distributed displays, infrastructure, and empowerment

Amanda Williams and Johanna Brewer
Donald Bren School of Information and Computer Sciences, UC Irvine
{ amandamw | johannab } @ics.uci.edu
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1. introduction: situated and distributed displays

In our current research creating tangible ambient displays of office activity, we have focused on the importance of site-specific displays. [1]. If we consider naturally occurring sources of ambient information, we see that they are in a sense ideally suited for their situations. Both the sound of rain and shadows from the sun are inherently wed to their location; hearing rainfall means that it is raining *right here*. Additionally, these displays are integrated into their surroundings, or rather, they constitute the surroundings.

In the course of designing our system, we have noticed a corollary to situated displays. In many environments – the office being one, the city being another – "situations" may tend to repeat themselves. Thus we see many offices in an office building, each with similar layouts and serving similar purposes. And similarly, in a city we will find many coffee shops, many intersections, many parking garages, bus stops, highway on-ramps, trash bins, drains and manholes. In such environments, situated displays may also become distributed displays.

Our system, Nimio, was designed to support a group of ten administrators at a technology institute. During our site study, interviewees made a point of telling us how closely they worked together, and it is notable that they like to present themselves as a close-knit group. At our first visit on site, most group members had jasmine blossoms in their offices. We were told later that they were all from the same bush.

Figure 1: a distributed display in the office

While one of these jasmine branches may constitute a mere pretty office decoration, the set of them, distributed throughout many coworkers' offices, conveys information about the working relationships of this group.

Based on the practices of the work group we are collaborating with, our design is itself a distributed display. Nimio takes the form of desktop toys in four shapes and three colors. These two properties create two "family groups," a shape group and a color group. Using embedded microphones and accelerometers as input and LEDs as output, they reflect activity level around the other Nimios. Objects of the same shape resonate with each other, as do objects of the same color. Each Nimio is uniquely identifiable by shape and color. If, for example, the green cube is shaken, the owners of other cubes will be able to identify the shaker while the owners of other green shapes will have a more nebulous awareness of the action. While each toy may allow awareness of the presence of several coworkers, the system as a whole conveys on one level who is active, and on another level, who is aware of whom.

