Pictures "In The Wild": Uncovering Privacy Concerns for Situated Snapshots

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ABSTRACT
Networked public displays offer new ways of communication between members of place-based communities. For example, they allow for taking situated snapshots, i.e., photos taken through a display-attached camera, and viewing them on a display network or (potentially) somewhere on the web. This paper discusses some of the preliminary privacy considerations arising from the use of such media: communicating where the publicly taken situated snapshots are stored, where they appear, that no surveliance is taking place, content control for situated snapshots, where (in what place) and how interactions happening on the web will appear on a display network. The paper shows privacy perception towards situated snapshots and also informs the design of similar future networked public display systems.

Author Keywords
Situated snapshots; urban screens; privacy.

ACM Classification Keywords
H.4.3 [Communications Applications]: Bulletin boards; H.5.1 [Multimedia Information Systems]; H.5.3 [Group and Organization Interfaces]

INTRODUCTION
Although there is a plethora of new communication media available, new ones are coming out every day. One of them - networked public displays - is envisioned as "the communications medium for the 21st century" 4. Due their embedded nature in public spaces, they can stimulate community interaction between members of the same or distinct communities residing within and across public spaces 10. This vision is coming to reality as public displays are "painting" the urban scenery 6 and more "live test beds" are emerging where researchers can investigate the use and effects of this medium, e.g., 3, 5, 12, and 13. One way of stimulating community interaction is through situated snapshots, i.e., pictures taken through a display-attached camera. These photos can be viewed on the local network or on the Internet. The Moment Machine 8 and Moment Machine 2.0 7 are two examples of such applications. In this position paper I briefly summarize

some of the observations regarding privacy of situated snapshots that came out of two longitudinal deployments of the two applications.

RELATED WORK
Privacy for networked public displays is an emerging topic. Previous work has shown that privacy on public displays is one of people's main concerns 1 and has described the tension between personalization and privacy for networked public displays 9. These tensions come mainly from finding appropriate ways to identify users in front of a public display and to what extent (user identification); where a user profile is located (profile location); and what information is stored in it (profile content); how noticeable content tailoring should be for a particular user (content tailoring); how to learn about users (model refinement); and creation of personalized applications for this public medium in general. The Tacita system 3 describes experimental privacy aware personalization architecture for networked public displays. In this system displays signal to potential users what applications they support. The Tacita mobile phone client detects available display applications, and based on the user's preferences decides if an application will be displayed or not. In order to preserve user's choices all communication between a user and a display is handled by an application that requires to be shown on a particular public display. Similarly, PriCal architecture supports display of a user's calendar events on public displays depending on the user's privacy preferences that are stored on his/her mobile device. Lastly, Brudy et al. 2 discuss several proxemics-based techniques for signaling shoulder surfing to public display users (i.e., flashing the display borders, showing a person's silhouette, and showing a red dot on a display that represents a person's eye gaze) and techniques for adapting the content so that the user's privacy is protected (moving the content, blacking out the content, and blurring the screen except for the part that is directly in front of a user).

PRIVACY CONSIDERATIONS FOR SITUATED SNAPSHOTS
The user interfaces for the Moment Machine and Moment Machine 2.0 are shown in Figure 1 and Figure 2 respectively. The two applications are based on a JAVA Play client server web framework. While the first version of the application allows posting photos only to a display
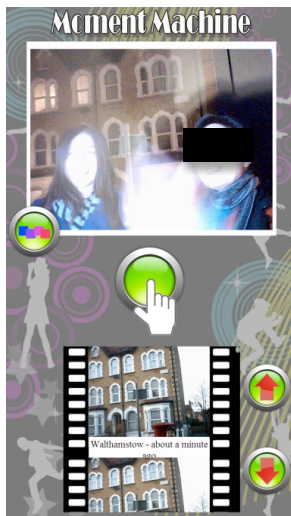
Figure 1 – The Moment Machine's user interface. The first version of the application allowed posting and viewing photos only on a public display network.
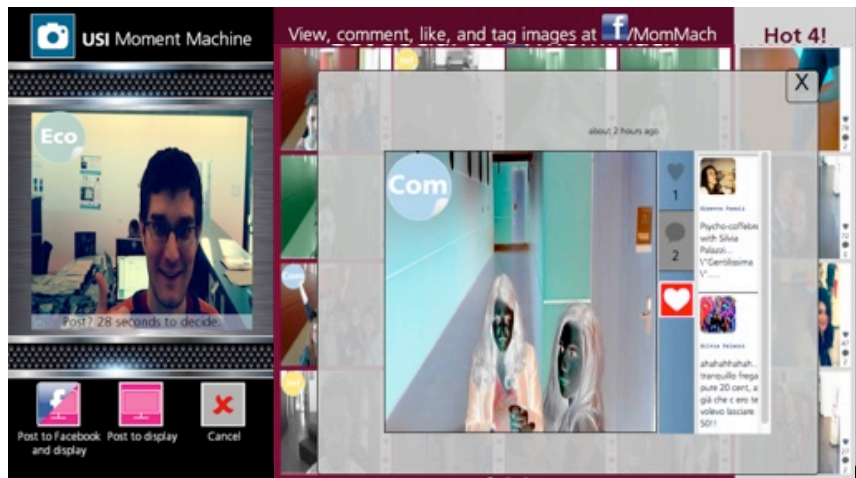
Figure 2 - The Moment Machine 2.0 user interface. The application allows posting situated snapshots through a display-attached camera to a public display network and a dedicated Facebook page. Comments and likes from Facebook are also shown on the display.

