

Connecting Virtual Worlds: paradigms for on-line transitions

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A recent project, which introduced students to using Web documents for representation, provided the chance to examine how designers can bring their ideas together. The project paired students at remote schools to work together using primarily asynchronous methods of e-mail with enclosures, posted discussions and Web postings. The students began by individually creating descriptions of real or imaginary places for the Web. They then were challenged to work with a remote partner to create a portal from one site to another. The exercise explored making transitions between imaginary worlds using directional hyperlinks.

The resulting transitions fell into categories according to how the links related the authors' work. Some of the categories mirror human relationships and can be found in collaborations of all sort:

- creating a Parent superstructure which contains the original parts
- merging two parts together to create a Child hybrid
- subordinating one part to its Big Brother

More specific to the world of hypermedia, where links put nodes into a sequential or tree hierarchy, are directional relationships:

- starting from one site and linking the second in a One-way Bridge
- starting from either site and going to the other in a Reciprocal Bridge

The categories are simplified paradigms for bridging more complex imaginary environments.

The paper explains why virtual connections are important, provides background on virtual navigation and then goes on to describe the experiment in which the categories were derived. Consequences and areas for exploration follow.

Keywords: *design collaboration, hypermedia, navigation, virtual worlds*

Connecting Virtual Worlds: paradigms for on-line transitions

Concepts about traditional navigation can be applied to wayfinding in digital space and designing navigable worlds. In both real and virtual settings, a prerequisite to informed movement is getting oriented in relationship to an ordering system. Virtual worlds commonly include strong ordering systems to facilitate access, but these systems or structures end at the boundaries of each environment.

Boundaries between virtual locations are particularly numerous on the Internet because of a multitude of independent authors. Boundaries may seem particularly abrupt when they move between worlds containing vivid spatial metaphors.

1. Introduction: Why explore virtual connections & transitions?

As the amount of Internet information skyrockets, the need to organize the vast realms of information increases. At scales from the desktop to galaxies, spatial environments hold potential for organizing large amounts of information in a familiar way, as they can support the use of real-world navigation techniques that support intuitive wayfinding. Whether the virtual world is an information landscape or a simulation of an inhabitable place, we can adapt traditional navigation techniques to fit. For example, constraining a VRML browser to stick to a consistent ground plane eliminates the disorientation of a fly-through, making it easier for the viewer to navigate. Worlds with conventional features invite the transfer of knowledge from the navigation of traditional worlds. For example places which can be tagged with Kevin Lynch's labels of paths, edges, nodes, districts, and landmarks may be designed with Lynch's prescriptions of urban legibility.

While research has focused on how to reframe traditional navigation techniques within virtual worlds (Dieberger 1994; Satalich, 1995), more attention is needed to look at what happens between these worlds. Because traditional navigation is dependent on a consistent frame of reference, the places where systems come together at the peripheries provide a challenge for maintaining orientation. Since the Internet consists of distributed information from independent sources rather than centralized information under a single organizing system, borders between sites are ubiquitous. No single structuring system will govern or organize the whole; each authoring entity will create a system which is the most useful to itself. Negotiation between authors of systems can make the experience of cyberspace transitions more continuous.

While browsing text hyperlinks between different kinds of sites may seem as natural as browsing through a library, navigating between different 3D virtual spaces requires more thought towards providing orientation. In graphical or virtual environments, jumps between worlds can be unsettling as they break away from the established reference frames necessary for navigation. For these environments to work together seamlessly without user disorientation or obvious gaps between systems, there has to be accommodation between sites. By looking at virtual places and how to connect between them, we can sort out typical ways that the sites can come together.

