ARCHITECTURE IN DIGITAL SPACE

Actual and Potential Markets (Short Term)

by

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ABSTRACT

As both the skepticism and 'hype' surrounding electronic environments vanish under
the weight of ever increasing power, knowledge, and use of information technologies,
the architectural profession must prepare for significant expansion of its professional ser-
vices.

To address the issue, this paper offers a survey of the professional services architects and
designers do and may provide in digital space, and who the potential clients are. The
survey was conducted by interviews with software developers, gaming companies, pro-
grammers, investigators, practicing architects, faculty, etc. It also included reviews of
actual software products and literary research of conference proceedings, journals, books
and newspapers (i.e. articles, classified ads, etc.).

The actual and potential markets include gaming and entertainment developments, art installations, educational applications, and research. These markets provide architects the opportunity to participate in the design of 3D gaming environments, educational software, architecture for public experience and entertainment, data representation, cyberspace and virtual reality studies, and other digital services which will be required for this new world.

We will demonstrate that although the rapidly growing digital market may be seen by some to be non-architectural and thus irrelevant to our profession, it actually represents great opportunities for growth and development. Digital environments will not replace the built environment as a major architectural market, but they will significantly complement it, thus strengthening the entire architectural profession.

INTRODUCTION

As both the skepticism and 'hype' surrounding electronic environments vanish under the weight of ever increasing power, knowledge, and use of information technologies, the architectural profession must prepare for significant expansion of its professional services.

This expansion may prove to be a difficult task as little discussion, work, or research on the subject exists within the architectural community. The lack of involvement on the part of architects is puzzling considering they have a recognized expertise in using representations and designing 3D environments and structures. The reason for this, appears to be that digital space is predominantly seen as only a virtual studio for real world designs. Such a lack of *vision* may result in a loss of the potential architectural services that digital worlds will require.

To address the issue, this paper offers a survey of the professional services architects and designers do and may provide in digital space, and who the potential clients are. The survey was conducted by interviews with software developers, gaming companies, programmers, investigators, practicing architects, faculty, etc. It also included reviews of actual software products and literary research of conference proceedings, journals, books and newspapers (i.e. articles, classified ads, etc.).

The actual and potential markets include gaming and entertainment developments, art installations, educational applications and research. These markets provide architects the opportunity to participate in the design of 3D gaming environments, educational software, architecture for public experience and entertainment, data representation, cyberspace and virtual reality studies, and other digital services which will be required for this new world.

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VISIONS OF DIGITAL SPACE

We understand by *digital space* the computer generated electronic medium that serves as an artificial environment for architectural work. Two visions of digital space are available:

(1) digital space is a *studio* for the development and testing of architectural products aimed at classical reality.[25]   In this vision, digital space depends on the rules and laws of the physical world and its value is tied to being a representational instrument for worry-free experiments and simulations.

(2) digital space, a reality of representations, is an *environment* with nature, functions, aesthetics, order, etc., not necessarily following or referring to classical reality. In this world, may people find and generate information, work, meet other people and seek entertainment. According to this vision, architecture should play a major role in the conceptualization, organization, and design of such an alternative reality. In other words, digital space is a virtual place in its own right that has no other justification than offering alternative experiences, structures and events to those of classical reality. Architecture designed for this interpretation of digital space is meant to be constructed in digital space and is not to be a part of the physical world, except to be experienced by people. We will call this architecture *digital*.

It is the latter vision that will be investigated in this paper. Our intention is not to make yet another philosophical or theoretical argumentation for the value or future of digital space as a self-standing environment. These have been done elsewhere [Anders, 1994; Benedikt, 1991; Negroponte, 1995; Novak, 1991; Rheingold, 1993/1991]. Rather we are interested in demystifying the confusion surrounding the subject by presenting an informal survey of actual and potential short term market opportunities for digital architecture. We believe that this will help to bring into our professional milieu a rapidly growing area that is presently viewed as outside the realm of architectural practice.

