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Interactive Environments: redefining sense of place in the 'noosphere'

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ABSTRACT

The rapid growth of the internet and the far-reaching ubiquity of our virtual networks within the last decade have spurred an entirely new generation of interactive devices and technologies; these include the technologies seen in cell phones, video games, televisions and computers. Furthermore, online social networks such as Facebook and our portable Internet devices, mainly the iPhone, have begun to redefine our sense of time and place in a world of global connectivity and instant-access. This phenomenon results in a constant flow of communication and information that blankets the globe and marks a cultural paradigm shift to a much more pervasive and personalized "climate" of technology.

As a result of this paradigm shift, contemporary modes of conceiving our interactions with our surroundings have made a distinct shift from traditional architectural modes of place making. Architecture should no longer rely on the repetition of static, mass-produced components, but should be like a "second skin" that adapts and responds to its inner workings—a network made up of people interacting with each other and with their physical environments, all while being mediated by technology. Diller + Scofidio explain the user's consciousness of the body in its relationship to space and the possibilities that exist for architecture as a living body:

> *The first task architecture ought to assume, therefore, is that of defining and imagining an environment not just for "natural" bodies but for bodies projected outside themselves, absent and ecstatic, by means of their technologically*

extended senses. Far from assimilating the tool with the body according to the mechanistic tradition of Cartesian dualism, we must conceive tool and instrument like a second sort of body, incorporated into and extending our corporal powers. It then becomes possible and even necessary to logically invert the terms of our proposition on the role of architecture. The incorporation of technology is not effected by "imagining" a new environment, but by reconfiguring the body itself, pushing outward to where its artificial extremities encounter "the world."[1]

In this way, the architecture becomes not only a building, but a body that expresses a "post-spatial" notion of a globally networked, soft architecture or what Francois Roche referred to as a "habitable organism." [2]

Space is a manifestation of human behavior and interaction. Traditionally, people have always been expected to adapt to their spaces. But what if our spaces could adapt to us? Architecture would then shape our experience and play a more active role in suggesting new ways for inhabitants to interact with and perceive their environment. A greater consciousness and self-awareness would be the result. The goal becomes to design adaptive behavior and architecture that is integral to the interactivity and inner-activity of the users within the space. It is important that the project's intervention not only respond to those interactions as a kind of cause-and-effect relationship but that it initiates a dialogue and participation between people and the environment it creates. By questioning the outdated concepts of space and time, contemporary relationships between the users, the environment

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[1] Elizabeth Diller, Ricardo Scofidio, and Georges Teyssot, Flesh: Architectural Probes. (New York: Princeton Architectural, 1994), 16.

[2] Neil Leach, "Digital Cities" Architectural Design 79.4, (2009), 8-9.

and a global network can emerge.

ECOLOGY OF THE NETWORK

On April 27, 1986, at 7:00 AM, a nuclear engineer set off an alarm as he arrived at the Forsmark nuclear power plant in Sweden. High levels of radiation were discovered on the soles of his shoes. National panic erupted when authorities were notified of possible nuclear fallout. Within hours, radioactive material was detected on the ground at Sweden's Oskarshamn, Barseback, and Ringhals nuclear power plants. After extensive testing, however, it was confirmed that none of the nuclear material had originated at any of the Nordic power plants.

Twenty-nine hours earlier, a nuclear reactor at a plant in the Ukrainian SSR had exploded causing a chain reaction of other explosions, sending highly radioactive debris into the atmosphere. Carried by wind, the particles travelled westward reaching the eastern coast of North America, thousands of miles from the source. It was the discovery of the debris by Swedish officials that raised the alarm of a serious nuclear disaster; eventually, the Kremlin admitted that the incident had occurred.[3]

The nuclear disaster represents a landmark moment where geographical and political borders no longer existed and the rippling effects of an ecological disaster had become a global crisis. The reactor explosion, the weather patterns and the scientist's shoes were inextricably linked in a network of cause and effect relationships. This event reveals the contemporary, ecological consciousness of our global interconnectedness where all

[3] J. Meejin Yoon, Eric Howeler, Expanded Practice. (New York: Princeton Architectural, 2009), 6.

things are relational.

