“Privacy-Shake”, a Haptic Interface for Managing Privacy Settings in Mobile Location Sharing Applications.

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ABSTRACT
We describe the “Privacy-Shake”, a novel interface for managing coarse grained privacy settings. We built a prototype that enables users of Buddy Tracker, an example location sharing application, to change their privacy preferences by shaking their phone. Users can enable or disable location sharing and change the level of granularity of disclosed location by shaking and sweeping their phone. In this poster we present and motivate our work on Privacy-Shake and report on a lab-based evaluation of the interface with 16 participants.

Categories and Subject Descriptors
H.5.2 [User Interfaces]: Haptic I/O, Interaction Styles.

General Terms
Design, Experimentation, Security, Human Factors.

Keywords
Haptics, privacy management, location sharing, mobile computing

1. INTRODUCTION
The proliferation of location sharing applications raises several concerns related to personal privacy. Some solutions involving location privacy policies have been suggested (e.g., [1]). However, prior research shows that end-users have difficulties in expressing and setting their privacy preferences [2,3]. Setting privacy rules is a time-consuming process, which many people are unwilling to do until their privacy is violated. Moreover, privacy preferences vary across the context, and it is hard to define privacy policy that reflects the dynamic nature of our lives. We see this as a strong motivation to design tools that help users update their privacy settings as a consequence of their daily tasks within the system. The underlying requirement of our system is to provide an efficient, *heads-up* interface for managing location privacy that does not overwhelm the configuration over action [4].

In order to fulfill this requirement we developed the Privacy-Shake, a haptic interface [5] supporting ad-hoc privacy management. To evaluate the Privacy-Shake interface we conducted a lab-based study to examine its effectiveness and explore users’ reactions to that technology. We also evaluated several usability aspects of Privacy-Shake and compared its performance against graphical user interface. Our study confirmed the potential of haptic interfaces for performing simple privacy tasks and showed that Privacy-Shake can be faster than the GUI. However, our subjective results suggest further work on improving the interface, such as support for individual calibration and personalized gestures for better efficiency.

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2. THE PRIVACY-SHAKE SYSTEM
The current prototype of Privacy-Shake is developed in Java and works on Android powered mobile devices. It uses the built in accelerometer to monitor the current position of the device. Our application works in a background to save time needed for switching the phone on.

The current prototype supports the following settings: visibility (user can enable/disable location sharing) and granularity (changing the level of granularity of disclosed location from exact location to city level location.

2.1 Haptic interaction
Due to the dynamic nature of the mobile device, every action has to be initiated by a dynamic, vertical shake. This is required to distinguish the action from the noise generated by user’s daily movements, e.g. walking, jogging, using a lift. As the system recognizes the movement, vibrational feedback is provided to confirm that the system is ready. Once the system is initiated, a user can change privacy settings by performing one of the following actions:

- Vertical movement enables location sharing (Figure 1a),
- Horizontal movement (left and right) disables location sharing (Figure 1b),
- By moving the phone forward, a user can change the granularity of disclosed location to the city level (Figure 1c),
- User instructs the system to share exact location by approximating the phone to his body (Figure 1d).

Successful action is confirmed by short vibration (the length depends on the action) and optional auditory message (e.g. natural language message “*Anyone can see you*”) when the user enables location sharing.

3. In lab evaluation
We conducted a lab-based trial of Privacy-Shake interface to evaluate the usability of the interface and examine both the potential and vulnerabilities of the current prototype.

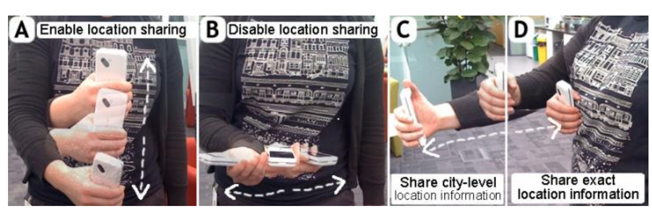

Figure 1. Privacy-Shake in action. Arrows present the direction of movement that triggers a privacy-management task.

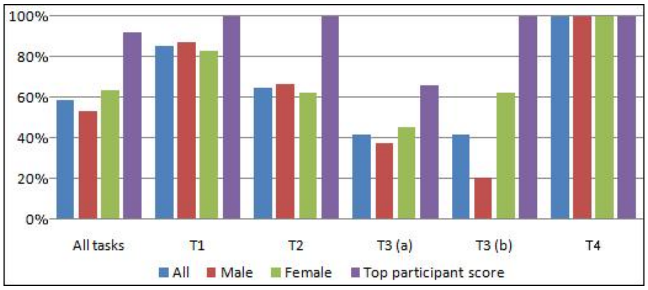

Figure 2. Bar chart presents the percentage of successfully completed tasks (efficiency) during the study.

