

Active Objects, Surfaces, and Zones

Interactive, Luminous Architectural Environments

Brad Koerner

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D. Michelle Addington, Advisor
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Preface:

The Convergence of Architecture, Theatrical Lighting Design and Interactive Media

During the past decade, theatrical lighting design and technology has slowly migrated into the more permanent realm of architectural design. While this transcendence has gained a momentum of its own, both of these professions are currently facing the same revolutionary changes as the outside world, due to the rapid growth of various interactive paradigms affecting almost every aspect of life. This convergence of architecture, theatre and interactive media is creating a new fusion of design methodologies that will very quickly lead us to radical new types of interactive built environments. This convergence forms the basis of exploration for this thesis.

Architecture has been hesitant to incorporate new media technologies into its vocabulary. In the past, architecture traditionally provided only infrastructure support for digital media installations; today architectural designers are seeking to re-inform their art through more poetic, carefully considered uses of these media technologies. Architects are seeking to instill stronger, more legible narratives into the spaces they create. The long-standing architectural paradigm of a narrative described through human movement through a series of spaces is being compressed; now narratives must often be described within a fixed physical space that must become internally dynamic. Designers frequently turn to the medium of light, in its many forms, to create dynamic spaces. Yet for the most part, they have been using preprogrammed lighting displays that lack a functional interactive dynamic.

Although lighting designers and architects have begun to experiment with the issue of dynamic narratives within the tangible world, the rapid growth and adoption of virtual interactivity has greatly overshadowed both of their successes to date. Both professions are now seeking ways in which to incorporate the raw technological and artistic powers contained within the virtual world into their own fields, but are lacking many of the basic tools to do so. As few functional or technical ground rules have been developed specifically for their fields, it has been difficult for designers of the built environment to experiment with new forms of interactivity.

The design and implementation of interactive spatial conditions creates numerous artistic challenges. For example, how does one begin to conceive of an "interactive architecture"? Is it a computer itself? Or should it be conceived of as an "interface," allowing some new form of interaction with the virtual world through the tangible world? How would someone recognize it as an interface? Which dynamic media should one choose: Light, Mechanical means, Audio, Video, etc.? What level of abstraction does one choose?

The challenge now is to create technologies that unite the virtual world with the physical world. New control platforms must be established for a variety of devices, from video capable projection units to large-format display surfaces. New systems with spatial sensing capabilities will need to be established, along with systems that can control not only lighting but audio, video and real-time connections to content databases. Essentially, sophisticated show control units with unprecedented new levels of integration will be required. Lighting designers, along with architects and other artists, will need to creatively manipulate these systems in order to achieve a new art.

The technological sophistication of interactive spaces will result in highly enriched environments that support the telling of narratives with multiple variations. Ultimately, a familiarity with these technologies and functions of space may instill architecture with a richness and depth not dissimilar to that of the great architecture of the past.

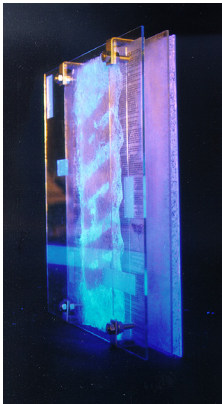
Background Research:
Reconsidering the Notion of “Performance Space” Through Luminous Media

As part of my graduate studies, in the fall of 1999, I participated in an Osram/Sylvania sponsored studio that involved the study of the material and architectural possibilities of electroluminescent panels, phosphorescent pigments and inorganic light emitting diodes. This work serves as a principal foundation for my current thesis research.