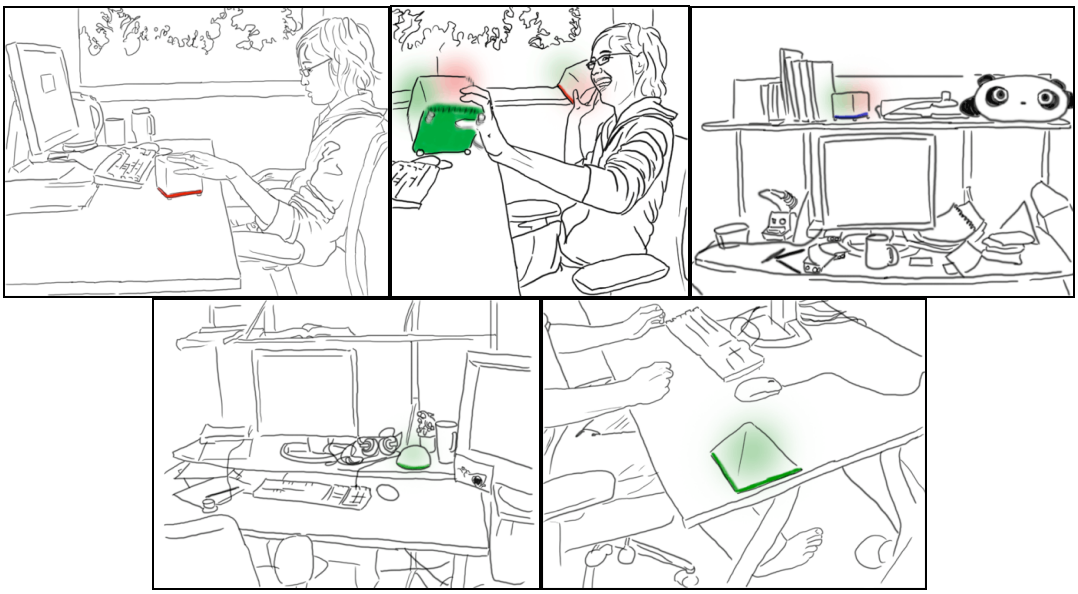


Figure 2: ambient awareness + distributed display

We first became attuned to distributed display in an office suite. However, we feel that cities – with their density of infrastructure, population, technology and built structures – are particularly rich sites for study of distributed display, and that being aware of distributed displays can be a powerful way to read a city and empower its inhabitants.

2. existing urban distributed displays

When studying distributed displays "in the wild", we should consider that much of their value as informative objects is imparted by those who read them as such. Some questions: What is the intent behind the object? Behind the set of objects? How do inhabitants render these objects legible? How do inhabitants' readings confirm or confound the intent behind these signs?

One common, indeed nearly inescapable[1] distributed display in our everyday lives is the repetition of brand logos. Brand logos serve as a marker of corporate identity, assuring potential customers of a certain quality of product and increasingly connoting image and lifestyle and personal identity [2]. Effective brands must be widely visible and readily recognizable, a sort of pervasive, repetitive distributed display.

Brand logos, however, do not exist in a vacuum. Situated in time, in locations, in complex and dynamic environments, what might we read into them that the manufacturers never intended? A favorite example is Popeye's Famous Fried Chicken & Biscuits, a fast food chain which – at least in California – seems to exist almost exclusively in dodgy neighborhoods. (In San Francisco they are located in the Mission and the Lower Haight.) An isolated Popeye's logo may indicate delicious fried chicken, but based on our experiences of situated Popeye's logos over many places and many instances, we may also take it as a sign that we

[1] The rightmost photograph of Starbucks was taken inside the Forbidden City.

shouldn't stick around alone after dark, a reading that surely could not have been intended by Popeye's marketing department.

An accessible sort of personal branding, graffiti tags are ubiquitous in many urban areas. (Note the octopus stickers on the signs in each of the above photos.) While each individual sticker conveys personal identity, their distribution may mark off territory – indeed, this is the supposed purpose of gang-related graffiti. In the case of sticker graffiti in the Capitol Hill area of Seattle, taggers do not seem exclusively possessive of territory; often several stickers and marker-drawn tags shared space on a single sign without encroaching on each other. A walk through the neighborhood and an attentive eye reveal not just the territorial claims of a single octopus artist, but an overlapping network of turfs claimed by several local sticker-artists.

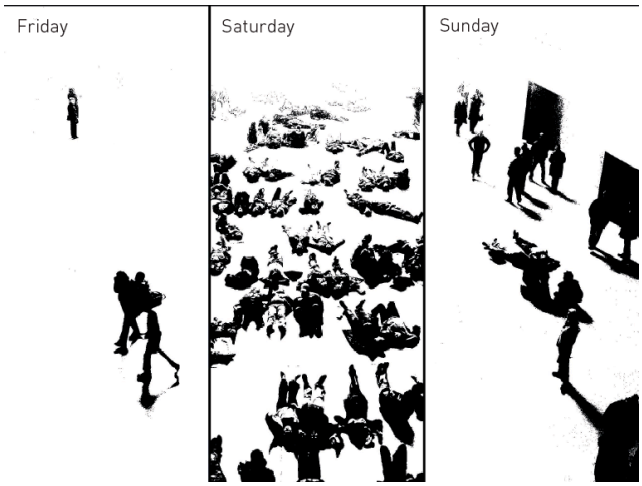
We find that infrastructural access points can easily be read as distributed displays, a trait hinted at by the fact that Capitol Hill taggers chose to tag parking signs, access points to a legal infrastructure regulating parking in the city. Manhole covers typically fade into the background, a generally unnoticeable part of the urban landscape (unless the covers are removed and the hole revealed). However, a closer look reveals care in labeling: covers providing access to the water system are distinguishable from those leading to drainage, which are different from those leading to electric. Still others are mysterious. The distribution of manhole covers can be used to discern the routing of these infrastructures, an activity occasionally undertaken by students motivated to explore the "steam tunnels" beneath Stanford University.