1.1. Defining navigation terms

The following is provided to clarify the use of vocabulary:

- **Virtual worlds** are imaginary worlds or simulations of real environments which often use a kind of enhanced sensory input. These can include Web-based HTML or VRML representations, immersive virtual reality or simple text-based depictions for individual browsing or group interaction.
 - **Orientation** means placing oneself in relationship to points of the compass or in relationship to a reference system.
 - **Navigation** is the theory and practice of making one's way through space.
 - **Wayfinding** is the act of using spatial perception & navigational awareness to reach a destination.
- (Satalich, 1995)

2. *Traditional navigation translated to virtual realms*

Traditional wayfinding and wayfinding design has shaped research of the navigation of virtual worlds. Orienting oneself relies on having an organizational pattern and sensing cues to find one's position in relationship to that pattern. Wayfinding requires 1) orientation, 2) a plan to proceed and 3) means for proceeding. In wayfinding, a person collects orientation cues, locating oneself within framework by formulating a mental map. The person then uses this map to create a course of action and then execute it. (Passini, 1992)

An organizational pattern or reference frame can consist of a recognizable geometric pattern such as an orthogonal or radial grid or may be represented by a hierarchical tree. (Dieberger, 1994, 2.2.3.1) The spatial ordering system can be a simple grid or include complex geometries and overlays. Legibility requires an appropriate amount of information, simplicity and clarity of forms, connections and continuity. (Lynch, 1960)

Within this regularity is a need to place one's self. A street sign in a grid of numbered avenues and lettered streets provides the same locating function as computer query of (x,y,z) coordinates. The pattern of the stars provided enough consistency to guide ancient mariners across oceans. We may use distant markers of known locations: mountain peaks or towers as a way to determine our relative location. In addition to using these fixed landmarks, directional cues such as the angle of sunshine at a particular time can give orientation. In daily existence, the omnipresent pull of gravity anchors us to the ground and gives the vertical direction a special significance. Our understanding of our bodies dimensions allows us to measure space and understand distances in terms of a body moving through space. In specific contexts other senses may provide more sense of place. Our ability to hear in stereo allows us to identify the direction of sound sources and use them as anchoring aids. In a similar way, we recognize the general origin of the smell of the ocean on a prevailing wind

To supplement large organizational systems which provide environmental orienting cues, we have a variety of explicit navigational aids. Maps are the most obvious way to provide correspondence between a local environment and a larger context. Local identifying signs can provide the correspondence necessary to make the mapping, particularly when the map is rooted with "you are here". Directional signs or exit signs provide limited information according to predicted need without necessarily requiring an understanding of global compass orientation.

With computer graphics, it is simple to have perspectives simultaneously with plan and section, so that the experiential view can be juxtaposed with orienting analytic views such as key maps. An extension of 2D maps to 3D called "Worlds in Miniature" substitutes a miniaturized model in place of a key map as a navigational aide for touring inside the same space (Stoakley, 1995). The system allowed immersed participant to manipulate the world as widget through a proxy of clipboard and ball to select supplementary views. In this project and others, miniature models have also been used as icons to allow selection of alternative immersive experiences. (Davidson 1996, Donath, 1997) Advanced computerized navigational aides mimic helpers or guides, with information kiosks answering queries and magic carpets providing shortcuts to desired locations. Mapping of networked group interactions can provide an understanding of the group as an organic system, which may be viewed from the inside or the outside. (Schmitt 1998).

With both systematic cues and local aids, the amount of information needs to be controlled so to allow the user to focus on the essential experience of the place. (Passini, 1992).

3. Navigating virtual space vs. real space

While there are many aspects of physical navigation that can be translated to the virtual environment, the analogy has limitations. The spatial metaphor breaks down in the relative ease with which we jump between organizational systems and subvert coherent spatial patterns. With the WWW hypertext, specific sites often provide a very unified, coherent presentation of material, complete with hierarchical index and graphics color-coded according to sub-section. However, with one mouse click a person can jump into a totally different environment cobbled together by a grammar-school student.

In moving from hypertext to VRML, the disjunction of moving in and out of different worlds takes on a different connotation. While we are comfortable with sifting through physical forms of texts by picking up or putting down books, switching spatial contexts is unnatural. With the ability to constantly shake reference frames comes a "lost in cyberspace" syndrome. "Teleporting" or "flying" between sites breaks the unity of a virtual environment and hence its strength. (Strong, 1998). We will eventually adapt to moving fluidly between environments, but we can make it easier by examining opportunities for enriching the transitions and using the juxtapositions between worlds.

