Urban Score: Measuring Your Relationship with the City

Eric Paulos* **Ian Smith**** **Ben Hooker***
Intel Research
*2150 Shattuck Ave #1300, Berkeley, CA 94704 USA
**1100 NE 45th St, Suite 600, Seattle, WA, 98105, USA

Introduction

In this paper, we introduce a new ambient display, *personal steganography,* and the concept of the *urban score.* Strictly speaking, the ambient display itself is a particular rendering of a value of the same name. As we will explain, the two are intricately linked. This ambient display does not convey stock prices, bus schedules, remind you to buy milk, or any other such useful bits; it gives the user a feeling--perhaps even just a hint--about their connection to the city they are walking in and its other inhabitants.

We argue that the display shown in Figure 1 is both an efficient display of a great deal of information and is well designed for its ambient task. Its task is to convey, likely helpful information to the user in a way that is both unobtrusive and always present. What cannot be depicted in Figure 1 is that this display is not typically shown at full brightness and it is always at the lowest level of the window stack or "in the background" on your PC. It is a resource that the user can draw on when they "aren't doing something else" or when they are between other actions. We in no way mean to criticize the display, its many brethren, or its authors.

Rather, we want to argue that there is another task of interest that, while it shares some constraints with Google's widgets in Figure 1, opens up a different and important design territory. This task is more closely related to exploring a new city or "neighborhood, walking into a restaurant or bar to "see what it's like", or chatting with a friend about local political events. The task is feeling the pulse of a city. The idea of the urban score is that somehow measures and conveys that pulse.

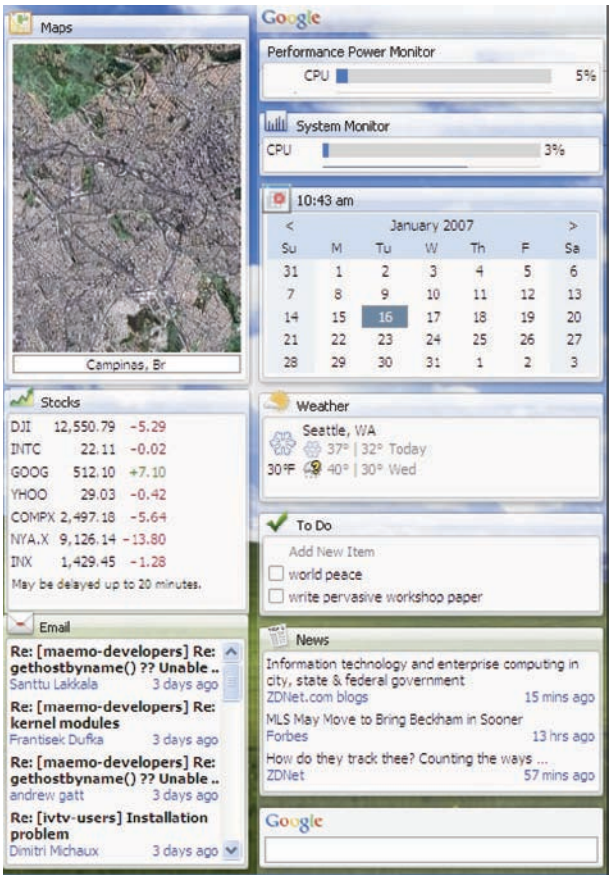

Figure 1: Typical set of Google widgets

Computing Your Urban Score

Any mention of an urban "score" quickly leads to a discussion of the rulesets used to calculate such a number (or set of values) and this discus-

sion often is followed by more vehement arguments about which set of inputs or outputs more validly describes one person's urbanity versus another. We encourage this argument and seek to foment it. We would like to see many designers come up with their own metrics of urbanity and have users compare, use, and find those metrics that suit their tastes; we want to encourage people explore what it means to be urban through these low-intensity displays. In the next two section we will discuss two categories of designs that we are proposing for an urban score.

It seems clear from recent work in industry and academia [1-5] that some type of sensing will be available on almost everyone's mobile device in the foreseeable future. Thus, our designs assume that many different sensors will be available for applications to use.

