The Invisible Display – Design Strategies for Ambient Media in the Urban Context

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ABSTRACT
This paper presents contextual strategies for staging ambient interfaces in public space. While ambient displays are often treated and evaluated as solitary objects in existing literature, I will argue that the experience of an ambient display is not determined in the first place by its intrinsic qualities, but essentially by the way how it is situated within its local context.

The six described strategies show how cultural notions and practices can be incorporated into the design of ambient displays. Some of them seem counterintuitive and take advantage of phenomena that a designer usually might want to avoid. At the same time they are an invitation for further experiments and cross-pollination between the fields of architecture, public art and interaction design.

Keywords
Ambient Media, Contextual Design, Urban Interfaces

Introduction
In the architecture community, the impact of large-scale outdoor displays on public space is currently intensely discussed. However, the discussion is mainly concerned with a rather traditional concept of the screen, designed to capture attention by displaying imagery on a prominent surface of a building. As a result of this narrow definition, much of the discourse revolves around the notion of the façade as an iconographic surface, resembling the discussions around the "architecture of the billboard" during the 1960's and 70's [1]. What is needed is a redefinition of the display, reaching beyond the traditional notion of a screen. For this purpose, a rich spectrum of methods can be deployed to display information through physical means[2].

Based on concepts of ambient media, I will try to make an argument for the architecture of the "invisible display", a display that is perceived in the background of attention and blends into the ambience its surroundings. For sake of simplicity, I will use the term invisibility for everything that we tend to overlook in our daily routine.

Ambient displays are architectural interfaces for presenting information that can be processed in the background of attention [3]. For capturing the viewers attention, ambient displays rely on a mechanism often referred to as the *Cocktail Party Effect* [4]: in the noisy ambience of a cocktail party with many voices simultaneously talking we immediately notice someone mentioning our name, while being unable to follow any of the conversations.

The importance of Context
Also the discourse among HCI designers about ambient displays could benefit from architectural design practice. A considerable body of research has been dedicated to the description and evaluation of ambient media, its possibilities and applications. However, the question of what makes a technology "calm", especially in the urban context, still deserves closer investigation.

In existing literature, ambient displays are often treated and evaluated as solitary objects. Throughout this paper I will argue that the experience of an ambient display is not so much determined by its intrinsic, absolute qualities, but essentially a result of its interaction with its surrounding and its references to cultural practices and preconceptions. Most evaluation criteria for ambient displays, such as the demand for minimizing the cognitive load [5], are relative and context dependent, and cannot be evaluated separately. This is especially true for aesthetic qualities, which are often reduced to the requirement for an "aesthetic pleasing design", however this might be understood. In this paper, the investigation of the ambient will not be a question of aesthetic judgment, but rather one of situation.

For the interface designer, ambient media poses a number of challenges, since traditional principles and best practices of user interface design cannot be applied, especially in urban public space. Communicating the mapping of a data source to an ambient display is considered a key problem [6]: what can be solved through learning how to read the display on in a private environment, is hardly possible for a general public und urban space.

A common strategy to overcome this problem is to reduce the amount of displayed information, down to a binary value that helps with a specific decision, such as whether to take the umbrella, when rain is to be expected [7]. This

works well for alerting purposes, but already with a simple range of two colors can make the mapping incomprehensible. The D-Tower, signals the emotional state of a city through the colors red and blue [8]. What exactly does the color red stand for – is it happiness or rage? It is important to point out that this is not a problem of arbitrary mapping, since signs and language are arbitrary by nature. It is the lack of a common convention. The mappings of ambient displays have to be learned, but again, what works in a personal application might not work in public space.

Design strategies

In this paper I will discuss contextual or situational strategies for the integration of interfaces into the urban ambience. They address the question how to stage ambient displays effectively in the public sphere in a specific social setting. Some of them are well established, while some seem counterintuitive and exploit phenomena that a designer usually tries to avoid. The presented principles cover different aspects of the relationship between observer, representation and environment.

A. Animism

Animism is the idea that all things and objects are inhabited by a living spirit. The concept can be found for example in the visual language of animated cartoons - we are familiar with the notion of signs and inanimate objects suddenly coming to life. Accordingly, one of the earliest examples from animation history, dating back to 1906, features a cartoon figure interacting with the cartoonist while being drawn [9] - a topic that never has disappeared ever since. In this case, invisibility is understood as the existence of a latent reality, surfacing only under certain conditions.