In searching for ways to make the transitions smoother and the connections richer, we can look to loosening up the literalness of the overly literal spatial metaphor. Loose application of metaphors to new technology are useful because they slide by the constraints of a direct correspondence. Often these loose metaphors allow "magic features" to be added to the literal model. For example, computer folders never get filled, windows can display information in a variety of ways, etc. (Dieberger, 1994) With operating systems, IRIX provides multiple desktops which appear to have some of the same documents and windows. These desktops exhibit the virtual world characteristic of being able to cohabit the same space without collision. In 3D space, partitions or instructions that melt away as you move towards them and paintings that contain linked worlds are examples of flexible architectural metaphors which could enrich virtual transitions.

A converse approach to smoothing transitions in a complex world is using filtering information so that the world is simplified in an appropriate way. An early example of how limited information could be presented in its most useful form was the Personal Newspaper created by Muriel Cooper's Visible Language Workshop at the MIT Media Lab. A program sifted through incoming news wires to find articles matching interest areas and then automatically formatted the information according to user preferences. More recent work looks at how tasks and subtasks can organize data browsing (Eckehard, 1997), and how group trails through data and adaptive annotations can make searching more effective. (Hook & Dahlback, 1997).

4. Boundaries & interstices: Going beyond the edges

With virtual worlds, there is no real need for turf wars as the room for expansion is as limitless as the addressing system that we can conceive. While this space of the imagination is boundless, at any time one site is finite. The organizational system or reference frame that makes it comprehensible only extends to the boundaries of the site. At that point, the system has to engage the outside world; it cannot remain complete to itself and also be accessible. Links leading into and out of the site provide this connection. The juxtaposition of the interior and exterior of the site accentuates differences. This follows the boundaries of natural systems in being a zone of intensity:

In the ecological structure of ponds or on wild land, the most intense activities take place at contested borders. On wild land, for instance, this intensity occurs in the zones where animals who live in fields come in contact with animals who live in forests; in ponds it occurs in the contact between organisms who inhabit the differing depths of water. Less conflicted spaces behind the borders are less active. The social center is at the physical edge.

--Richard Sennett (1990, p. 197)

By definition, those on opposite sides of a boundary have differences of identity. These differences require the residents to negotiate a type of connection or relationship. Identifying archetypal relationships between sites can provide greater understanding of possible alternatives.

In a situation where imaginary worlds are being designed, seeing possible relationships can give insight about appropriate connections.

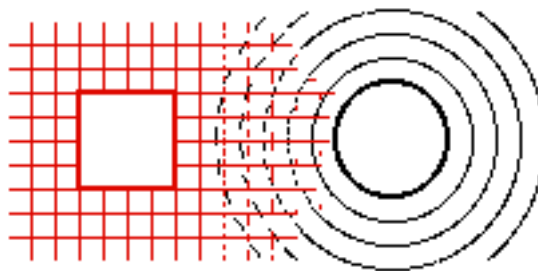


Image 1. Systems and their zones of influence come into conflict at site boundaries.

5. Virtual Design Studio: Defining virtual places & linking them

We examined virtual connections in the context of a design collaboration project linking three schools of architecture. Leading my University of XXX (UX) digital media students, I worked with colleagues Prof. Y of the University of YYY (UY) and Prof. Z of University of ZZZ (UZ). We set up a problem to explore the nature of virtual places and the design of strong virtual connections.

We asked our students first to create a vivid Web place interpretive descriptions by using a combination of HTML, VRML, and animation. Once the place descriptions were posted, the students were asked to choose a remote partner with whom to create a connection. To encourage quality in the initial place

presentations, students were allowed to market their sites and solicit partnerships with those they felt were strongest. Those who had not been able to find a partner after 10 days (approximately half of the group) were assigned one.

To communicate, the students used primarily asynchronous methods: e-mail, WWW pages and Hypernews, a cgi-forms based bulletin-board software which archives text, HTML and image references. Synchronous communication was limited because of bandwidth and financial limitations: trans-Pacific desktop video-conferencing was limited to either video or audio, access to higher-end video-conferencing was unavailable. To work around mail and Hypernews delays, students met through Internet Chat rooms.