The Dosimeter

One urban score design avenue that we have been considering is taken from the world of nuclear engineering and radiology, the dosimeter. The idea is to make an ambient display for a mobile device such a phone or Ultra-Mobile-PC (UMPC) that measures your "dose" of the city. This display could be a background or a screen saver in the simplest case. In any case it should be unobtrusive and require little, if any, of the user's active attention or input.

Figure 2: Classical worn dosimeter. The badge changes color based on amount of exposure to radiation

In our first variant of the dosimeter, we measure airborne pollution that the user is exposed to. Many pollutants, such as carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, and fine particulate matter can now be measured with cheap, handheld instruments [6-7] and we expect that these sensors will be easily integrated either into a mobile device's packaging or into small attachments.

This simple urban score is a display that shows the total and highest amounts of pollutants a user is exposed to over the course of the day. This could be displayed as simply a mixture of background colors, with no text at all, making it very low-demand in attention terms. Although there are certainly communities who would find this type of ambient information both useful and important, it fails, in our view, to spark a debate about how one is experiencing the city. This type of design might even be better as a more direct, non-ambient, display by compiling information from many users into standard maps showing the geographic relationship to exposure levels.

A second design that is superior in our view, is the dosimeter that measures the amount of a city's "vibe" as your urban score and then gives a more ambiguous ambient display we called a *personal steganographic* ambient display. The name comes from steganography which is the art and science of writing hidden messages in such a way that no one apart from the intended recipient knows of the existence of the message; this is in contrast to cryptography, where the existence of the message itself is not disguised, but the content is obscured. A typical steganographic application is to high messages within images via alter low order bits of pixels, etc. In our approach we alter small portions of what appears to be a regular image. The alterations are subtle and occur over long periods of time making them hardly perceptible to the casual untrained glancer. However, to the person who knows how to read the display, a wealth of information is stored within it.

The image shown in figure 3 is one example of a personal steganographic display. It shows a view of the skyline of Shanghai, PRC and has many easy to manipulate dimensions. For this example, the figure shows only two of the possible ways to modulate this display, the height of the tower at the left and the number of smaller build-

