Workshop on Mobile Cognition: Using Mobile Devices to Enhance Human Cognition

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Abstract
With the mobile phone turning into a lifelogging device alongside with the prevalence of wearables, people are able to record, store, and make sense of their daily activities. Using such insights, applications can help monitor physiological data, motivate behavior change, but also create new ways to aid human memory: mobile devices not only allow us to create records of information, but also present us with proactive reminders and instant access to information relevant to the current situation and context serving as cognition support and for retrospection. This workshop brings together practitioners, designers and researchers with the goal of exploring the requirements, challenges and possibilities of mobile cognition, *i.e.* how to track activities beyond the physical realm, make sense of that data and feed it back to the user in meaningful ways to augment human cognition.

Author Keywords
human memory; memory aids; cognitive systems; quantified mind; recall

ACM Classification Keywords
H.5.m. [Information Interfaces and Presentation (e.g. HCI)]: Miscellaneous

Introduction

The ubiquity of mobile devices has lead to variety of ways to track, make sense of, and influence daily human activities. The proliferation of the quantified-self movement has inspired both the research community as well as commercial products to come up with new mobile devices: activity trackers, such as *Fitbit*, bio-physiological data recording like the *Zephyr BioHarness*, media capturing, and the plentitude of sensors integrated in today's smartphones allow for rich data collection. Especially fitness and health tracking has become a popular use case for smartphone apps for monitoring and motivating behavior change. But there is more to activity tracking than logging physical data: already early versions of smartphones included a rich set of productivity tools, such as personal calendars, reminders, or todo lists. As humans we have learned to outsource cognitive tasks and make use of coherent cognitive systems, also known as distributed cognition [2]. Mobile devices allow us to quantify our cognitive activities, so we can track mental processes, such as reading or learning. This may help us to optimize our mental fitness and overall well-being [3] and further allow us to reminisce and engage in retrospection for memory strengthening.

We define *mobile cognition* as the approach of activity tracking beyond the physical realm in the wild, making sense of the resulting data, and feeding it back to the user to augment human cognition. Thereby mobile devices are key components for sensing, processing and turning data into actionable information with the goal of supporting cognitive processes and especially human memory.

This workshop aims at exploring the requirements, challenges and possibilities of mobile cognition and its application realm. We focus on mobile technologies that help collect and analyze lifelog data and provide applications for augmenting human cognition: this includes sensor technologies for deriving people's activities, algorithms to mine this data and different ways of presenting that information to the user. Further, we are interested in the social, economical and ethical implications that such technologies entail [1]. With the development of a focused research agenda we want to lay down the path to a better understanding of human memory in a mobile context with the potential to have a transformational impact on many aspects of life, such as work, family, health and education. The goal of this workshop is to discuss visions and concrete approaches for developing mobile technologies that nurture the augmentation of human cognition. Therefore, we address the following objectives: 1) applying cognitive theories beyond lab experiments to real-life situations, 2) compensating cognitive limitations through technologies, models and algorithms, 3) identifying use-cases for mobile cognition applications and 4) formulating a research agenda to hoist human cognition support from a niche application to the main stream.

Workshop Themes

To tackle the challenges of augmenting human cognition, we will focus on the following themes:

Applying cognition theories to mobile devices.
Cognitive psychology is constantly revising its theories under the scope of technological possibilities. The prevalence of mobile devices gives researchers the chance to study user behavior, physical and mental activities outside of the lab. This can help validating known theories and create novel applications that support cognitive tasks.

Lifelogging through mobile devices. As more sophisticated sensor capabilities are developed in form of wearables and integrated into smartphones, we are able to create comprehensive life logs of physical and mental activities throughout the day. Challenges include the efficient collection of that data, making sense of it and displaying it back to the user in meaningful ways.

Applications and scenarios. The ubiquity of mobile devices drastically alters the way we communicate, socialize and behave. We are interested in applications supporting mobile cognition with the potential to have similar effects on how people learn, what people remember and change their behavior.

Designing knowledge acquisition points. Mobile displays allow us to consume information and learn anytime, anywhere. Can physiological sensors provide current attention levels and determine opportune moments for cognitively demanding tasks? Can we design future learning interfaces that take into account real-time data and currently available output modalities?

Privacy and security. Mobile sensors produce great volumes of highly sensitive and personal data. What strategies should we apply for ensuring that this data will be safely stored, processed, and accessed?

Agenda

We are planning to host a full-day workshop comprising short participant talks, focused discussion groups and break-out sessions. In the following we will briefly describe the pre-workshop preparations, the general workshop activities as well as the post-workshop follow-up.

Pre-Workshop Preparation. Before the actual workshop we will compile and send out a reader comprising the accepted position papers along with introductory literature on the topic of mobile cognition. We expect participants to skim-read those beforehand to facilitate a quick start into the topic.

Workshop. The workshop will start with a general introduction followed by a brief keynote motivating the topic at hand. We will then proceed with introductory presentations to allow participants to get familiar with each other and their ideas: participants will have 5 minutes to present their work, during which we will collect notes on provided Post-Its, which we will share on a large whiteboard to prepare for the discussion sessions. After the lunch break workshop participants will start developing scenarios in groups. Results will be shared and discussed all together on the whiteboard. To identify challenges and opportunities for technologies that support mobile cognition we sort the Post-its into affinity diagrams. After the group discussions we will focus on the identified challenges and opportunities. The organizers will actively moderate the session to formulate concrete first steps for future projects in the field to collaborate on. We will conclude the workshop by summarizing the key insights from the workshop and planning follow-up activities.

Post-Workshop Follow Up. Throughout the workshop we will document the results of the group analysis, identified challenges and developed scenarios. This will be made available to workshop participants through a shared folder. Participants will be invited to an existing online repository on *Zotero* where they can share relevant papers regarding the workshop themes. One goal is to put in place first steps for a conjoint article for a special issue of a magazine, such as *IEEE Pervasive Computing*.

Participants and Submissions

Workshop candidates are invited to hand in position papers outlining their research, formulating research questions, sketching concept designs, experience reports, or a description of a specific prototype that is related to the workshop themes. Position papers should have a maximum of 4 pages in the SIGCHI Extended Abstracts format and are handed in via email to one of the organizers. Up to 15 Participants will be selected on the basis of the relevance of their work and their interest in and familiarity with the topic. Therefore we will put in place a review process that includes external experts.

Outcomes

The intended workshop outcomes include: 1) bringing together researchers, designers and practitioners to discuss aspects of technologies and applications for mobile cognition, 2) creating a common understanding and awareness of the challenges of using mobile technologies to augment human cognition 3) developing new ideas and scenarios to apply insights to a main stream application space and 4) formulating a research agenda comprising concrete first step for conjoint projects regarding using mobile technologies for cognitive augmentation.

Organizers

Tilman Dingler is a researcher in the HCI group lead by Albrecht Schmidt at the University of Stuttgart. He focuses on concepts and applications in the field of Pervasive Computing that support cognitive and especially memory tasks.

Evangelos Niforatos is a researcher at the University of Lugano, Switzerland. His main research interests lie in the area of Ubiquitous Computing, where he develops methods and tools for supporting episodic memory recall.

Agon Bexheti is a PhD student and researcher at the Faculty of Informatics of University of Lugano, Switzerland. He is working on the RECALL project funded by the European Union. Agon's current research is in developing secure human memory augmentation systems preserving privacy of users.

Florian Alt is a professor in the Group for Media Informatics at the University of Munich. His research interests are at the crossroads of pervasive computing and HCI, including ubiquitous interactive systems with a focus on interaction with large displays in public spaces, 3D displays, and usable security on mobile devices.

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