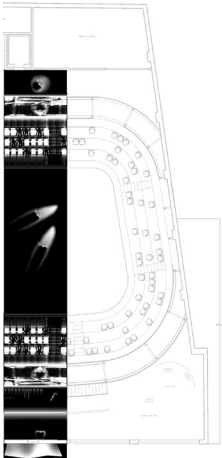
Following a study of naturally occurring luminescent organisms and the physical seductiveness of their oftentimes diaphanous structures, the studio constructed full-scale material samples exploring the transformation of ordinary building products (plaster, glass, and wood products) into luminous objects. Incorporating these materials into the historic brick remnants of an abandoned vaudeville theater, the studio’s goal was to create a new type of “experimental” performance space. I concentrated specifically on forthcoming electroluminescent, flexible thin-film digital display panels that have no practical size limitations and which are fully transparent in their non luminous states. The ability to convey a narrative through these surfaces, to use them as luminous, dynamic set pieces, became the core technology of my new theater. I felt that current artistic trends in interactivity and participatory immersion require a fundamentally new type of “performance space,” one that ultimately would allow theater professionals to push beyond the often static architectural and technological theater infrastructures they must routinely challenge. To this end, I inserted a high technology “vessel” of aluminum, steel, glass, and luminescent composites, into the existing brick shell. The flexible luminescent surfaces of the vessel itself will offer freedom of choice to the theatrical design teams. The versatility of the inherently digital sub-pinnings of this space will allow theatrical groups to present far more encompassing, engrossing environments to the theater participants, at very low staging costs. By suspending this pliable, active luminous medium from the scaffolding-like frame, the theater organization will be continually able to critique the notion of “stage set,” immersing the theater patrons within the new forms of performance. Additionally, I incorporated electroluminescent material into custom clear silicon rubber seat cushions and armrests on removable theater seats. With this flexible seating on the ground plane and in the mezzanine level, the theater group is afforded various levels of integrating the audience into the theatrical performance through an intimate point of contact.

Such a radical change in the notion of light sources, from objectified, staid points of light to architecturally integrated, spatially defining systems of digital media displays, has drastic implications for both theater and for architecture. These materials will form new integrated systems of illumination and media displays, systems that will be augmented by the current state-of-the-art lighting technologies and controls being developed. Architects attempting to create these revolutionary spaces will need to learn many of the fundamental principals and technologies common to theatrical lighting designers.

These “Performance Space” investigations into luminous materials and systems paved the way for a more detailed exploration of interactive luminous environments: “Active Objects, Surfaces and Zones.”

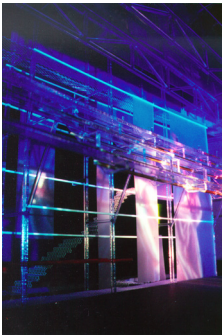


luminous wall system prototype



luminosity study; plan of theater

interior theater views



Spatial Interactivity Studies:

The Human Body as a Luminous Interface Controller

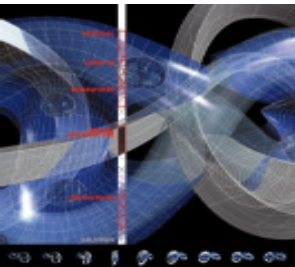
In an investigation into how architecture can begin to interactively convey narrative information to a person within a space, existing websites were analyzed for their current “spatial” characteristics. Although a person experiences websites on the physically flat, luminous surface of a monitor, websites produce a third dimension of spatiality by layering information. A person “navigates” through these layers to reach the specific level of detail that they seek.

In the translation of this “navigation” into the built environment, a person becomes free to use his or her complete body to seek out and reveal layers of information. This newfound freedom requires the careful exploration of how surfaces, objects and zones can best relate to a human’s eyes, body and hands in moments of dynamic interaction and narration. Additionally, this examination can be cross referenced with an exploration of using light as a tool for narrative communication. The resultant matrix forms a new architectural “language” of luminous spatial interactivity, a collection of the basic methodologies for creating interactive environments that bridge between the physical and virtual worlds.

two types of existing websites



typical retail web-site that uses layers of information to create a “spatial narrative”
www.outpost.com