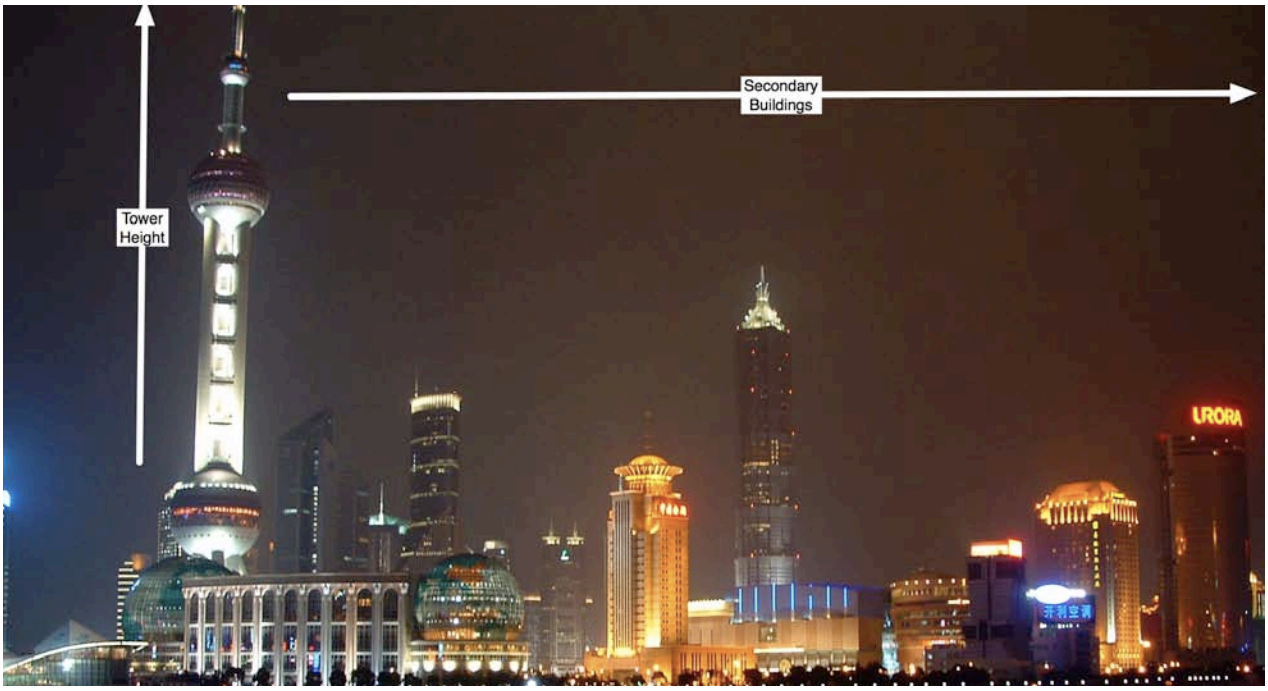

Figure 3: Example of a Personal Steganographic display of an Urban Score measuring the city "vibe" of Shanghai, PRC.

ings shown. These and many other properties could be easily layered within the image.

In our effort to promote conversations, even arguments, about life in the city, we claim that it is better to entangle the notions of the display, the measurements taken, and the mapping between them. This encourages exploration and opens up new avenues of dialogue. We claim that there are any number of metrics that one could measure about the city, the user, or other people that could be used as fodder by designers. We will demonstrate here a simple, two-dimensional, easy-to-implement display that could be generated in real time on a mobile device at any time.

For this urban score, we map the height of the tower to the number of other people that you have encountered over some interval. Are you "out on the town" or "stuck at home?" This can be measured easily with bluetooth scanning. Even though only a small fraction of people turn on their bluetooth radio and make it visible for scanning, we can safely assume that this proportion is roughly constant so that seeing twice as many bluetooth phones indicates roughly the twice the number of people. Naturally, this part of the urban score can be manipulated to include well-known persons, be they friends [8] or strangers [9].

The second dimension, shown as number of secondary buildings in Figure 3, a running average of your proximity to the city's "center" for some spatial definition. The latitude and longitude could be easily measured by GPS, now common on mobile devices, or by some approximation based on visible beacons [10] which has the advantage of working indoors. We also would include in this measurement altitude, as this is often connected with city center locations such as San Franciso's Starlight Room, Tokyo's Roppongi Center, and Paris' Jules Verne Restaurant on the Eiffel Tower. Given some average over a 24 hour period of proximity to the city center, differing amounts of the secondary buildings in Figure 3 would be exposed, perhaps with the most buildings being exposed when one is distant from the city center and fewest when one is "in the center" or vice versa.

An effect of this display is that commuters who live out of town would see the city unfurl or disappear as they went through their day. The skyline would remain "distant" on the weekends if they do not venture into the city for non-work activities. A

slight variant of the measurement computed here would be to take the geographic centroid of a set of friends' movements and measure from this point. If there is a "standard hangout" for the gang, it would become the center of the city for that group of people and the display would change accordingly.

Personal Stegonographic Designs

In Figure 4 we demonstrate two envisioned personal steganographic view of an urban score for San Francisco, USA. The views exaggerate a wide range of changes. In reality, a very small handful of changes would be subtly occurring at any given time. For example, the sky color change could indicate air quality with the smoke from building representing sulfur dioxide (SO_2) specifically. The crane could indicate the arrival of new buildings as you approach your “center” of the city. Strangers and familiar strangers are captured by the birds - both flocking and perched. There are also balloons, airplanes, boats, flowers, and tents whose number and appearance can map to specific elements of an urban score. Similarly with animals (grazing) and people (walking, picnicking, and sunbathing.

Figure 4: Example of a Personal Steganographic display of an Urban Score for San Francisco, USA.

Iconic Designs

An alternate approach is shown in Figure 5 using a more iconic representation of various elements to “render” an urban score. In this example as you move from suburb to city the screen “slides” to reveal the urban image (top). The sky color shows air quality comparing air quality where you are now with sensors in the city. Familiar strangers are represented by people and unfamiliar strangers by birds.