Altogether there were 46 students from the 3 schools involved, with a mix of cultural backgrounds. The project involved different kinds of classes: a digital studio at UY, a computer media class at UX and a more general computers in architecture class at UZ. Due to the different learning agendas and schedules, the initial place description phase also had different durations varying from one week of UY's studio to 6 weeks of the UX web authoring & modeling course. Due to overlaps in schedules, they only had 2 -1/2 weeks in which to build the connection. (As a follow-up to this project, a year later Univ of XXX students have been working on place descriptions and using animation to create place transitions.)

6. Archetypal connections from the collaboration

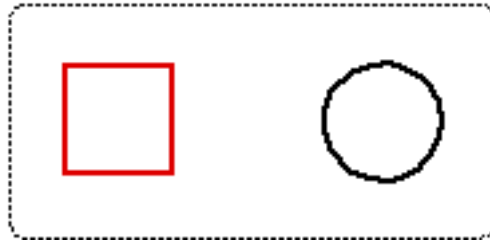
The student solutions for joining Virtual Design Studio sites provide an opportunity to define approaches to connecting. The approaches can be categorized according to how the connection relates the original sites in terms of sequence and hierarchy:

- 1) creating a parent superstructure which links to the component sites
- 2) creating a child as destination
- 3) making one site dominant by placing one site within the other
- 4) creating a one-way bridge from one site to the other
- 5) creating reciprocal bridges from site to site



Image 2. Archetypal connection types: Parent Superstructure, Child as Destination, Big Brother Assimilation, One-way Bridge, Reciprocal Bridges

In our sample of 23 pairs, we could characterize the projects roughly as 8 Parents, 2 Children, 7 one-way bridges, 2 reciprocal bridges and 1 Assimilation. (1 pair was unable to communicate & information for the remaining pairs was ambiguous).



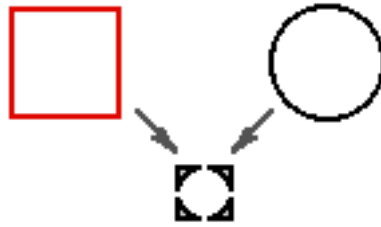
6.1. Parent Superstructure: creating a larger framework

In linking places, the most common way to create a joint project was to create a unified entry to both sites which would identify each and give them a relationship. Most simply, a team title with a few introductory images could lead to a page offering the component sites. More elaborately, ZZZ student Yeung Ho King and XXX student from Cambodia, Chamrenrat Khou created an animated gif complete with gorilla travel guides flying to the separately developed sites. The manic tone of the introduction was quite different from the tame component sites, revealing the synthesized energy of the collaboration.



Image 3. Parent Image Map (L) provides a contextual frame for component sites (R) by Winnie Tam, UX, and Richard Chong, UZ.

Any index or image map that gathers together diverse links under an umbrella works provides a unified front for diverse sites. In the example above, UX student Winnie Tam created an image map which organized historical photographs of ZZZ, including the two sites which she and her partner Richard Chong had investigated. The image map and linked format provided a context for understanding the earlier work.



6.2 Child as Destination

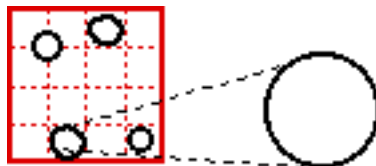
While the parent creates puts the combined effort before the original sites as a prelude which shapes how we see them, an alternative is to maintain the independence of the two sites and have the joint effort as a finale. The integrity of each site is maintained, but connection to the partner site is played down. This combination would be useful when members of a consortium prefer to keep prioritize individual identity.

Blending the sites into hybrid forms

Combining elements of the two sites creates a hybrid. This resultant can be positioned by links into a parent, a child (a new piece which would act as a destination from the component sites) or a bridge from site to site. Within our '97 trial, 7 of 46 pairs created a visual hybrid. The project hand-out suggested 3D components could be reconfigured by the partners to create a physical portal. Because only XXX's students had a course agenda including 3D modeling, little 3D synthesis occurred. One pair did create a hybrid 3D place using some massing forms from one project and overlaying rose garden images from the partner's site as transparent screens. Another pair created an abstract boulevard containing components from both sites. Due to the short time frame, the models remained rudimentary and the choice of simpler image manipulation proved to be more expressive.

