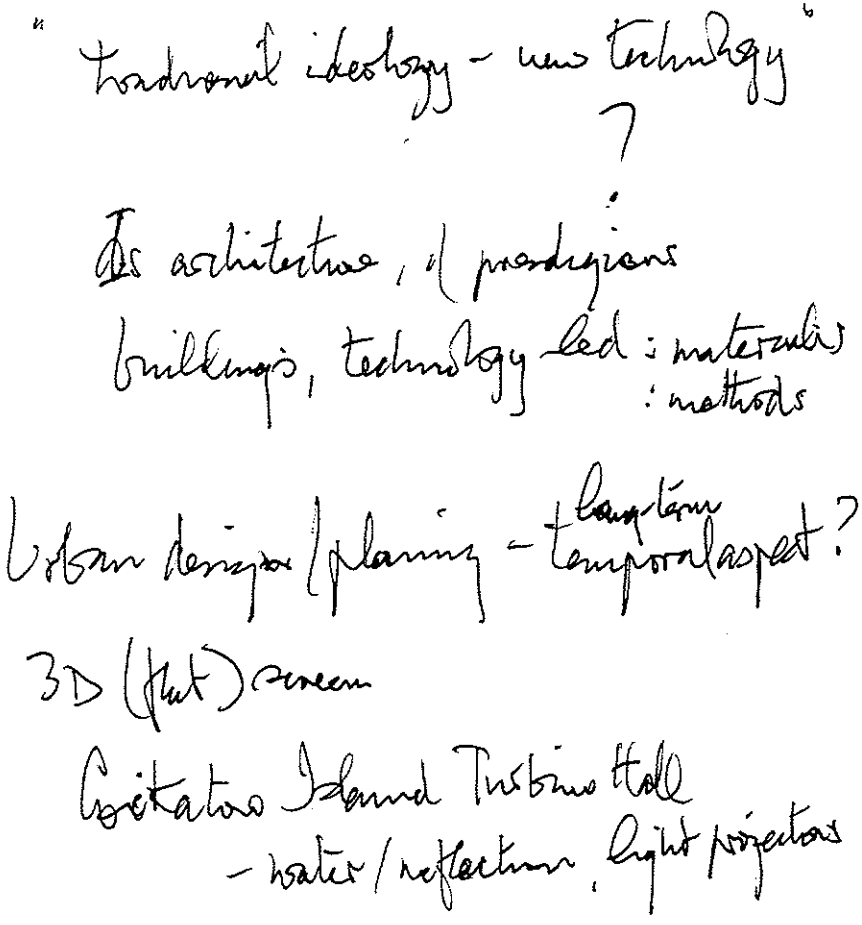

From Audience to Inhabitant: Interaction as a medium in architecture

Joanne Jakovich & Kirsty Beilharz

This paper presents a framework for conceiving and implementing interaction as a medium in architecture. Architecture is the theoretical and practical art of creating a plan of a complex object or system in which the subjective mapping from a human perspective to components of the system is the core design focus. Traditional architectural design involves the specification of materials, which implement creative expression in the mediums of space, light and time. Interaction, or the reciprocal action between a human and another entity, is the basic medium of expression manipulated by the interactive artist. The aim of the paper is to outline a logical framework for considering the techniques and materials of interaction, as used in interactive art, in the context of architecture. The framework is a four-part collection of interlinking concepts that we established to define i. architecture, ii. medium, iii. interaction, and iv. interaction as a medium in architecture. Following, the implications for implementation of the framework are discussed, based on works by several hybrid artist-architects. The framework is an analytical ground point to base practice and research occurring in this emerging field of spatio-experiential design.

Architecture is a practice that predates interactive art by several thousand years. However, under a climate of technological change it must adapt with comparable agility. Where architecture traditionally dealt with buildings and structures for long-term human inhabitation, it now also addresses systems and their structure as spaces within which the demands for human existence can be fulfilled in temporal and intangible ways.

In parallel, interactive art, which aims to produce engaging, immersive experiences, also addresses the design of a system that deals with human existence, although with a differing context and goals. In interactive art, the interactive experience itself is considered the content of the artwork (Rokeby 1998). In turn, interaction can be viewed as the medium with which the artist conceives and produces the artwork (Krueger 1977). The question we address here is how this notion of interaction as medium translates to the goals and context of architectural design.

