the emission mobilityscope: personalized data collection for agile urban planning

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July 14, 2017
Overview

Motivation

It works!

We used it

And so can you!

Recap and questions
Motivation

It works! We used it And so can you!

Recap and questions
CHESC sustainable transportation projects

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Questions?

- Effect of Uber and Lyft
- Why can’t students bike to relieve overcrowding on buses?
- What about last mile problems?
- How to encourage pooling and dynamic ridesharing?
- How to change people who live within 3 miles and drive?
- How to convince the community to relax parking requirements?
CHESC sustainable transportation projects

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- How to change people who live within 3 miles and drive?
- How to convince the community to relax parking requirements?
But what kind of data?

vehicle-oriented
But what kind of data?

vehicle-oriented

- recent
- uni-modal
- fine-grained
- automatic

freeway sensors
bus-mounted GPS
bikeshare GPS
But what kind of data?

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- semantic (why?)
- perceptual (how?)
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- travel survey
- door-to-door
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Motivation

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Mobilityscope analogy (weak?)
Mobilitiescope analogy (weak?)
Mobilityscope analogy (weak?)
Using a mobilitiescope

≈ 6 exhibitors on building automation
Using a mobilitiescope

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- recommendations for greener travel
Using a mobilitiescope

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- recommendations for greener travel
- carpool match with tinder-like swipes
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- run a real-time challenge for bike to work month
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- mapathons to fill in stress network
Using a mobilityscope

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- recommendations for greener travel
- carpool match with tinder-like swipes
- run a real-time challenge for bike to work month
- mapathons to fill in stress network
- evaluate the impact of temporary changes
It works!
Automatically sensed travel diary
User-initiated perceptual reports

Incident to report? Swipe right to report any positive or negative experiences on this trip. Swipe left for more - Busy? Snooze 30 mins. Annoyed? Mute.

Mute

Snooze

Yes
Motivation

It works! We used it And so can you!

Recap and questions

Gamification for motivation
Aggregated for planning
**Planner-initiated surveys**

This will be auto-filled with your unique user id. This allows us to link your answers with the passively collected data without giving out your email to qualtrics.

c76a04877e5a3b17a449:

Which alternative do you prefer for a bike lane along this stretch of Hearst?

Press home to unlock
Mobilitiescope components

automatically sensed travel diary
Mobilitiescope components

automatically sensed travel diary

combined with semantic data
Mobilityscope components

- automatically sensed travel diary
- combined with semantic data
- user-initiated
Mobilityscope components

- automatically sensed travel diary
- combined with semantic data
- user-initiated
- personalized nudges
Mobilityscope components

automatically sensed travel diary
combined with semantic data
user-initiated
personalized nudges
aggregated for planning
Mobilityscope components

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- combined with semantic data
- user-initiated personalized nudges
- aggregated for planning
- planner-initiated surveys
Motivation It works! We used it Recap and questions
e-mission → bic2cal
Motivation
It works!
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And so can you!
Recap and questions

**e-mission → bic2cal**
**Public leaderboard**

**TOP 10 GROUPS**

Go to **Group section** to learn more about joining a group.

<table>
<thead>
<tr>
<th>POSITION</th>
<th>PARTY</th>
<th>MEMBERS</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Software Defined Party</td>
<td>7</td>
<td>184</td>
</tr>
<tr>
<td>2</td>
<td>PACT Pedalers</td>
<td>8</td>
<td>183</td>
</tr>
<tr>
<td>3</td>
<td>EECS</td>
<td>2</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>LINQS</td>
<td>4</td>
<td>76</td>
</tr>
<tr>
<td>5</td>
<td>I Will Ride</td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td>6</td>
<td>Hariyo</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>7</td>
<td>Joan's Group</td>
<td>5</td>
<td>55</td>
</tr>
<tr>
<td>8</td>
<td>For Better or For Wurster</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Jubaland</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>The Bikers</td>
<td>3</td>
<td>14</td>
</tr>
</tbody>
</table>
Game focused instructions and complex challenges

HOW IT WORKS

1. INSTALL THE APP
   Get started by installing the app and help us spread the word.

2. FORM A TEAM
   Playing with friends is a lot more fun! But don't worry, you can still play solo if you prefer.

3. PICK A CHALLENGE
   There are different challenges for different levels and categories to fit a range of needs and preferences. Everyone is welcome!

