Ubiquitous Computing with Event Driven Mobile Application Platform – Social Computing Cloud Experiment

Przemysław Dadel[1], Adam Belloum[2], Emiel van Loon[2], Reginald Cushing[2]
(1) AGH Kraków, Department of Computer Science, Kraków, Poland, (2) Informatics Institute, University of Amsterdam, The Netherlands

Introduction

Objective: develop a platform for ubiquitous mobile applications development.
This poster describes a prototype application - **Social Computing Cloud** and a study of a potential **Mobile Bio-loggers** application.
The **foundation** of this work comes from observations of the mobile ecosystem which features:

- over a billion activated devices based on Android platform,
- considerable and growing computing power of smartphones,
- a rich set of sensors,
- noticeable patterns of users behaviour that can empower mobile applications,
- ubiquity in all sorts of human activity environments.

Architecture

In this platform mobile devices are modelled as **software components** that provide well-defined functionality e.g. script execution in Social Computing Cloud application.

To address the key consideration in the mobile system design: **inherent variability** and the **dynamics** of these software components, the platform follows an **Event Driven Architecture** with the application of Complex Event Processing (Fig.1).
This duo has proved to be effective in:

- adaptive systems with dynamic components,
- scalable processing of a variable stream of monitoring data,
- enabling the platform to aptly respond to changes in the monitored devices.

Platform maintains an event-driven state of the mobile ecosystem atop of which mobile applications can be build.

Google Cloud Messaging system is used to communicate with the devices under platform supervision and to trigger those devices to respond with the events describing their state.

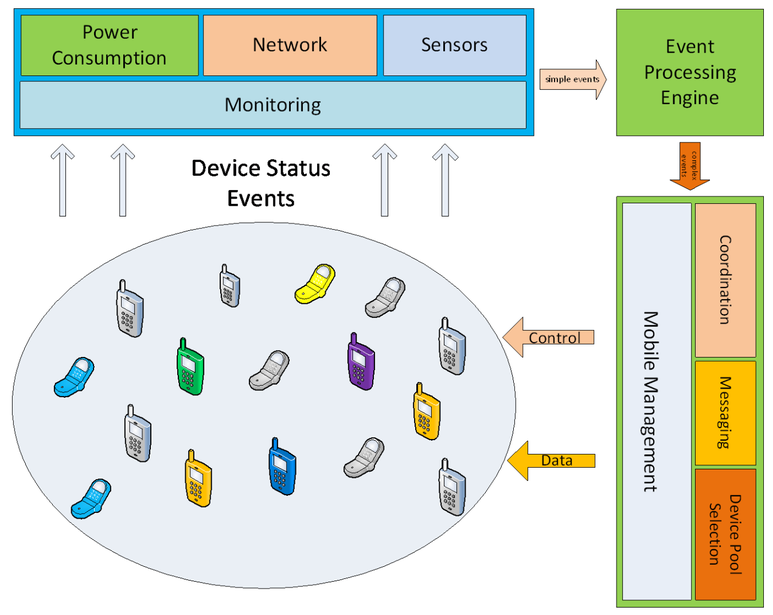

Fig.1. Architecture of the event-driven mobile computing platform. Functionally orthogonal monitoring and management layers.

The platform manages the pool of devices that satisfy the application requirements. E.g. selection criteria Can Accepts Only devices with enabled WiFi that are connected to USB/AC.

Social Computing Cloud Application

The Social Computing Cloud (SCC) application was developed to illustrate platform features.
It is a voluntary computing application that uses mobile devices as computing task executors.
It takes advantage of the following features and observations of Android platform:

- install & forget approach - application can work as background services without user supervision
- scheduler handles the background task execution to minimize their impact on user experience
- user tend to connect to Wi-Fi whenever it is possible
- patterns in battery consumption and charging can be observed

Server communicates with SCC Android client on the mobile device. Client application receives computation tasks, executes them and responds with the results to the server (Fig. 3).

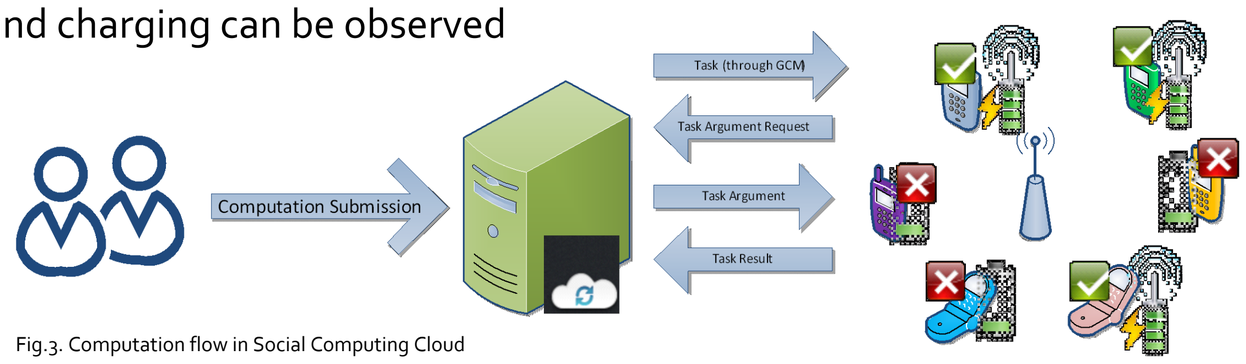

Fig.3. Computation flow in Social Computing Cloud

Social Computing Cloud server sends task to the devices that satisfies the selected criteria (WiFi network, device is plugged)

