Aesthetic Interaction
A Model for Re-thinking the Design of Place

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Abstract

We live in a landscape of digital information and communication. Digital technology finds pervasive application in many aspects of modern habitable spaces—environmental control systems, internet based systems for information exchange, cellular systems for instant communication, and the list goes on. In fact, recent Intel studies show that every day we encounter at least 150 different computing devices in our living environments. As computing initiatives evolve intelligent devices that work in the background of our day to day living, several questions arise about how we interact with these devices.

The design of “smart” places will eventually involve the seamless integration of both the physical and virtual. Such interventions will lead to a transformation in the way we design. Architects will increasingly find themselves using the computer in design as opposed to design. Over the last few years our lab has been working on several projects, from the level of a room to the level of urban design, that use embedded interactivity and computing as part of the design. This paper describes three such projects, completed at different times, which deal with different problems and the overall impact of computing on the way the designs were developed. The description and evaluation of these projects will be used to develop a theory for the use of pragmatist aesthetics for “information interchange” within architectural design. In short, the paper will explore the evolution of Computer “Aided” Design from a model for designing architecture to a model for designing computing within architecture through aesthetic interaction.

Introduction

The disappearing computer

“As a result, our actions in physical place are closely and unobtrusively coupled with our actions in cyberspace. We become true inhabitants of electronically mediated environments rather than mere users of computational devices.”

William Mitchell (1999)

Today’s architects have to negotiate with two kinds of computer usage—the first, the use of digital media as a tool in the design of spaces, and the second, the use of digital media embedded within designed spaces. Our thinking is beginning to shift from the notion of computers in architecture or computers affecting architectural design to the notion of architecture as the computer (Senagala 2005).

“Smart” spaces and interactive environments have found prevalence in architecture with the emergence of powerful mobile computing devices and real time context aware computing (Edwards and Grinter 2001). As early as 1991, Mark Weiser (Weiser 1991) coined
the term “ubiquitous computing” referring to computers embedded in everyday objects serving people in their everyday activities. These arrays of embedded intelligent devices could work invisibly and unobtrusively in the background, anticipating the need of the user. As we progress into a new era of architectural design, digital mediation within architecture and everyday objects will lead to what is called the “disappearing” computer. The disappearance of the computer does not necessary allude to physical invisibility; instead it refers to “invisibility of usage”—computers that are embedded into lives such that they work only in the periphery of our senses (Tolmie, Pycock et al. 2002).

As architects, it is the second category that should interest us: artifacts that are still large, but not perceived as computers because people discern them as, maybe, interactive walls or interactive tables. When this happens, interactions will move from the level of objects to the level of the space plan (Petersen 2005).

However, the places we live in are physical embodiments of our existence, constructed from layers of memories and experiences. Unlike our interaction with desktop computers, our interactions with space are not results of solitary, temporal instances nor do we negotiate space in the same manner that we negotiate physical computing.

Herein lies the basic problem—current attempts of designing mediated spaces lack primarily because it is the artifact itself that is given prime importance. “Design” in Interaction Design means the rational *programming* of interaction. Thus most such “designs” become an attempt to improve efficiency and not the experience of inhabitation. They become programs that mechanize process, not designs that solve problems. Inherently our definition of “smartness” remains limited to sensors that detect air temperature and open windows or systems that negotiate with lighting conditions to decide optimal illumination levels and so on. When implemented in our daily living, we spontaneously reject these systems *because* they are simply another attempt to digitize our lives.

Yet, our places call out for new ways of interaction and, perhaps through an expansion of ideals of transparency and efficiency, we can include poetic elements in our mediated spaces that excite one’s imagination (Petersen, Iversen et al. 2004).

**The digitization of our existence**

*“The computer screen has become the 17” gateway to all the digital information out there”*  
Mahesh Senagala (2005)

With the increased acceptance of computation in our homes, we have seen a drastic change in the way people use media. There is a sudden drive to digitize our physical existence; photos, music, movies, calendars, recipes, notes, and messages from school no longer have inherent physical forms. In spite of this mass conversion, our interactions with media are limited in perception and manifestation; our image of a computer is still the 17” computer screen on our desktops.