network, the second one allows for posting photos to a dedicated Facebook page. Also, the second version of the application shows interactions from the Facebook page on a display, i.e., who liked a particular photo as well as who commented and what was the comment. The two applications were deployed "in the wild" for a significant amount of time, i.e., the Moment Machine for 12 weeks 8 on the *Screens In The Wild* network[1] on two displays in London and Nottingham, and the Moment Machine 2.0 7 for 15 weeks on a display network (four displays) at the University of Lugano campus.

One of the challenges that relates to privacy is communicating *where the photos are stored*. While this was not the problem for the Moment Machine 2.0 as it allowed posting the photos to Facebook (which might have hinted to the users that photos are stored on Facebook or somewhere else), it turned out to be challenging for the first version of the application. For the Moment Machine application I conducted interviews to understand the user experience and impact of the application, and at the end of it the participant and I would browse the photos in order to find potential future participants. One participant expressed that it was really strange to see the photos on my laptop as he thought that photos were stored only on the display itself, while in fact they are stored on a secure server (far away from the display's location). This caused some unexpected privacy concerns, i.e., who can see my photos and who has access to them, as it was not clear from the application's design that photos are not stored "there" on a display.

[1] http://screensinthewild.org/

This can be further connected to the challenges of *communicating where the photos will appear*. Although this was not explicitly mentioned, some of the participants did not realize that their photos did not only appear on the display where the photo was taken, but also on other displays in the network. While this might be a benign problem at the moment, as there are not that many physical places where the photos appear, it might be a challenge for the future where there are potentially hundreds of thousand (or even millions!) of displays: your photo could end up in an undesired location. Connected to this challenge is supporting *on-display content control for situated snapshots*. This relates not only to deciding where to store the photos (as potentially they could be stored on a user desired location), where to post the photos (on what displays and places on the web), but also *how to support controls that allow deletion of photos*. In one particular case a person complained that she could not delete a photo that she was in. She appeared in the photo by accident, i.e., someone else took the photo while she was passing by a display. The participant commented that she's a "perfectionist" and that she does not want to have photos of her where she is not looking good, especially not in a place that she attends/passes-by on a regular basis.

For both applications another privacy related challenge was *how to communicate that no monitoring is taking place*. In order to communicate to the passers-by that a display is interactive we showed a live video feed, as suggested by prior research 11. However, for both applications this raised some concerns that the live video feed is being recorded. While most of the aforementioned problems relate to situated interactions with a display, there were also concerns coming form interactions on the web. For the Moment Machine 2.0 application an open challenge

remains in what way to indicate to the online users *where and how interactions happening on the web appear on a display network*. While liking and commenting on Facebook (and elsewhere on the web) has to be discovered and is potentially seen by a known (and potentially limited) audience known to the user, comments and likes on a public display might be seen by anyone who passes by a display.

CONCLUSION

Networked public displays are a novel communication medium. As such it offers novel ways of interactions within and across public spaces, e.g., through situated snapshots taken through a display-attached camera. This paper summarizes some of the early privacy concerns that are associated with them. Future research can build on the insights and provide solutions for the presented challenges.

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