BODY TAILORED SPACE: Configuring Space through Embodiment

NANCY DINIZ
Bartlett School of Graduate Studies, University College London, UK
n.diniz@ucl.ac.uk

Abstract. With this project I propose that embodiment can be more emphasized and better supported in space-design frameworks. This paper presents background on several theories of embodiment since the beginning of the twentieth century to recent developments of the concept in tangible and social computing and anticipate that this reveals pathways for designing new embodiment framework systems for architecture. I suggest that architecture and interactive computing can share a common theoretical foundation in embodied interaction. The main thesis is for designers to use the body as an interface to understand how the interaction between a person and his/her surroundings arises and how our embodiment reveals other rich spatial qualities during the conception phase of design. This paper proposes a conceptual framework for embodied interaction based on the creation of real-time systems in order to instigate a framework for interactive processes that can help designers understand architecture phenomena and the performance of space. I present a design experiment on embodied performance space entitled "Body Tailored Space" where the boundaries of the human body are metaphorically extended into surrounding membranes.

Keywords. Embodiment; embodied interaction; interactive architecture; phenomenology; second order cybernetics.

1. Introduction

Traditionally architecture looks further deeply into relations with place and territory leaving issues of phenomenology of perception (Merlau-Ponty 1945) and "being-in-the-physical-world" (Gibson 1979) approaches to a second if at all level of analysis. However Interaction Design namely Tangible and Social Computing trends are built upon a notion of embodiment (Dourish 2001). Embodied Interaction is the term Paul Dourish uses to describe an approach which places an emphasis on understanding and incorporating our relationship with the world around us, both physical and social, into the design and use of interactive systems. Architecture might offer a new area for exploration on embodied interaction as it also is based in the practice of everyday life and as a result challenges architects to balance the ever-changing unpredictable actions of the occupants with their own design preferences. This paper seeks to theorize the experience of interactivity in architecture addressing issues of phenomenology, cybernetics and embodied interaction.

2. Background

This paper draws on a number of theories ranging from philosophical phenomenology to tangible computing, but has a solid start namely in philosophical hermeneutics. Hermeneutic theory is based on accepting the effect of this indefinite, inevitable and infinitely detailed situational background. "Any use of a symbol in a human activity carries with it assumptions, abbreviations, applicability, the people involved, the other information that they share as part of their current activity, their organisational structure and practices, and so on, endlessly" (Chalmers 2004). But as by putting in parallel, Second order cybernetics and Embodied interaction I will show how these areas are inter-connected and how they are present in a framework for embodied interaction in architecture.

2.1. PHENOMENOLOGY

Phenomenology is a school of Philosophy defined as the study how phenomena emerge. The history of Phenomenology is multifaceted. Over time, as often happens with philosophical traditions, there developed different phenomenological schools, styles, and emphases (Spiegelberg, 1982). Edmund Husserl, who is generally considered as the father of phenomenology (Husserl, 1927), had put phenomenology on the philosophical map during the early 20th century. His goal was to reconnect science with the real world, and the means by which this was to be done was to develop the philosophy of human experience on a rigorous scientific footing. Phenomenology set out to explore how people experience the world – how we progress from sense-impressions of the world to understandings and meanings. Fundamentally, it put primary emphasis on the everyday experience of people living and acting in the world, and the "natural attitude" towards the world that lets them easily and unnoticeably make sense of their experience. Through his transcendental phenomenology Husserl was in search for a rigorous science that could establish a firm foundation for science and philosophy. To him, every term, every judgement and thus every theory were ultimately founded on pre-predicative experiences; the original perception or observation was considered as the source of all knowledge.

