scripting rather than conventional modeling software allowed students to add interactivity to their environments which would not be available otherwise. These included hyperlinks, and actionable buttons to play sound or quicktime animations. In addition, at weekly presentations, projects were not only viewed through the interpretive filter of a browser, but were examined in a word processor as well, in order to analyze the format of the script. In this way students developed a rigor for ordering their work, so that if mistakes did occur they could quickly and easily be identified and edited.

The second assignment required students to create a "complete" virtual environment. This environment would be the basis of the third assignment so the students were asked to specify their program before beginning. In addition the use of pre-formed objects was dropped in favor of the complex, but more deliberate methodology of coordinate mapping points and planes in three dimensions. Again all projects were scripted, no modeling software was used, although by this time several applications had been released which exported in the VRML format. We found that these were limited in function, exported extremely blotted, large files, and did not allow for efficient editing at the text level, therefore preventing the use of interactivity. Much like the first assignment the students produced a wide variety of solutions to the problem. A number of the undergraduate students used the class as an expansion of studio projects which was not necessarily an appropriate use of either the class or the technology. The graduate students who are in a professional degree program, however, used the class as an additional design studio and generated strong projects. The variety of spaces ranged from Corbusier's Villa Savoye, (although rotated at 90° and enclosed within a long complex of amorphous forms to disorient the viewer) to an interstitial space which contrasted the limits of dimensional size versus data size.

The latter project utilized VRML to its fullest ability,

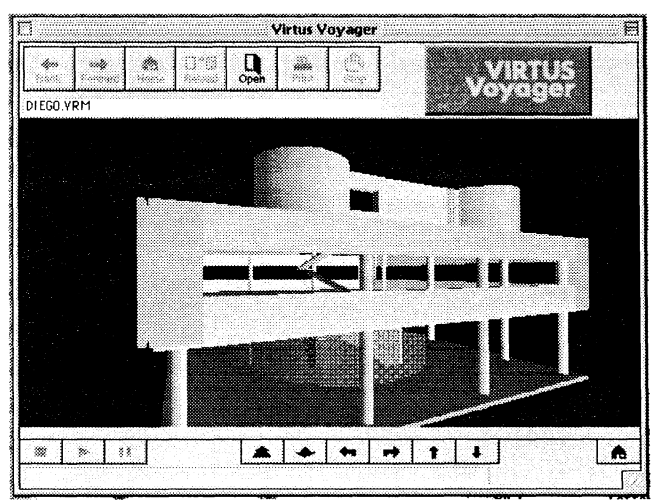


Image C: Villa Savoye model by Diego Gronda.

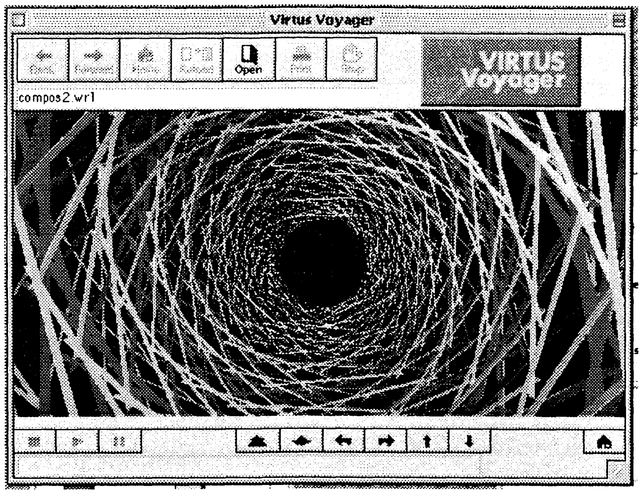


Image D: Virtual gateway by Mark van Schendel, this space describes a dimension of 6,000 x 1,000 units, but is only 26 kilobytes in data.

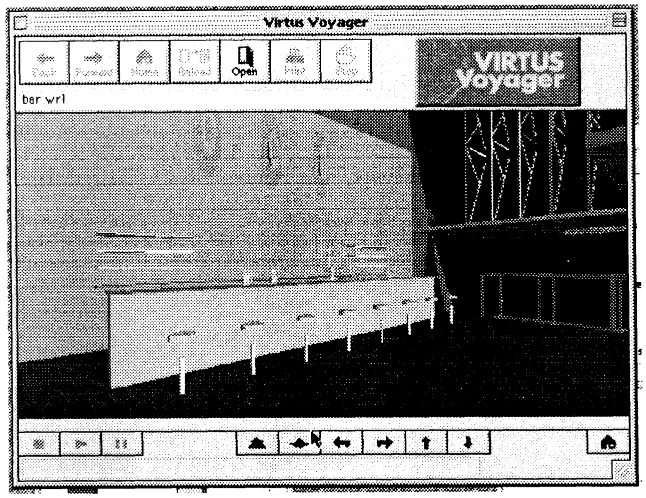


Image F: A pub for multi-user interaction complete with virtual libations and real music by Joshua Harper.]