3.1 Method

We recruited 16 participants aged from 23 to 45 for the study, 8 women and 8 men. Most of them had prior experience with motion-capture interaction, mainly from playing the Nintendo Wii. Eleven participants were graduate students, 4 were recruited from the university's stuff and the remaining user was recruited outside the university. Participants were asked to complete the following privacy management tasks using Privacy-Shake and GUI (results presented in Figure 2):

T1. Enable location sharing using Privacy-Shake,
T2. Disable location sharing using Privacy-Shake,
T3. Change the granularity of disclosed location to (a) exact location (building level), (b) city level (both using Privacy-Shake),
T4. Disable location sharing using the GUI.

The following measures were recorded:

- Time to performing a task – from the time when user started the initiation movement to the vibration confirming the action,
- Number of successfully completed tasks,
- Time of disabling location sharing using the GUI.

Participants took part in the study individually, at the beginning of each session we introduced the Privacy-Shake concept and the purpose of the study. Users were presented a short demo of the system and were given a chance to play with the interface prior to performing four privacy management tasks using Privacy-Shake. Each participant had three attempts to perform each task. At the end of each session we asked participants to complete a questionnaire to rate the Privacy-Shake.

3.2 Results

Twelve participants reported that learning how to use the Privacy-Shake was easy (2 users reported that it was difficult), 12 of them said that it is also easy to remember how to use it, as the interaction is simple and intuitive. However, 4 users said that they would not like to use it due to the *awkwardness* of the interface and potential harm it may cause, e.g. accidentally pushing people in a crowded bus. Four participants reported that using Privacy-Shake was annoying and six of them said that it caused frustration, which is related to the problems their experienced with the interface. Only five users managed to successfully complete each privacy management task using Privacy-Shake. Three users could not disable their location sharing and nine users had problems changing the granularity of disclosed location. The biggest difficulty users experienced was with task 3b, only three users successfully completed the task three times. More than a half of all attempts to perform this task were unsuccessful (58%). Only task T1 was successfully completed by all users, thirteen participants disabled location sharing using Privacy-Shake and ten of them successfully changed the granularity of disclosed location to city level. Two users successfully completed 11 of 12 attempts, which was the best result during the study. 58% of all attempts were successful. We observed that females performed slightly better at using Privacy-Shake with 64% efficiency versus 53% for males.

4. CONCLUSIONS AND FUTURE WORK

We presented the concept and initial results of the evaluation of Privacy-Shake, a novel interface for 'heads-up' privacy management. The chosen demographic was not broad, but the study helped us identify both social and technical issues related to the interface. One of the main issues we found were lack of individual calibration and support for more discreet movements, which highlights the future research agenda for our work on Privacy-Shake. Though the actual efficiency is not ideal, the comparison between the mean time of performing tasks T2 (6 seconds) and T4 (18 seconds) shows that haptic interface can be successfully used to perform some basic privacy management tasks faster than the traditional GUI. The Privacy-Shake concept received a positive feedback, which encourages us to continue the work on improving the interface and enhancing the user experience. Further work is also needed to extend the functionality of Privacy-Shake by implementing new gestures for managing group settings or expressing more fine-grained preferences.

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6. REFERENCES

[1] G. Myles, A. Friday, and N. Davies, "Preserving Privacy in Environments with Location-Based Applications," IEEE Pervasive Computing, vol. 2, 2003, pp. 56-64.

[2] L.F. Cranor and S. Garfinkel, Security and usability: designing secure systems that people can use, O'Reilly Media, Inc., 2005.

[3] N. Sadeh, J. Hong, L. Cranor, I. Fette, P. Kelley, M. Prabaker, and J. Rao, "Understanding and capturing people"s privacy policies in a people finder application," The Journal of Personal and Ubiquitous Computing, vol. 13, Aug. 2009, pp. 401-412.

[4] S. Lederer, I. Hong, K. Dey, and A. Landay, "Personal privacy through understanding and action: five pitfalls for designers," Personal Ubiquitous Computing, vol. 8, 2004, pp. 440-454.

[5] S. Robinson, P. Eslambolchilar, and M. Jones, "Sweep-Shake: finding digital resources in physical environments," *Proc. of Mobile HCI'09*, ACM, 2009, p.12.