Other phenomenological thinkers such as Martin Heidegger and Maurice Merleau-Ponty reacted against Husserl's transcendental structures of consciousness (Heidegger, 1927; Merleau-Ponty, 1962). These "existential" phenomenologists, as they came to be called, argued that such transcendental structures are questionable because Husserl based their reality on speculative, cerebral reflection rather than on actual human experience taking place within the world of everyday life (Schmidt, 1985). Prior to thought and representation there is a primordial coexistence between the body and its world, which develops the possibility of developing conscious awareness and knowledge. Whereas Husserl included transcendental perception that would interpret essential structures as basic categories of human experience rather than as pure, cerebral consciousness. Husserl's phenomenology was considerably developed and revised by perhaps his best-known student, Martin Heidegger. His work is based on a rejection of one of Husserl's basic premises. This is the doctrine of Cartesian dualism – the idea, descended from Descartes, of the separation of mind and body. Husserl, who saw himself developing a Cartesianism for the modern age, had adopted this position, and his form of phenomenology explored the inner mental phenomena by which sensory impressions could be interpreted and meaning assigned to them. Heidegger rejected this idea. He argued that rather than assigning meaning to the world as we perceive it, we act in a world that is already filled with meaning. The world has meaning in how it is physically organized in relationship to our physical abilities, and in how it reflects a history of social practice. For Heidegger, the primary question is not "how do we assign meaning to our perceptions of the world?" but rather, "how does the meaning of the world reveal itself to us through our actions within it?" In his 1927 Being and Time, Heidegger argued that conscious-ness was not separate from the world and human existence. He called for an existential correction to Husserl.

Merleau-Ponty's existential phenomenology focused on bodily perceptions and regarded the body as the central locus of all life, all knowledge and thus of all science and philosophy. In his 1945 "Phenomenology of Perception", Maurice Merleau-Ponty (1962) broadened Heidegger's correction to include the active role of the body in human experience. Merleau-Ponty sought to reinterpret the division between body and mind common to most conventional Western philosophy and psychology. This "existential turn" of Heidegger and Merleau-Ponty moved Husserl's realm of pure intellectual consciousness "into the realm of the contingencies of history and embodiment". This turn of putting the body to the forefront of philosophy is Merleau-Ponty's major achievement. For Merlau-Ponty, thinking was not the product of some disembodied mind located somewhere outside the material world, beyond time and space; nor was it simply the result of body reacting to its surroundings. Instead, thought is part of the active relationship between humans and their world. (Burkitt 1999).

2.2. PHENOMENOLOGY IN ARCHITECTURE

Differently as the architecture theoreticians used to interpret architecture, phenomenology in architecture is concerned with the way things appear to us in *experience* or *consciousness*. Phenomenology strives to depict phenomena appealing directly to the consciousness as such without any theories and categories taken from the natural sciences or psychology.

Christian Norberg-Schulz in his seminal book *"Genius Loci: Towards a Phenomenology of Architecture"* was one of the first architects to bring the phenomenology into the critique of Modernist architecture and the problematic of place. He wrote: "functionalism is a pragmatic approach that leads to a schematic and characterless environment".

Phenomenology in architecture has embraced two specific themes: the sense of place or engagement of the site, and tectonics (onthological and representational qualities in constructional elements). The phenomenologists Holl, Herzog & De Meuron, Pallasmaa have mostly addressed the first theme, with the exception of Norberg-Schulz (guided by Heidegger). Within a digital discourse in architecture, several architects have a tectonic embodied approach (Marcosandmarjan, 2005). Although their views are consistent, the architectural results show different interpretations or ways to further these issues. For the purposes of this paper, "Phenomenology thus means examining a phenomenon of the consciousness in its own dimension of consciousness." (Pallasmaa, 1996). Thus the concern of phenomenology is exclusively with the perception of the receptionist in our case the all day user of architecture and neglects any theoretical background.

2.3. SECOND ORDER CYBERNETICS

Philosophical Hermeneutics and Phenomenological Architecture objectives meet with Second Order Cybernetics ones. In the beginning Cybernetics adopted the traditional approach in epistemology or cognitive sciences which sees knowledge as a passive reflection of the external, objective reality. This implies a process of "instruction:" in order to get such an image of reality, the subject must somehow receive the information from the environment, i.e. it must be "instructed." If cybernetics unveiled a new vision of complex systems, second order cybernetics introduced the role of the observer, asking questions like: what happened when the observer was factored into the system under observation? These questions inevitably led to the highly reflexive "second wave" cybernetic theories of Gregory Bateson, Humberto Maturana, and Francisco Varela, (Maturana and Varela 1980) which reached their peak of influence in the 1960s and 70s. Second-Order Cybernetic epistemology is, in essence, constructivist: it is defined by the belief that knowledge is not passively received either through the senses or by way of communication, but is actively built up by the cognising subject. Another principle is that the function of cognition is adaptive and serves the subject's organization of the experiential world, not the discovery of an objective ontological reality (von Glasersfeld 1995). Another important notion for the purpose of this paper is the notion of

