Ubiquitous Mobile Sensing: Behaviour, Mood, and Environment

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Abstract

Our world is increasingly interconnected via a wide variety of computers, IoT, wearable and mobile devices. The information provided collectively through these devices offers insightful information on our everyday lives, daily patterns, mood, behaviour, and surrounding environment. Our workshop brings together researchers interested in collecting and augmenting context to understand device specific behaviour and routines, human behaviour and mood, and changes in the environment. The outcomes of this workshop are new *tools*, *methodologies*, and potential *collaborations* for sensing the outlying world as well as ourselves.

Author Keywords

Mobile Sensing; Ubiquitous Computing; Instrumentation; Mood Sensing; Middleware; Experiments; Context-aware; User studies.

ACM Classification Keywords

H.m. Information systems: Miscellaneous.

Motivation

The rapidly increasing use of computers, IoT-devices, and interconnected wearables and mobile devices have

given individuals, researchers, (commercial) organisations, and governments access to nearly unlimited information in the form of digital data. This personal information offers unique insights on different tiers of human affect – individual behaviour traits, combined traits, and group behaviours as observed through a combination of data from multiple individuals. Mood plays an important role in individuals' daily lives and can influence communication, decision making, and social behaviour. Thus, sensing mood it is a relevant topic within the Ubicomp community and opens opportunities for building more intelligent technologies. Another application for mobile sensing is related to human mobility, and further, its use in sensing the environment, *e.g.*, air quality.

In the context of mobile computing, mobile and wearable devices can collect an uninterrupted stream of information about the user's activity, location, and *e.g.*, device usage related information. Mobile devices have several built-in sensors (*e.g.*, accelerometer, proximity sensor, gyroscope). These mobile sensors are primarily used by the mobile operating system to enhance the user experience, such as app functionality or mobile device user interaction (*e.g.*, vibration feedback, screen orientation detection). Other sensed measurements (*e.g.*, overall device use, application choices, battery-related characteristics) can reveal information on a user's device usage behaviour. Information retrieved via these sensors and further processed can further reveal associations with the users behaviour in vivo, or daily affect, such as boredom [3] or stress [7].

In this workshop, we bring together researchers who take advantage of the proliferation of mobile devices, use these devices as instruments for research on human activities and device usage behaviour. We investigate new and existing methods and tools for collecting instrumented data. We are especially interested in mobile devices, systems, applications, methods and tools that were built to collect, augment, and explore such rich datasets. More so, we want researchers to share their experiences, successes, and frustrations on conducting research and analysing information from such power and processing constrained devices to capture the state-of-the-art.

Background

In recent years there has been a rapid growth of research conducted within the area of mood and emotional state sensing, particularly within the Ubicomp community. Smartphones have been shown to be a powerful tool for this purpose due to their ubiquitous nature and range of available sensors [5]. For example, Servia *et al*. utilised mobile sensing for predicting user's mood with an accuracy of 70% based on user's activity, sociability and psychological dimensions (*e.g.*, perception of health and life satisfaction) [9].

Furthering the range of mobile sensing, Zhang et al. [11] devised a novel method for identifying household appliance use and household activity via the smartphone's magnetometer. Sarker et al. [8] used phone call logs as a tool to characterise and model individual user's behaviour. Gustarini and Wac created a methodology for energy-efficiently keep track of context changes in user's mobility [2].

Asadzadeh *et al.* [1] studied user behaviour in using a pedometer app over a period of 1-8 weeks. Sano *et al.* [6] identified patterns of behaviour in the autistic spectrum and proposed a tool to help alleviate the

disorders. Lastly, group behavioural studies were conducted by both Purta *et al.* [4] – estimating dining hall usage in a campus setting – and Van Berkel *et al.* [10] – studying group dynamics in an elementary school setting. In this year's workshop, we hope to continue this trend of human-computer behaviour.

Workshop Topics & Outcomes

Investigating and developing mobile sensing approaches needs to be addressed as a research community effort. In this workshop, we expect to *harvest experiences, challenges, and outcomes* in collecting and augmenting sensor collected data and in *creating tools* that collect or leverage this information or improve performance. Topics of *improving* mental health are outside the scope of this workshop, as the aim is to highlight the earlier stages of affect recognition. We wish to generate discussion between individuals interested in data collection and leveraging it in studies related to the human aspects. We expect contributions on the following topics:

- **Devices and techniques**: design, architecture, usage and evaluation of mobile devices and techniques that create valuable new capabilities for identifying human behaviour and affect;
- **Systems and infrastructures**: design, architecture, usage and evaluation of mobile systems and infrastructures that support behavioural studies;
- **Applications**: design and/or study of how mobile applications can leverage other ubiquitous devices, systems, applications, and human reflection;
- **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 mapping digital data to behavioural patterns;
- **Experiences**: empirical investigations on the use of new or existing mobile technologies that can potentially motivate future work.

The End result of our workshop is a better understanding of the current state-of-the-art in mobile devices instrumentation and its possibilities in performing and augmenting human-computer behavioural studies. A future journal article depicting the workshops' findings and rules of thumb will further highlight the importance of mobile devices instrumentation.

Schedule

Oct. 12th: Workshop papers presentations & Discussion session regarding interesting topics and theorems in converting digitally sensed information into behavioural patterns.

Important dates

Submissions: July 30th, 2018
Acceptance: August 15th, 2018
Camera-ready: August 25th, 2018

Participants

We expect between 15-25 attendees. Their research interests and areas of expertise are in, but not restricted to, ubiquitous technologies, behavioural studies, mobile computation, mobile interaction, mobile user studies, and quantified-self.

Publications

All accepted (4/5-page + 1 references maximum length is 6 pages) workshop papers will be archived in the ACM Digital Library.

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