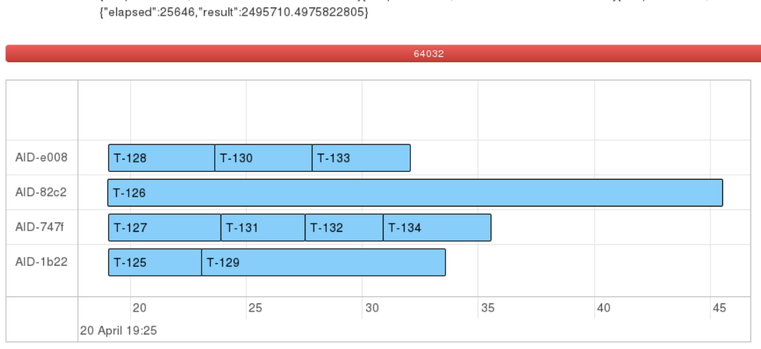

Fig. 5. Task are executed in parallel on available mobile computing nodes. Performance of the mobile devices can vary considerably.

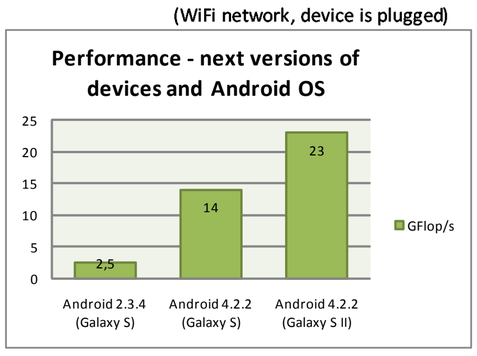

Fig. 4. Performance comparison of the next generations of smartphones as measured with Social Computing Cloud application.
Not only the devices are becoming faster but also Android platform has matured over the last years.

Device Availability

Battery

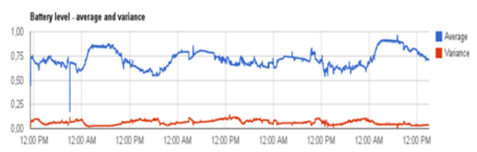

Fig.2. Observation of mobile device characteristics: their availability and power consumption can help in application design.

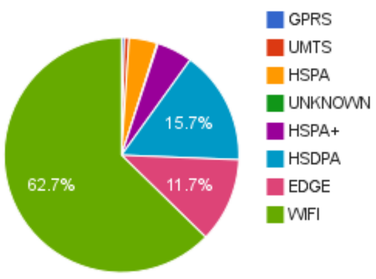

Fig.6. SCC users tend do use wireless Internet whenever it is possible e.g. at home, in work.

Mobile Bio-loggers

Biological tracking systems such as UvA BiTS often suffer from limitations of the wireless (ZigBee) communication. Certain specimens frequently escape from a range of base stations and cannot be effectively monitored.

We propose to use the Event-driven Mobile Application Platform to build a human-assisted distributed sensor network that can extend BiTS tracking systems capabilities and leverage platforms features: monitoring, management and coordinating of mobile device pools.

When bird watchers come close to an interesting specimen:

- a mobile application on the device with ZigBee transceiver can detect the vicinity of a bird,
- analyse its coordinate and movements,
- notify another human tracker that in his area,
- assist in the transmission of the data from bird tracking devices to the central BiTS server.

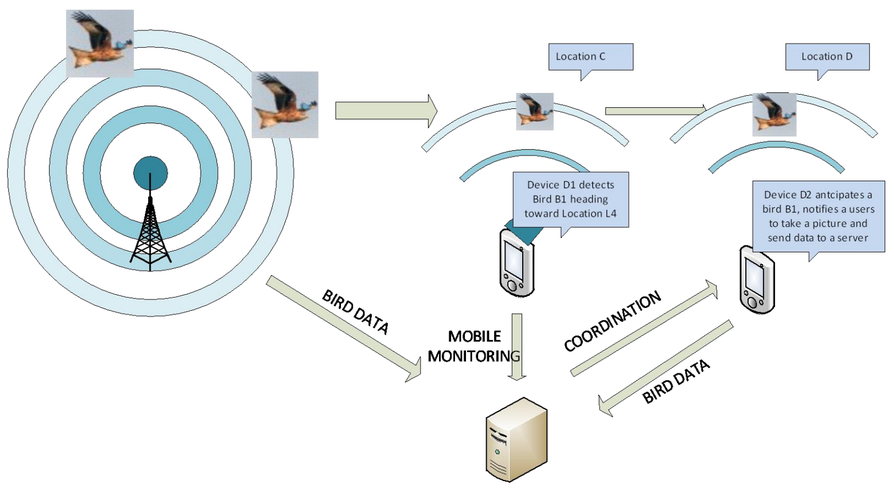

Fig. 7. A vision of a bird tracking system extended with mobile devices that are coordinated by the platform.

Future Work

Conclusions:

- mobile devices can be used for voluntary computing without negative user impact (Wi-Fi enabled and battery charging)
- event driven architecture can be efficient in coordination of mobile software components

Future work:

- analysis of the performance and impact on user experience in SCC
- investigation of network handover patterns and the possibility of peer-to-peer device communication
- adapting frequency of the events to the application needs
- implementation of prototype Mobile Bio-logger application

Refrences

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doi: 10.1109/MIC.2013.3
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Contact: Przemysław Dadel (pdadel@agh.edu.pl), Adam Belloum (A.S.Z.Belloum@uva.nl)