

Situated Memory for Situated Public Displays

Ivan Elhart, Marc Langheinrich

Faculty of Informatics

University of Lugano (USI)

6904 Lugano, Switzerland

{ivan.elhart, marc.langheinrich}@usi.ch

ABSTRACT

As part of the EU-funded project “PD-Net”, we are investigating the design of a global public display network with the intent of creating an entirely novel communication medium. Globally networked public displays can provide guidance to new visitors, allow regulars to express themselves and their interests, and connect different social communities. Endowing a display network with such capabilities requires some form of digital object memory for each of the displays, allowing it to “understand” its surroundings and “get a sense” of the place it is located at. This position paper describes the opportunities and challenges of creating such a digital object memory for places, and the role of public networked displays can play in doing so.

1. INTRODUCTION

The EU-funded project “Towards Future Pervasive Display Networks (PD-Net)”, <http://pd-net.org/>, has the ambition to explore the emergence of large-scale networks of displays and associated sensors, and open them to applications and content from many sources for information access, sharing, and interaction. Ultimately, the vision is to create an entirely novel communication medium with the same potential impact on society as radio, television, and the Internet.

As part of this endeavor, the project tries to develop a common framework for situated displays that will support the categorizations of place according to interactions with an individual user or users within a social group. In this way, situated displays will become adaptive to the place they are located at and become aware of the surrounding physical and social environment – they will in effect develop some sort of *situated memory* of a space. To illustrate the vision of PD-Net, let us briefly introduce two short scenarios (taken from [5]) that make use of situated data collection to create rich and meaningful settings.

Scenario 1: *Eric is a teenager on vacation with his family. ‘How dull is that’, he thinks. He would rather be at SK8, his favorite skating park back home, hanging out with his friends and kickin’ some cool flips with “Mercedes”. “Mercedes” is the name of his skateboard and he never leaves home without it. When he exits the hotel he sees something that looks like a skate park nearby. When closer inspection shows that it is one, Eric is first thrilled, then anxious: ‘What if all the people inside are, like, amateurs?’ He is pretty good with Mercedes and he only wants to hang out with skaters that are as skilled as or even better than him. Luckily he sees that there is a public display at the park showing some of the recent tricks performed at the park. “Skull” just did an “Air walk grab” this afternoon, and “Death at the disco” is usually doing “Kickflips” around this time. Scanning the display, Eric finds a*

number of skaters in the park that do really cool tricks, and he decides to give it a try.

Scenario 2: *Visiting a new city can be hard, especially if you have only one day to explore it. Jane knows that. She has been traveling on business for more than ten years and visited literally hundreds of cities. To prevent her from burning out on the road, Jane usually tries to explore a bit of the city she is in, even if it is only for a short evening. Back in the early days, she did not like it that much: wandering the streets alone... ‘God knows what might happen’, she often thought. But today’s ubiquitous public displays usually help her “reading” a place much better than before. Many public spaces have systems that visualize the activities that happen in them over the course of the day, giving Jane a chance to quickly assess her own personal comfort levels. And if an area has a particularly interesting mix of activities, Jane usually ends up in a cute bar or restaurant, meeting interesting people during the course of an evening. As her meeting went well, Jane feels like experimenting: She notices a bar where nearby displays show that it is popular with people her daughter’s age. ‘Why not something else for a change?’ she thinks. When she enters, she is pleasantly surprised, as it is all decked out in a 60s design: ‘Wow, it seems my teenage days are finally en vogue again!’*

Albeit simple, the two scenarios illustrate how a display at a particular location can be aware of the social community in its vicinity, and how it can communicate their actions and interests to visitors and regulars alike.

2. SITUATED MEMORY

Situated memory is a memory of a place. There are numerous descriptions of a public place and what environmental and social artifacts should be considered in defining a public space [1], [4]. However, in order to support the scenarios described above, we can simplify the understanding of space and say that a space consists of individual persons, communities, and an infrastructure (hotels, restaurants, attractions, squares, public parks, playgrounds, streets, etc.). Public displays within PD-Net will be located at specified positions with intention to remain static. The display located at a place could be seen as an object that would establish connections both between people and between people and a place. Therefore, here we will discuss what could be suitable memories of a place in terms of individuals, communities, and infrastructure.

In the case of individual users, memory could consist of a simple user profile, possibly extended with the actions the user has taken at the place. In scenarios 1, e.g., the basic user profile contains information about a skater’s “tag” (name) and his or her equipment. As a skater uses the skater park, the profile is then continuously updated with information about individual tricks

performed, or with results from competitions. It is obvious that each place has different set of properties and for each place the set of attributes and possible actions would need to be separately defined. Work on place typologies can help establish some basic patterns [1]. The combination of the mutual activities of all visitors to a place can form the memory of a community (or: of several distinct communities). In scenario 2, e.g., the combined (anonymous) profiles of bar patrons form a “community fingerprint” of the place, while the (equally anonymous) activity levels of an area provide Jane with feedback on the perceived safety of a place. Note that several distinct communities can regularly be engaged in different sets of activities at a certain place. The relevant local infrastructure surrounding a place can be complex and may require the inclusion of many details. In scenario 2, e.g., a public display on a street should be aware of all hotels, restaurants, attractions, parks, etc., in nearby vicinity, in order to collaborate with close-by displays and provide more information to the users. Basic descriptions of surrounding infrastructure can potentially be acquired from existing sources, e.g., online maps, and then continuously updated with users’ feedback. The combined tracked and contributed activities of users (e.g., ratings, reviews, mood messages) can then create a narrative of a place showing the list of visitors, their activities, interests, and thoughts over the time.

