Using Mobiles Phones to Learn and Persuade Human Behavior

jon froehlich
Taipei 101
Taipei, Taiwan
508 meters

Petronas Towers
Kuala Lumpur, Malaysia
452 meters

Sears Tower
Chicago, U.S.A.
442 meters

Jin Mao Tower
Shanghai, China
421 meters
Mobile Phone Subscribers Worldwide 1995

1.67%
2010 Worldwide Projections

51.47% Mobile Phone Subscribers

19.12% PC Users
The mobile phone will revolutionize the way we collect data about people, their behavior and the environment.
data collection

Infrastructure

Device Side Logging

Explicit User Feedback

Some Combination
Device usage and environment states (e.g., GPS) can be automatically sensed.

- Technique scales well
  - Cannot capture user intention, perception, reasoning, or feelings

Users respond to short context-triggered surveys on their mobile device.

- Can gather otherwise imperceptible data (both qual. and quant.)
  - Lower sampling rate than sensors (increased user burden)

MyExperience is open source software under the BSD license
We noticed that you just finished your morning walk, how is your breathing rate?

I feel out of breath
I’m breathing heavier than normal
I had to stop walking to catch my breath

Example Sensor:
- DeviceIdleSensor
- PhoneCallSensor
- RawGpsSensor
- SmsSentSensor
- HumanScaleActivitySensor

Example Triggers:
- DeviceIdle > 15 mins
- PhoneCall.Outgoing == true
- Gps.Longitude == “N141.23”
- SmsSent == true
- Activity.StateExited == Walking

Example Actions:
- ScreenshotAction
- VibrationAction
- SmsSendAction
- DatabaseSyncAction
- SurveyAction
Self-report surveys can be significantly richer and more expressive than plain text responses. This is fully customizable and new response widgets can be added using C# .NET CF.
high level research questions

• Can we automatically infer transportation habits?
• Can we increase a person’s awareness of their own transit habits?
• Can we motivate behavior change?
ubigreen field study
ubigreen design goals

• Design around being a personal \textit{ambient awareness} device
  – Require little-to-no user feedback
• Use evocative imagery
• Do not require specific goal setting or utilize a point system
mobile sensing platform

MSP Features
- Built on iMote2
- Linux OS
- 32MB RAM
- 2 GB Flash Storage
- Zigbee and Bluetooth
- 12-16 hours battery life

10 Built-in Sensors
- 3D Accelerometer
- 2D Compass
- Barometer
- Humidity
- Visible light
- Infrared light
- Temperature
- UART, GPIO breakouts for additional sensors

wearable msp
msp & ubigreen

Bluetooth

raw data

inference data

standing sitting walking biking jogging
visual design
activity
designer
initial study

- Deployed to 14 people
  - In Seattle / Pittsburgh
- 1 – 3 weeks per subject
- Recruited off of craigslist
- Used subject’s personal SIM card in phone we provided
• Application use became a game
• Some self-reported behavior change
• Participants enjoyed social aspects
• Recommendations requested
• Some quantitative analysis to come
mobilebicing

Jon Froehlich\textsuperscript{1,2}, Joachim Neumann\textsuperscript{2}, Nuria Oliver\textsuperscript{2}

\textsuperscript{1}University of Washington, \textsuperscript{2}Telefónica
A continuació es poden visualitzar, en el següent plànol, les estacions de bicicletes actualment en funcionament. Així com, veure en temps real la disponibilitat de bicicletes a cadascuna d'elles.

Districte:  
Direcció:  
Estacions buides:  
Estacions Plenes:  

AAtlantida  
Bicicletes 16  
Espais buits 3  

Estació amb més d'una bic  Estació sense bicis
Cyclists head for the beach and downtown...
preliminary data gathering

Question 1.
Quin és el teu sexe?

Required.
○ Home
○ Dona

Question 4.
Per què vas decidir registrar-te a Bicing?

Required. Select one or more answers.

☐ Per l'exercici
☐ No tinc bicicleta, així doncs Bicing em permet utilitzar una bicicleta quan vul
☐ Em va semblar més eficient que altres opcions de transport
☐ Per diversió (p.e. passejades per la platja)
☐ És un mitjà de transport respectuós amb el medi ambient
☐ Per desplaçar-me
☐ L'utilitzaven els meus amics, família, i/o companys de feina

☐ Altres: ____________________

Question 9.
Amb quina freqüència trobes una estació buida quan vols agafar una bicicleta?