1. Introduction

The notion of a 'medium' in architecture is less familiar that in art, since the design process in architecture involves a strict distinction between design and construction. Traditional architectural design involves the specification of materials (e.g. steel, timber, glass, lighting), which directly reflect creative expression in the mediums of space, light and time. Human experience of these mediums is enabled through our perceptual and cognitive faculties.

Interaction, or the reciprocal action between a human and another entity, is the fundamental condition invented and manipulated by the interactive artist. Sensor systems and digital display are some of the materials the artist uses to influence audience interaction with an art system (Edmonds et al. 2004). Interaction involves communication between the audience and a constructed environment in a spatial, contextual and temporal way. Through both perception and action, the audience is able to interact with an artwork, and become immersed into the world created by the artist.

The aim of this paper is to outline a logical framework for considering the techniques and materials of interaction as used in interactive art in the context of architecture. The intention of this is to build a platform for exchange at the point where interactive art and so-called media architecture (Moeller 2004) overlap, without explicitly addressing the differences between art and architecture.

Our creative practice and research interests lie in both the interactive art and architecture domains, producing works that fall into the overlap between. It is from this standpoint that we see the need to establish a clear language and logical understanding about what architecture and 'interaction as a medium' is, so that there may be a foundation for discourse and practice in this emerging domain. The visionary work of several hybrid artist-architects (Hidaka 2006, Ikeda 2005, Iwai [in Bullivant 2005a], Lozano-Hemmer 2006, Moeller 2004, Somlai-Fischer 2006) informs the framework and ensuing discussion about its implications. We present these ideas in this forum (of interactive art research) for discussion and feedback for the purpose of developing its application in pedagogy and practice-based research as a unique field of spatio-experiential design.

2. Background

The artist-programmer Myron Krueger's pioneering work from the early 1970s developed the notion of a 'responsive environment' in which the audience could use gesture to interact with spatial projections of themselves, remote collaborators and artificial intelligence creatures. A

contemporary parallel in an urban context is Lozano-Hemmer's (2006) 'Body Movies' (2001-3) in which the wall of a public space is transformed into an engaging interactive shadow game whereby passers-by use their shadows to reveal projections of people hidden in the otherwise floodlit wall. While some computation is necessary in Lozano-Hemmer's work, the simplicity of the materials eliciting interaction is commendable – large spotlights and intermittently changing projections. In 1977 Krueger proposed 'response' as a "new art medium based on a commitment to real-time interaction between men and machines... comprised of sensing, display and control systems" (Krueger 1977 p.115). Most significant is Krueger's claim that the composition of the relationships between action and response is of chief importance, and the beauty of the visual and aural response is secondary (Krueger 1977 p.115). This statement is most evident in Lozano-Hemmer's work, which skilfully and subtly connects the relationship between action (movement of one's shadow) with response (projection within the shadow of another person's image). This simplicity nevertheless contradicts other intimations by Krueger (Krueger 1977), and common focus of interactive art today, that the success of interaction is directly influenced by the accuracy and intelligence of sensing, display and control systems.

The Tokyo art group 'Responsive Environment' (Hidaka et al. 2006) (who are also practicing architects) argue that an understanding of the spatial and experiential effects of the materials of the interactive medium must be understood before too much sensor-based interactivity is implemented. We recently collaborated with them to create an installation in a massive abandoned turbine hall on an ex-maritime, exconvict island in the Sydney Harbour (Figure 1). The design goal was to enhance the existing attributes of the space and allow the audience

Figure 1. Part II of an installation in the Turbine Hall on Cockatoo Island, by the Responsive Environment art group in collaboration with local artists

to become aware of the complexity and grandness of the structure through the installation. This was addressed using the most simple, cheap and sustainable methods that could achieve the greatest result. Firstly, we chose to break the viewing of the installation into two parts: by daylight and by dark. In both parts, the entire floor of the hall (1000m2+) was covered with a shallow layer of water, such that the 25m high structures of the space could also be seen in the mirror reflection, creating a spatial experience of effectively 50m in height. In the night viewing, a fragmented animation was projected from behind the structural walls of one side of the hall, with the effect of complicating and confounding the already spatially complex architectural forms. The entire ceiling of the hall became a virtual spider web of moving structures. While this projection was not responding to human movement in the space, it sufficiently engaged the perceptual and contextual systems of the viewer to produce a highly immersive experience.

