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HAUNTING SPACE – THE ROLE OF THE BODY IN DESIGN INTERACTION

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1. Introduction

The maxim states that 'seeing is believing but that it is touch that determines reality'. Instinctively we reach out to touch those objects that attract or perplex. Touch conveys an intimacy both at a physical and emotional level. In the pursuit of the digital world, the sense of engagement that touch offers has largely been sacrificed. Instead the Graphical User Interface (GUI) has been created, the ubiquitous portal into the digital world, with its levels of indirection acting as a constant challenge to HCI practitioners and users alike. Interaction with technology has lost its grounding in physicality.
The vision of an environment populated by interactive and interacting artefacts, as articulated by ubiquitous computing [Weiser, 1993] offers the opportunity to reclaim the interface and return it to the physical world. Form and function will be reunited, leading to the design of artefacts that both engage and provoke interaction. In the words of Buxton [1996] there will be a move away from the safety of the 'Henry Ford' school of design that practitioners currently adopt to a world populated with bespoke technologies. Breaking 'the box' raises the question of where will these technological artefacts go? Most probably the migration from the desktop will be either into the environment or onto our skins. Technology will be more personal and form will impact on how users relate to and interact with these devices. This is more than product semantics - form and function are inextricably linked to the affordances conveyed by these new artefacts. Touch is a pleasurable sensation; the sweep of a curve, the precision of an angle, the tactile quality of a material (see Figure 1). What is less well understood is how such haptic qualities play a role in the creation of a sense of engagement and a linkage with the body that underpins much of our learning.

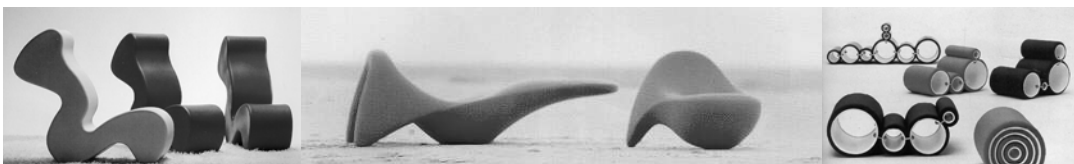

Figure 1. Three Chairs (a) Verner Panton, 1998 (b) Luigi Colani, 1965 (c) Joe Colombo, 1969

The phenomenologist Merleau-Ponty's account of 'being-in-the-world' emphasises the importance of the body. He places the body at the centre of our relation to the world and argues that it is only through having bodies that we can truly experience space. In the context of perception Merleau-Ponty [1962] formulated a sense of sight as an embodied vision that is an incarnate part of the flesh of the world: 'our body is both an object among objects and that which sees and touches them'. The body is interpreted as having a central role in how we engage with and learn about the environments we inhabit. Not surprisingly a number of ideas underpinning phenomenology have been appropriated by the design community when discussing the acquisition of design skills. This in turn has lead some researchers [e.g. Tweed, 1998] to comment that design based skills are both bodily and cognitive. In the context of how we interact with and through technology such an emphasis on the role of the physical body raises a series of research issues. These can be seen in the work of a number of researchers, most notably at the Royal College of Art (RCA) and Ishii at MIT who describes his approach as the development of Tangible User Interfaces (TUIs) [Ishii & Ullmer, 1997].

Increasingly, the importance of the body in understanding and learning is being acknowledged within other disciplines. In the context of this paper, this can be seen from the tradition of experientialism, for example in the work of Lakoff and Johnson [1999]. They argue that a fundamental part of cognition is the development and usage of base metaphors that are built up through the experience of the physical object. In the context of architecture, the feeling of buildings and our sense of dwelling within them are more fundamental to our architectural experience than the visual sensation that the building provides. If such a proposition is accepted then it is vital that tools that are aimed at supporting the design process seek to integrate and capitalise on all the senses. In particular haptic and orientation as these appear to contribute most to our understanding of 3-dimensionality, what Bloomer and Moore [1977] referred to as 'the sine qua non of architectural experience'.

