
Harnessing Multiple Devices and Crowds for Richer Productivity Tasks on Small Mobile Devices

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Abstract

Mobile devices are generally mostly used for relatively simple tasks rather than productivity tasks such as word processing and creating presentations and spreadsheets common to desktop environments. Despite increasingly more powerful hand-held and wearable devices, but due to small screen real estate and limitations of touch interaction, tasks that require more complex information interaction are usually not carried out on small mobile devices. In this paper, I will describe a new research project with the overarching goal of enabling more complex applications and tasks on, around and between small mobile devices. The project will investigate how next-generation applications on hand-held and wearable devices could be enabled based on a) new cross-device interaction concepts and techniques and b) automated support for crowdsourcing based on design-by-example and programming-by-demonstration. Starting from collocated settings, I will explore appropriate ways of supporting increasingly complex applications using crowdsourcing and identify the kinds of productivity and information tasks that would become feasible on small-form devices, as well as how they could be facilitated.

Author Keywords

mobile and ubiquitous computing; cross-device interaction; crowdsourcing

Motivation and Background

Given the current proliferation of new devices, my PhD thesis on *Lightweight Informed Adaptation* [2] introduced a novel approach to improving the adaptability of web interfaces based on crowdsourced adaptation, domain-specific language extensions and adaptivity metrics. Crowdsourced adaptation presents a new method that involves end-users in the adaptation process, allowing them to contribute web site adaptations for poorly supported viewing conditions including large screens and touch devices. At the implementation level, my concept of language-integrated context-awareness enables the development of adaptive web applications with context-aware constructs and multi-dimensional adaptivity mechanisms based on existing languages with which developers are already familiar. Finally, I developed a set of adaptivity metrics for assessing the ability of web interfaces to adapt to different screen sizes and guiding designers in the development of new adaptations.

In my current work, I have started to experiment with new techniques and visual tools for developing cross-device user interfaces. For example, we are investigating one approach based on the idea of *mashing up* multiple devices and existing web applications to support new cross-device applications [1]. In a second approach, we investigate *interactive development* based on a new GUI builder for visually designing distributed user interfaces using simulated or on-device authoring strategies [3]. My previous research has contributed user interaction tracking [5] and remote usability evaluation techniques [4] optimised for mobile devices. Based on [6], part of my current work is to extend these techniques with new concepts for *cross-device studies* to enable technical and user evaluations in multi-device environments using external sensors such as Kinect for interaction tracking.

The new project described in this paper will take this research further in mainly two directions. First, I will investigate how involving multiple devices can provide new interaction possibilities and enable tasks that are difficult to do using a single mobile device. Here, a particular focus will be on the combined use of hand-helds and wearables. Second, I will study how involving other users can facilitate advanced mobile interaction tasks. The project will start from mobile collocated interaction scenarios, but develop and generalise the underlying concepts and techniques further by building on crowdsourcing to enable individual users to carry out richer productivity and information tasks hard to achieve on small mobile devices.

At this stage, I have defined two important application domains that will be explored in the course of this project: *mobile office work* and *mobile interface design*. These include tasks such as text editing, making slideshows and creating spreadsheets as well as mobile interface development itself that are currently not feasible on a mobile device and therefore restricted to desktop settings.

Research Questions

In the literature, many different techniques have been explored with the goal of directly improving interaction capabilities of mobile devices by developing new hardware and interaction styles. However, these then require special hardware and new forms of interaction that are not available on everyday mobile devices. Therefore, I will take a different approach based on the idea of involving other devices and users to extend current interaction possibilities with mobile devices. Two specific questions this research will address are:

- **How can we better support users in device-to-device interaction and easily facilitate cross-device applications and tasks?**

- **How can existing crowdsourcing techniques be leveraged and adapted to improve mobile interaction for individual users?**

First, the project will study how existing context-aware concepts and adaptivity mechanisms including those developed in my PhD thesis [2] can be extended to scenarios that span multiple, different devices. This is an important requirement to allow users to coordinate and jointly use multiple devices to benefit from different input and output characteristics that may better support the task compared to using only a single mobile device.

Second, the project will examine the seamless integration of crowdsourcing based on design-by-example and programming-by-demonstration approaches to support users in mobile contexts by building from existing examples, extrapolating from demonstrated interactions and involving more experienced mobile users, or users with other devices, to contribute to the current task.

Throughout the project, I will systematically study what kinds of productivity and design tasks can be achieved and by how much the user performance gap can be closed on small mobile devices comparing existing and my new techniques in both collocated and remote settings.

Contribution to the CHI Workshop

I see the CHI Workshop on mobile collocated interactions as an opportunity to discuss my project and exchange ideas with workshop participants. I believe that this

project and associated research questions align very well with the workshop's goals. I hope to contribute with my experience and could share first results of my project.

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