It is possible to speculate that spatial interactive art draws on an understanding that movement through space itself can be a kind of 'interactive' experience: by manoeuvring one's body position or speed certain spatial constructs may appear differently, creating an analogue immersive effect. This is evident in the exploratory architectures of the Induction House (2005) (Figure 2) by Adam Somlai-Fischer (2006), in which 300 physical pixels arranged in a 3D volumetric area are projected with a dynamic grid of colour that changes in response to the proximity

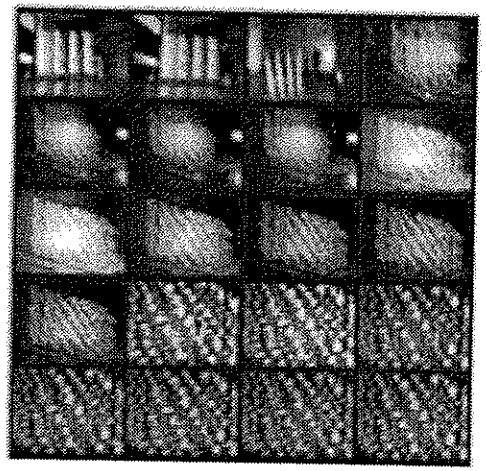

Figure 2. Induction House V2 (distributed projection structure) by Somlai-Fischer

of visitors. Here, interaction is the product of both the changing display and - most significantly - the interplay between the perception of space and changing colour as orchestrated by one's own spatial location in relation to the 3D pixel space. Nevertheless, the definition of interaction in the context of interactive art has a specialised (and inferred) meaning. Bongers (2000) and Paine (2002) assert that interactive systems require a level of cognition, such that responses can be situatedly constructed according to the current behaviour of the user. Interactive art attempts to elicit a response from the audience, and to provide a novel, entertaining or engaging experience.

This is fundamentally driven by the circumstance of art, whereby its short lifespan and competition with adjacent works means it must perform efficiently. In contrast, architecture, Moeller notes, "is a pretty permanent installation... if it gets too expressive it becomes like stage design – you get bored of it." (Bullivant 2005b, p. 67).

Several of Moeller's (2004) spatially interactive artworks use a sound display emanating from a touch-sensitive interface to respond to user interaction. Again, sound in itself is a highly spatial medium that is perceived differently according to the location of the listener in relation to the source. As illustrated in the gesture-responsive soundspaces of Rokeby (1998), Paine (2002) and Beilharz and Jakovich (2006), the spatial relationship between human gesturing and sound also augments the interactive experience. We observed participants developing gestures that had not been planned as part of the action-response repertoire, but in fact produced distinctive audio outputs. This actionresponse loop (Rokeby 1998) of interaction is initially defined within an interactive system that frames and generates behaviour. While systems typically consist of interacting components, the term interactive system is used where human participation forms part of the interaction, and is in turn, part of the system (Burnham 1968, Cornock and

Edmonds 1973). This implies the audience or participant can actively stimulate or influence events (i.e. information exchange) occurring in the system, and the system is able to adapt in response to this input as in Edmond's (2003) 'learning interactive video construct' Heron. Feedback influences the participant's motivation and strategy to act (Rokeby 1998). The artist's challenge is to create a system within which semi-autonomous growth or arrangement of structure is able to occur through ongoing participation and feedback.

3. Framework

The following presents a four-part framework for conceiving and implementing interaction as a medium in architecture. The purpose of the framework is to clarify the point of overlap between interactive art and architecture, whereby techniques from interactive art are applied to an architectural context. The definitions and statements presented here are specific to this purpose and their foundations have been outlined in the previous section. The four parts stipulate the interlinking concepts that we developed to define i. architecture, ii. medium, iii. interaction and iv. interaction as a medium in architecture. As a whole, the framework can be used as an analytical ground point to base practice and research occurring at the intersection of interactive art and architecture. It invites the reader to re-frame the ways in which we perceive and describe these.

I. Architecture

• Architecture is the theoretical and practical art of creating a plan of a complex object, or system, intended for human inhabitation or use.

• A system is a complex of interacting and interrelated components. A system has structure and, through interaction, behaviour.

• Structure is the interrelationships within a system. It defines the behaviours between components, and the behaviour of the system overall. Structure may be fixed, responsive, adaptive, or autonomous.