2. Design for the Body by the Body

The emphasis on the visual sense in Western culture, coupled with the level of indirection introduced by the use of Computer Aided Design (CAD) technology during the design process, has resulted in 'designs which housed the intellect and the eye, but that have left the body and the senses, as well as our memories and dreams, homeless' [Pallasmaa, 1996]. Buildings are encountered, they are not merely observed. Their importance lies in their ability to articulate and give significance which can only truly be achieved through physical encounter. This position is supported by Franck [1998] when she comments, with specific reference to the role of technology within the design process, that 'it seems likely that the opportunities afforded by the computer will increase the propensity that already exists in architecture for the form to be disconnected from everyday use and for vision to be the only sense attended to'. This imbalance of our sensory system has prompted the suggestion that the increased experience of alienation, detachment and solitude in the world today may be related with a certain pathology of the senses which has in turn lead to isolation, detachment and exteriority [Pallasmaa, 1996].

Such a demarcation, it is contended, will impact not only on the nature of the buildings with which we interact but also with the nature of the design process through which they are created. As buildings loose their plasticity and their connection with the language and wisdom of the body, they become isolated in the cool and distant realm of vision. Increasingly architecture is loosing its tactility and measures designed for the body. Indeed the detachment of construction has prompted the view that architecture is rapidly turning into 'stages sets for the eye' [Pallasmaa, 1996]. The sense of 'aura', the authority of presence, that Walter Benjamin [1997] regards as a necessary quality of an authentic piece of art has been lost. In the context of the design process the role of the body has been diminished for architects who use CAD systems. Elaborate drawings, rendered objects and virtual reality walk throughs can be created with the movements of one hand. No longer is there the need for physical manipulation of material or tools and the sense of engagement that this provides. Currently touch is a sense which is seldom explicitly supported by computer based design tools. Whereas physical models enable the designer to walk around it, handle it, touch its surfaces and immerse oneself in the representation.

3. The Re-Introduction of Touch as a Means of Interaction

An emergent theme from a series of case studies of design practice [Smyth, 2000] was the importance of touch during design interaction. The sense of engagement provided by tools, in particular the haptic qualities associated with physical models, was recognised by designers as being central to their understanding. In particular the ability of such models to facilitate the consideration of the problem in the context of the whole building, rather than the more limited views provided by hand drawings and CAD. A further quality attributed to physical models was that they enabled the designer to manipulate, through touch, a 3D representation of the building space. The sense of engagement provided by such models was viewed as something qualitatively different to that provided by drawings, whether produced by hand or by CAD (see Figure 2). The characterisation of the designer as 'thinking with their hands' while creating or manipulating physical models supports the findings of Candy & Edmonds [1996] and Roy [1993] and echoes the sentiment of Schön [1983] when he described the act of drawing in terms of the designer 'conversing with an image'. The haptic qualities of the physical model provided the necessary degree of intimacy in order to visualise, explore and understand the space. What is being proposed is that the body plays a part in how we make sense of, and interact with, the physical spaces that we design and inhabit and which constitute our environment.

Figure 2. A series of physical models constructed from white card and balsa wood

This raises the question of how might technology provide designers with such essential attributes? Indeed, the level of indirection that technology introduces between users and their workaday world has been an important factor in its failure to significantly contribute to the early phase of design [Lawson, 1994]. Designers demand tools which provide direct engagement. Current mainstream technologies fail to meet this basic requirement. Possible leverage on this problem might be found in research into Tangible User Interfaces. This work seeks to augment the real physical world by coupling digital information to everyday physical objects and environments [Ishii & Ullmer, 1997]. Translating this approach into a design context prompts the following question: why should the act of building a physical model or drawing a plan sketch not also act as a method of inputting that information into a knowledge based system? This approach has been applied to the field of urban planning and design with the development of URP [Underkoffler and Ishii, 1999] a physical workbench which allows planners to examine shadows, reflections and wind flow effects on proposed buildings. A similar question was asked by John Frazer during his study of physical design models as input devices, in particular his work on the Walter Segal Model [Frazer, 1995]. Based on Segal's standard grid pattern for self-builders, Fraser built an electronic version of the panel model in which various panel combinations represented different elements of the building. The result was a system whereby people without any knowledge of architecture or computers could design a house by building a simple physical model.

