WAYFINDING IN CYBERSPACE

Negotiating connections between sites

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Abstract. As the number of 3D virtual worlds grow, the distributed nature of the Internet will juxtapose many different kinds of spatial environments. Moving between these environments can be disorienting due to the lack of structural continuity. How can we create an easily navigable experience in a realm so different from the stable, natural world that we inhabit? This paper provides background about navigating virtual worlds, discusses the boundary gaps and describes efforts in how to bridge these gaps. Using examples from an academic exercise, archetypes of negotiated connections between sites are proposed.

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 for 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 and makes it easier for the viewer to negotiate his position. Worlds with conventional features allow knowledge from other realms such as Kevin Lynch's urban legibility theories to be applied.

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 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 these systems can make the experience of cyberspace transitions more continuous.

While browsing text hyperlinks to different kinds of sites may seem as natural as browsing through a library, navigating between different 3D virtual spaces requires more thought about providing orientation.   In graphical or virtual environments, jumps between worlds can be unsettling as they break the continuous reference frame 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 should clarify how the paper will be using specialized 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 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 into the navigation of virtual worlds. Orienting one's self depends on having an organizational pattern and having cues to find one's position in relationship to that pattern.   Wayfinding requires 1) orientation, 2) a plan to proceed and then 3) means for proceeding. In wayfinding, a person collects orientation cues, locating himself within framework by formulating a mental map. The person then uses this map to create a course of action and then executes it. (Passini, 1992)

An organizational pattern or reference frame can consist of a recognizable geometric pattern such as an orthogonal or radial grid or a hierarchical tree. (Dieberger, 1994, 2.2.3.1) The spatial ordering system can be as simple as a grid or include complex geometries and overlays.

Legibility requires an appropriate amount of information, simplicity and clarity of forms and connections and continuity. (Lynch, 1960)

Within this regularly 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 locations, directional vectors such as the direction of daylight at a certain time of day 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 body's 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. The smell of the ocean on a prevailing wind or the sound of canned music can provide anchoring cues.

To supplement large organizational systems which provide 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 providing 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 a 2D map to 3D, Worlds in Miniature allow those navigating a virtual space to have a 3D map at their fingertips as well as a simple tool for manipulation of that space. (Stoakley, 1995) More advanced computerized navigational aides mimic helpers or guides, with information kiosks answering queries and magic carpets providing shortcuts to desired locations.

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

3. Navigating virtual space vs. real space

While there are many aspects of physical navigation which can be translated to the virtual environment, the analogy has limitations. The spatial metaphor breaks down in the ease with which we can jump around 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. One mouse click and 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 documents by picking up or putting down books, switching spatial contexts is unnatural. With the ability to constantly shake reference frames comes the "lost in cyberspace" syndrome. We will eventually adapt to moving fluidly between environments and in the meantime it is important to examine the 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 spatial metaphor. Loose application of metaphors to new technology are useful because they slide by the constraints of a literal correspondence. Often these loose metaphors allow "magic features" to be added to the literal model. For example, folders never get filled, windows can display information in a variety of ways, etc. With operating systems, IRIX provides multiple desktops which appear to have some of the same documents and windows. These desktops exhibit the common virtual characteristic of being able to cohabit the same space without collision. In 3D space, partitions that melt away or paintings that contain linked worlds are two examples of how flexible use of architectural metaphors could enrich virtual transitions.

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 one time a 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. In a similar way, the interaction at ecosystem boundaries is cited by Richard Sennett as 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." (Sennett, 1990, p. 197)

Boundaries create a need to negotiate and provoke questions of identity and relationships.

5. Virtual Design Studio '97: Defining virtual places & linking them

Using a class focusing on digital design, a group of us explored how to bridge boundaries with strong virtual transitions. Leading my University of Oregon (UO) students, I worked with colleagues Jerzy Wojtowicz of the University of British Columbia (UBC) and Thomas Kvan of University of Hong Kong (HKU). We set up a collaborative problem to explore the nature of virtual places and 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 images. Synchronous communication was limited due to 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 UBC, a computer media class at UO and a more general computers in architecture class at HKU.   Due to the different learning agendas and schedules, the initial place description phase also had different durations varying from one week of UBC's studio to 6 weeks of the UO 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 students at the Univ of Oregon 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 linking.   The approaches can be categorized according to how the authors came together to create a link:

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

Parent   Child Destination   Bridge   Reciprocal Bridges   Assimilation
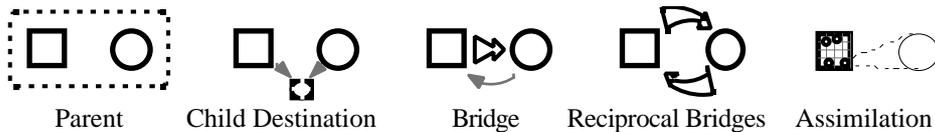
Image 1. Archetypal connection types

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 was sketchy).