As we become increasingly aware of the interdependence of a global network, we become even more connected through structures of information and communication exchange. This network, which impacts cultural and technological modes of production, blankets the globe and links nodes, places and individuals. This contemporary "climate" of pervasive connectedness has created a new "ecology of technology."[4]

The first major communications technology to have its social and cultural effects observed since its inception is mobile Internet. Three major changes resulting from mobile internet have been observed and are important cultural and social markers that redefine people's relationships to their environments and their sense of time and place (or lack of). First, the mobile internet has created a level of personalization and customization never before seen in communication technologies. Second, it has allowed for the creation of immediate social networks and virtual communities regardless of a person's location. Finally, mobile internet has had great effects on the structure and hierarchy of polity, culture and civilization by giving the individual the reins.[5]

One question architects should ask when considering the social and cultural role that the iPhone and other mobile internet devices have had is how the digital can be transcribed to the scale of the city. The need for us as humans to understand and sense our world in immediate relationship to our bodies has not changed for centuries; therefore, there becomes a need for digital media and information, which exists in cyberspace, to manifest

[4] Ibid., 7. The ecology of technology has reordered social and political hierarchies in "bottom-up" movements. This has created communities of interest that challenge centralized information structures. This new structure of information exchange has also resulted in the negative effect of an overabundance of information; spam, feeds and email have created a culture of distractedness.

[5] Howard Rheingold, Smart Mobs. (Cambridge, MA: Perseus, 2003), 24-25.

itself in a physical way that humans can sense and interact with. The iPhone does this.

Benjamin Bratton, of UC San Diego, recounts his experience of being anywhere at any time, a phenomenon of mobile Internet devices:

> *Sitting in traffic on a Los Angeles freeway, I am reminded of Joan Didion's revelation that this is the most authentic Angeleno social experience. We are not going to any place, all lined up behind our windshields; we are all already there. Today, bumper-to-bumper, we are now all also on our phones and PDAs: taking meetings, texting, emailing, Googling, checking on this and that, editing essays on our iPhones. This is the home and the office. We do not always need to arrive, because we are already there: if this was your home, you would live here by now.*[6]

The first function of the city is to provide a sense of proximity to people, places and information. The smart mobile device condenses the city into a software/hardware handheld platform.[7]

Mobile Internet devices such as the iPhone present new possibilities for technologies that allow for physical interaction with our virtual network. This technology changes the way architects and designers understand program as programmable space with the same software + hardware capabilities seen in handheld devices. Computation will no longer be limited to the desk top or even lap top, but will become an active network linking moving bodies through an active world. It will enable physical, communicative and social mobility because it dramatically reinstates specific location into digital space.

The ubiquity of computing and our "open source" culture where information and

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[6] Benjamin H. Bratton, "iPhone City," Architectural Design 79 (2009): 92.
[7] Ibid., 93.

technology becomes naturalized has resulted in the saturation of our physical environment with information. Examples of this can been seen in New York City's Times Square and Tokyo's Shibuya Crossing.

Howard Rheingold describes the immersive virtual environment that can be experienced in Shibuya Crossing. There are more mobile media devices per capita in Tokyo than anywhere else in the world.[8] The experience of the pedestrians in Shibuya Crossing can be described as existing in three worlds at once. They exist in the physical world where pedestrians are expected to avoid walking into each other, the concrete built world including all the digital propaganda, and the virtual world of private texting tribes. It is the third environment in which "bursts of terse communications link people in real time and physical space."[9]

The profound impact of the mobile virtual world has redefined our sense of place as a society and culture, thus, redefining and reorganizing our cities. The definition of "place" has become uncoupled with the physical and has been reassigned to a social network that extends far beyond any single location. As long as people continue to participate in the shared communications of the group, they will continue to assert their "presence." This phenomenon also affects our sense of time as well. For example, a mobile internet user can still be available to one social network while participating in another social event.[10]

With the emergence of new communication technologies causing a desensitizing of the body, we have arrived at a "disembodied" state of existence, where our consciousness exists in the virtual, and physical space has no relation to the body. Imagining our personal

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[8] Howard Rheingold, Smart Mobs: 3.
[9] Ibid, 2.
[10] Richard Ling and Brigitte Yttri, Hyper-Coordination via Mobile Phones in Norway (New York: Cambridge University Press, 2002), 153.

networks as an extension of the body rather than a separate component of our existence will allow architecture to assume a more adaptive role as a "second skin." Teyessot comments on the state of the body in relationship to technology: "Architects should imagine not just environments for our "natural" bodies but also our bodies projected outside ourselves." [11]

Communications technologies continue to exist in separate but parallel environments to our physical ones. And although electronic devices have been inserted into our built environments for years, they are just beginning to be incorporated into a single body of architecture that responds to use. By incorporating technology in relation to the body and the built environment, a new hybrid of architecture can manifest itself and create more productive environments that re-establish a new understanding of our physical relationship to our places.