"structural coupling" given by the theory of "Autopoiesis" (Maturana and Varela 1980) which can be described as an autonomous and strictly bounded system that has nevertheless been shaped extensively by its interactions with its environment over time, just as the environment has been shaped by its interactions with the system. Note that this is not the "fitting" of a system to its environment, but rather correspondence between systems and environment, arising from the changes that each prompts in the other. Structural coupling in biological systems arises as a result of the plasticity of their structures, and the plasticity of the structure of the environment.

2.4. EMBODIED INTERACTION

If Phenomenology was mainly concerned with how we perceive, experience, and act in the world around us. What differentiates it from other approaches is its central emphasis on the actual phenomena of experience, where other approaches might be concerned with abstract world models. Thinking does not occur separately from being and acting. In addition to perception, it is also concerned with action, with understanding, and with how these are all related to each other, as part and parcel of our daily experience as participants in the world. "What the phenomenologists have explored is the relationship between embodied action and meaning. For them, the source of meaning (and meaningfulness) is not a collection of abstract, idealized entities; instead it is to be found in the world in which we act, and which acts upon us. This world is already filled with meaning. Its meaning is to be found in the way in which it reveals itself to us as being available for our actions. It is only through those actions, and the possibility for actions that the world affords us, that we can come to find the world, in both its physical and social manifestations, meaningful." (Dourish 2001).

3. Body Tailored Space – Configuring Space through Embodiment

I pointed out similarities between discourses in phenomenology, Autopoiesis and embodied interaction that today influence interactive design. Here, I discuss a conceptual framework for embodied interaction where a HCI has to cross the phenomenological environmental matrix with the complexity of human input as a practical approach in order to create a truly living interactive experience and not just a detached interactive art device. Like Dourish I believe that everyday human interaction is embodied i.e. is non–rationalising, intersubjective and bodily activity. Traditional approaches to HCI offer many guidelines for system design, but do not take full account of embodiment.

"Body Tailored Space" (Fig.1) is a physical performance space incorporating computer vision motion tracking, and real time sensor-actuated interactive membranes. This project looks into issues of embodiment as a way of stimulating the physical response of interactive surfaces. The system continually senses the movement of performers and responds with a physical manifestation on the surrounding membranes. The membranes are controlled by a set of machine learning techniques that start to adapt and predict movement, not just reacting but suggesting movement creating a "give-and-take" relationship between body and space.

"Body Tailored Space" suggests a conceptual framework for spatial interactions that evolve their own expressive performance producing a continuous transformation representing here the structural coupling between system and environment. The system has a responsive membrane controlled by a genetic algorithm that reconfigures its behaviour and learns to adapt itself continually to the evolutionary properties of the environment, thus becoming "a situated, living piece". Participants here approach the environment outside of a goal-oriented frame, aiming to experience a new social, ambiences or moods that will affect a physical wall in an evolutionary fashion. All the necessary and sufficient conditions are therefore present for hidden features to be added to for a physically embodied architecture. This notion of disappearance, where a tool is "literally visible, effectively invisible" is from philosophical hermeneutics (Heidegger, 1927). By this I mean the membranes can become part of the physical

boundaries without being considered *"anti-natura"* or a prosthesis to architecture. An old example from Heidegger is the way that a skilled carpenter engaged in his work focuses on the use of the hammer, and how it changes and is combined with other tools and materials, rather than focusing on the hammer in itself. Heidegger called this practically engaged and non–rationalising use 'ready–to–hand', in contrast to the rationalising, objectifying and abstracting activity he categorized as 'present–at–hand'. He saw both modes or categories of use as being set within a circular process of interpretation, in which one influenced by one's understanding and past experience of older tools and media when using any new tool or medium. One's use of the tool in the course of everyday, situated and social interaction, combining the new tool with the heterogeneous others used in everyday life, builds up new experience and understanding—that will affect how one uses and interprets another new tool. In time, this process of accommodation and appropriation lets one focus on the use of the tool, and not on the tool as a thing in itself, thus making the tool 'disappear'. This paper focus on raising our awareness of embodied interaction, i.e. the interpretation of a system by a user as ready–to–hand.