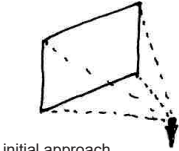


web-site that uses a conceptual “body” to scan over a three dimensional model to bring up appropriate information
www.guggenheim.org

web based retail versus digitally augmented, tangible retail



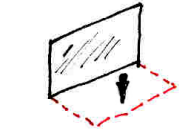
address selection



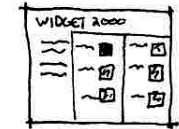
initial approach



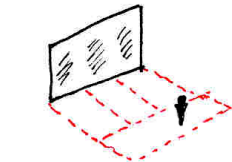
introductory narrative



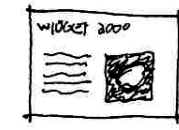
recognition zone; wall shows introductory narrative



group overview; category selection



group overview; category selection by spatial zone

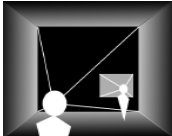

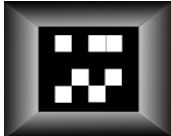
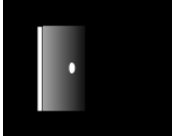
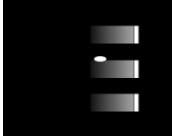
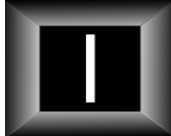
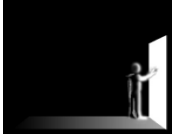

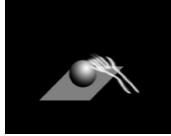


database-derived specific product exploration

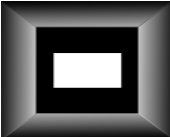

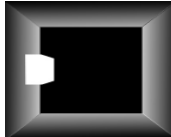


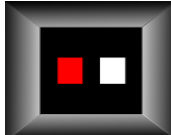
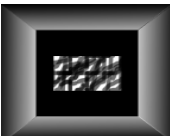
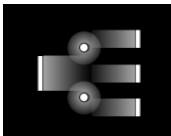
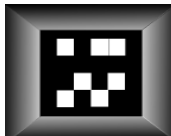





database-augmented, tangible product exploration

relationship of a body to an interactive luminous environment

	SURFACES	ZONES	OBJECTS
EYES	 <p>Cone of vision relationships provide hierarchies of groupings/divisions</p>	 <p>Visual qualities of surfaces create perceived overlapping zones</p>	 <p>Visual points of highlight combine to form matrices</p>
BODY	 <p>Surfaces define edges of zones that bodies move within/against</p>	 <p>Progression of body through zones manipulates surfaces and objects</p>	 <p>Objects have bodily presence that mirror the human body</p>
HANDS	 <p>Surfaces only pressable, not graspable</p>	 <p>Zones at the scale of hands allow precision, definitive control</p>	 <p>Graspable objects provide points of tangible contact</p>