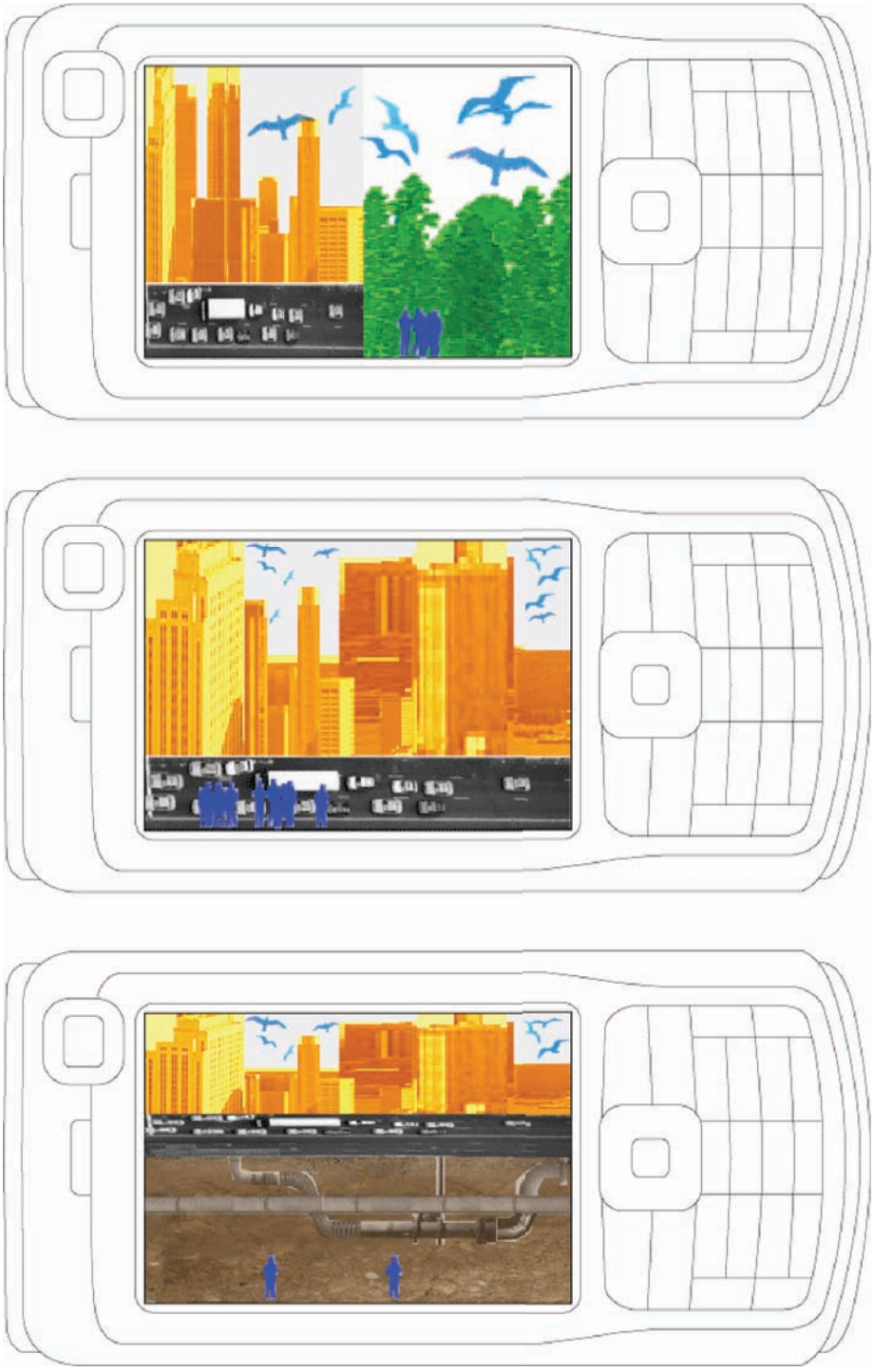

Figure 5: Example of an icon display of an Urban Score

Clouds

We would argue that a key factor that differentiates cities, especially major ones, from towns or the rural environment is leadership, "being ahead of the curve." It is hard to imagine fashion trends coming "to" New York, London, Los Angeles, Paris, or Milan. Similarly, musical trends often coalesce around cities' both large densities of musicians and people eager for new experiences: Hip-hop in New York city, R&B and soul in Detroit, downtempo in London and Manchester, and hair-metal on Los Angeles' Sunset Strip. Films are routinely shown only or make their debuts in major cities, to say nothing of the film festivals. Part of living in a city is the stimulation, even excitement, brought by new things happening in front of your eyes.