Streitz and Nixon (Streitz and Nixon 2005) talk about two forms of the disappearing computer: a physical disappearance and a mental disappearance.
Understanding Place

“Space is an ordering of understanding; place is an ordering of experience”

At this point it is important to understand the difference between space and place. Place is an appropriation of experiences, while space is merely the construct that envelopes it. McCullough (McCullough 2004) presents the idea of place as integral to the idea of architecture. He claims that architects do not design spaces; they design place—the phenomenological quality of space that enables us to retain memories, weave stories, and describe our experiences. Thus, the design of place can be seen as the design of an interaction between humans and their environment. Architects and designers wield the capability to design artifacts that can influence a person’s life—the way they live, move, and interact. We seldom tell stories of walls or tables or chairs; we tell stories of our lives around them. Thus walls, ceilings, tables, chairs are all simply physical artifacts that aid inhabitants in the development of personal experiences. In short, we are merely designers of large interfaces for information interchange.

The idea of architecture as an interface for information interchange is not new. In fact it has existed since the beginning of human civilization. The difference now is that for the first time we can interact with this information—change the way it envelopes our existence, search for more information or better information, communicate our needs, expect a reaction and so on.

All of this leads to a realm of experience that was hereinafter unheard of. The onset of ubiquitous computing signals a paradigm shift. Design of interactive (mediated) places will not necessarily change what is being designed, only how it is designed, and how it will be perceived. As computers slowly recede into walls, tables, and furniture, we transition from designing human-computer interaction (HCI) or human-space interaction to designing human-information interaction (HII). Although architects and designers have been doing this for centuries, the difference is that we now have in our repertoire new tools of computing and multimedia. Therefore, the challenge is design of mediated places situated in unique contexts where their spatial, temporal, and material configuration matter contrary to abstract network diagrams made by engineers.

Pragmatic Aesthetics – a solution?

In 2004, Petersen et al presented the idea of Aesthetic Interaction to the larger HCI community, bringing in the concepts of design to the largely computation dominated world of ubiquitous computing. In their work, they expanded the concepts of pragmatist aesthetics as proposed by Dewey (Dewey 1959) into the realm of interaction design. They claim that aesthetics of an artifact cannot be understood without understanding the socio-historical dimensions associated with that artifact. Or in other words, aesthetic is not inherent in the artifact, instead it is the result of human appropriation of that artifact (Petersen, Iversen et al. 2004).

Because our ability to engage in an
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aesthetic experience is the result of our social context and our own intellectual abilities, the manifestation of this aesthetic experience is prolonged beyond the immediate exposure. Hence, the aesthetics of a chair is not defined merely by its design; instead, it is defined by our perception of that design. This perception is a constant revival of a history of past experiences and memories. Moreover, the aesthetics of the chair lingers in our modal systems beyond the singular instance of our interaction with it. Pragmatist aesthetics works on the understanding that our experiences are not unique temporal instances, but a complex build-up of use relations that construct every aspect of our daily life. Thus aesthetics has the ability to surprise and provoke and to move the user to a new insight of the world (Petersen, Iversen et al. 2004) beyond the mere ascribed use that is afforded by an artifact.

Experiencing Place

In order to understand the connection between experience and place, one must first understand experience. Forlizzi and Battarbee categorize experience into three unique types:

1. Experience: Experience is how we constantly assess our goals relative to the people, products, and environments around us.

2. An experience: An experience has a beginning and an end, and often inspires emotional and behavioral changes in the person who experiences.

3. Co-experience: Co-experience is about user experience in social contexts. Co-experience takes place when experiences are created together or shared with others. (Forlizzi and Battarbee 2004)

They present this categorization in order to contextualize interactive systems and the design of such systems. They claim that through the provision of mediated communication channels, interactive systems enable co-experience providing new channels for social interaction. Since we have seen how space can be expressed in the form of an interactive system, experience of place must be derived from either experience, an experience, or a co-experience depending on the channel of interaction that the user chooses for his/her interaction.