• The human component, which is the human inhabitant or user, is an equal and integrated part of the system. For this reason, architecture is always concerned with human interaction with constructed systems.

• The structure consists of the subjective mapping from elements of the human experience to elements of other components of the system. This is the central creative concern of the architect.

• An architectural plan is primarily specified through structure. However, the medium in which this is implemented affects both the specification and the applied outcome.

• Once implemented, an architectural artefact is a system upon or within which human patterns of behaviour adopt and adapt the relationships initially specified in the structure.

II. Medium

• A medium is an intermediate condition between two states. In creative practice, this implies that a medium is the condition between states of intention and realization.

• A condition is itself a state - it is a state of transition, or transformation. A medium is a means for transferring or transforming information, e.g. an idea, into another form of that information, e.g. a creative representation.

• A medium is a method for exchange. It is the means for creative expression, but also for creative interpretation. In this iterative way, it is a machine for continual creative exploration.

• A medium is a method, but it is not a material. A material is the specific substance or hardware chosen to implement the method, e.g. both a woodblock and inkjet printer are materials used in the medium of print.

• The characteristics of a medium however, can be expressed according to the shared affordances and constraints of its materials. And in this way, a medium is both limited and enabled by the technologies available.

III. Interaction

• Interaction is the combined reciprocal action between two or more agents that have an effect on each other.

• Agents are (some of) the components, or elements of components, in a system.

• An agent may be any human, computer, building or software system, for example, that has the capacity for producing a non-predetermined response, or an action. That is, a response that is based on the specific information and context acquired from the current interaction.

• Agents possess a means for receiving information from others, and

for expressing (displaying) information in return.

• Interaction produces feedback. Feedback is the direct and implicit information about how actions are interpreted by the opponent agent(s).

• Feedback occurs directly through reciprocated action, or indirectly through the overall effect of system actions. Feedback motivates and informs further actions.

• Through reciprocal action, a dialogue develops which is specific to the present interaction. The dialogue is not repetitive, but grows based on information exchange over time.

• The dialogue is a unique temporal account of the interaction. Cross-referencing of these accounts produces generalised rules about the cause and effects of actions.

IV. Interaction as a medium in architecture

• Interaction is the real-time condition between two or more agents that acts as a mechanism for exchange. That is, interaction drives exchange because feedback informs action.

• As a mechanism of exchange, interaction has the potential to communicate creative ideas. Ideas are expressed inherently in the structure of the system that enables interaction.

• The design of the system structure aims to achieve functional and aesthetic spatial goals through the medium of interaction. This is the main creative focus of the architect.

• As a medium in architecture, with its own inherent affordances and constraints, interaction can be used to bring certain qualities to a built environment, just as light and form do.

• The aesthetics of a space are hence conceived according to how one interacts both directly and indirectly with the environment, through exploratory action, interaction in addition to passive perception of conventional spatial mediums.

4. Implications for Implementation Temporality

Interaction is a medium that does not require cumbersome or expensive hardware for implementation. Somlai-Fischer (2006) and the Responsive Environment art group (Hidaka et al. 2006) specifically explore the most obvious and low-tech means for creating the greatest impact in an

interactive installation. Their works are not only cheap, but also take little installation time and leave no physical mark on the host space.

Sustainability
Architecture that responds to the needs of its inhabitants as they change is sustainable. While a conventional shell and infrastructure is necessary, programmatic and functional demands within a space can be addressed using the more flexible medium of interaction.

Immediacy
Interaction is a highly accessible design medium that allows immediate and ongoing testing during the design phase. Unlike conventional architecture, which must use scale models and drawings during the design phase, interaction design can incorporate the immediate responses of volunteer testers. Design, development and construction can occur in parallel. Intuitive and improvisational methods of hacking and re-appropriation can be used to benefit the creative process.

Scalability
Significantly, a wide variety of scales, from sculpture to urban planning, can be accommodated with the human-oriented medium of interaction. This framework enables observations and knowledge on one scale to be translated and tested on another.

Social function
Art in the urban context can play the role of raising social awareness and liberating the imaginations of the inhabitants (Miles 1997). In his outdoor permanent installation Audio Park (1995), Moeller describes the positive urban impact the artwork had on this public park which was previously neglected and lifeless.