4. PLAY!
   Start riding and have fun! When you bike, Emission will make sure your well deserved points are computed automatically. No data input hassle!

CHALLENGES

£-OPTIMIZATION
Can you get your travel to be £-optimal? Short trips (< 5km) are eminently walkable and bikeable, and around campus, faster than driving. This reward function discourages deviations from this optimum, with a simple linear benefit for longer trips.

BABY STEPS
Not sure where to get started? This challenge lists baby steps to get started. From tips on choosing a bike, to recommendations on increasing visibility. Complete your first solo ride and ace the challenge!

LEVEL UP YOUR COMMUTE
Like to be challenged? This challenge starts slow but unlocks new goals as you level up. How far can you go as the going gets tough? See your position on the leaderboard and find out!

RIDE FAR AND OFTEN
Increase biking to campus and Zero Emissions Trips. Pick the days that work for you to walk or bike to campus, and we’ll see whether you met your goal. The more days you commit to, the more points you get, but beware, broken promises cost you points.
**Multi-department, multi-institution team**

<table>
<thead>
<tr>
<th>Technical</th>
<th>Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. Shankari (UCB)</td>
<td>Office of Sustainability (UCB)</td>
</tr>
<tr>
<td>Juliana de Heer (Mills College)</td>
<td>CITRIS (UCB)</td>
</tr>
<tr>
<td>Sunil Thapa (SJSU)</td>
<td>I Will Ride (ASUC)</td>
</tr>
<tr>
<td>Kris Ma (UCB)</td>
<td></td>
</tr>
<tr>
<td>David Culler (UCB)</td>
<td></td>
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</table>
Separate IRB protocol using e-mission as a platform

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Investigator</th>
<th>Title</th>
<th>Start Date</th>
<th>End Date</th>
<th>Status</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-04-6267</td>
<td>David CULLER</td>
<td>E-Mission: Data driven carbon emission reduction</td>
<td>06/22/2014</td>
<td>06/22/2017</td>
<td>06/21/2027 Designated Review</td>
<td>CONTINUING REVIEW</td>
</tr>
<tr>
<td>2016-09-9149</td>
<td>David CULLER</td>
<td>Emission, Habitica, and Bic2Cal: Using gamification to in...</td>
<td>11/20/2016</td>
<td>11/20/2016</td>
<td>N/A Designated Review</td>
<td>NEW</td>
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And so can you!

Recap and questions

Deployment (app store stats)

- ≈ 100 people installed
- iOS app store analytics are confusing
  - Opt-in installation data
  - App units are not opt-in, but 63 → 286!
Deployment (our stats) Aug 15 - Jan 15

137 new app signups
  • android: 22
  • ios: 44
  • "None": 11

71 game signups
  • android: 26
  • ios: 44
  • "None": 1

  • ≈ 7 million location points
  • ≈ 5.5 million (walk/bike/still/...) entries
  • ≈ 1 million battery entries
  • ≈ 34 million total

  • ≈ 50k raw trips
  • ≈ 62k raw sections
  • ≈ 31k cleaned trips
  • ≈ 69k cleaned sections
  • ≈ 2 million resampled locations
  • ≈ 3.3 million total
And so can you!
Studies lead by other researchers

If this platform is being used to collect data for a study conducted by another researcher, for example, from a Transportation Engineering Department, then you will be asked to assent to a separate document outlining the data association, retention and sharing policies for that study, in addition to the policies above. We will make all data, including the mapping between the email address and the UUID, directly available to the lead researcher for the main study. This will allow them to associate the automatically gathered information with demographic data, and any pre and post surveys that they conduct as part of their study. The other researcher may also choose to compensate you for your time, as described in the protocol document for that study.
More complex: customize with extensibility $\propto$ effort