There are a number of ambient interfaces that rely on the aesthetics of cartoons, such as the *nabaztag* [10]. Another example is the *thankstail* [11], a robotic dog tail for cars enabling drivers to communicate through non-verbal signals. Another popular animistic notion is the independent life of shadows, as illustrated by *Ombra* [12], a public installation that subtly animates the shadows of a bronze statue.

Beyond these figurative applications, the concept can also be found more abstract forms of expression. In fact, everything that is considered static and inanimate will produce the effect when animated in a proper way. For example, the project *Atemraum* [13] presents a wall with the ability to breathe according to a person's respiration. The effect is achieved by inflating a rubber surface covering the wall. On a larger scale, the public art project *txtual healing* [14] gives houses a "voice" by projecting speech bubbles with text messages from mobile phones pointing to open windows and doors.

In terms of ambient media the moment of transformation from a static object to an animate one is of special interest. It has been stressed that a calm technology should easily migrate from periphery of attention to its center and back again [15]. This strategy is a way to initiate this shift of focus through a language that most people are familiar with. Animism can make the transition surprising and humorous, yet at the same time plausible.

Figure 1 Freddie Yauner, *signs of life* – an apparently ordinary sign coming to life.

Figure 2 *Atemraum*, making the walls breathe

B. Invisibility through Mimicry

The natural environment has been mentioned as a perfect example of an ambient display [6]. It conveys a plentitude of information that we have learned to read and understand. At the same time we also have learned to ignore most of what we encounter through habituation, we become blind to many things we see repeatedly in the course of our daily routine. This section investigates the possibilities of invisibility in the sense of this inattentional blindness. In the animal kingdom, mimicry is the strategy of a species to imitate the appearance of another, usually more powerful or dangerous species. In analogy, an ambient interface might be disguised as a familiar object that we tend to ignore, and therefore will slip the attention of the habituated mind.

Naturally, this works well as a subversive strategy for implanting alien objects into public space. One example is Leo Bonnani's design of an ordinary bus schedule, fixed on an existing pole in front of the main entrance on MIT campus. On closer inspection, however, the bus schedule turned out to be a historical chart of suicides that have occurred on MIT in the recent years [16].

On a more general level Mimikry creates what Bill Gaver calls *ambiguity of context* [17]: something may be understood in different contexts, each offering a different meaning. Gaver mentions Duchamp's iconic *fountain* sculpture as an example, a ready-made consisting of a urinal turned on its side. The thus ready-made generates an additional layer of meaning to ordinary objects. This double meaning is what differentiates Mimikry from existing examples of ambient displays, for example in the shape of furniture or picture frames. They may adopt the shape, but remain in the same context of interpretation as the referenced object.

Figure 3 Bonanni's display disguised as a bus schedule.

C. Blending the Object and its Representation

When we talk about ambient visualization in the urban context, the map sometimes becomes the territory - the boundary between the visualization and the object it represents becomes blurry, with both occupying the same space and often having a similar scale. As a consequence, it can become unclear whether something is part of the representation or the visualized concept. The outdoor environment is a natural information display itself for those who know how to read it. Yet, at the same time it is also the subject of representation.

This ambiguity can be illustrated with a project for public focusing on the display of environmental information. The public installation *garden of eden* [18] uses salad plants placed under glass boxes where they are exposed to polluted air that has been generated according to environmental data from different cities in the world. The effect of the polluted air on the plants is the only form of visible representation. In this example, the distinction between the visualization and the visualized concept is blurred, since the plant can equally be considered as part of the environment and exhibits the actual effect - the impact of polluted air on the urban environment. The urban-scale project *Nuage vert* [19] offers an even tighter connection between representation and its subject. The project augments the emissions coming from the chimney of a power plant – whose size is connected with the energy consumption of the local neighborhood – with the actual data of this local consumption, being projected onto the cloud itself.

This overlap is unusual in traditional forms of information visualization, where data and representation are separate entities. In these forms of visualization, iconic and symbolic types of representation prevail: the content is expressed either through resemblance or abstract mapping. In contrast, the two projects described above are part of a new class of visualizations that have an indexical character, putting emphasis on the actual phenomenon. In interface design, ambiguity is usually considered something to avoid. In these examples, on the contrary, this ambiguity is employed to increase the understandability of ambient displays by integrating elements of common knowledge. Furthermore, the strategy can be also a way to increase the credibility of the presented information, since the effects can directly be observed. Finally, by incorporating natural phenomena, it adds richness to the representation.

