Participatory Sensing: Data Collection with Mobile Sensing Devices

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In collaboration with faculty, staff and students at CENS and Mobilize project team
What is Participatory Sensing?
enabled by mobile (smart)phones + web + social networking

An approach to data collection and interpretation in which individuals, acting alone or in groups, use their personal mobile devices and web services to systematically explore interesting aspects of their worlds ranging from health to culture.

Campaigns – focused, lightweight, easy to create

real time
(always on)

real place
(always carried)

real context
(historical, environmental, spatial, social)

real applications
(civic and environmental data, transportation, health, education)
Participatory Sensing Applications

- Inquiry-based observation, analysis, for biological, physical, environmental, social sciences, arts/culture
- Leveraging coordinated, real-time, geo-coded, tagged, images and prompted entries

GarbageWatch
Recycling Practices on Campus

Boyle-Heights

- ~70 residents documenting conditions in and between work, school, home.
- Where they go and gather, the conditions surrounding them.
Participatory Sensing Applications

**StressChill mapping**
- identifying/describing/mapping things/places that are stressful or relaxing in the environment.
- Pilot w/~200 high school students in LA

**What’s Invasive**
Invasive plant and pest monitoring

http://whatsinvasive.com/
Participatory Sensing in Mobilize

*Pedagogical tool: Provides a hands-on technique for students to engage and organize around data practices.*

- Mobilize Project (NSF)
- Collaboration among:
  - CENS
  - Center-X
  - LAUSD
  - CSTA
- Improve student learning by engaging students in Computational Thinking (CT) and data analysis through the use of participatory sensing technology
Use mobile devices to enhance health and wellness by extending personalized health interventions and research beyond the reach of traditional clinical care.

all 168 hours of the week...

all 1440 minutes of the day...
(not necessarily all 365 days a year...)
Participatory Sensing in mHealth

Enable exploration of experience sampling (i.e. in-situ) data collection in health and wellness.

<table>
<thead>
<tr>
<th>Pilots</th>
<th>Number of Participants</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC (Breast cancer survivors)</td>
<td>100</td>
<td>Mood, stress and exercise</td>
</tr>
<tr>
<td>NIH (young moms)</td>
<td>60</td>
<td>Monitoring heart disease risk factors --- diet, stress and exercise.</td>
</tr>
<tr>
<td>CHIPTS (people living with HIV)</td>
<td>40</td>
<td>Risk behavior due to sexual encounters, drugs and alcohol usage.</td>
</tr>
</tbody>
</table>
Ohmage

Campaign management, Data management, Visualization

Campaign Management

Server

Data storage, Security & access control, Data aggregation/analysis

Data Capture, Triggers, Feedback

10:40 AM

Take a saliva sample now, and enter time.

Enter your answer above and tap Next to continue.
Campaign

- Scriptable
  - XML
- multiple prompt types
  - number
  - text
  - single_choice
  - multi_choices
  - photo
  - hours_before_now
  - remote_activity
  - single_choice_custom
  - multi_choice_custom
  - Timestamp
- conditional branching
- Allow skipping
Campaign Management
Data Management
Data visualization

- Campaign-level visualization

- Prompt-level visualization
Data visualization

- Others: Mobility
  - Over space
  - User interaction with phone
  - Memory usage on phone

- Others: SystemSens
  - Remaining battery on phone

Previous Week | May 16 - May 22 | Next Week
---|---|---
Man | | |
Tue | | |
Wed | | |
Thu | | |
Fri | | |
Sat | | |
Sun | | |

Over time
Data collection

self-reported surveys

- Automatically time-stamped and geo-coded upon submission
- Scheduled/manual data submission

Automated capture

Mobility

GPS  ACCELEROMETER

classification

Mobility State (i.e., still, walking, running, biking, driving)

SystemSens

Collect phone usage, context (e.g. time/space) and resource consumption
Triggers

Location-based

Time range
Trigger only during the following interval
Start Time 5:35 pm
End Time 5:35 pm
Trigger always
Trigger at End Time even if not reached
Minimum re-entry
120 minutes

Time-based

Trigger Time
11:27 am
Repeat
Everyday
Time range
Enforce a range for the trigger
Start Time 11:27 am
End Time 11:27 am
Randomize
Use random trigger times within the range
Feedback

Map view

Participation count

Individual prompt data

Map

Response #1

When was your last snack? Mid-morning
What did you eat? Hot Cheetos
How healthy was the snack? (1 very unhealthy, 5 very healthy) 1
Where did you eat? School
Who were you with? Classmates
Why did you eat? Hungry
Why did you choose this snack instead of something else? I wanted some chips
How much did the snack cost? Less than $1.00

Close
Ohmage Architecture

Browser-based clients: Firefox, Chrome, Safari

Java 1.6 + GWT + JavaScript + CSS + HTML

API Endpoints

Java 6 + Tomcat 7 + mySQL 5.1

Rapache 1.1.4

Server: CentOS + SELinux

Mobile phone clients: Android 1.x, 2.x

Java + SQLite

Internet

JSON/HTTPS

Java +

Browser-based clients:
Firefox, Chrome, Safari

Mobile phone clients:
Android 1.x, 2.x

Server: CentOS + SELinux

Java +

JSON/HTTPS

Java +

JSON/HTTPS

Java +

JSON/HTTPS

Java +
Android → Cross-platform app

- **Feedback**
  - self-reported surveys
  - Data presentation
    - Form
    - Plots
    - Maps
  - Access to native device
    - Camera
    - GPS
    - Accelerometer
  - Access to native applications
    - Mobility classifier
    - Background process
  - Triggers
  - Automated capture
  - HTML5, MWF

- **Conversion**
  - Android
  - Cross-platform app

- **Tools**
  - PhoneGap
  - (or tools that support plugins to native devices and apps)

- **Additional Features**
  - Access to native apps
    - Mobility classifier
    - Background process
  - SystemSens
    - Collect phone usage, context (e.g., time/space) and resource consumption
URLs

• For PS software and documentation  
  [www.lecs.cs.ucla.edu/ohmage](http://www.lecs.cs.ucla.edu/ohmage)

• Mobilize Project:  [www.mobilizingcs.org](http://www.mobilizingcs.org)

• CENS:  [research.cens.ucla.edu/](http://research.cens.ucla.edu/)