3. three proposed urban distributed displays

a. distributed shift

During the CHI 2005 Engaging the City Workshop, a number of participants proposed an installation, *Shift*, designed to "invite authorship, performance and interaction amongst inhabitants of a public space across

time in order to sensitize us to natural rhythms in urban space."[2] Though potentially an informative (and fun) single interactive display, *Shift*, with some alterations, could prove to be an engaging distributed display as well. In its original form, images of a certain place would be continuously captured, while display of those images in the same public space would be time-shifted. Cameras and displays, rather than being hidden, would be obvious enough to invite interaction. The ebb and flow of activity within the space is thus highlighted, though perhaps also mitigated by the presence of a population remote in time but not place.



Shift could be turned into a distributed display simply by being installed in many different sites in a city, sensitizing residents to the ebb and flow of activities in different areas, perhaps allowing them to gain a sense of how activities in different parts of the city might influence each other. Another distributed version of *Shift* might instead serve as portholes from one site to another, revealing the quiet of a residential neighborhood to revelers on a street full of bars and clubs, or showing a bustling shopping district to a nearly deserted university campus.

b. distributed display of demographic data

The Dorchester and Roxbury neighborhoods in Boston suffer asthma rates that are 178% higher than the state average [3], a trend that is often blamed upon the diesel buses that frequently run through those areas. Income in those neighborhoods also tends to be lower than the citywide median income [4]. Fairfax County's median income is almost double that of the United States as a whole [5] and its SAT scores are 79 points above the national average of 1026 [6]. Malcom McCollough writes in *Digital Ground*, "More than any other single indicator, ZIP correlates with how you vote, what kind of money you earn, which kinds of actors you prefer to see in television commercials, and what kinds of places you frequent. [7]" Maps displaying statistics such as income, disease rates, high school graduation rates, or crime rates can be extremely enlightening, but such information must be sought (and hence is easy to avoid, or never encounter). What if such information were to be made visible, in situ, something to be encountered in everyday life?

Situated displays of pollution can be potent and empowering tools for activism, as demonstrated by Natalie Jeremijenko's "feral aibos" project, in which a pack of aibos are modified and equipped with toxic gas sensors and set loose at a Southern California middle school (formerly a Superfund site). Such a demonstration, however, is a one-time thing, not a constant reminder. A situated pollution display that would stay in place might employ wireless sensor networks and some inexpensive form of display, such as colored LEDs reflecting localized pollution levels. There is no reason to limit display to pollution; demographic data is readily available and can be tied to location.

Distributed displays of demographic data would not only be pervasive situated displays, but also, by highlighting local *differences* in things like asthma rates and SAT scores, could help quantify disparities within a metropolis in an everyday, situated way.

c. distributed display of wireless infrastructure

One infrastructure we, especially those of us reading this paper, have come to rely on is, of course, wireless internet access. Many of us have become so concerned with access that we map out our daily routines based on WiFi hotspots. Services like JiWire boast a database listing of 67,432 WiFi hotspot locations in 101 countries [8]. Like many modern infrastructures, you cannot see, hear, or smell WiFi. However, we all manage to find it somehow; the easiest way is to scope out a coffeeshop and see if anyone has their laptop open. If someone does, chances are there is WiFi access, and so you open up your laptop too.

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[2] From the workshop poster.