Figure 1. Membranes of "Body Tailored Space".

3.1. DESIGN DESCRIPTION

The prototype physically responds to movement, light and sound thus, it interacts spatially and temporally with the environment and its inhabitants. The prototype behaviour is the result of a system composed by: sensors, microphones, web cams, shape memory alloys actuators, and a genetic algorithm (GA) component. The dynamic of the system is made by: levers actuated by the smart memory alloy, different types of materials and textiles shaping the membrane, sound sources and LED's.

3.2. DESIGN METHOD

"Body Tailored Space" is controlled by a genetic algorithm in an attempt to develop a technological approach to performance skins that possess adaptive and evolutionary personality relative to changing phenomena of the environment of buildings. The behaviour of "The Life of a Wall" is the result of a complex system composed of sensors, actuators and a Genetic Algorithm (GA) A GA is a computational technique that roughly simulates biologic genetics. A GA involves a "genotype" which is a string of code specifying a "phenotype." Here, our "phenotype" is the shape of the membrane and the behaviour of the levers and LEDs. The environment feeds are inputs for genetic variations. When there is a feed for a low temperature, the LED's brightness increases, for example or, with high pollution levels, the actuators create "disturbed" patterns. These occurrences change the behaviour of the membrane in shape, trigger motion and light and can create random patterns on the surface, making the wall a situated living piece. The wall should respond to "empathy" and "repulsion" from the people around it. A wide range of possible phenotypes can be generated, and are evaluated for their "fitness" based on some formally specified criteria. The wall begins its learning phase by running a random set of behaviours (raising and lowering levers to form patterns), and will try to adapt its effect sequences to get the maximum "empathy" responses. The main sensory unit is a web cam and a video analysing program that determines the "empathy" or "repulsion" regarding the current skin behaviour by noticing at any given time how close the viewers get to the wall. These inputs change the behaviour of the prototype in shape, trigger motion and light and create patterns on the membrane. The material should respond to "empathy" and/or "repulsion" from local inputs. A wide range of possible phenotypes can be generated, and are evaluated for their "fitness", based on some formally specified criteria. The wall begins its learning phase, by running a random set of behaviours (raising and lowering levers to form patterns), and will try to adapt its effect sequences to get the maximum "empathy" responses.

4. Results

4.1. TOWARDS AN EMBODIED PHYSICAL ARCHITECTURE

Physical Computing is descendent of frustrating CAD design paradigms. The computer enables multiple perspectives and so an understanding of the physical context of an architectural object in terms of voids, streets, and other solids. However, I think that in digital design, qualities of material are lacking, and justice is not done to the phenomena of sound, color and light. Following Juhani Pallasmaa's ideas (S. Holl, J. Pallasmaa, A. P rez-G mez, 2007) I argue for the physical processing of architecture over CAD conceptualization, and criticize the loss of sensitivity in technology's handling of materials. In order to created truly embodied systems the future goal is to create computational tools that include embodied interactions as a CAD interface that assists in real time design processes. This experiment explored the notion of what body and spaces boundaries are, and how they are inter-connected, how presence, proximity and touch can re-direct the way we position ourselves with and within space. I argue for a more physiologically based phenomenology, and a multi-sensory approach to architecture. I consider the way in which we perceive built environment is through our own physicality- through our senses and through our body's interactive movement. Focusing on

the connection between our physical experience of a building through sound, scent, touch and sight, I describe a process which renders the viewer the central figure in his subsequent reactions. With this experiment I tested possibilities to create a responsive system as an embodied, "living", material using sensor-computer-actuator technologies and the architectonical flesh. This material has the ability to act in a responsive way, thus communicating and constantly reshaping our perception augmenting the physical properties of environments.