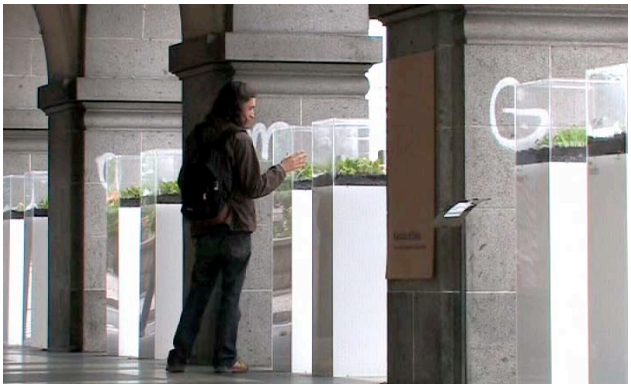

Figure 4 Timm Wilks et al., *garden of eden*

D. Embracing unstable Display Media

For traditional displays, the display medium has to be as generic and controllable as possible. Every influence from its local environment has to be minimized; the display should always appear in the same way in every light condition. Designers of outdoor LED displays are making big efforts in order to neutralize the influence of ambient light. In spite of these efforts, the outdoor environment is a different case and independence from context is not always possible to achieve. Consequently, architects have learned to incorporate successfully the impact of different environmental conditions on the appearance of a building into its design. What is a generally accepted as a site-specific quality of architectural design, could also make sense for urban interfaces – to embrace the influence of environmental conditions on the appearance and characteristic of the display.

An example from contemporary art history is Hans Haacke's *condensation cube*, using humidity as its primary medium. The piece is a minimalist sculpture in the shape of a sealed off glass-cube containing a small

quantity of water, which causes a layer of condensation covering the walls. Through the continuous cycle of condensation and evaporation, the artwork's appearance changes constantly influenced by environmental variables like temperature or light. Inspired by this artwork, we developed the ambient display *dewy* [20], that displays pixilated pattern of condensation, facilitated by a matrix of peltier elements and a fan for erasing the patterns. While the display allows high-level control over the emerging patterns, the actual appearance of the condensation patterns depends a lot on external humidity, temperature and light direction.

There are numerous other examples and possibilities - especially plants are an interesting choice for a display medium: they interact with their environment on a number of levels, yet exhibit persistent features such as petal color. Examples of ambient displays include projects that exploit a plants' phototrophic behavior or the possibility to tint the petals by watering white flowers with colored water.

Ephemeral materials as display media are without doubt harder to control, and therefore offer less bandwidth for displayed information. Additionally, the display will never represent the data in a pure form, but blended with environmental influences. If these influences are taken into account and are conceptually compatible with the purpose of the representation, this approach might contribute an additional dimension to the display.

Figure 5 Left: Hans Haacke's *Condensation Cube*; Right: Parkes / Offenhuber - *Dewy*

E. Designing with Physical Wear

Physical wear is usually considered a mechanical problem that has to be minimized. Despite this prevailing negative connotation, physical wear offers a lot of interesting features as well, since it is a reliable record of an object's interaction history. The location of ditches in old marble staircase tells us about how people have stepped on it, the shiny parts on the patinated surface of a copper door-handle reveals how people prefer to operate it. In that sense, physical wear is an ambient information display – we include it into our perception of the value and age of an object. Wear and patina are major elements of what Walther Benjamin called the "aura" of an object [21], the totality of an objects subtle features that can never be completely described.

The emulated form of physical wear, *computational wear* as a metaphor for a documents interaction history was introduced back in 1992 in the "edit wear / read wear" paper [22]. It presents a text processor, displaying graphical wear patterns that indicate the amount of previous reading / editing of different parts of a document. The authors differentiate between active and passive wear. The latter is resulting from passive consumption or aging, while the former is a consequence of active editing or commenting. In a similar way, the *history tablecloth* [23] incorporates this concept of computational wear by recording the placement of objects on its surface.

Beyond the metaphorical treatment, there are also examples that treat wear in the literal, physical way. In one of our own projects[1], dust is used as a medium for recording interaction history. The project is a sound installation for a room with dusty floor, on which a number of phonographs are placed, playing back silent vinyl records. The visitors' movements stir up the dust, which subsequently accumulates on the records and generates a soundscape of noise. In the some examples the interaction irreversibly consumes the display or the interface, for example in the "email erosion" project [24].