6.3. Big Brother Assimilation

While some students had difficulty getting a meaningful collaboration going, others focused completely on the concept of collaboration. For example, Ashar Nelson had done the first phase, the site definition as a local collaboration with UX classmate Whitney Grumhaus on the concept of a maze. When he heard about the distant collaboration, he created a Web-based maze consisting of linked images with decision points. Depending on the choice of text options, the maze would lead to 4 different rooms, each a prelude piece for one of the distant classmate's website. In effect, his work subsumed the other sites, turning them into extensions of his sites, and thus framing them with his own introduction.



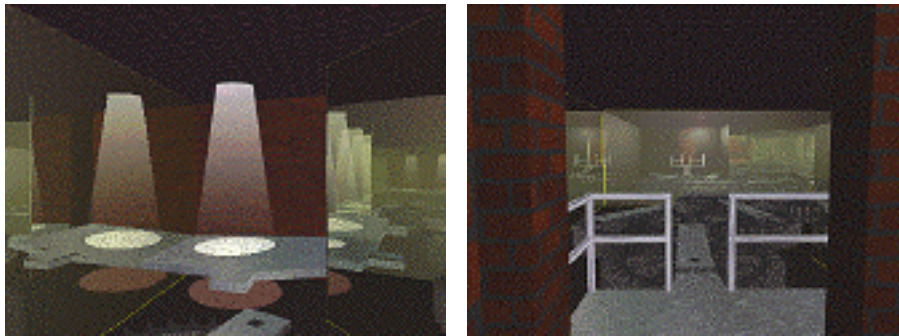


Image 7. Ashar Nelson and Whitney Grumhaus of UX created an online maze leading to other students' sites. The maze concept gave a context for multiple worlds to come together.

6.4. Directional bridges

From a pragmatic point, creating a directional link ended up being particularly expedient when communication between partners was difficult. As the students relied mostly on e-mail rather than more immediate methods, there were complaints about time delays and lack of responsiveness. As a result, some of the students took the project in their own hands by extending their own site with a sequence that would end with a link to the partner's site. The partner's efforts could be incorporated, but were not essential for the project to move ahead. It was common to supplement this one-way bridge with a pointer from the destination site's title page to the starting site. Other students created two different bridges, with each student appending to his base site a path to the other's student's.



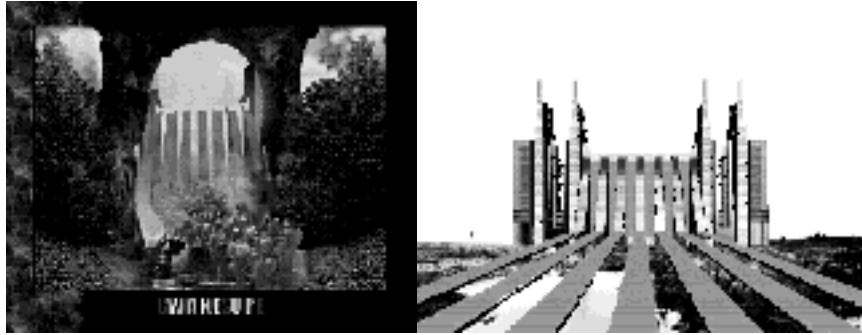


Image 4. Directional bridges lead from one site to another. Portal from a sequence of images developed by Midhat Delic, UX, and Sonya Carel, UY

6.5 Reciprocal Bridges



Image 5. Reciprocal bridges: Maia Chowdhury, UY and Wong Wa On, UZ, each created a bridge to the other's site with interpretive image processing. Original images on left of ZZZ's Mongkok District and Vancouver's Burrard Street Bridge.

The directional bridge can also be seen in 2D techniques such as the dissolve or morphing which originated with the cinema and are available in presentation software as standard effects.