They also provide a framework to understand the kind of interactions that people can have with such systems:

1. Fluent Interaction—This is the kind of interaction that is automatic or based on skills. Examples are riding a bicycle and making the morning coffee.

2. Cognitive Interaction—This is the
kind of interaction that has to be learned from the product at hand. An example of cognitive interaction is trying to identify the flushing mechanism of a toilet in a foreign country.

3. **Expressive Interaction**—Expressive interactions are interactions that help the user form a relationship to a product or some aspect of it. In expressive interaction users may change, modify, or personalize, investing effort in creating a better fit between person and product. Examples are restoring an old chair and painting it to accent the color of the wall.

Most computational systems address the first two interactions well; mostly because these interactions are predictable. However, the third kind of interaction is often unaccounted for. This is a result of the *programmed* quality of interactive systems—one that limits interactivity. However, expression arises in spite of it. People adapt such systems to work in the manner that they deem appropriate to that environment and context. But why does this happen? Why cannot systems be designed to predict or even encourage expressive interaction? To understand the problem we must first understand the legacy of the computational model that these systems are so dependant upon, and then understand the difference between the computational model and an experiential model.

**Computation**

“To see, to perceive, is more than to recognize.” —John Dewey (1932)

The prevailing Computer-Human Interaction (CHI) model of interface design tends to be a computational model that promotes efficiency over experience. Such a model for computing is understandable because it is quantifiable—hence its legitimacy and acceptance in the scientific community (McCullough 2004). However, “design” looks at the world in a very different perspective. Architecture, for example, evolved a social frame before it introduced efficient mechanization within itself. In fact, efficient technology and automation is a relatively new concept to architecture. Even today technology within architecture is only the means to achieve a certain quality of living.

Not all architectural space, however, evokes experience. In fact, most architectural space only allows for experiences of small parts of itself while creating a sense of the whole. Very often we trudge through designed space without noticing any qualitative aspects of that space. The difference is that space, unlike computing, does not call out for an interaction. It remains passive, waiting for that one unique moment in space-time when a user reacts to it. It does not ask the user to form his/her experience, but mediates it through its very existence. This nature of architecture makes it a passive interface, one that exists for experience yet does not coerce it.

Computation, however, works differently. The very existence of computation depends on a blatant
expression of requiring interaction. Thus our reactions to computational devices are very different from our reaction to architecture or designer artifacts. This reaction is derived from the fact that we perceive computers as infallible calculating machines. We do not expect a computer to make a faux pas (at least not unintentionally). Computers are perceived with a bias, and this bias is inherent in every aspect of our interaction with these interfaces. Let us take in comparison another interface in an architectural environment—the door. In spite of being physically tangible and highly efficient, doors afford users with an intangible quality of experience. Doorways have been used in design to evoke awe, to impose humility, to change facets of a space. The act of walking through a door evokes sentiments that are separate from the efficient operation of walking from one space into another.

In the use of digital interfaces, however, there exists very few uncertainties, no reason for surprise, no element of excitement, and no cause for storytelling. The computer is digital, always offering a yes or no solution. Thus when you try to tie these two systems together, computation inherently resists the phenomenological qualities of architecture. The best we can do is design interfaces that will lead to the build-up of experiences as a secondary or tertiary result of the interaction. Yet most results of user studies/product testing surprise HCI designers; they find people using tangible interfaces in ways that the designers never imagined it would be used, inventing new ways of enhancing play with even mundane interfaces (Churchill, Nelson et al. 2006).

Perhaps because of this, there has been a strong discussion within the HCI community for a cohesive theory of experience design (Forlizzi and Battarbee 2004; Petersen, Iversen et al. 2004). HCI programs around the country have “design” as part of their core curriculum, some even going on to establish separate schools of design. We can also see this change happening beyond the academic/research community. Corporations advertise a larger need for creative User Experience (UX) designers and Industrial Designers. This momentum has resulted in products and services where “high-design” is the prominent character of products (think Apple iPod, Microsoft Xbox 360) with an intentional subjection of the technology within. Such changes signal a complete volte-face in the conventional “technology-is-everything” thinking of computing design.