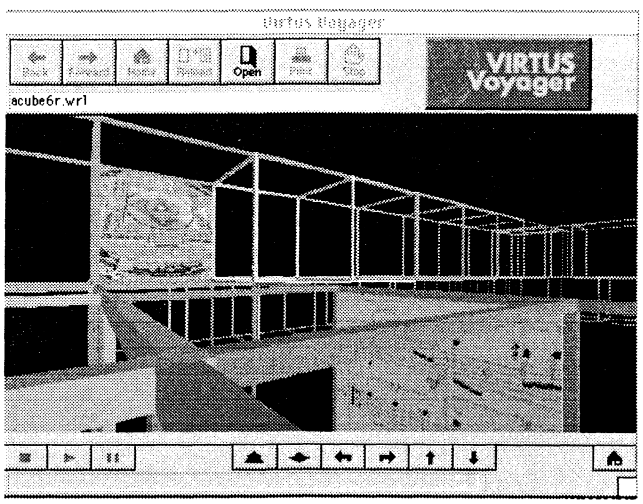


Image E: A site which explores the impact of fractal theory on art and architecture by Andrea Russell.

using three polygons to create a nest which encompassed a space of 6000 by 1000 feet, but only took up 26 kilobytes of drive space. Other projects included environments which could be used as staging areas for exploration of other websites and virtual environments.

The third and final assignment required the students to add a level of interactivity to their sites. At the time this was limited to hyperlinking (electronically connecting) files, but even this simple action was used creatively by the students.

One of the more successful solutions is a site which explores fractals. The site which itself takes on the form of an expanding fractal pattern, has several hotlinks where a user can link to other sites relating to fractals including ones that generate VRML fractal models. Other students created virtual museums which linked to real museum sites, pubs complete with sound and jump sites which linked a number of sites together. Unfortunately we found that some students literally became lost in space. Those who did not establish a ground plan, or at least engage the problem of where is up and what is down, wound up designing a space that lacked both reason and definition.

This final assignment was juried by professional architects who were familiar with computer modeling and virtual reality, although who were not necessarily users of CAD or the Internet. They had the daunting task of not only critiquing the design work but of understanding the potential of this medium. The potential for architectural visualization was immediately apparent. Projects at the design stage can now be explored inside and out, at scale—with any number of consultants and clients—no matter where they are, as long as they have a computer and a phone line. The more perplexing issue was that of establishing design criteria for these new spaces. There were almost as many solutions to this question as there were students in the class. For the most part the projects were considered successful, although once again where a sense of disorientation set in when it was not intended, the students were criticized. The jury was enthusiastic about the work of the class on whole and as a result our architecture department has expanded its digital offerings. The VRML class is being taught again this year along with an advanced course focusing on real world/virtual world interactivity.

In reviewing the work of the class we found that the students adapted quickly to the techniques and tools of designing for the computer as an end medium. Within the first third of the semester, they had become comfortable with a methodology of mapping out the coordinates of their environments, imputing the data in the VRML format, and then checking and exploring their work with a browser. Architecture students are ideal candidates to learn this kind of scripting language, specifically because of their training to think and design in three dimensions. As abstract as the working conditions were, the students were able to translate their concepts from drawing to script and back to 3D as easily as they would convert plan and section drawings into a chipboard model. It was of immense importance to us as educators, that our students learned to use this technology quickly and easily since a steep learning curve might have made this technology inaccessible to others who do not have time to become computer gurus. By the two thirds mark in the semester students were using advanced features of VRML, such as texture mapping and linking their projects to other VRML objects and websites. Their flexibility in designing spaces for use in digital network environments was highly rewarding for the teaching staff.

It was our intention to use VRML and computer based design to go beyond simply previewing architectural projects; it was our hope to open up a new arena of design to architectural study. Digital speed makes the distance between the designer/ presenter and the client/users moot, and networks such as the Internet allow for communities which are inhabited instantly, simultaneously, by anyone and everyone with Internet access. In cyberspace, we function as architects as we design, and the difference with the physical world is that we encode and enclose space in a local state which can be accessed globally, creating a new kind of public domain. In virtual reality we realize a goal which architects have historically set for themselves, creating architectural form which is inherently metaphoric - by making a specific place accessible to a communal whole. Our present challenge is to define new means of access and new kinds of usage to an even greater number of users.

## ACKNOWLEDGMENTS

Sven Travis, Chair, Department of Digital Design, Parsons
Karen van Lengen, Chair Department of Architecture, Parsons
Nancy Herrmann, teaching assistant

## REFERENCE

Mark Pesce, "VRML Browsing and Building Cyberspace," 1995 New Riders Publishing

Andrea Ames, David Nadeau, John Moreland, "The VRML Sourcebook," 1995 John Wiley & Sons

## A SAMPLE OF TYPICAL VRML SCRIPT

```
VRML 1.0 ASCII

DEF columnA

Separator{
DEF color1
Material{
emissiveColor 0.5  1.0     0.73
shininess 3.0
transparency .02
}

Translation{
translation        0.0     -50.0    0.0
}
DEF cube1
Cube{
height    2.0
width     2.0
depth     22.0
}
DEF trans2
Translation{
translation        0.0     10.0     0.0
}
USE cube1
USE trans2         USE cube2
USE trans2         USE cube2
```