For the Cloud type of visualization, again we seek to score what is latent in the experience of a city. A naive Cloud visualization, such as the one shown in Figure 6, would be to take the tags of the songs that people near you are listening to on their mobile devices and form a tag cloud. These tags are usually categories or the names of artists, but experience with last.fm (music) and flickr.com (images) shows that users will tag in useful and unexpected ways. User contribution also implies wrong or distasteful contributed tags; note the misspelled tag in Figure 6 "electroic" is more popular than say "chill." Also the tag "czilaut kompletny" (really "chillout completely") is a joke on (easing of? mistranslation of?) slavic or eastern european languages that represent a significant fraction of the listeners to this type of music.

The relative size in Figure 6 indicates the number of times one of the authors listened to songs with that tag, however in an urban score it would be more interesting to map size to the preferences or current selections of those people nearby. This could be easily sensed among people with Apple iPhones, Microsoft Zunes, or bluetooth enabled devices that share music information. In Figure 4, the position of words is not a controlled dimension, it is alphabetical. Of course this dimension could be easily controlled as well, in the simplest case putting words radially closer to the center if that tag was sensed "recently." With this measurement and visualization, a user walking down 5th Avenue could get a sense of what the world is listening to and why they live "in the city."

A More Aggressive Cloud

We dubbed the visualization shown in Figure 6 naive because it can really show very few of the properties that make cities trendsetting. It is, or soon will be, possible to do this for music, as

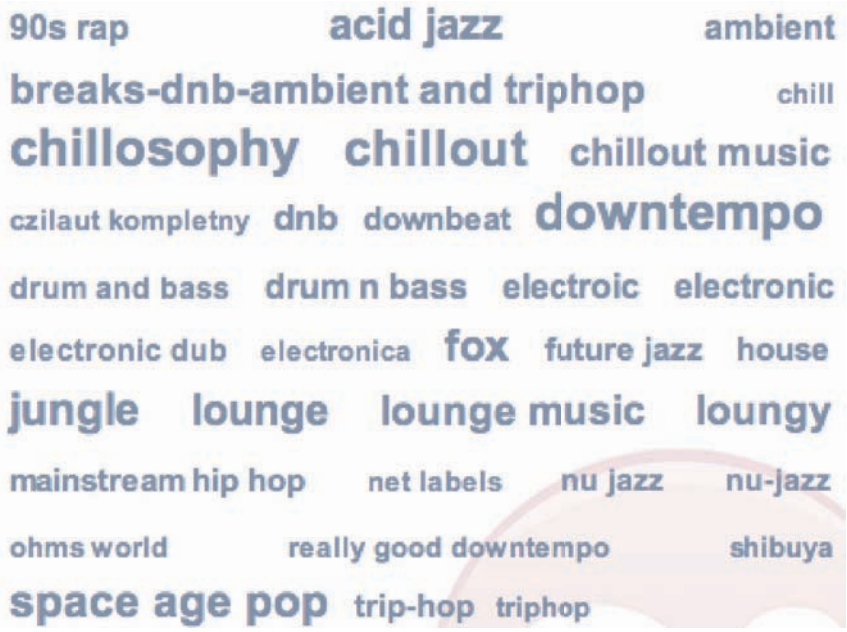

Figure 6: Simple cloud tag visualization. Words shown are tags of music listened to by one of the authors over a two month period. Tags were entered by many users. **Image by http://last.fm**.

shown, and perhaps photography as cameras emerge with networking capabilities. This is insufficient in our view to get a view of the complexities of the trends in the world's cities.

We propose a new scheme based on credit card sales transactions. In its simplest form, the music tags in the figure would be exchanged for goods/services recently purchased by those nearby or perhaps the names of stores they patronized. This would present a much more accurate portrait of activities in the city and all the data is collected already (by credit card companies) and is already available to most users on the internet. Almost needless to say, though, this presents a privacy problem of the highest order. If this were actually the desired design it is likely that a technical scheme could be devised to "hide" a single user's data amongst the great multitude, ala mix routers [11]. This would allow meaningful clouds to be generated without exposing an individual's behavior. Even still, it seems unlikely to gain wide acceptance due to the perceived privacy invasion

Evaluation Opportunities

In this section we will give a brief overview of some of the evaluations of an urban score that we think might be interesting research contributions to the community.