The sad news, however, is that very little research happens in the field of tangible experiences—understanding place and developing computational interventions that can enhance our experiences in that place. Most such research still tends to concentrate on efficient mechanization of processes—home “labs” that create laboratory like spaces using ubiquitous computing as the backbone. Shape, size, and technology may have evolved, but the perception has not. However, the inevitable shift of pervasive computing into architecture will be heralded not by the design of such computational boxes; instead it will be through the use of these systems to enhance, encourage, and even persuade experience. It will be through carefully designed mediation. It will be through a conscious attempt encourage expression.
We will have designed true interactive places when these weave into themselves interfaces that allow us to tell new stories, stories of our experiences around them.

**Designing places + Aesthetic Interaction**

“The twenty-first century will still need agoras maybe more than ever. But these will not always be physical places...and even where they look familiar, they will no longer function in the same sorts of ways as the great places of the past”

William Mitchell (1999)

But what does the pragmatist view of aesthetics have to do with the design of interactive place? Because aesthetic interaction focuses less on the interface and more on the resultant experience, such interfaces will automatically subdue to the level of invisibility while users and their use histories will gain prominence. Moreover, inherent in its theoretical construct is the need for “design” as opposed to “programming”. The use of pragmatist aesthetics in architectural computing will lead to passive interfaces not programmed to automate space, but to enable a willful interaction of users with the space. The experience derived from such interaction will not be bound to specific time-space; instead it will extend beyond it, manifesting itself through the imagination of users and finding inherent expression in the form of memories or stories.

Thus even though future spaces may not look or function in the same sorts of ways as great places of the past, the challenge is to design places that will evoke the same kind of emotions.

The following half of the paper will be used to describe three projects (two implemented and one conceptual) that explain how aesthetic interaction was used as a framework for the design of mediated spaces. Because the intention is to present ways in which these interfaces encouraged experiences, we will delve very little on technical aspects of each. The interactions are presented in order of scale moving from a personal scale (room level) to a social scale (public and urban level). This range will enable us to establish the idea of aesthetic interaction and how it can be used to design all kinds of spaces from bedrooms to agoras.

**Personal Scale – Augmenting spatial experiences**

This project came out of a need for bringing in outside influences into a closed architectural space. Since our visual senses have the highest influence on our perception of space, a visual connection is often the best option. However isolated spaces within buildings eliminate the option of a visual connection to the outside. In these spaces it becomes important to explore other modalities that may add to the perception and improve work quality. Using music in workspaces has found commonplace acceptance, mostly because some kinds of music have been shown to improve the comfort level of a space and productivity of inhabitants. However, for this project we were interested in bringing in other arrhythmic, everyday sounds of outside space: the pitter-patter of rain, the sound of rumbling clouds, the chirping of birds. The hypothesis being that ambient
sound—even uninterrupted (arrhythmic) sound—would improve quality of isolated spaces by adding an aural connection to the outside environment without a significant influence in productivity.

In order to establish such a system, we chose a basement room in our school. It was in the center of the building with no windows or conduits. We then set up a multi-directional microphone on an outside terrace which was connected through to a computer in the room. The computer ran a program which analyzed the sounds from outside and presented it as it happened through speakers within the space.

The computer mediation was necessary to avoid sudden peaks or unwanted sounds (like the sound of a jackhammer). The mediation allowed only sounds within a certain range to be presented into the class (see figure 3).

Professors and students were then invited to use this space for classes during which we studied interruptions from the system. We found that arrhythmic sounds like the sound of rain or the chirping of birds moved easily into the periphery of our senses. Nevertheless these sounds allowed users a reasonable understanding of outside conditions even though there was no visual connection (birds chirping meant that it was pleasant outside; pitter patter of water meant that it was raining). They allowed the users to create an image of what was happening outside without actually interfering with their ability to work, slowly evolving into what is referred to as ambient sound.