This thesis seeks to explore the implications of ubiquitous computing on architecture and urbanism. How can we experience the places and the choices we make in them through utilizing computation, mobile communications and pervasive media? By changing the way architects conceive of spaces, they will become increasingly responsive and truly personalized.

Despite the new possibilities for place making as a result of new technology, wiring the world will also have effects that will disrupt old social arrangements. Untethering the world with computation pervades communities far from the desktop or laptop. Telecommunications networks become available in places where wires weren't previously economically feasible. Finally, high-speeds made possible by radio-based technologies are

[11] Elizabeth Diller, Ricardo Scofidio, and Georges Teyssot, Flesh: Architectural Probes: 10.

likely to multiply the effects of mobile Internet in unpredictable ways.[12] It is the role of architecture to re-assert those social relationships in the globally networked "noosphere."

It is also important for architects to consider the threats that a global network poses. Smart technologies pose a threat to civil liberties. Pervasive computing is converging with ubiquitous surveillance, providing totalitarian "snoop power." It threatens our quality of life, from the angst of the individual to a deteriorating sense of community. Finally, it poses threats to human dignity. As we turn more towards technology and away from each other, we pose the risk of becoming more like mechanical robots and less humane.[13]

SMART ARCHITECTURE

Arguably, architecture has always been responsive to a certain degree, but the ubiquity of computing has created a much more "open source" and interactive environment. New technologies put pressure on architecture to become even more adaptable and intelligent. Technology has become increasingly customizable allowing for a "bottom-up" (user-outward) approach to personalization when it comes to a user's sense of place. Moreover, the open source approach to architecture might provide the means through which people could construct and reveal narratives about a city's culture and history. As a completely networked environment, architecture then has the ability to gather information on user activity and actively use that information in reestablishing the user's experience of place. In addition, content may be collected at a global scale and expressed at a local scale. [14]

Advanced communications and digital media are providing the means by which

[12] Howard Rheingold, Smart Mobs: 135-136.
[13] Ibid., 185.
[14] Dennis Frenchman and Francisca Rojas, "Zaragoza's Digital Mile: Place-Making in a New Public Realm," Places 18 (2006): 19.

architecture may start to achieve sense of place in an open source way. One of the most obvious examples that exist is the widespread use by architects of large digital displays being incorporated into buildings.[15] These displays are no longer seen as signs but as integral components of the spatial experience. Digital media allows the surfaces of the urban space to change in pattern, color and message and give the users varying levels of experiencing a space.

Another example of how the digital is being translated into an architectural experience involves the ubiquitous presence of wireless access to the Internet. Wireless Internet access provides the means by which architecture may access information in order to respond to specific elements. This allows architecture to serve multiple functions such as work, play or education and would depend on user input through the use of wireless Internet devices such as the iPhone. These digital places would become like nodes within a city's larger network of people and information flows.

The nature of digital architecture that is interactive and relational is not a linear problem but becomes a complex, intertwined relationship between user, public realm and technology. This type of architecture allows people to experience the built environment in a more playful and participatory manner, and may perhaps transform peoples' perceptions of public space.[16]

Sited in Athens at the base of the Acropolis, the responsive environment of WHITE NOISE WHITE LIGHT, by MY Studio, is tied to a complex historic discourse about the nature of public space. This temporary installation responds in a purposefully playful way, inviting and indexing public participation in an open interactive field.

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[15] Ibid.

[16] Valentina Croci, "Relational Interactive Architecture," Architectural Design 80 (2010): 122.

Attempting to decode the installation's responsive parameters, visitors experiment with their bodies in the space: running, dodging, stomping, tip-toeing. The static field transforms through their play into an unpredictable aggregation of space, light, and sound. White Noise White Light explores the idea of public space as one negotiated and defined by its users.[17]

The project consists of four hundred fiber-optic stalks, emerging out of a raised wooden platform. Custom-designed electronics modules contain passive infrared (PIR) sensors capable of registering the proximity of visitors. When triggered by the sensor, each electronics module delivers a degree of white noise and white light, emitting light through the fiber optics and sound through a small hidden speaker integral to the module. The light and sound increase as visitors approach and decrease as visitors move away. The resulting effect is for each visitor's movements to trigger a sonic and visible wake of their trajectories. Within the field, flickering white lights signal the presence of others, and white noise mutes the sounds of the surrounding city.[18]