Different Digital Environments

Digital environments have been undergoing structural transformations since their beginning. What started as cryptic, one-dimensional, text-based worlds have evolved into user-friendly, two-dimensional and graphical realms, and more recently into desktop (i.e., flat, screen constrained) three-dimensional, real-time and interactive environments. The widespread availability of three-dimensional immersive interfaces (Virtual Reality) is around the corner. On top of these developments lies *cyberspace*, an "n"-dimensional digital environment that is publicly accessible via multiple networks of computers and telecommunication technologies such as telephone, cable and satellite.

Digital architecture may be called upon to serve in any one or more of these different digital spaces. The programmatic requirements may also be varied to include gaming, entertainment, education, operating systems and databases. As a result, architectural practice in digital space may take on many forms ranging from the design of backgrounds and texture mapping to the design of complete, albeit virtual, buildings/artifacts, experiential events, digital spatial infrastructure, visual interfaces and software coding.

ARCHITECTURAL MARKETS: ACTUAL AND POTENTIAL

As it is impossible to fully cover the whole range of markets for digital architecture in the length of this paper, we will present the main areas of development. Some areas may receive more attention than others. This is due to the fact that some areas have greater market potential than others. Companies and individuals may be called upon as examples when specific details or issues demand it. This is to show that what is discussed here and by others is not just theory but actual and as real as traditional built environment architecture.

Our presentation involves only **short term** (present to 5 years into the future) **markets**. We will cover long term markets in a future paper. However, many of the short term markets have a life span that will carry them into the future and therefore into long term markets. Some might even develop into other related markets altogether. The intent is not to be prescriptive but to provide a guide so that architects, educators, students and others can make decisions regarding their present and future work. We will keep the level of speculation regarding potential markets to a minimum as the digital field is just beginning and therefore does not allow for major forecasting.

The main short term markets we will discuss are *Gaming & Entertainment*, *Cultural (Art)*, *Educational* and *Research.*

Gaming & Entertainment Markets

These two markets are sometimes distinct and sometimes blended together. In the following discussion, we will keep them together.

Digital architecture enters the Gaming & Entertainment area as virtual environments that give the mood of the place where the users' adventures take place. 'Architectural design' is done as either an imitation of what exists in the real built environment or as an original creation that may or may not relate to anything that has previously been built. The scenes in these adventure games are rendered realistically and the structures and placement of the buildings in the landscape are intriguing. Architecture is used as a place of reference with backdrops, images and real world simulations, in which the players journey into fantasy worlds. If this use of architecture is literal, and perhaps superficial, great opportunities exist for development beyond the existing patterns. For instance, the popular game Doom allows users to design, add, and exchange new areas and chambers to the default environment.

Adventure and role playing games have existed for several years, but in 1993, a new level was brought to this market as Virgin and Trilobyte released *The 7th Guest*. It has been followed with the entry of several other role playing and adventure games. These include the releases of Cyan's *Myst*[26] and Access's *Under A Killing Moon*. *The 11th Hour*, a sequel to *The 7th Guest*, has just been released this year. Companies have even been created solely for the development of these types of computer games, and more are appearing each year. Access, Strata Inc. and SingleTrac are among the companies who have recently entered, the growing computer gaming market. All three of these companies are located in the state of Utah, and therefore, it is conceivable that there are many more companies throughout the United States and the world who are or will be joining this expanding market in the near future.

Please refer to **Figure 1** located at the end of the paper.

Although most of these games are aimed at 2D and occasionally 2.5D PC-generated digital environments, one can clearly foresee that they will eventually become virtual reality entertainment systems in the future. Many observers have pointed out that networked and highly interactive computer games (e.g., Doom and other similar games) are where large areas of cyberspace will be developed.

The electronic Gaming & Entertainment business (totaling over $15 billion world-wide), which is growing at an amazing pace [Negroponte, 1995], undoubtedly repre-

sents the largest short term market of digital architecture. With this level of popular demand, investment, and growth the future of Gaming & Entertainment appears bright indeed. Faced with these facts, one wonders what place and role architects should play in the design of such elaborate gaming environments. We have specifically looked at this possibility in both large and small scale companies within the state of Utah. The results however are similar to what is happening elsewhere in California, Minnesota, Massachusetts and New York.