The system itself was not a complicated one, yet it mediated a space and allowed for interaction. The beauty of the system, however, was in its design for experience. We did not anticipate or control the sounds coming in through the system; instead we let the system present actual sounds (the computer only controlling for loudness or sudden peak levels). We then allowed the users to incorporate their own imaginations, use history, and experiences to create the scenario that they wanted. We found that

Figure 2. Diagram and Image showing the setup of the project

Figure 3: How computer mediation was used to cut off unwanted sounds and peaks
often such scenarios could be wrong (a “whoosh” could be just the movement of a bird flying low, yet can be interpreted as wind blowing), but that was the whole idea! Thus using an experiential model that allowed for errors to happen reinforced the validity and acceptance of the system.

Social Scale—Interactions within public domains

From personal space we graduate into ubiquitous computing mediation in a large subway station. In this project it is the transitional nature of the space that defined the characteristics of the interventions. However we also had to address the problem we set out to solve—persuade people in a largely metropolitan subway station to exercise and interact with each other.

For this purpose, we designed two separate domains of interaction:

The Staircase

Intention: Encourage the people to use the stairs in lieu of the escalators, helping them to get more exercise.

Poor diet and inactivity contribute to 300,000 deaths annually, and nearly 70 percent of cardiovascular disease cases are due to excessive weight. One of the suggested ways of alleviating this problem was through environmental systems that motivate healthy behavior changes. Further, such change in behavior will work if it had an element of exploration. In order to incite exploration, it is essential to invoke interest first. This can be achieved in many ways: by having information that will attract people, by having a device that differentiates itself from both its competition and its surroundings or environment, and so on.

In order to create such a distinction, the structure of the staircase in the subway station was changed slightly, giving it a “floating” feeling. We further altered the material of the staircases by introducing a translucent digital interface into the stairs. The interface was deliberately placed such that it is visible only when one starts to use the staircase and not from afar.

Additionally, a visual display projected on this interface that would reward the passengers for using the staircase. Various such visual displays were conceived:

Figure 4. The Staircase and the Artist’s Wall in relation to the transit area.

Figure 5. The two displays projected onto the staircases
(a) weather display (showing outside temperature, wind-chill, and a graphic display of the forecast)
(b) a real-time motion sensing game which locates a square around the feet of each person using the staircase, showing his/her relation with the other people on the staircase.

The difficult part of the problem was influencing the decision making process—stairs or escalator. In the end, this interface allowed for the shift from escalators to stairs because users felt an:

1. an eagerness to see what was happening on the stairs
2. and once on the stairs, an experience was created through the interaction

**The Artist’s Wall**

*Intention: Increase social interaction among the people using the subway station.*

There is a temporary feel to the whole environment of a subway. People and things are in transit and you usually never see the same person again. This gives a leverage to do wrong or break rules—“No one knows me anyway.” Thus in order to motivate people to remain healthy and keep resolutions, it is paramount that we change this perception of the subway station. One way to change this is by increasing social interaction amongst the users of the station.

The Artist’s Wall’s primary purpose is to provide a common ground from where to begin conversation and help the users of the station initiate some sort of relationship with their co-passengers. The design of the wall itself is very simple as illustrated in figure 6. It has two transparent touch sensitive screens that are placed together, such that the interface can be used from either side. The transparency of the material is essential to the design because we want people using the wall from either side to see each other, thus enabling them to interact better. The height of the wall was kept at 2 meters for people to view this as an element in the environment rather than a barrier or wall.
If no one is using it, the wall would have many different blinking dots spread across it. If one were to touch one of these dots, it would leave an imprint of one's touch in the form of a colorful blob. This would initiate the user to explore more and hence lead her to discover that by using one's fingers and running it across the wall she is able to create colorful blob patterns. The user then discovers that she can interact with other people on either side of the wall to create better forms and pictures, incrementally persuading the user to talk and develop a bond with the other person. These blob patterns are not permanent; once the device senses that it has not been used for a while, it will erase all artwork and go back to the blinking dot stage. The main purpose of the wall is to initiate social interaction. And even if no exchange of formal information happens, the next time one of the users sees the other user there is an experiential link established from memory. In long term, such social links could lead to a more personable space.

In both of the above domains, the computing interface only plays a passive part. It is the users that take control of the system and generate their experiences. Some controls are built into the system; however, most controls are flexible enough to allow for a free and democratic establishment of user co-experiences. And more importantly, since the experiences from both systems last beyond the singular usage, there is the possibility of sustained behavior change, which was our original intention.