This behaviour creates a distributed display of sorts, but it is, unfortunately, pretty limited. It only allows you to spot a potential access point once you've actually taken the time to enter it. Furthermore, seeing people with open laptops does not guarantee there is access, and more importantly, it does not say anything about the nature of that access. How many times have you opened your laptop only to realize that the WiFi is restricted either by requiring money or a by means of a WEP key. Frustrated by a lack of access, pressed for time, or too tired to walk to the next potential access point many people will give in and pay a one time fee.

Currently, Hotspot Bloom displays the existence of coverage as an illuminated flower [9], and the Digital Hotspotter, which is a personal handheld device with an LCD display, provides more information about coverage such as SSID, encryption and channel data [10]. Wifisense, a handbag with an array of embedded LEDs, provides both coverage strength and in some cases the existence of WEP encryption [11]. We propose a device that provides an outward display of both the positive and negative aspects of WiFi coverage, specifically is the access open or restricted (to those willing to pay or having a password). The device would be a small display easily attachable, for instance, to laptop bag. This device would consist of a small microcontroller and corresponding display, either LEDs or a small patch of augmented fabric. It would resemble a small bar with two circles on either end (like a double ended thermometer, or the two "i"s in WiFi). One circle would be always red, and the other always green. In the absence of any coverage the bar would remain black. When coverage is present the color on the bar would be a mixture of red and green, the ratio of color indicating the ratio of open to restricted (either requiring payment or a key) access. Furthermore, one could imagine these devices having an additional display component that receives information about WiFi coverage in more distant places. As I move through the city my device can transfer information about wireless coverage from one location to another, adding a "getting warmer" component to the displays. The key idea behind this proposal is the fact that it is distributed display whose small form facilitates widespread adoption. This simple device, if adopted by enough people would provide an indicator of what kind of coverage is available, and hopefully, would cause people to change their patterns of WiFi usage. People would gravitate toward areas with more "green" coverage, and thus establishments which supported restricted infrastructures would suffer and lose business. A small technology like this, with enough dissemination, can then act as an impetus for broader social change.

4. conclusions and further questions

Often we (okay at least the authors) can be heard to gripe about how the true natures of many infrastructures are hidden. Plenty of them lie in the hands of government organizations or massive corporations, so what can we really do to change things? Much of our research relies on these infrastructures (e.g., the internet, urban landscapes), and so we get caught in a kind of Catch-22: fight for technological freedoms or continue with our work? We think that it might be worthwhile to try to do both. What if we design technologies to expose these infrastructures for what they are and try to create pushpoints which allow the end users to promote change? Clearly we cannot expect that those who control the infrastructures to help us in this task, and so distributed displays become an attractive option. If enough people are willing to participate, if enough people care about the state of an infrastructure, then a critical mass can be achieved for the proliferation of a distributed display. Our task is then to see what about an infrastructure we would like to expose, and how we could actually go about doing that without the support of the organization whose curtain we would like to pull aside.

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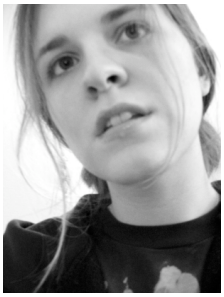
author bios

Amanda Williams is a PhD student in the Donald Bren School of Information and Computer Sciences at UC Irvine. Her research interests are generally in the realm of Human-Computer Interaction, including but not limited to ubiquitous computing in urban environments, tangible user interfaces, computer mediated communication, teledildonics, and how Irvine got to be such a bizarre planned community. Her latest celebrity crush is Benjamin Franklin, though for quite a while it was Miss Piggy.



Johanna Brewer is a Ph.D. student in the Donald Bren School of Information and Computer Sciences at UC Irvine who also holds an M.A. from Boston University. Her research focuses on the ways in which information functions in society, particularly in urban and public settings. She is interested in how technology can forge new types of connections between people and how it can transform or reinforce old ones. These studies motivate her designs of ambient displays and tangible interfaces. She is also a robot.