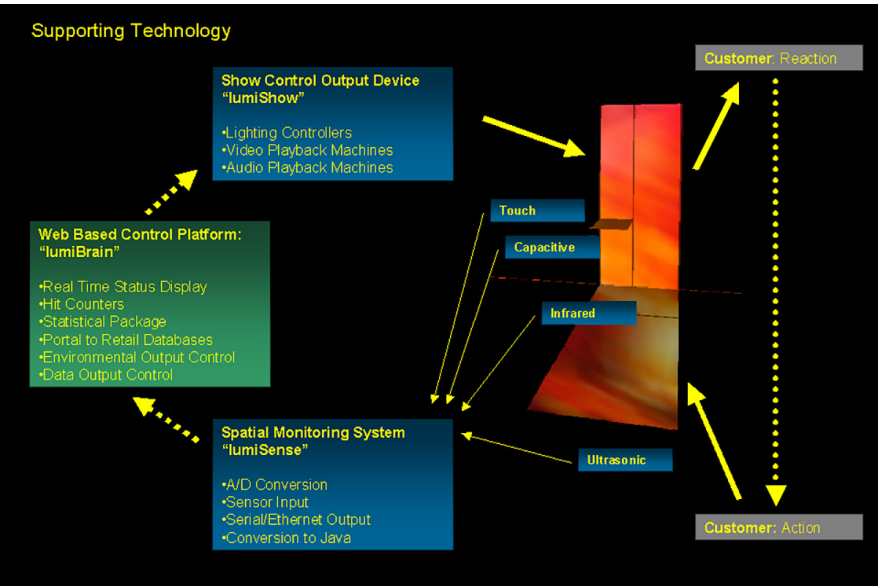
relationship of light to space

	SURFACES	ZONES	OBJECTS
LUMINOSITY	 <p>Luminous presence attracts people to look inward to the plane</p>	 <p>Light emanating from surfaces creates zone conditions</p>	 <p>Luminous presence attracts people with 3D zone around object</p>
COLOR	 <p>Differentiates between surfaces; Suggests emotive meanings</p>	 <p>Overlapping colors create additional zone conditions</p>	 <p>Differentiates between surfaces; Suggests emotive meanings</p>
TEXTURE	 <p>Produces an enhanced presence with complex variations over time and emotive meaning</p>	 <p>Spatial texturing of zones produces points, lines and gradient conditions of sensing</p>	 <p>A matrix of objects produces unique spatial textures</p>
DYNAMICS	 <p>Change of meanings over time: direct change of emotive meaning and change of visual relationships</p>	 <p>Spatial moments may change connection to surface/object attributes via sensing to change spatial activity attributes</p>	 <p>Change of meanings over time: direct change of emotive meaning and change of visual relationships</p>

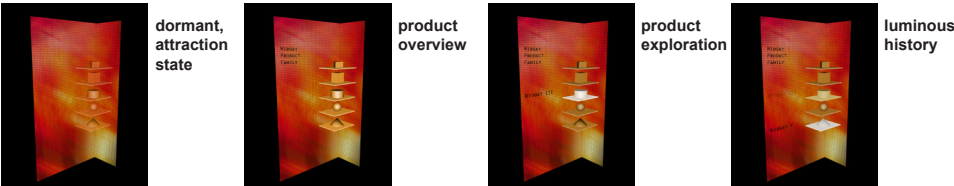
Retail Explorations: The Digital Third Dimension

In order to test the functionality of an interactive luminous environment, several explorations into enhancing physical retail environments were undertaken. An interactive, physical retail store should be able to guide a person much like a virtual retail web-site, from general introduction to product overview to product category and finally to the individual product, which can then be examined with the appropriate contextual information. To accomplish this, two dimensional wall surfaces can realize a third dimension of meaningful "depth" through dynamic augmentation. An entire spatial sequence can become compressed into a singular space, one that contains overlapping zones of intelligent sensing in front of a flat, dynamically luminous surface. A body moving against this surface has continually changing perceptions which the surface can dynamically alter to guide the person in a specific, meaningful direction.

Technically, this system will use a matrix of proximity sensors linked to a web-based controller, which will provide real time dynamic connections to content databases and statistical analysis of the spatial usage, much like "hit counters" on web-sites. The web-based system then directs the show control systems, providing audio, video and lighting control.



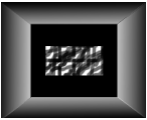
spatially interactive kiosk



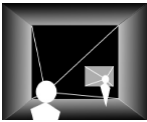
spatially interactive wall surface



non luminous state



dormant, attraction state



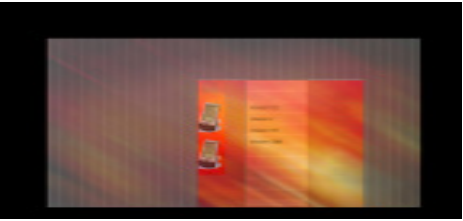
recognition state



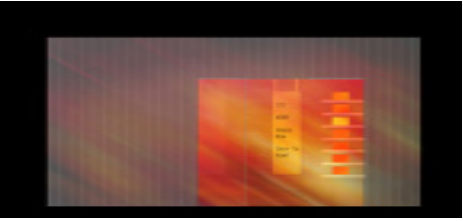
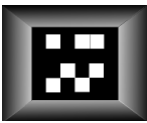
captivating, introductory narrative



seeking greater depth of information



visual overview state



augmented tangible exploration



Perceptual Control:

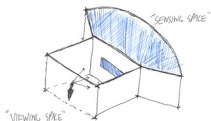
Interactively Controlling Virtual/Tangible Divisions

Interactive luminous spaces will form a new type of “interface” between the physical world and the virtual world. Although normally sharply divided, an interactive architectural space creates moments of overlap, zone conditions in which tangible objects can be acted upon by the virtual world. In retail environments, an important use of this overlap is the active control of the perceptions of a person within the space to conceal and reveal tangible objects. To create such an effect, luminous “portals” are created in luminous display surfaces, within which objects are placed. Such portals visually resemble an installation by James Turrell, in which a person looks through an aperture in a wall into a uniform, luminous space. Adjusting the balance of the two surfaces distorts the depth and clarity of what is in the portal, allowing the surface to selectively conceal and reveal the physical objects placed in the portals as necessary.