**Urban Scale – Negotiating large places**

Childhood obesity is a growing national concern. Many schools and universities seldom encourage physical activity within campus, and often students drive their cars or take a bus to traverse relatively short distances. There is an active effort to increase physical activity of school and college going children.

We set out to solve this problem by introducing a thin layer of computing into the urban fabric of the campus. We designed interactive systems that would go up in strategic places around campus – interfaces that provide subtle information cues to persuade behavior change. In the design, we considered the fact that although our university can be called a highly “walkable” campus, most students preferred to take the bus to reach even
close locations. Thus it was important to introduce an interface that would not only influence a behavior change, but also allow for negotiating the walk within a large campus.

So we designed a simple computer mediation that was placed at bus stands around campus:

When unused, the interfaces would merely pick up GPS signals from the buses and show a location relative position of the buses with respect to that particular bus stand. When a user approaches the interface to view this information, she is given the choice of interacting with the system. Upon interaction, the system tells her how much time the next bus would take to arrive, what the walking distance is between two buildings on campus, and a comparison of the time it would take to walk to the place if she chose not to take the bus. The interface also gives the user information about the calories that could be burned by walking and the percentage of average daily calories this walk accounted for.

To explain our findings, let us look at a specific scenario (see figure 9) where the bus would take 7 minutes to arrive and another 4-6 minutes to reach the place; meanwhile, the walk (the route for which was displayed on the screen) would only take 6-8 minutes to complete. In such or similar scenarios we found that users re-considered taking the bus—a simple behavior change that led to increased physical activity amongst the users of the interface.

Because the system does not rely on actual experience making, only a thin layer of computing was required to accomplish the task. Moreover, no behavior change is expected and no rewards are accorded to the user for changing behavior. Instead, the experience is a result of choices made by the user. Although unlike the two earlier systems, this interface does not actually create an experience. But because the interface relies strongly on past experiences and uses evaluations of the users to initiate the behavior change,
aesthetic interaction is an integral aspect of the makeup of the system.

**Five Lessons from the Aesthetic Interaction Model**

The three examples above synthesize an understanding of how we can use aesthetic interaction as a framework for design of place. In some cases the interaction led to an experience; in others, experience is the driving factor for the design. In the process of designing aesthetic interactive systems, a few valuable lessons were learned:

1. **Computers are not the problem – the computational model is.** What is needed instead is an experiential model, one that allows the users to take control. Such a model will allow a more personable interaction while working counter to the perceived bias against computing.

2. Perception of computing will not change overnight. But evolving modes of interaction deserve new models of design, one that solves problems rather than dealing with efficient mechanization.

3. **Tangible interaction is everywhere.** We do not need computation for interacting with our environment. Walls, doors, windows, chairs, tables are all tangible devices that enable us to interact with our spaces. It is important thus to understand that computers only help to enhance this interaction not form it.

4. **Design experiences not artifacts,** and to do that use the thinnest layer of computing needed to accomplish the task; leave the rest to users.

5. Do not design for singular incidental interactions; instead design for long term sustained experience. In short, *design place and experience will follow.*

A cautionary note to the reader: these are merely lessons that were learned from our experiences in designing such systems; heuristics that will guide future designs deserve a paper unto itself and the above should not be taken as such.

**Conclusion**

One question still lingers—are such interventions merely a response to the availability of technology? Are we perhaps moving into a latter day Baroque period in which ornamentation has taken the form of computation? Or are there serious implications to be derived that will enhance the design of place?

Implicit in the above discussion is a much larger question—should the design of computation change to adjust to the design of space or should the design of space change to adjust to the design of computation?

It is perhaps still premature to answer that question just yet. One thing is certain, the answer is not digital. In order for “smart” places to exist, not just find mainstream acceptance, it must be woven around the lives that people live. Not differentiating itself from the environment, rather blending into it. Not adding another dimension to an already complex lifestyle, rather augmenting without being perceived. Thus the aim is not to create an “invisible” computer; it is to create
one that is perceived as invisible, allowing interactions that excite people and allow for imagination.

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References


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