In pursuit of such engagement some model makers have explored the use of film and slide projection as a means of enhancing communication. Examples of this approach can be seen in the early work of Daniel Libeskind, who fabricated models using texts and images torn from books and magazines. This approach enabled the designer to denote specific elements of the proposed building through the use of materials. An example of this technique can be seen in his City Edge Project (Cloud Prop Model – Figure 3). In this case the entire model is laminated with words and images taken from a variety of sources including The Bible and telephone directories. Libeskind's later models have sought to utilise a variety of materials as a means of expressing both the radical geometric shapes characteristic of his work but also as a means of considering the use of materials in the final design. For example the zinc plated models of his design for the Jewish Museum in Berlin, Figure 4. Libeskind's work acts as an illustration of the intimate relationship between the physical model and the eventual design.

Increasingly complex technologies have been incorporated into physical models in the pursuit of communication. The architect John Neale has included timers and sensors, back projected video and still images, models and part models of varying scales and examples of building materials in a bid to convey a richer understanding of the proposed building. Indeed such an approach to model making can begin to blur the distinction between the model and the design process that it is intended to support.

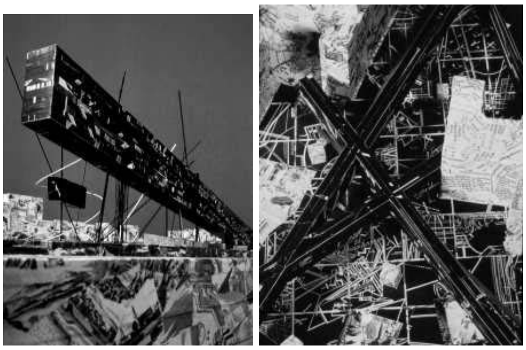

Figure 3. The City Edge Project – The Cloud Prop Model, Berlin (Daniel Libeskind)

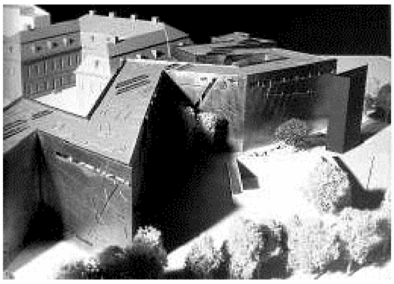

Figure 4. The Jewish Museum, Berlin (Daniel Libeskind)

4. Reconnecting the Body to the Artefact

An issue that permeates the previous discussions is that of engagement and in particular how this is experienced through and by the body. All artefacts provide both a level of engagement and a degree of embodiment. The ability to touch and manipulate an object, sense its weight and texture, are attributes that are only possible when interaction is conducted in the physical world. Such richness is further enhanced when the user is placed in the physical space occupied by the artefact. Full-scale environments enable the experience of the concept they depict in the fullest sense. All our senses are engaged resulting in a level of richness of experience the like of which most designers can only aspire to. It is contended that touch and its associated intimacy with the body, provides a means through which interaction might be enriched. Touch has the ability to both connect the body to the artefact and also the artefact to the body and thereby to introduce a sensuality for objects. The remainder of the paper will describe a strategy for the reconnection of touch at the level of the interface. The approach will be based on a previous system designed to support design thinking through the representation and manipulation of design knowledge as articulated by shape grammars.

5. Shape Grammars

Increasingly, there have been moves away from the traditional case study within architecture where the concern was with descriptive examination, to the search for principles of design. The underlying objective being to make architectural knowledge and its teaching explicit and to facilitate the intellectual appropriation of formal precedents in design [Wojtowicz & Fawcett, 1986].

One such model for representing formal principles of design is that of shape grammars [Stiny, 1975]. The analogy between language and architecture is long established. Whereas semiotics deals with meaning, generative grammars are concerned with mechanisms for the construction of sentences, shape grammars follow this model and are applied to the generation of shapes. A shape grammar is a set of precise generating rules which, in turn, can be used to produce a language of shapes. Just as linguistics is primarily concerned with analysis, rather than the invention of new languages, the initial application of shape grammars have been in analysis or criticism. Typically, a given building or style has been taken and the shape rules induced that can re-generate the given shapes. Rather than the generation of new languages of design, work with shape grammars has focused on the definition and articulation of designs in known styles. For example, Frank Lloyd Wright's Prairie-style houses [Koning & Eizenberg, 1981]. Such work on the characterisation of similarities is distinguished by the following:

- clarifying the underlying structure and appearance of known instances of style;
- supplying the conventions and criteria necessary to recognise whether any other design is an instance of the style;
- providing the compositional machinery needed to generate new instances of the style.