Extending expression
Through the medium of interaction, the expression of design is extended. Spaces can be specified and evaluated using higher-level controls that specify conditions for interaction, rather than solely tangible or perceptual properties such as form, colour and so on. Such an expansion of expression through a new digital medium is best illustrated in the computational graphic art of Maeda (2000) and Reas (2006), who advocates software as a medium capable of 'unique expressions' that are inherent in its structure: self-organisation, adaptation, dynamic form, simulation etc.

5. The future

It is interesting that some of the key exponents of interactive art are architects and that the work of eclectic groups like Archilab (Brayer et al. 2005), embodies this very synergy of fantastical, art-inspired

structures that favour artistic outcomes more than serving architecturally or physically realistic concepts. This same adventurousness pushes boundaries of imagination, unfettered by constraints of conventional architectural rules and bureaucratic regulations. Thus the framework presented formalises the relationships between conventionally, perhaps artificially, distinct disciplines of architecture and interaction design and to elicit ways in which one can inform the other.

We invite collaboration for pedagogical and research projects to continue to explore this domain. We envision that through the medium of interaction, new creative expression and understanding of space can augment and extend the richness and inherent intelligence of the architectural and urban systems we inhabit.

Acknowledgements

This research is supported by a University of Sydney Postgraduate Award and a Cooperative Research Centre (CRC) for Construction Innovation Scholarship.

References

Beilharz, K., & Jakovich, J. (2006) Hyper-shaku (Border-crossing): Towards the Multi-modal Gesture-controlled Hyper-instrument, *Proceedings of New Interfaces for Musical Expression* (NIME) 2006, pp 352-357.

Brayer, M., Migayrou, F and Fumio Nanjo, F. (2005) *ArchiLab's Urban Experiments: Radical architecture, art and the city,* London, Thames & Hudson.

Bullivant, L. (2005a) ICE, Klein Dytham Architects, Toshio Iwai, Bloomberg Headquarters, Marunouchi, Tokyo 2003, in *Architectural Design*, Volume 75, Issue 1, pp 12-13.

Bullivant, L. (2005b) Interactive Urban Design as Event: Christian Moeller, *Architectural Design*, Volume 75, Issue 1, pp 62-67.

Burnham, J. (1968) Systems esthetics, *Artforum*, Volume 7, Issue 1. Available online at: www.dxarts.washington.edu/coupe/wk2/sys_aes.pdf

Cornock, S. & Edmonds, E. (1973) The Creative Process where the Artist is Amplified or Superseded by the Computer, *Leonardo*, Volume 6, pp 11-16.

Edmonds, E. (2003) Logics for Constructing Generative Art Systems, *Digital Creativity,* Volume 14, Issue 1, pp 23-38.

The promise of little arty micro-fish

Natalia Radywyl

Drawing from an empirical investigation conducted in the Screen Gallery at the Australian Centre for the Moving Image in 2005, this paper considers a methodology for examining visitor behaviour in interactive, media art spaces. When investigating the interrelated historical narratives of the museum and art object, it appears that in recent times, visitors are being required to exercise increasing levels of self-determination in the museum space. This paper illustrates how a phenomenological framework not only captures emerging forms of visitor agency and experience in the museum, but also sheds light on significant relational shifts between art institution, visitor and art object.

You hold the bowls to these projections, and explore the image, which is really fun. I think that's got a lot of potential, it's like a little arty micro-fish... I really liked that one....Just the interactivity of it. And the fact that the gallery trusted people with these fragile bowls... I found it pretty amazing that there's these glass things sitting there and that you're welcome to touch them. It's not something that you get in an art space – that you're actually allowed to interact with the work. (Paul at the Australian Centre for the Moving Image, 2005).

Figure 1 (left) and Figure 2 (right) – Hold: Vessel 1 (2001) Lynette Wallworth. Appeared in ACMI exhibitions World Without End (2005) and Deep Space: Sensation and Immersion (2002)

Here, Paul is reflecting upon his interaction with Lynette Wallworth's Hold: Vessel 1 (see Figures 1 and 2 above), included in an exhibition entitled World Without End, at the Australian Centre for the Moving Image (ACMI) in 2005. This installation was incredibly popular with ACMI's visitors, drawing strong responses in relation to its evocative and experiential qualities. The visitor's encounter with Hold commences with