6.1. PARENT

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, Hong Kong student Yeung Ho King and Oregon 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.

Any index or image map which gathers together diverse links under an umbrella works provides a unified front for diverse sites. For example, UO student Winnie Tam created an image map which organized historical photographs of Hong Kong, 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. BLENDING THE SITES INTO HYBRID FORMS

One way to create a parent site is to make a hybrid combining elements of the two sites. The resultant can be positioned as 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 Oregon'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.

Image 3. Directional bridges lead from one site to another. From a sequence of images developed by Midhat Delic, UO, and Sonya Carel, UBC.

6.3. 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 which 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.
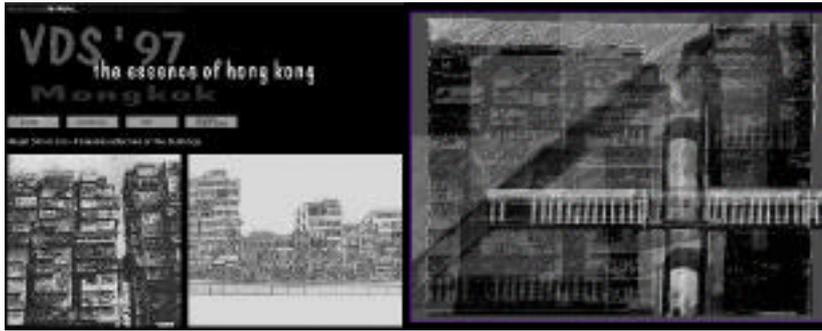
Image 4: Reciprocal bridges: Maia Chowdhury, UBC, and Wong Wa On, HKU, used image processing to interpret each other's site.

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. 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.
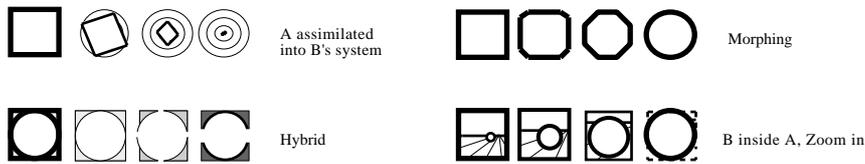

Image 5. Transformation variations as one-way bridges

6.4. 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 UO 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 framing them with his own introduction.
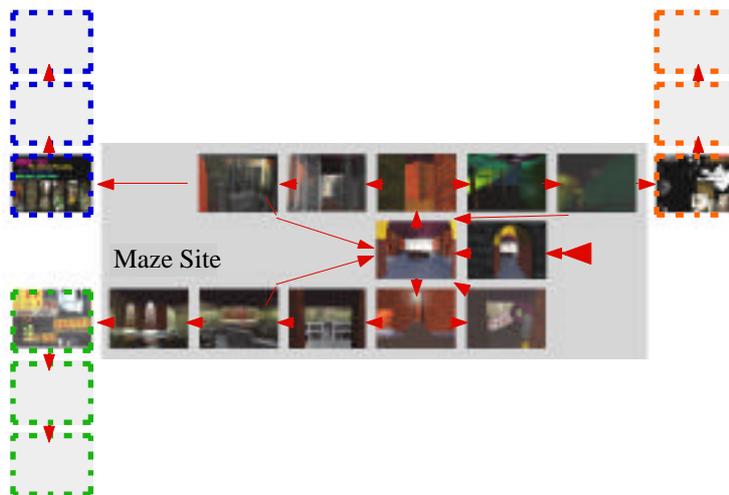
Image 6. Ashar Nelson and Whitney Grumhaus of UO created an online interactive maze leading to three other students' sites.

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 of parent, child, one-way bridge, reciprocal bridges & assimilation. While the technology used in this case was simple, the characterization of the different connection methods can be extended to worlds of much more complexity through the labeling of linking approaches.

Identifying archetypal relationships between sites can assist creators of virtual worlds create appropriate connections. A converse approach of making appropriate connections from the user's approach utilizes filters to shape or screen incoming information into an useful form.   An early example was the Personal Newspaper created by Muriel Cooper's Visible Language Workshop at the MIT Media Lab which 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)

7. Future Directions

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 whether specific methods allow other

kinds of connections. As the necessity to join together pieces of different authorship may be found in other realms, analyzing music (medley, rounds, counterpoint), literature (collections), arts & crafts (quilting), and science could provide models for collaboration and connection.

It is important to compare the effectiveness of the different linking techniques and develop methods which 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 human subjects 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. While this approach could be less rigorous, it allows leaps of imagination to be incorporated in the development of new forms.

Acknowledgements

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