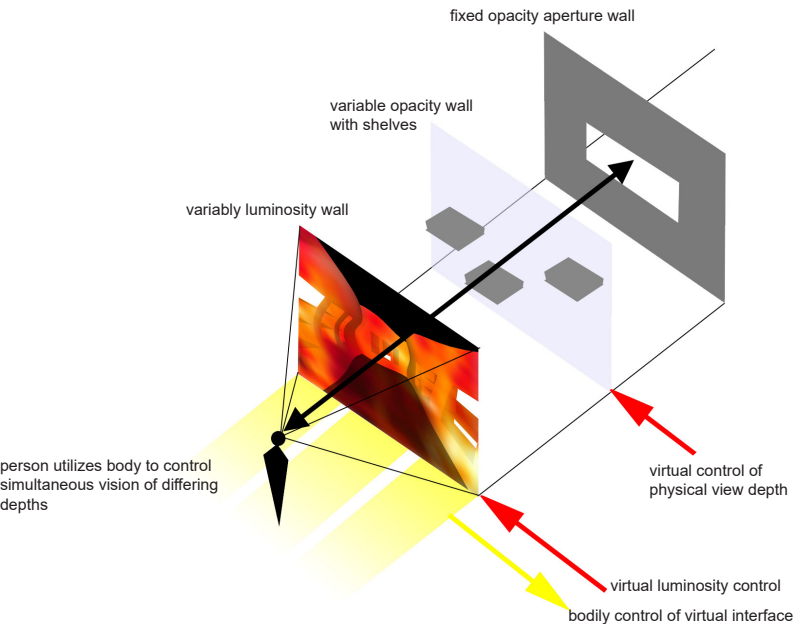
The physical substantiation of the “overlap” between the virtual and physical worlds will provide designers many opportunities for exploration, particularly when other optical effects, such as variable transparency, opacity, translucency and luminosity, are layered into a wall surface. Multiple internal spaces can be dynamically revealed or concealed. Additionally, virtual space, as created through luminous displays, can also be layered into a surface, creating multiple readings of both tangible and virtual depth.



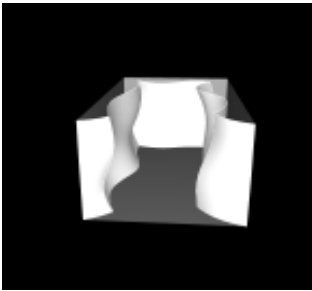
James Turrell: Spirit and Light Exhibition Catalogue, 1998, Contemporary Arts Museum, Houston



layered wall surface with multiple readings of tangible and virtual depth

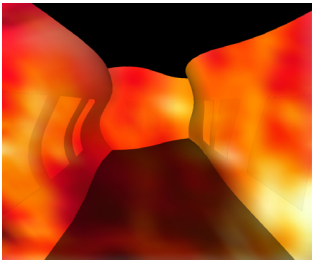


interacting with a digital “body” of light



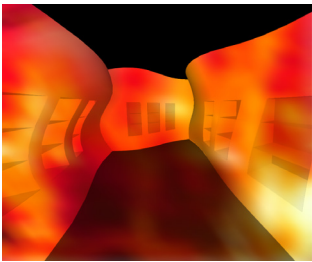
non luminous state

A visually and spatially “fluid” luminous surface is inserted into the typical retail shell. This surface seems ubiquitous, undifferentiated spatially, as if a person has entered into a living, active space within a much larger body. This active, living space becomes the architectural interface into the digital world.