In interviews with a few small game developers, it was found that there is a need for individuals with skills that architects normally possess. These include 3D visualization and design, computer modeling, rendering and animation, organization, planning and creativity. Although these developers are not interested in actually subcontracting the services of an architectural firm, they do have the need for individuals with these skills and talents to work in their art development departments.[27] The role of these individuals would be similar to that of corporate architects that work in-house in developing designs.

Local game companies have contacted architectural students at our school of architecture for this very reason. These companies felt that their internship development program allows them to turn to individuals that have training and skills in 3D visualization and creative problem solving, such as those in the architecture department, instead of turning to the mathematics, computer science and art departments as they have in the past.

Contacts with professional animators from Minneapolis & New York confirmed these arguments and indicated that the market demand for people skilled in electronic 3D modeling, rendering, animation and art is many times that of labor supply. A collection of classified adds from local and national newspapers demonstrates the reality of this phenomenon.

Please refer to **Figures 2** and **3** located at the end of the paper.

Gaming developers Sega and Nintendo have similar needs in the creation of their video/computer games that could be satisfied by architects. This is demonstrated by the fact that the *architectural firm* Archimage designed a 'neighborhood' to be used as a backdrop in one of Nintendo's games.[28] With the continued growth and popularity of these two market giants, there is certain to be the increased need and opportunity for architectural services similar to those provided by Archimage.

The larger gaming and installation developer, Evans & Sutherland (of flight simulation fame) has, over the past couple of years, developed computer games and larger gaming installations such as *Droid Whackers* and *Virtual Adventures*. The latter is similar to a theme park ride where people experience a tour through an environment in a pod that resembles a flight simulator.

Evans & Sutherland has an art development department and requires virtually the same skills as the other gaming companies. Evans & Sutherland however, is exclusive and the work is accomplished using proprietary hardware and software. Therefore, it normally takes several years for individuals to be properly trained and work their way through the company's departments. There are staff members in the entertainment and modeling divisions that have design and architectural training/backgrounds, who have followed such a path in working their way into their current positions.

Microsoft and Dreamworks SKG have just recently announced that they will form a company in a joint venture [Fabrikant, 1995].[29] This will be an enterprise to develop interactive and multimedia entertainment products. These will include initially interactive stories that could fall under the educational area as well as adv enture or role play-ing games. Employees are to come from software, animation and film industries. This would indicate again that there is potential work for architects with training in anima-tion and digital environment design.

In summary, the Gaming & Entertainment markets are open to architectural students and professionals with the necessary skills and determination to persevere in this new niche. As the example of Archimage shows, it is possible to become known for one's work and to be hired as a consulting firm to design virtual environments for gaming developers. In addition, there is the possibility that architectural firms could enter into the digital market of gaming/entertainment themselves by designing and developing their own adventure games (both small and large products). This could be accom-plished by taking the lead of the software development team and having in-house pro-grammers or sub-contracted ones perform programming tasks. Architects could also co-venture or merge with existing software companies to combine the skills of each. Since several of the gaming companies are startup companies, it seems logical that archi-tectural firms, with their skills in creative problem solving and visual design, could fol-low similar paths and become strong competitors in this growing marketplace.

Cultural (Art) Market

The major work in this market is comprised of art displays and shows. Artists, design-ers and architects have become increasingly active in the exploration of the

aesthetic/communication potentials of digital space at many levels. Given the growing interest in electronic media in general and Virtual Reality (VR) in particular, it seems likely that the public would pay to participate in or observe artistic displays or installations much like they do with more traditional art exhibits.

This is by no means a new concept. Myron Krueger created such displays and experiences with the use of lighting, video equipment and computers in the late sixties and seventies (e.g. his Glowflow, Metaplay, Psychic Space and Videoplace art installations) [Krueger, 1991/1983; Rheingold, 1991]. There have been several art installations displaying digital work in the past year at the Guggenheim Museum, the Banff Centre for the Arts, and in Austin, Texas.[30] This is also happening abroad. The New York firm, Diller & Scofidio Architects, is now working on a VR project for the Pompidou Center in Paris.

The Cultural markets for digital architecture are a more risky venture, but if commissions could be obtained, either as joint ventures with artists or on their own, it would provide publicity for architects and allow the public to see what they have to offer in the realm of digital space design.