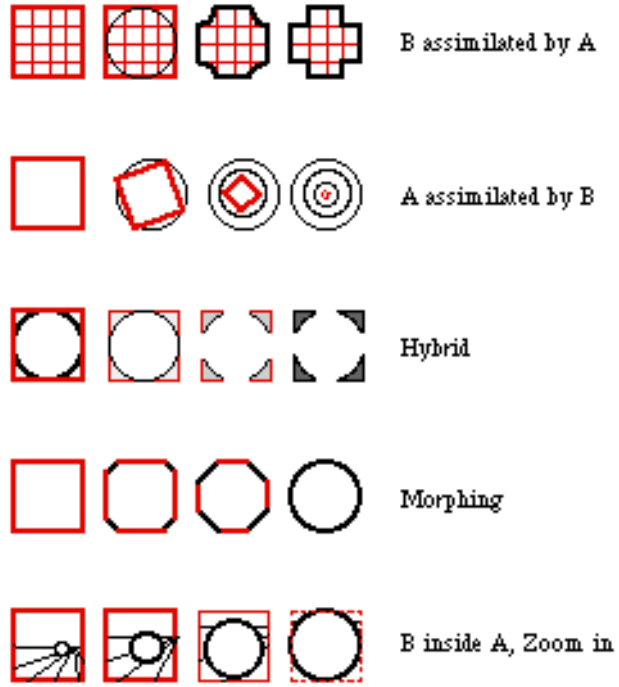
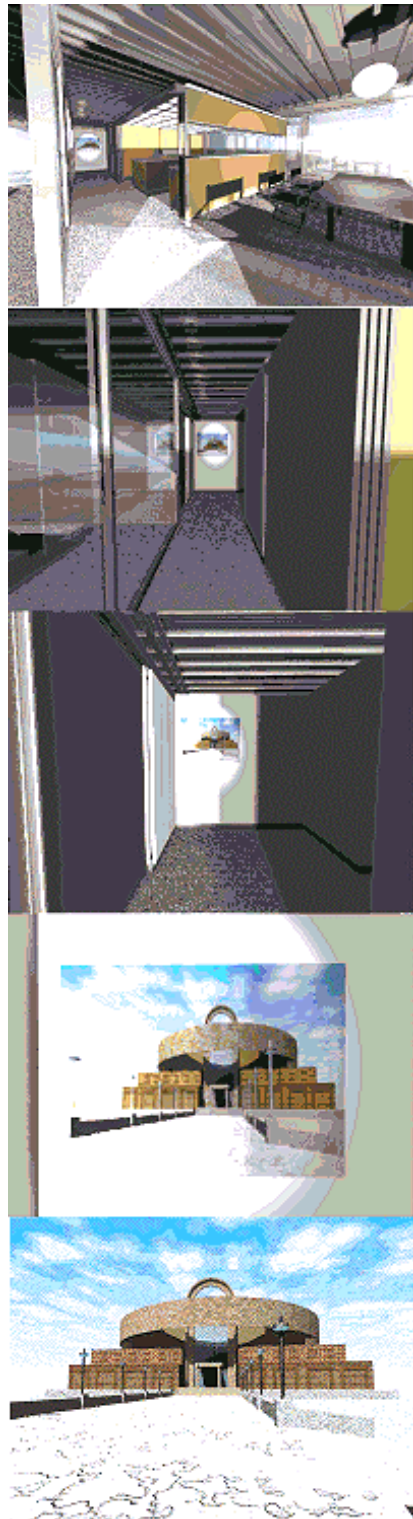