Easy: for short studies

- Custom UI skin
- Standard app functionality
- Shared server
More complex: customize with extensibility $\propto$ effort

Easy: for short studies

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**Medium: for complex collection**
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<tr>
<th>operation</th>
<th>comment</th>
<th>ios</th>
<th>android</th>
</tr>
</thead>
<tbody>
<tr>
<td>createCalendar</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>deleteCalendar</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>createEvent</td>
<td>silent</td>
<td>yes</td>
<td>yes (on Android &lt; 4 dialog is shown)</td>
</tr>
<tr>
<td>createEventWithOptions</td>
<td>silent</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>createEventInteractively</td>
<td>interactive</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>createEventInteractivelyWithOptions</td>
<td>interactive</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>findEvent</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>findEventWithOptions</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>listEventsInRange</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>listCalendars</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>findAllEventsInNamedCalendars</td>
<td></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>modifyEvent</td>
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<tr>
<td>deleteEvent</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>deleteEventFromNamedCalendar</td>
<td></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>openCalendar</td>
<td></td>
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```
$ cordova plugin add cordova-plugin-calendar

// find events (on iOS this includes a list of attendees (if any))
window.plugins.calendar.findEvent(
  title,
  eventLocation,
  notes,
  startDate,
  endDate,
  success,
  error);
```
Motivation
It works! We used it And so can you!

More complex: customize with extensibility \( \propto \) effort

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**Hardest: for full data control**
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- Custom plugin list
- Custom Server install
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```
C02KT61MFFT0:e-mission-phone shankari$ ionic plugin cordova-plugin-app-version 0.1.9 "AppVersion" cordova-plugin-compat 1.1.0 "Compat" cordova-plugin-console 1.0.5 "Console" cordova-plugin-crosswalk-webview 2.3.0 "Crosswalk Webview" cordova-plugin-customurlscheme 4.2.0 "Custom URL scheme" cordova-plugin-device 1.1.4 "Device" cordova-plugin-email-composer 0.8.3 "EmailComposer" cordova-plugin-file 4.3.1 "File" cordova-plugin-inappbrowser 1.6.2-dev "InAppBrowser" cordova-plugin-registerusernotifications 1.0 cordova-plugin-whitelist 1.3.1 "Whitelist" cordova-plugin-x-socialsharing 5.1.6 "SocialSharing" de.appplant.cordova.plugin.local-notification-ios9-edu.berkeley.eecs.emission.cordova.auth 0.0.1 "JWTAuth" edu.berkeley.eecs.emission.cordova.comm 0.0.1 "Server" edu.berkeley.eecs.emission.cordova.datacollection 0 edu.berkeley.eecs.emission.cordova.serversync 0.0.1 edu.berkeley.eecs.emission.cordova.settings 0.0.1 "Server" edu.berkeley.eecs.emission.cordova.transitionnotify 0 edu.berkeley.eecs.emission.cordova.unifiedlogger 0 edu.berkeley.eecs.emission.cordova.usercache 0.0.1 ionic-plugin-deploy 0.6.5 "IonicDeploy" ionic-plugin-keyboard 2.2.1 "Keyboard" phonegap-plugin-push 1.9.3 "PushPlugin"
```
Recap and questions
What’s next

✓ Come up with a benchmark for travel diaries
✓ Evaluate e-mission + others using benchmark
✓ Personalized models for semantic labels
✓ Privacy-preserving aggregation
Recap

✓ I have built a first version of a complete mobilityscope.
✓ It has a lot of cool features that you can play with.
✓ It is open source and extensible, so you and your students can use it in interesting ways that are relevant to your campus.
✓ How would you like to use this? Tell me!

Thoughts? Questions?
https://e-mission.eecs.berkeley.edu