Using smartphones for population research

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University of Melbourne
What your phone knows about you

Computer scientists are not (just) programmers

Do not hire developers to build research apps

Let’s collaborate!
Brief history of computing

1960’s

1980’s

2000’s
3 “Waves” of computing

Capabilities

Size

Usage

Research

Technology

People

Spaces
Understand people -> build better technology

Study technology -> better understand people
Modus operandi

- Smartphone/Facebook data
- Behaviour, attitudes, questionnaires, etc.
- Establish correlations
- Describe behaviour
- Calculate metrics

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Sources
- Social Media
- Smartphone use
- Smart city
- Interaction

Methods
- Smartphone instrumentation
- Crowdsourcing
- In-the-wild methods

Insights
- Happiness
- Personality
- Habits
- Exposure
Smartphones for science
Scientific instruments
Non-invasive sensing
Sensor growth in smartphones

**Galaxy S1**
- Ambient Light
- Accelerometer
- Magnetometer

**Galaxy S2**
- Gyroscope
- Proximity
- Ambient Light
- Accelerometer
- Magnetometer

**Galaxy S3**
- Pressure
- RGB
- Gyroscope
- Proximity
- Ambient Light
- Accelerometer
- Magnetometer

**Galaxy S4**
- Temperature
- Humidity
- Hall Effect
- Pressure
- RGB
- Gyroscope
- Proximity
- Ambient Light
- Accelerometer
- Magnetometer

**Galaxy S5**
- Heart Rate
- Fingerprint
- Temperature
- Humidity
- Hall Effect
- Pressure
- RGB
- Gyroscope
- Proximity
- Ambient Light
- Accelerometer
- Magnetometer
“LEGO” - context

Accelerometer → Step-counter → Calorie counter → Diet → Well-being

Calendar

Questions
Individuals: Record your own data

No programming skills are required. The mobile application allows you to enable or disable sensors and plugins. The data is saved locally on your mobile phone. Privacy is enforced by design, so AWARE does not log personal information, such as phone numbers or contacts information.
You can additionally install plugins that will further enhance the capabilities of your device, straight from the client.

Scientists: Run studies

Running a mobile related study has never been easier. Install AWARE on the participants phone, select the data you want to collect and that is it. If you use the AWARE dashboard, you can request your participants’ data, check their participation and remotely trigger mobile ESM (Experience Sampling Method) questionnaires, anytime and anywhere from the convenience of your Internet browser. The framework does not record the data you need? Check our tutorials to learn how to create your own plugins, or just contact us to help you with your study! Our research group is always willing to collaborate.

Developers: Make your apps smarter

Nothing is more stressful than to interrupt a mobile phone user at the most unfortunate moments. AWARE provides application developers with user’s context using AWARE’s API. AWARE is available as an Android library. User’s current context is shared at the operating system level, thus empowering richer context-aware applications for the end-users.
Demo (online)
Earthquake_japan

**Status:** Closed

**Join study:**
https://api.lawareframework.com/index.php/webservice/index/63/oiRWYUr4
Show QRcode

**Description:**
Earthquake sensing using smartphone accelerometer.

**Sensors:**
- **Accelerometer**
  - True or false to activate or deactivate accelerometer sensor.
  - Frequency accelerometer: 20000

  Non-deterministic frequency in microseconds (dependent of the hardware sensor capabilities and resources), e.g., 200000 (normal), 60000 (UI), 20000 (game), 0 (fastest).

- **Ambient Noise**
- **Android Wear**
- **Applications**
- **Barometer**
  - True or false to activate or deactivate sensor.
  - Frequency barometer: 20000

  Non-deterministic frequency in microseconds (dependent of the hardware sensor capabilities and resources). You can also use a SensorManager sensor delay constant.

- **Battery**
- **Bluetooth**
- **Communication**
- **Device Usage**
- **ESM**
  - Status esm
    - True or false to activate or deactivate ESM sensor.

- **Google Activity Recognition**
- **Gravity**
- **Gyroscope**
- **Installations**
- **Light**
- **Linear Accelerometer**
- **Locations**
- **Lux Meter**
- **Magnetometer**
- **MQTT**
- **Network**
- **NTPtime**
- **OpenWeather**
- **Processor**
- **Proximity**
- **Rotation**
- **Screen**
  - Status screen
    - True or false to activate or deactivate sensor.
Owner: Kostakos, Vassilis

Co-researchers: Ferreira, Denzil x Gonçalves, Jorge x Pandab, Pratyush x

Database name: Kostakos_63

Created: 23 May 2014

API key: dRWYUlt4

Visualization:

Date:

November 2014

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**Type** | **Total records**
--- | ---
Accelerometer | 171653610
Magnetometer | 169680505
ESMS | 111
Battery | 1

Devices:

Displaying 1-8 of total 8 devices. Total of 0 devices selected.

- Select all

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Scientist ➔ Define study ➔ Store data (MySQL) ➔ Visualise ➔ Deploy to participants
Scientific instrument

Experience Sampling Method
Passive sensor collection

Behavioural studies
(Personality prediction)

Medical studies
(Parkinson’s / Cancer / Pain)

Environmental exposure studies
(Urban mobility)

Transport engineering
(Crowd simulation, queue modelling)

Economics
(Power consumption modelling)
Role of UbiComp Scientists?

• We need scientists who can build market-ready technology
  • Our software is deployed into the hands of patients/users/consumers

• Who have experience with human-subjects studies
  • Our software is used on a daily basis, in-situ

• Who can “speak” the language of other disciplines
  • Large multidisciplinary teams

• Who can understand the nuances of interaction
  • Separate “noise” from “valuable” data
Measurement instrument

- Bias
- Reliability
- Transparency
- Repeatability
- Privacy
- Battery life
- Convenience
Repeatability: automated testing

Calculate metrics
Reliability: ESM/EMA accuracy
Reliability: situational impairments
Privacy: on-board inference
Sensor growth in smartphones

- **2010**
  - Galaxy S1
    - Ambient Light
    - Accelerometer
    - Magnetometer

- **2011**
  - Galaxy S2
    - Gyroscope
    - Proximity

- **2012**
  - Galaxy S3
    - Pressure
    - RGB
    - Gyroscope
    - Proximity

- **2013**
  - Galaxy S4
    - Temperature
    - Humidity
    - Hall Effect

- **2014**
  - Galaxy S5
    - Heart Rate
    - Fingerprint
    - Temperature
    - Humidity
    - Hall Effect

- **2015+**
  - Pressure
  - RGB
  - Gyroscope
  - Proximity
  - Ambient Light
  - Accelerometer
  - Magnetometer
Convenience: gamification

Calculate metrics
Convenience: crowdsourcing

Calculate metrics
Convenience: crowdsourcing

Calculate metrics
Keeping our eyes on the future

NIRS: Near Infrared Spectroscopy
The end!

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http://awareframework.com