Educational & Other Markets

There is an increasing movement of companies to release reference material, interactive books, etc. on CD-ROM for home, office and institutional use. A publisher of architectural books, John Wiley & Sons Inc., recently issued a survey to evaluate the need and desire for educational CD-ROM's in lieu of traditional books. The use of CD-ROM's is growing in number and tripled during the year of 1994.[31] According to industry experts, there will be about 60 million homes with PCs with CD drives by 1998 [Pulley, 1995].

This growing market consists mainly of documented existing works of architecture or other real world artifacts. *The Ultimate Frank Lloyd Wright: America's Architect*, for example takes the user on a multimedia tour of his architecture, city planning and furniture design. *The Great Buildings Collection* on the other hand, is an encyclopedia of architectural works that includes models, photographic images video and animations. Other educational uses of digital space include, for instance, teaching students methods of design and visualization (e.g. *Visualize!). The Great Buildings Collection* and *Visualize!*, are further examples of work that has been done by architects who are currently working as professors of architecture.

This market also has the potential for educational software and interactive books that make learning attractive with innovative and creative environments such as those in *Calculus Castle* and *Forum/America*. *Calculus Castle*, a learning adventure set in a castle environment, takes individuals through a castle as they learn about calculus. The interactive magazine, *Forum/America*, contains a 'virtual building' which was designed and created as part of a nation wide design competition [P/A Staff, 1994].

Please refer to **Figure 4** located at the end of the paper.

It appears that CD-ROM's will grow to constitute a popular source of educational content in the future. Although little work has been done by architects in this area so far, what is available demonstrates that architects are able to develop this niche either as developers of architecturally related educational software or as designers of backgrounds, artifacts and environments for other educational software products.

Research on Cyberspace & Virtual Reality

Architects are also involved in the research and development of networked digital space (i.e., cyberspace and VR). However, in contrast to what has previously been discussed, most of this research is 'basic', that is, it is interested in the study of the 'architecture of cyberspace' and not in 'cyberspace architecture'[32] and of VR interface design and not of VR applications.

Two major areas of investigation are (a) the examination of the very element that constitutes cyberspace: data and (b) the study of VR systems. Here we also found great opportunities for the practice of digital architecture.

The first line of investigation is concerned with cyberspace as an information space. Studies of how to visualize, store, represent, navigate, locate, and access data, are being conducted at several institutions, including The University of Texas at Austin and The University of Utah. This research assumes the viability of a 3D, immersive cyberspace within a foreseeable future which ongoing developments of the internet seem to support — see the Sequoia Project below. Models are drawn from urban and building typologies, scientific visualization and the arts. Marcos Novak and Michael Benedikt have been involved in researching visual databases and how data will be represented in cyberspace [Benedikt, 1991; Novak, 1991]. One of us has just received a university faculty grant to study the design of 3D informational environments.

The second line of investigation is that of developing interfaces and operating systems and studying the architectural implications of VR systems. Several institutions are

working on this area, for example The University of North Carolina, Georgia Tech, The University of Manitoba, and The University of Illinois at Urbana-Champaign. Gottfried Meyer-Kress, who has been involved in VR research at the University of Illinois, has indicated that some of their current developments need to incorporate another level of orientation to aid in way finding that is based on architecture [Anders, 1994]. Individuals are also involved in this area of VR research and limited practice. Clayton Graham and Jim Leftwich, trained as an architect and industrial designer respectively, for example, have been working on the development of future operating systems and interfaces for various clients. Each has incorporated architecture as a metaphor for organization and orientation [Anders, 1994]. Finally, Richard Perron and Bruce Dexter [1994] are working in notation systems for interfaces that help designers interact and create in VR.

Please refer to **Figures 5** and **6** located at the end of the paper.

Shopping is another area that is currently being researched and developed in VR. Marc Fredrickson and Dema Zlotin for example, from the University of California at San Diego, have been designing a prototype for this new type of shopping environment. *In The Bag* began as a masters thesis in architecture and has developed into a VR prototype through continued research. It is a 3D, immersive environment that allows individuals the opportunity to go shopping in a virtual mall [House, 1994].