The same rules can then be used to generate new shapes in the language of the original. Just as linguistic grammars provide a finite set of rules capable of generating an infinite set of linguistic constructions [Chomsky, 1957] so shape grammars consist of sets of rules that can be used to generate infinitely many instances of shape arrangements that conform to the specified rules. The rules are *replacement rules*, so typically state that if a spatial configuration contains a given sub-element then that element may be replaced by a new, specified, shape. The application of the rules begins with a given seed shape and can proceed in a non-deterministic manner. Furthermore, by making alterations to a given shape grammar the language of shapes can be modified in either subtle or radical ways. In this way it could be possible to model an incremental development of style. Knight [1981] has demonstrated how a shape grammar for a known style can be systematically transformed by the application of 'change rules' to produce new shape grammars defining new styles. Shape grammars thus offer the potential to formally represent rules and objects associated with a particular design style and, critically, the opportunity to apply these rules thereby generating new shape arrangements in the language of the original.

5.1 Design Scenario

As a means of articulating the approach a concrete example of a possible design prototype that incorporates touch will be provided. Using a previously developed shape grammar system [Smyth and Edmonds, 2000] as a starting point it is postulated that touch could provide an important mechanism through which a designer might interact with a shape grammar. For example, an interactive drawing board which utilised back projection techniques would allow physical objects to be placed on the surface and manipulated by a designer or designers as a means of interacting with the shape grammar. The resulting shape configuration could then be displayed on the surface of a drawing board. Figure 5 illustrates this idea using envisionment sketches.

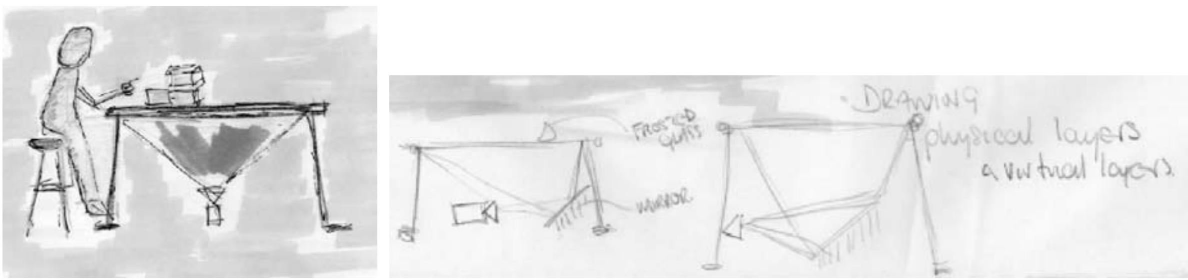

Figure 5. Envisionment Sketches for an Active Drawing Board incorporating Shape Grammars

A possible prototype could take the form of a table that incorporates a ground glass insert. The insert would enable computer generated images to be projected onto its surface, thereby making them accessible to those seated around the table. Physical objects could be placed on the surface of the glass tabletop and their location calculated by a series of equidistant infrared sensors incorporated into the frame of the table. Such a prototype, when used in conjunction with the shape grammar based system described earlier offers the potential of a physical interface to a computer based system which can then present its results on the working surface. Such a strategy is not without problems, for example how would the system deal with shapes which overlapped, or identify labels associated with specific shapes? From a technological standpoint, it is envisaged that sensors would provide sufficient location information but may be unable to identify specific objects (eg. labels). This potential shortcoming may lead to the investigation of overhead cameras and image processing as used in systems such as URP [Underkoffler and Ishii, 1999] and Augmented Surfaces [Rekimoto and Saitoh, 1999].

6. Conclusion

The role of touch and its incorporation within both the creation of and interaction with designed artefacts is crucial. The nature of this relationship can be seen most clearly during the creation of physical concept models and their consequent role during the early phase of the design process. The ability to touch and be touched by the models we interact with provides a direct linkage to the body and the understanding that that provides. Embodied interaction offers a level of engagement that is critical to how such artefacts as used to communicate with and about a problem. Currently touch is a sense which is seldom explicitly supported by computer based design tools. The prototype described in this paper will attempt to redress the imbalance through the reconnection of the body and the senses to the eye. Through such a process it is envisaged that the benefits will permeate society at large through the production of design solutions that are more grounded in humanity.

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