Figure 6 physical and computational wear (right: Gaver, history tablecloth)

Comparing the metaphorical versus the physical treatment of the concept, the latter seems to be especially interesting for urban interfaces. In the unprotected outdoor environment, physical wear is a permanent issue and maintenance is a necessity. Incorporating physical wear into the design by carefully choosing materials instead of emulating it computationally could be a way to provide a subtle hints about an objects history. By taking advantage of the viewer's ability to assess material qualities, it offers additional cues about extent and age of previous interactions.

F. Deliberate Exclusion of the User

In this case, invisibility is understood in the sense of opacity, by making it deliberately hard to understand what is presented. This seems at first paradox and nonsensical,

[1] "From Dust till Dawn" presented at ars electronica 2006

and in fact few examples of public interfaces come to mind. However, curiosity is a powerful motor, and with the right cues, this strategy can be a way to encourage the user to learn the conventions of an interface.

Observing the modes of visual communication in public space, the play between inclusion and exclusion of users is quite common. Fashion signals work on many levels – a part is universally understood, other parts of their meaning only by members of a certain group. Street art and graffiti are another example, where new codes are invented continuously as part of a somewhat exclusive, self-referential system. The spatial paintings of Felice Varini illustrate how public space can be engaged through a codified visual language that might not be immediately understood. Built upon the renaissance technique of anamorphosis, the visual elements of his spatial paintings are distributed in space according to projective geometry. From one single viewpoint, they form a coherent picture.

The strategy to obfuscate information is found also in real-world interfaces of alternate reality games. Invisibility plays a central role in the applied *this is not a game* aesthetic, mainly achieved through deep integration of game elements and puzzles into the urban context. Again, the goal is to awaken the curiosity of participants by withholding information.

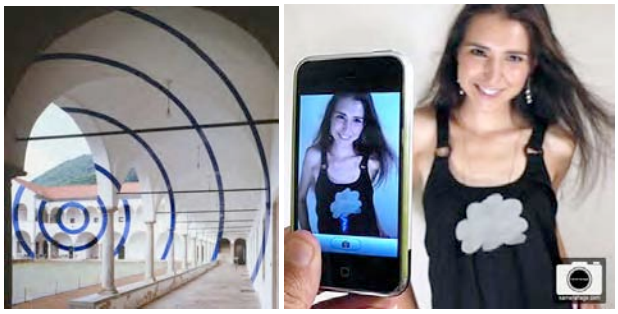

Figure 7 left: F. Varini, *archi e corone*, 2004; right: Connor Dickie, *Kameraflage*, 2007

Two examples for this strategy take invisibility in the very literal sense. *Kameraflage* employs near-infrared display elements that are not visible to the eye, but to digital camera devices. Similar and perhaps even more puzzling for the unsuspecting viewer is the *Image Fulgurator* - a device for injecting hidden content into other people's photographs in the moment when they are taken. The flash from a nearby camera activates the device, which then projects arbitrary content into the scene, just long enough to show up in the picture but go unnoticed by the photographer.

How should this strategy be used beyond the artistic application, given the introductory critique of arbitrary data mappings? The first challenge is to make the viewer recognize that some information is displayed at all [25], therefore the presence of encoded information has to be clearly communicated. In many cases, this might be more feasible compared to the heroic task of finding a mode of expression that is universally understood. Finally, without the burden of general accessibility, this approach might offer more value for the knowing user.

Discussion

The strategies described in the six sections above illustrate ways for blending an interface into the ambience by establishing a relationship with the context of the interface. The presented principles focus especially on the transition process between background and foreground of attention. Depending on the direction of this transition, the described approaches fall into two groups:

The first group covers the transition into the background: it includes mimicry, embracing unstable display media and incorporating physical wear. They help to tighten the coupling between foreground and background. Mimicry accomplishes this by playing on tendency to blend out familiar elements, both unstable media and physical wear by increasing the influence of environment and users on the interface. The other group focuses on the opposite direction, the emergence from the background. It includes animism, ambiguity of object and representation and, to some extent, the deliberate exclusion of the user. These strategies increase awareness within a specific context. Animism helps by bringing supposedly static objects to life, ambiguity by putting emphasis on to an existing phenomenon that might be overlooked, and exclusion by creating a moment of irritation. This categorization shows general tendencies, however, many principles work in both directions, for example the strategy of exclusion.

Conclusion

The presented strategies emphasize the importance of situation. They are an invitation to designers of ambient interfaces to reach beyond the current best practices of interface design and usability engineering and explore strategies that seem counterintuitive, and draw inspiration from art and architectural practice. They add a subversive, irritating aspect that might help us to see our environment with different eyes.

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