- Measuring the different "uses" that a mobile device takes on. This evaluation would compare a personal steganographic urban score visualization with a more functional one, such as in Figure 1. Within a subject, it seems clear that news and weather have value, but how does that value (both by usage and perception) differ from the value of the urban score? When? How does this tie in with the idea of promoting “wonderment” in cities [12]
- Measuring the different properties of the urban score that create the highest interest or usage level. This could be done easily by measuring perceived satisfaction and usage and varying the properties sensed without changing the display or vice versa.
- Measuring the degree to which an urban score influences action, especially in contrast with traditional advertising. Assuming one could do location based advertising, for example, is that more effective at causing people try to a new restaurant versus an urban score that "suggests" that people in some area have some unusual or unexpected property?
- Measuring the degree to which people want to view their own urban score and compare it to others. Is it possible that there could be agreements on rules such that one could have a "most urban person in Rome" contest?
- Measuring the front-stage vs. back-stage [13] behavior with data that is being publicized about a user. Do users try to manipulate the system in some way (say by *not* playing Vanilla Ice on their iTunes so it will not appear in the "recently played" list) so as to present a particular *face* to others that see their data? Even in aggregate data? Do people use urban scores as a way publicize their interests in a particular band, restaurant, or way of life?
- If the urban score is a complex amalgam of many sensed features, it might be interesting to have users use the system for a while and see what mental model they build up about the system and how they feel when the system's true working is revealed. Their mental images of how such a system works is likely to yield insights into what an urban score system *should* do.

Conclusion

In this paper we have introduced the notion of an urban score, partly a low-attention display and partly the basis on which that display rests. This "score" allows users to put their finger on the pulse of a city, to get a feeling of those around them, and question assumptions about their urban life. We have introduced the idea of a personal stegonographic ambient display. We have suggested a variety of mostly personal stegonographic visualizations of the urban score to kick-off the debate about what an urban score should measure and how it should be visualized. Two of these displays, the dosimeter category, attempt to show you how much of the city you have consumed, via inhalation or inebriation. The last two focus on understanding those that are near you - a common situation in densely populated areas. These two cloud visualizations could be generated from easy to sense values and provide insights into a community. With these designs have try to highlight our significant concern for designing usable, thought-provoking systems that protect the users privacy.

We hope that these thoughts can be a springboard to others.

Research Question For The Workshop

What's your urban score?
What would you like it be?

References

1. Apple iPhone, http://www.apple.com/iphone/, 2007

2. Nokia 5500, http://europe.nokia.com/A4160003, 2006

3. S. Consolvo, K. Everitt, I. Smith, J.A. Landay, “Design Requirements for Technologies that Encourage Physical Activity,” Proceedings of the Conference on Human Factors and Computing Systems: CHI ’06, Montreal, Canada, 2006.

4. SensorPlanet, Nokia Research, http://www.sensorplanet.org/, 2006.

5. Participatory Sensing, J. Burke, D. Estrin, M. Hansen, A. Parker, N. Ramanathan, S. Reddy, M. B. Srivastava, Workshop on World Sensor Web, 2006.

6. Lascar Electronics, Carbon Monoxide (CO) Data Logger with USB Interface, EL-USB-CO, 2007.

7. MicroChemical Systems, CO and NOx dual sensors, 2007.

8. Persson, P. and Jung, Y. 2005. Nokia sensor: from research to product. In Proceedings of the 2005 Conference on Designing For User Experience (San Francisco, California, November 03 - 05, 2005). ACM International Conference Proceeding Series, vol. 135. AIGA: American Institute of Graphic Arts, New York, NY, 53.

9. Paulos, E. and Goodman, E. 2004. The familiar stranger: anxiety, comfort, and play in public places. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Vienna, Austria, April 24 - 29, 2004). CHI '04. ACM Press, New York, NY, 223-230.

10 Finding Yourself: Experimental location technology relies on Wi-Fi and cellphone signals instead of orbiting satellites. Anthony LaMarca, Yatin Chawathe and Ian Smith. IEEE Spectrum 2004.

11 Security without Identification: Transaction Systems to Make Big Brother Obsolete", CACM (28, 10) D Chaum - 1985 - October

12 Paulos, E. and Jenkins, T. Objects of Wonderment: Hullabaloo, Demonstration at Ubiquitous Computing Conference, September 2006

13 Goffman, Erving, The Presentation of Self in Everyday Life. New York: Doubleday, 1956.