To create such a memory of a place, the Public Display Network will need to collect data from a variety of sources. The data can take many different forms, but will need to be rich enough to provide meaningful information, while at the same time preserve the privacy of users.

3. DATA COLLECTION OPPORTUNITIES

Advances in digital technologies increase the ability to sense and store data. Data can be collected from numerous sensors and stored in different forms such as log files, databases, in pictures, videos, or audio files. From collected data, the memory of a place can be extracted using data-mining techniques [6].

First, the display has to be able to detect the presence of people. Video cameras could be used to provide shape-based “head counts,” while infrared cameras could count the “eyeballs” that look at a display. A less obvious observation can be performed through Bluetooth or WiFi scanning by identifying and potentially connecting to wireless personal devices (e.g., mobile phones). RFID readers could be used to detect tagged items carried by passer-by’s, e.g., RFID-enabled transport cards.

Identified users could have personal profiles stored globally within the display network, or alternatively only at the individual public displays. Mobile phones could provide alternative storage for profiles, in principle allowing for pseudonymous profiles where a display dynamically downloads the user’s profile via Bluetooth or WiFi. Fixed identifiers from a wireless address or an RFID tag can in any case be used to create a local pseudonymous profile. Online interactions in a place could be logged by individual users to their personal profile through geo-location protocols, tying an activity to a particular space (e.g., the skaters’ tricks in scenario 1). Video cameras can employ scene recognition algorithms to get a sense of the physical activity of a space.

Initial information for each display about its surrounding infrastructure could be collected through online map data such as Google Maps. Using GPS receivers, displays can be aware of their own location. Further input can come by using text analysis on,

e.g., user-contributed posting to a display, or from other location-enabled community websites. Projects like wikicity [7] could provide dynamic, real-time information about a display’s surroundings.

4. PRIVACY AND SECURITY ISSUES

Collecting data within PD-Net includes collecting information about individual users. Any possible disclosure of private information raises serious privacy concerns [2].

Even anonymously collected data can create privacy issues, e.g., an infrared camera counting “eyeballs” creates a sense of being caught on camera. Each installation will thus need to consider some of the following question: What kind of data – and how much – will need to be collected to satisfy the purpose of the collection? How much of the original data needs to be retained, and for how long? What knowledge should be legitimate to draw from it? What could be negative consequences if either the original data or some of its derivative information is disclosed? Applying privacy-preserving algorithms such as k-anonymity or l-diversity can help mask the identity of users within a group. However, based on the previous knowledge about the individuals or the group in general, it might still be possible to reveal the identity of a masked user. From a privacy perspective, it would thus be better to have localized memory at each individual display, instead of a centralized database. Distributed privacy-preserving data mining tools [3] might play an important role.

5. CONCLUDING REMARKS

Public Display Networks have the potential to significantly alter our perception and use of public space. Endowing public displays with a sense of their surroundings, both in the here and now, but also in the past, will create *situated memories* that can help establishing connections both between people and between people and a place – something that goes beyond improved advertising and situated services. Understanding the socio-technical realities of how communities work (see, e.g., “With Our Ears to The Ground” [8]) will form an important building block of this vision.

6. ACKNOWLEDGMENTS

The research was in part supported by the EU Research Framework Programme 7 via the PD-Net project (244011).

7. REFERENCES

- [1] Carr, S., Francis, M., Rivlin, L.G., and Stone, A.M. Public space. Cambridge University Press (1992).
- [2] Chary, A.C., and Philips, Y.S., Privacy-Preserving Data Mining: Models and Algorithms. Springer (2008)
- [3] Clifton et al. Tools for privacy preserving distributed data mining, ACM SIGKDD Explorations Newsletter, v.4 n.2, p.28-34, December 2002
- [4] Holland, C., Clark, A., Katz, J., and Peace, S. Social interactions in urban public places. Policy Press (2007).
- [5] Memarovic, N., and Langheinrich, M., Enhancing Community Interaction in Public Spaces Through Situated Public Displays. SISSI Workshop @ Ubicomp2010 (2010)
- [6] Witten, H.I., and Frank, E., Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann (2005).
- [7] Wikicity Project: <http://senseable.mit.edu/wikicity/>
- [8] Proboscis Homepage: <http://proboscis.org.uk/>