5. Conclusions

What does it mean embodied architecture? What has changed and what has stayed the same? How has technology changed the answers we supply to such questions?
Today, the body is, more visible than ever, contemporary explorations of the body cut across disciplines and this interdisciplinary discourse on the body is producing various effects in art, interactive design and architecture. Over the 20th century and especially over last twenty years, the concept and implications of embodiment have become increasingly prominent in various areas of cognitive science and the humanities. These range from robotics, neuroscience and psychology, through linguistics and philosophy (of mind, science, aesthetics, and epistemology), to literary studies, art-history, and art. Unlike the cyber punk theories from the eighties with the mind dissolving into cyberspace, today I witness a shift from embodying cyberspace to embodying space. Virtual reality never lived to its expectations as it will never displace the three-dimensional world in which our perceptual systems evolved; the richness, diversity, and spontaneity of this immensely complex environment makes even the most sophisticated computer simulation look like an insipid world by comparison. So the evolution for architecture is in physical computing, seeing space in which the natural and the artificial are increasing entwined. I believe in a "cyber-architecture" that melds together computer technology and an architectural source. Where I hold opposing views from recent interactive experiences, perhaps, is in seeing the situation not as a dichotomy between the real and virtual but rather as space in which the natural and the artificial are increasing entwined. I foresee a proliferation hybrid objects produced by collaboration between nature and culture—architecture like humans with cybernetic implants prosthetics, intelligent agent systems with evolutionary programs who have evolved to the point where they can converse in a convincing fashion with humans, and so forth. But then, this is nothing so very new, except for the techniques involved, for humans have been producing hybridised environments for a very long time. Researchers challenge now, it seems to me, is to think carefully about how these technologies can be used to enhance human well-being and the fullness and richness of "*human-being-in-the-world"* (Hayles, 1999), which can never be reduced merely to information processing or information machines. Space within an embodied interactive approach is to be perceived not as abstract, neutral space, but as the space of "*lived experience***"**.

References

Burkitt, I.: 1999, Bodies of Thought, Embodiment, Identity and Modernity, SAGE Publications.

Dourish, P.: 2001, Where the Action Is: The Foundations of Embodied Interaction, Cambridge: MIT Press.

Chalmers, M.: 2004, Hermeneutics, Information and Representation, European Journal of Information Systems 13(3), pp. 210–220.

Gibson, J.J.: 1979, The Ecological Approach to Visual Perception. Houghton Mifflin, Boston.

Glasersfeld, E. von.: 1995, Radical constructivism: A way of knowing and learning. (213 pages). London: Falmer Press.

Hayles, N. K.: 1999, How we became posthuman: virtual bodies in cybernetics, literature, and informatics, The University of Chicago Press.

Heidegger, M.: 1927, Being and Time, Tr. Macquarrie and Robinson (1962). New York: Harper and Row.

Holl, S., Pallasmaa, J. and Perez-Gomez, A.: 2006, Questions of Perception: Phenomenology of Architecture, William K. Stout Publishers.

Husserl, E.: 1927, Phenomenology, Edmund Husserl's Article for the Encyclopaedia Britannica. Reprinted from Journal of the British Society for Phenomenology 2 (1971): 77-90; in Husserl's Shorter Works, pp. 21-35. Revised translation by Richard Palmer.

MarcosandMarjan: 2005, Interfaces/Intrafaces, SpringerWienNewYork.

Maturana, H. and Varela F.: 1980, Autopoiesis and Cognition. The realization of living things. Living. D. Reidel, London.

Merleau-Ponty, M.:1962, Phenomenology of Perception, Tr. G. Smith. London: Routledge.

Norberg-Schulz, C.: 1980, Genius Loci, Towards a Phenomenology of Architecture Rizzoli, New York.

Pallasmaa, J.: 1996, The eyes of the skin: Architecture and the senses, London: Academy Editions.

Schmidt, J: 1986, Maurice Merleau-Ponty: Between Phenomenology and Structuralism, Author(s) of Review: Allan Megill, The American Historical Review, Vol. 91, No. 4.

Spiegelberg, H: 1981 The Context Of The Phenomenological Movement. The Hague: Nijhoff.

Wiener, N.: 1967, Cybernetics: Control and Communication in Animal and Machine. Cambridge MA:MIT Press. Originally published in 1948.