MEDIA AND TECHNOLOGY

With interactive architecture, there is beginning to be a paradigm shift from mechanical to biological. Change in the mechanical sense is cyclical (with an expected outcome), whereas change in the biological world is developmental and reciprocal: it emulates life.[19]

Intrinsically tied to the developments of intelligence in space is the mental shift

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[17] J. Meejin Yoon and Eric Howeler, Expanded Practice: 158.
[18] Ibid.
[19] Neil Leach, "Digital Cities," Architectural Design 79.4 (2009): 9.

that has taken place in the user of the space. This mental shift has taken place as users have moved from directly manipulating computation in order to control space to being immersed in a fully ubiquitous intelligent environment. An interactive environment without a level of computation is like a body without a brain. In order to be capable of adapting and changing to the environment, computation is necessary to control the "body." [20]

In addition, the concept of open-source architecture is crucial in creating global, shared solutions that manifest site-specific, local results. These results become site-specific because the users' interactions are the variables, which complete any given set of instructions. In theory and in practice, a single open-source design solution would elicit different results in Syracuse compared to New York City and New York City compared to Tokyo.

Embedded computation (EC) is a system that is literally "embedded" into a building and serves to gather information from the environment, process it, and appropriately respond to that behavior. In its physical manifestation, EC can be reduced to possessing a combination of both sensors [information gatherers] and processors [computational logic to interpret].[21] EC is important not only in sensing change in the environment, but also in controlling the response to this change.

In order for architecture to respond to environmental and user change, it must have physical sensors that can sense and gather information. Some of the kinds of sensors that are currently being used include those that can sense infrared rays, color, light, facial

[20] Mahesh Senagala and Chris Nakamura, "Going Past the Golem: The Emergence of Smart Architecture," in Conference Proceedings ACADIA International Conference (Louisville, KY:2006).
[21] Michael Fox and Miles Kemp, Interactive Architecture: 58.

characteristics, motion and gait. These sensors have become sophisticated enough to even be tailored on an individual basis. This allows for greater personalization and customization.

Computer vision uses video projection to detect user movement within a static environment. The computer is programmed to acknowledge pixel change within a static field and then responds based on facial expression, the gestures of limbs or even the movement of an entire body. The tracking of people using computer vision can work at a variety of scales from extremely intimate studies of facial expressions to movement of entire bodies of people.

The movements of people or objects within a video frame can be detected and quantified using a method called frame differencing.[22] In this technique each pixel in a video frame is compared with the previous frame. The differences are then quantified to measure the amount of movement within that video frame. Another technique can detect the presence of a person or object within a video frame by comparing the pixels of a frame to the pixels of the original image of the background.[23] This latter method is best for digital video projection of heterogeneous, rather than solid backgrounds.

The use of computer vision is increasingly being used in interactive and other computation based art to track people's activities. These techniques can be used to create real-time reports about people's identities, locations, gestural movements, facial expressions, gait characteristics, gaze directions, and other attributes.[24]

Knowing our exact geographic location is one form of context awareness that can be used in created smart, responsive architecture. Detecting presence and use, locative

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[22] Ben Fry and Casey Reas. Processing: 550.
[23] Ibid.
[24] Ibid., 555.

media may be embedded into infrastructural nodes within a city as one component of an interactive spatial experience.

Locative media makes it possible to create a distributed messaging environment where all moving people and vehicles can be tracked. In the project Aula for Helsinki Virtual Village, the architects created an environment that located moving vehicles that then correspond to avatars in a virtual environment.[25] Instead of using locative media to initiate a completely virtual experience, I propose locative media be used as a tool for collecting information on use and interaction between moving people and vehicles to create physical spaces that respond. The Zarazoga Digital Mile smart parking project does this by using this technology to create convenience and simplicity in an urban environment; the project does not, however, forego a physical component. The result is a physical experience using computation as a tool.