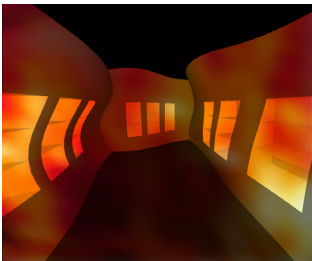
dormant, attraction state

The dormant status for the surface presents highly animated, abstract patterns of light. Using the differentiation of viewing space/sensing space, as recognized by Turrell, the space appears to be surrounded by a non spatial, smoothly flowing surface.



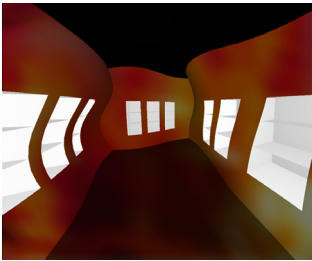
perceptual balance of human/digital domains

As programmed, when a person moves within this physical space, they affect specific zones of sensing, which alter the balance of the viewing space/sensing space to reveal a more tangible level of features.



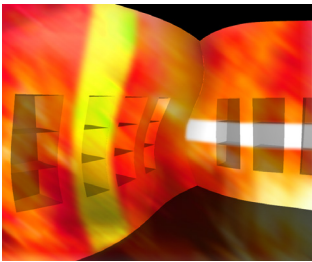
altering focus

When a person selects a specific zone and his/her proximity is within defined parameters, the surface further alters the viewing space/sensing space ratio to alter a viewers focus. Only specific zones need be altered, allowing many people to experience different parts of the space in different balances.



tangible object exploration

Product examination can be facilitated by changing the quality of the sensing space to a neutral white. Such a change allows the “digital body” to selectively offer tangible products to be explored. A person quickly realizes that he or she is physically “reaching” into the digital realm, which offers the appropriate level of “information augmentation” to correspond to the physical grasping of the objects.



luminous avatars

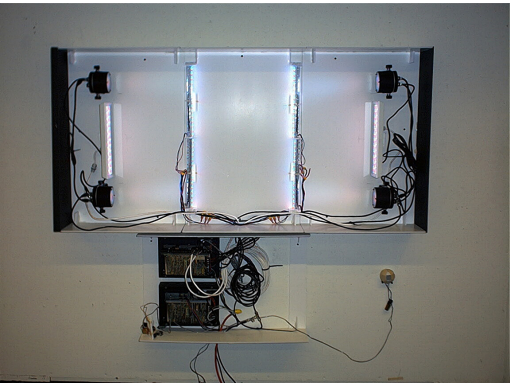
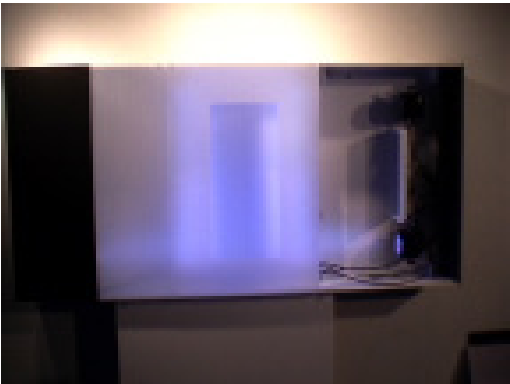
The digital body offers a physical morphing of its surface properties. This morphing can create a fluid movement of patterns or “guiding bodies of light,” similar to digital avatars, throughout the space. For example, a person may engage the surface at an early point and the surface may create an avatar of yellow light which moves along the surface to guide the person.

Built Prototype:
Creating a Language of Narrative Luminous Effects

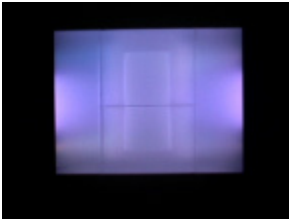
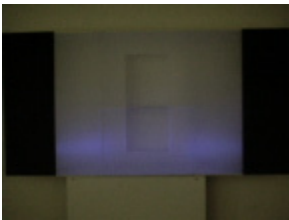
As part of this thesis project, two grants of equipment were obtained to create a working prototype of an interactive luminous environment. Light sources were provided by Colorkinetics, which produces digitally controlled LED based color changing lights. The control system was provided by Rosco/ET, whose Horizon control system allowed control of the prototype by two proximity sensors. The luminous surface was made of translucent corrugated plastic backlit with ten Colorkinetics light sources. In the center of the luminous surface was a portal that allowed viewing of two transparent internal shelves, behind which was a similar luminous panel.