Although there is currently no significant market in developing VR applications, operating systems and 3D interfaces, except for basic research funding, there are potential markets for the near future. Cyberspace is the fastest growing community on Earth (10% per month — [Jacobs, 1994; Negroponte, 1995]) and will likely be a long lasting market in the future. This can be seen from the explosion in the consumption of cyberspace related magazines (Mondo 2000, VR World, Wired, etc.) as well as the growing interest in the popular press (e.g., Newsweek, The New York Times, Time, etc.).

There are many other opportunities that cannot be described in detail here, but warrant attention as they relate to short term and long term markets. Some involve the development of Multi-User Domains (MUD's) on the corporate and entertainment levels such as WorldsAway (animated graphical on-line chat) by Fuji and CompuServe [Staff, 1995]. In addition, ongoing work on the World Wide Web (WWW) shows the use of geographical and urban metaphors for the organization of information (e.g., Apple's e-World). Other projects include Sequoia 2000 or TECATE [Herbst, 1995; Wanger, 1995]. TECATE involves the development of a 3D interface for navigating through current cyberspace (the Internet via the WWW).

CONCLUSION

As the digital revolution spreads throughout today and tomorrow's world, important new opportunities for exciting architectural work will open. For the realm of digital space, whether it be CD-ROM games, virtual reality systems, or desktop educational software, involves the creation of multimedia environments that possess architecture.

It should be clear, however, that the digital markets presented here will not just be given to architects and design professionals. In contrast to the current practice of architecture, there are likely to be no regulations that require individuals to hire architects for digital design. Hence there is an important question. How can architects secure for themselves a place in the future digital markets? The answer may be that work will come through competition in providing quality services at competitive prices and with the aid of aggressive marketing.

Architects engaged in this electronic reality will have different roles and will need to be trained accordingly. This raises the issues of (1) how to reconceptualize what has been traditionally understood as 'architecture', (2) what the roles of architecture schools and educators are; and (3) what the potential division between traditional architects and digital architects may be.

To be competitive, architects will need qualifications that put them above others in the marketplace. These of course include the traditional 3D visualization, space planning, creative problem solving and design team management. However, in light of the potential markets, architects will also need to develop other skills to thrive in the world of digital architecture. Randal Walser and Michael Benedikt have described some of them:

> *"The talents of a cyberspace architect will be akin to those of traditional architects, film directors, novelists, generals, coaches, playwrights, video game designers. The job of the cyberspace designer will be to make the experience seem real."*[Walser in Rheingold, 1991: 190]

> *"For cyberspace will require constant planning and organization. The structures within it will require design, and the people who design these structures will be called cyberspace architects. Schooled in computer science and programming (the equivalent of "construction"), in graphics, and in abstract design, schooled also along with their brother "real-space" architects…"*
> [Benedikt, 1991: 18]

The architects of digital space will need to be trained in multimedia (video, film, etc.), computer modeling, rendering and animation, computer programming and interface design along with the traditional training of visualization, space planning, etc. Digital architects of the future will have the ability to both design and construct their visions, albeit in virtual environments.

Should architects choose to ignore the actual *and* potential digital work opportunities or not to develop a vision of digital futures, architects will lose these markets to other professionals as they have lost the construction management market and other portions of their profession in the past. However, to lose out on such great potential would be a significant, if not the largest loss of all.

ENDNOTES:

1   Toffler, Alvin and Heidi. Creating a New Civilization: The Politics of the Third
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2   Greinacher, Udo. "The New Reality: Media Technology and Urban Fortress",
        Journal of Architectural Education. Volume 48, Number 3. (February, 1995):
        176.

3   Garreau, Joel. Edge City: Life on the New Frontier. (New York: Anchor Books
        / Doubleday, 1991): 278.

4   Van der Ryn, Sim and Calthorpe, Peter. Sustainable Communities: A New
        Design Synthesis for Cities, Suburbs and Towns. (San Francisco: Sierra Club
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5   Crosbie, Michael J. Editorial: "Public Space Held Hostage". Progressive
        Architecture, March 1995: 9.

6   Cameron, Beverly J. (Editor). "Teaching in a Clinical Setting", Teaching at the
        University of Manitoba: A Handbook. (Winnipeg: University Teaching
        Services, 1993): 30-33.

