UbiMI: Ubiquitous Mobile Instrumentation

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ABSTRACT
Thanks to the rapid development of mobile technologies, smartphones allow people to be reachable anywhere and anytime. In addition to the benefits for end users, researchers and developers can also benefit from the powerful devices that participants potentially carry on a daily basis. This mini-track workshop brings together researchers with an interest on using mobile devices as instruments to collect data and conduct mobile user studies, with a focus on understanding human-behavior, routines and gathering context.

Author Keywords mobile, ubiquitous, computing, instrumentation, frameworks, experiments, studies.

ACM Classification Keywords H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms Design, Experimentation, Theory, Verification.

INTRODUCTION
Recruiting a large number of participants for user studies in HCI has been challenging (*i.e.,* participation compensation, location and time differences, *etc.*). Techniques such as surveys and questionnaires for data collection have taken a new form in recent years, where "in the field" has been replaced with "online"; and automated logging devices have augmented diaries, video recorders and cameras (*e.g.*, Microsoft's SenseCam (Microsoft Research, 2007), Nokia's LifeBlog (Nokia, 2007)). This shift represents a new trend in research methods, whereby mobile devices are used to collect data on participants and their behaviors.

Mobile devices are increasingly popular and diverse, with worldwide sales approaching 1.6 billion units, just last year (Gartner Research, 2010 & 2011). As "convergent" devices, smartphones empower their owners with Internet access, music, audio and video playback and recording, navigation and other communication capabilities (phone calls, SMS, MMS, *etc*.) (Zheng & Ni, 2006). In addition to the benefits for end users, researchers and developers can also benefit from the powerful devices that participants potentially carry on a daily basis.

Researchers can use smartphones and develop applications to collect a variety of sensed data, such as that from accelerometers, GPS, network usage, and application usage.

In this workshop, we bring together researchers who take advantage of the proliferation of mobile devices and use them as instruments for research on ubiquitous computing. We are especially interested in the mobile devices, systems, applications, methods and tools that were built to explore such rich datasets. More so, we want researchers to share their experiences, successes and frustrations on conducting research in such power and processing constrained devices in order to capture a state-of-art on theories, models, methodologies and tools that cope with these challenges.

RELATED LITERATURE & CHALLENGES
As examples, such applications and tools can take advantage of the sensors available on the handset, typically GPS and Internet connectivity to facilitate context-aware applications (Cuervo, 2010; Oliver, 2010), accelerometers for motion tracking (Reddy *et al.*, 2010), Bluetooth for distance measurements from the device (Patel *et al.*, 2006) and anomaly detection (Buennemeyer *et al.*, 2008; Schmidt et al., 2009).

The data collected from subjects is then analyzed *post-hoc* in most cases, informing both researchers and industry of users' actions and current practices. Unfortunately, our understanding of users' everyday practices in their natural contexts is still very limited as the cost of performing such real-world data collections is often quite high. Instead, insights are often derived from observations and analysis of user behavior in laboratory or staged environments (Korn, 2010), which might suffer from reduced ecological validity.

Furthermore, the growing functionality of smartphones requires more power to support operation throughout the day. Processing power, feature-sets and sensor use are bottlenecked by battery life limitations, with the typical battery capacity of smartphones today being barely above 1500 mAh (Corey, 2010). This is an important limitation because smartphones are increasingly regarded as a gateway to one's daily life, providing networking access to email, social networking, and messaging, making the battery life an important limitation for the user (Cuervo, 2010) as well as for researchers.

Using mobile devices for understanding human-behavior, routines and context is indeed difficult. Although tools do exist to facilitate data collection on mobile devices (Miluzzo *et al.,* 2008; Aharony *et al.,* 2011), these tend to

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become outdated as new devices are introduced to the general public. The mobile devices' diversity, plus the ever-evolving functionalities that come built-in with these devices, make the development of such tools demanding in terms of scalability, stability and distribution.

EXPECTED RESULTS

Instrumenting mobile devices needs to be addressed as a research community effort. In this workshop, we expect to harvest experiences, challenges and recommendations on:

- Devices and techniques: design, architecture, usage and evaluation of mobile devices and techniques that create valuable new capabilities for ubiquitous computing;
- Systems and infrastructures: design, architecture, usage and evaluation of mobile systems and infrastructures that support ubiquitous computing;
- Applications: design and/or study of how mobile applications can leverage other ubiquitous devices, systems and applications;
- Methodologies and tools: new methods and tools that are applied on studies or building novel mobile ubiquitous systems and applications;
- Theories and models: critical analysis or organizing theory with relevance to the design or study of mobile ubiquitous systems;
- Experiences: empirical investigations of the use of new or existing mobile technologies that can potentially motivate future mobile ubiquitous systems.

The end result is a better understanding of the current state-of-art in mobile devices instrumentation and how it affects future mobile ubiquitous systems. A future journal article depicting the workshops' findings and rules of thumb will further highlight the importance of mobile devices instrumentation. After all, mobile devices are the widest distributed sensor-enabled devices.

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