Image 6. Transformation variations as one-way bridges

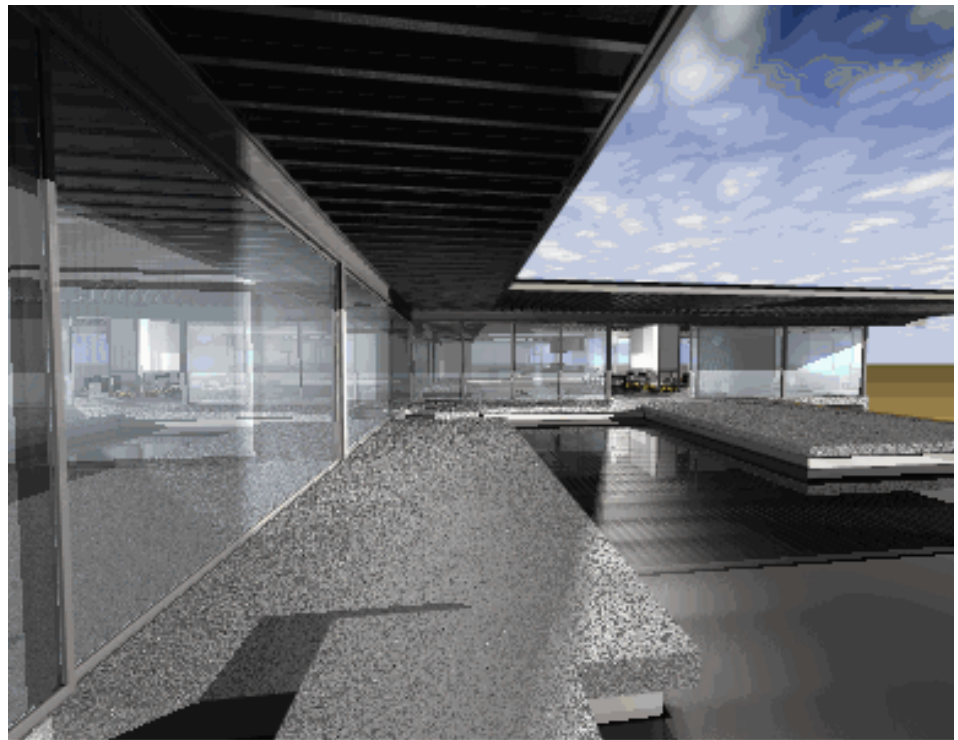


Image 7. Animated slide show portraying Pierre Koenig's Case Study House by Ulrich Dangel shows the emergence of Enge Xing's Shanghai Museum from a wall-mounted painting.

These simple techniques can work well when the transition images are carefully chosen to maximize meaning and the effect does not overwhelm the subject matter. While film has developed a whole arsenal of ways to get from point A to point B (Bordwell, 1979), adapting only film techniques can be limiting because they are predicated in leading someone sequentially in time. Other possibilities from film are to discover an alternate reality in a "magic" prop such as the rabbit hole or the looking glass in Lewis Carroll's Alice-in-Wonderland stories.

7. Conclusions & Future Directions

In summary, the results from this simple linking exercise make it possible to identify archetypal relationships between virtual realms controlled by different parties. The results show that the partners created solutions that fell within categories (parent, child, big-brother, one-way bridge, reciprocal bridges). Labeling linking strategies for pairs of worlds provides a vocabulary for discussing multiple links from one site.

It is important to compare the effectiveness of the different linking techniques and develop methods that enrich the component sites. Careful study of the navigability of the archetypal connections could point out directions for development. Since the creative interpretation of each connection approach holds a wide range of possibilities, deducing rules from controlled testing of participants in Cyberspace requires tight constraints on variations. To complement this scientific approach of exploring controlled specific factors, open-ended exploration of each archetype could be analyzed in case studies, leading to the development of guidelines for making effective transitions. This would invite imagination to be incorporated in the development of new forms.

While the technology used in this study was simple, the characterization of connection methods can be extended to worlds of greater complexity. In the realm of imaginary worlds, connections can take a great number of forms. Links can be manifested not only in words but in 2D or 3D objects. As designers let their imaginations shape synthetic environment's, Lewis Carroll's visions can be given form. In virtual worlds just as in Alice in Wonderland, objects such as carpets or mirrors can be used for transportation and food or drink can adjust scale. Designers need to strike a balance between the delight of surreal "magic" qualities and the necessity for guideposts which are understandably familiar.

Further work looking at cases involving different types of virtual worlds (MUDs, VRML, immersive VR) could confirm the applicability of the connection archetypes and identify other kinds of connections which might be media-specific. Because collaboration runs through many fields, looking at organizing patterns in other areas could yield insight. For example, music has traditions for combining themes or voices in medleys, rounds, and counterpoint. And traditional quilting graphically shows how individual efforts can be combined in a modular system. Whether in intellectual areas, creative projects or in physical endeavors such as relay races, the richness of shared efforts can take many forms.

Acknowledgements

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