7   Ibid.: 32.

8   Bloom, Benjamin S. (Editor). Taxonomy of Educational Objectives: Handbook
        1 - Cognitive Domain. (New York: Longmans Green).

9   Manitoba Science and Technology Advantage, 2nd Edition. (Winnipeg:
        Manitoba Industry, Trade and Tourism, 1994): 30.

10   Ibid.: 30.

11   Dunham-Jones, Ellen. "Learning From the Liberal Arts".   Proceedings: The
        Liberal Education of Architects. (Lawrence: The University of Kansas School
        of Architecture and Urban Design, 1990): 62.

12   Rafael Moneo, "On Typology," Oppositions , p. 23-45

13   These exercises and investigations are relatively pain-free ways to learn some
        basic computing strategies and could be employed across the curriculum—espe-
        cially in beginning theory classes and design studios or as a device to integrate
        design and theory in later studios. The computer systems required for these
        exercises do not need to be high-end. The application UpFront was used to
        develop the block exercise. This is an inexpensive application (academic price is

$99 at this time), the equipment requirements can be minimal (typical Macintosh or Windows installments), and it is very easy to learn.

14   The concept of holism is integral to Gestalt theory. Parts of the manifold of sensations making the experience (a field of some sort) will interact and, in doing so, lose their individuality and produce a whole-quality or configuration that is different than the sum of its parts. In this characterization of the mental process, the brain spontaneously achieves organization into objects on back-grounds and configures the components of these objects into whole qualities such as unique shape and form.   For more on Gestalt theory see Frederick Perls, Ralph Hefferline, Paul Goodman, Gestalt Therapy (New York: Julian Press. 1951).

15   Moneo, "On Typology."

16   Italo Calvino, Invisible Cities, translated by William Weaver (New York: Harcourt, Brace, Jovanovitch, 1972).

17   William H. Gass, "Invisible Cities", in VIA #8 (Graduate School of Fine Arts, University of Pennsylvania and MIT Press, 1986) p. 136-155.

18   Colin Rowe and Fred Koetter, Collage City (Cambridge, MA: The MIT Press).

19   This description of Calvino's Invisible Cities is from William H. Gass, "Invisible Cities."

20   The Bauspiel ein Schiff Blocks were designed by Alma Buscher, a furniture designer who taught at the Bauhaus. She was well-known for her children's fur-niture and toys. (See Wingler: Bauhaus). Both the Bauspiel Blocks and the Modular blocks are manufactured by Kurt Neaf. The set, Building Blocks, was developed by Paul Tesar and his students at North Carolina State University fol-lowing a workshop with Juan Pablo Bonta at an ASCA Cranbrook Teachers' Seminar.

21   Students were asked to play with these sets of virtual objects in part as a way to develop strategies for movement and assembly in virtual reality.

22   The "Semiotics Game" was developed by students at Ball State under the instruction of Juan Bonta as described in Juan Pablo Bonta, Architecture and its Interpretation, (New York: Rizzoli International Publications, 1979) 227-228.

23   I have considered a more involved design activity that begins with specification of primitive entities and procedures for their manipulation.   In an upper-level design studio, "block" sets were developed that were more closely linked to con-struction tectonics.

24   Hugo Haring, "The house as an organic structure", 1932, reprinted in Programs and Manifestoes on 20th-Century Architecture edited by Ulrich Conrad (Cambridge, Mass: MIT Press, 1993).

25   Classical reality refers to the traditional built environment as well as the physical, social and cultural worlds associated with it.

26   Myst® is a trademark of Cyan, Inc., and is marketed by Brøderbund.

27   For example, Aaron Conners, the writer of Under a Killing Moon, indicated that many of the individuals that currently work in their art department, performing design development tasks, have art and design training and backgrounds. The major skills they look for in an employee are whether one can quickly create (computer models and renderings) original and creative environments. Maxis, the creators of SimCity 2000, SimTown and SimTower, have also been looking for artistic oriented individuals to aid in the design of cities, buildings, etc. for their software developments.