To demonstrate the many capabilities of a luminous surface, a series of preprogrammed sequences were shown, sequences that in a more elaborate interactive setting would merely be part of a broad vocabulary of visual actions. A series of simple diagrams demonstrated the effects luminosity, color and texture. An abstract narrative was then displayed, showing a thirty second “sunrise” sequence.

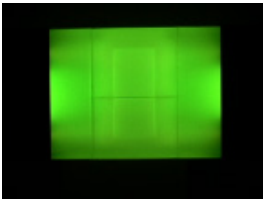
equipment



narrative sequence: an abstract sunrise



luminous diagrams

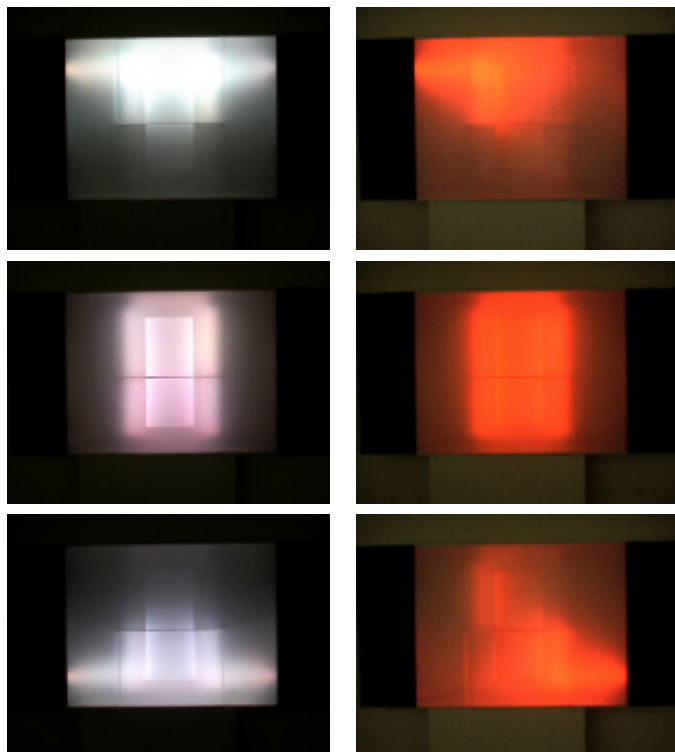


Built Prototype:

Exploring Interactive Luminous Functions

As part of the demonstration, an example of spatial interactivity was shown, in which a person could approach the active surface and then be guided through an exploration of the two shelves. Additional explorations demonstrated how a “luminous avatar” could guide a person’s focus.

directing focus through luminous avatars



interactive recognition and guidance



dormant, attraction state



initial approach/recognition



physically seeking more information



revealing the product in neutral white



tangibly interacting with an item on the top shelf



tangibly interacting with an item on the bottom shelf



reset back to dormant state on exiting zone

Conclusion:

Creating a Sense of Place

To introduce interactive narratives into the built environment, designers must create a new language of dynamic elements capable of sensing and responding to a space's inhabitants. These dynamic surfaces, objects and zones will dramatically alter traditional notions of architectural space, creating new conduits between the physical and virtual worlds. Designers will need to consider their environments as conceptual interfaces, defining those environments as specific places through the introduction of particular narratives. These spaces will have a living presence, with their dynamic fusion of light and the human body blending two seemingly disparate worlds together and reinvigorating the significance of our tangible experiences.

Included CD-ROM:

Quicktime Videos of the Prototype

Included at the end of this portfolio is a CD-ROM with video clips documenting the actual prototype when it was installed. There are four Quicktime format digital videos, which require the free Quicktime Movie Player available from www.apple.com. Included on the CD-ROM is an edited collection of the various sequences demonstrated with the prototype, in both a high version and a medium quality version, along with lower quality versions of just the sunrise sequence and the interactive demonstration sequence.