Required.
○ Molt sovint
○ Sovint
○ De vegades
○ Gairebé mai
○ Mai

Question 25.
Quan utilitzes el teu telèfon mòbil mentre circules en bicicleta, què fas? Selecciona una o més respostes

Required. Select one or more answers.

☐ Responder trucades
☐ Navegar per internet
☐ Llegir missatges de text rebuts
☐ Buscar informació relacionada amb la circulació (p.e., mapes, informació sobre carril bici, etc.)
☐ Realitzar trucades
☐ Enviar missatges de text
☐ Navegar per la pàgina web de Bicing

☐ Altres: ____________________
dirty data
3 weeks bicing activity
predicting bicing usage
mobile application

Feedback to Bicing

Optimal drop-off station

Optimal pick-up station
auto-load balancing

Real-time Recommendations

Go to Pl. Jean Genet

Automatic Load-balancing System

Real-time Recommendations

40% 45% 50% 75% 90% 95% 60%
Madonna Concert
Cellphone activity in Stadio Olimpico Rome
2006-08-06

At Rome’s Olympic Stadium
Located about three kilometres from the Vatican
During the song Live to Tell...
Madonna appeared against a mirrored cross
7 categories of messages:
- 3 don’t cares (Test, Status, Ack)
- 4 location event types
  - Currently connected cell ID
  - Includes “geodata” flag. If set, the next 4 fields are valid

Unique yet obfuscated ID assigned to mobile for duration of a single call

Currently connected cell ID
preliminary ideas

• Automatic discovery of meaningful places based on cell id (e.g., plaza catalunya)
  – Automatic discovery and classification of routes

• Characterizing phone usage activity based on sensed motion and place

• Compute density patterns in the city
  – Perform similar analysis to real time rome
  – Maybe emphasize pollution?
  – Incorporate bicing, metro, bus data?
per person data

• Predictive modeling of phone usage activity and motion in the world
• Exploration of social network activity with re: to phone calls and sms
• Cluster users based on phone usage (e.g., call length, sms usage, etc.)
• Individual level place / route detection
<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days of Data</td>
<td>31 (but we should have 38 days)</td>
</tr>
<tr>
<td>Message Headers</td>
<td>2,957,964 (100 MB)</td>
</tr>
<tr>
<td>Message Bodies</td>
<td>330,633,935 (25 GiB)</td>
</tr>
<tr>
<td>Message Category</td>
<td>Message Category Description</td>
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<tr>
<td>------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>0</td>
<td>Acknowledgement</td>
</tr>
<tr>
<td>1</td>
<td>Location Event (Original Format – No Event Type)</td>
</tr>
<tr>
<td>2</td>
<td>Location Event (Incl Event Type)</td>
</tr>
<tr>
<td>3</td>
<td>Location Event with two Angles (No Site Type)</td>
</tr>
<tr>
<td>4</td>
<td>Location Event with two Angles (Incl Site Type)</td>
</tr>
<tr>
<td>14</td>
<td>Status</td>
</tr>
<tr>
<td>15</td>
<td>Test</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>

However, this message category does not contain the “Event Type” field which tells us information like SMS vs. phone call.
more on prediction
### Overview of Trip Data

14,468 trips / 240 subjects

<table>
<thead>
<tr>
<th>description</th>
<th>avg.</th>
<th>med.</th>
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</thead>
<tbody>
<tr>
<td>trip distance (miles)</td>
<td>7.7</td>
<td>4.2</td>
</tr>
<tr>
<td>trip time (min)</td>
<td>16.3</td>
<td>11.5</td>
</tr>
<tr>
<td>num trips / day</td>
<td>4</td>
<td>3.9</td>
</tr>
<tr>
<td>num trips / subject</td>
<td>60.3</td>
<td>50</td>
</tr>
<tr>
<td>num days of data / subject</td>
<td>15.1</td>
<td>13</td>
</tr>
</tbody>
</table>

High Level Trip Stats

Greater Seattle Area
After approximately 1 month of observation, the number of repeat trips reaches 50%.
The most frequently traveled route accounts for 12% of a driver’s trips.

The top ten most frequently traveled routes account for 50% of a driver’s trips.

This line represents the hypothetical case where no repeat trips occurred in our dataset.

average cumulative distribution of trips in routes
Thank You!

jonfroehlich@gmail.com