28   Archimage is an architectural firm that in 1991 ventured into other architectural markets due to a recession. They moved more into the digital environment by performing computer imagery. This work generates approximately 80% of all their income. They now offer a wide range of services in this area from corporation communications and TV station identity to animations. Their work for Nintendo is just an example of the commissions they receive and the type of powerful clients they have been able to acquire. Arguably, Archimage has received these kinds of commissions over more traditional animators because they are an architectural firm. Kaderlan, N., "It's Still A Design Firm - Or Is It?" Architectural Record, (1994): 28-31.

29   Dreamworks SKG is a recently formed entertainment company which combines the talents and resources of entertaining giants Steven Spielberg, Jeffery Katzenberg and David Geffen.

30   For example, see the work of Diane Gromala (University of Washington School of Communication) and Marcos Novak (University of Texas School of Architecture).

31   This is according to estimates by Dataquest, a market research firm. The major areas seeing the growth are in games, reference books and educational titles. Reuters, "Market Triples For CD-ROM's, "The New York Times, (1995).

32   "Architecture of cyberspace" is the infrastructure, environmental qualities and the larger organizational nature of digital space. "Cyberspace architecture" consists of structures, objects or artifacts occupying an already given digital space.

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F I G U R E S

Figures 1 & **2** show representative advertisements in papers across the nation, The Salt Lake Tribune (left) and The Los Angeles Times (right). Each were in the classifieds around the same time period of February and March, 1995.
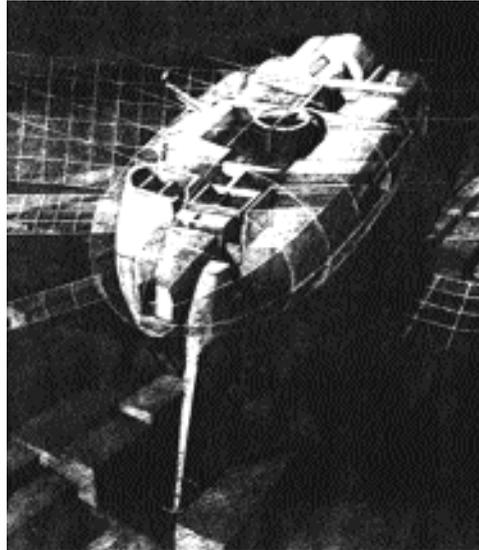
Figure 3 is an image of the winning design of the Virtual Building for *Forum/America* by Corvin Matie and Afshin Lavee-Motlagh. They are architecture students at the University of Texas - Arlington. (This image has been reprinted with the permission of Progressive Architecture, Penton Publishing).
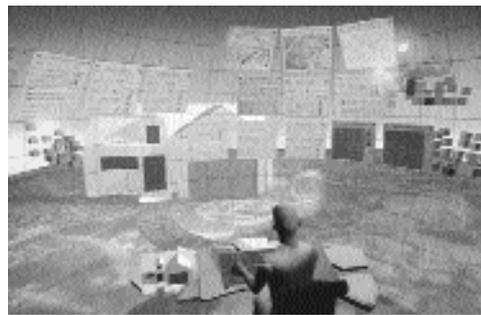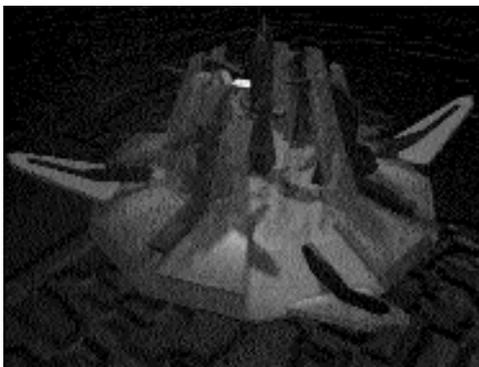
Figures 4 & 5 are examples of the work being done by Clayton Graham and Jim Leftwich respectively. Graham's is a design for an operating system that is a 3D immersive environment. (These images have been reprinted with the permission of Progressive Architecture, Penton Publishing).

Figure 6 is an image of Apple's eWorld (Copyright © 1994 Apple Computer Inc. All rights reserved. Used with permission.) that is available to Macintosh users. It is an on-line system and services are accessed by selecting the building which represents the desired service, as is done in the real built environment. If you need information on computer systems, you select on the Computer shaped building. General information can be found by selecting the Information Kiosk. Each building is representative of the services provided.