PROPOSAL

The virtual network has become like second infrastructure in addition to the physical infrastructure networks in cities today. What makes the new virtual network different is its invisibility. It is detached from the physical and exists everywhere at any time. By acknowledging the design possibilities that include the virtual network, new ways of conceiving architecture become possible; architecture is no longer traditionally static, mass-produced space-making. A global solution, therefore, can be inserted into any city and, in tangent with the physical elements of that city, will elicit a unique, interactive response. The physical elements that exist in a city and that will become nodes or conveyors of the virtual

[25] Howard Rheingold, Smart Mobs: 99.

include, but are not limited to, highways that define edges, roads, walkways, walls, furniture, monuments, transportation hubs and parks. Each city has its own complex network of physical elements, so each city will have a unique response. The virtual network has the role of mediating between a user's personal and singular experience of his physical spaces and a global society and culture.

The city of Syracuse, specifically the Connective Corridor area, will be the test-bed for further study into open-source, interactive place-making. By looking at the city's unique infrastructural makeup, especially its neighborhood edges, cultural landmarks, transportation hubs and park system, we can uncover the networked relationships between the people of Syracuse and their places in Syracuse. This will inform the interactive spaces, whether they be a network of bus stops, responsive public furniture, responsive pavement or a more program-specific digital space such as a library or cultural center.

The cultural hot spots to the right and the transportation spots are concentrated around the Connective Corridor area (highlighted in yellow). This area represents a unique instance of social juxtaposition between the students and members of Syracuse University and the local Syracuse residents. It also marks a transitional area between the University campus and downtown Syracuse, an area clearly demarcated by Interstate 81 (a prominent urban 'edge').

DESIGN

The design of a children's play environment embodies all of the elements of an interactive environment in that both are inherently non-linear, process-oriented and adaptable. The design of a children's play environment serves as a catalyst to test the thesis of designing interaction.

Several rules define the meaning of 'play'. First, it is personally motivated, not socially driven. There is a greater emphasis on process than the final outcome. It occurs following the exploration of unfamiliar objects. It is nonliteral. It is free from rules imposed by the outside. Finally, it requires active engagement of the players.

The play environment is designed specifically for children between 5 and 6 years old. Children at this age are using generic object in fantasy play and role-playing. This is also the age where play begins to become the most social. Spatially, the most beneficial type of environment for children to successfully play in is one that is made up of low-structure/low realistic materials. This allows for children to not be hindered by any intended goal for how something should be played with and allows them to be as creative as their minds allow.

The first design iteration was a grouping of cellular structures that could be physically manipulated by children. They could be added to and subtracted from, built up into many different configurations to create a unique experience based on a child's own creativity. While the cellular arrangements were physically interactive, this initial concept was lacking in digital interaction.

By utilizing the digital environment as a tool for designing, parameters could be set up which could be manipulated through a user interface to create an endless possibility of environments. In this case, the parameters for the design of each 'stalk' were number of stalks and rotation of stalks.

The next question to be asked was how a virtually interactive environment could become physical. Using MY Studio's White Noise White Light installation as a precedent, each flexible stalk would respond to varying degrees of touch through the use of motion/vibration sensors. Each stalk would respond with a degree of light emitted through programmed LED's. In addition, each stalk would become physically interactive because children could physically manipulate the configuration of their environment.

A majority of the design process became increasingly about how a space designed completely in the digital environment could exist in the physical environment without compromising the original design. Through rapid prototyping a variety of digital fabrication techniques and materials were tested including CNC milling, vacuum forming, 3d printing and laser cutting.

The first construction iteration made use of laser-cut sheets of plastic that folded along the edges and was assembled by a series of joints that corresponded to the proportions of the body. At each joint were LED mounts and a touch sensor. This construction method was not ideal, however, because it compromised the monolithic quality of the original concept.

From this point on, I began testing formwork for pouring molds using a process that involved all of the fabrication techniques available. The original formwork was sent digitally to the CNC mill. The milled formwork was then used to vacuum form plastic negatives for pouring and testing rubbers and resins. The iterative process allowed for a precise method to be pinpointed. The final full scale prototyped was made of poured resin, a water-clear, rock-hard material. The final half-scale prototype of the entire environment was made using the process of 3d printing, the most precise of all digital fabrication methods.

CONCLUSION

The most important aspect about this capstone was the process-oriented nature of the design and construction of the environment. The final ‘design’ was not the most important realization but it was the process of integrating the virtual with the physical. The same parallel path exists between interaction and children’s play. Interaction involved revealing narratives and relationship and involves a certain level of personalization and adaptation. Similarly, play involves the process of discovering and creation rather than any predetermined end result. This goes back to the idea of a ‘soft’ body of architecture (or habitable organism) that involves an infinite number of solutions based on a variety of human input.

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