Supporting mobility analysis with crowd-sourced data - Opportunities and challenges

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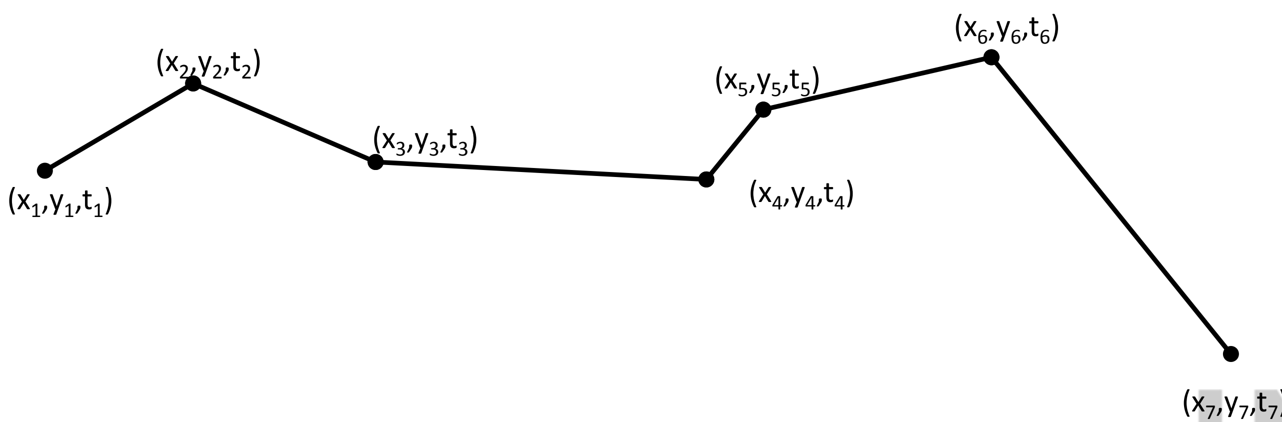
Problem and objective (1)

Mobility in real world

Individual trajectory

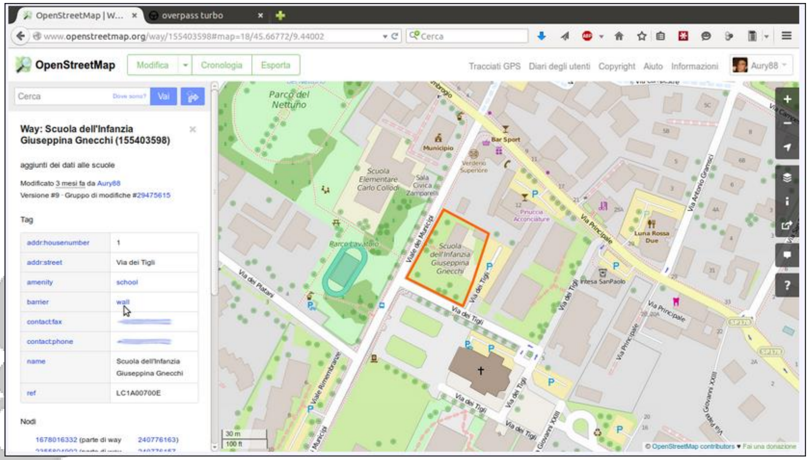


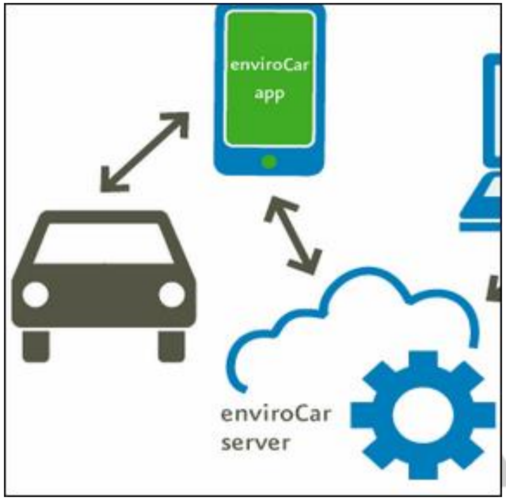
Problem and objective (2)

- Mobility data are used in many applications
  - Transportation: traffic management, routing
  - Urban planning: land use and infrastructure utilisation monitoring
  - Environment: air pollution and noise pollution control
  - Business: advertisement, choice of new business location
  - …
- However, such applications require high level information:
  - characteristics of places visited
  - events that took place at the time of visit
  - characteristics of the geographic space where the movement took place
  - ...
- Surveys are expensive to deliver such information
- Manual annotation by the moving individuals is not feasible
- What about crowd-sourcing?

Opportunities (1)

- Increasing people's participation to producing geo-referenced crowdsourced data





Opportunities (2)

- Produced crowdsourced data are rich in semantics
  - social network data
    - main data + social structure
    - Social structure given a high importance
    - Example:

      check-ins (https://foursquare.com/)

      mainly text (http://www.twitter.com/)

      mainly text (http://www.facebook.com/)

      photos (http://www.flickr.com/)
  - contribution-focused data
    - main data (+ social structure)
    - If available, social structure given low importance
    - Example:

      noise level data (http://www.noisetube.net/#&panel1-1)

      vehicle emission data (https://www.envirocar.org/)

      pleasantness of urban locations (http://urbangems.org/)

      geo-referenced pages (http://en.wikipedia.org/wiki/Main_Page)

      geographic features (http://www.openstreetmap.org)

Opportunities (3)

- Availability of APIs for accessing crowd-sourced data

- Root
- Friends
  - /users/:username/friends
  - /users/:username/friends/:friend
- Tracks
  - /tracks
  - /tracks/:trackid
  - /users/:username/tracks
  - /users/:username/tracks/:trackid
- Phenomenons
  - /phenmenons
  - /phenmenons/:phenomenon
- Sensors
  - /sensors
  - /sensors/:sensor

The Flickr API is available for non-commercial use by outside developers. Commercial use is possible by prior arrangement.

Read these first:

- Developer Guide
- Overview
- Encoding
- User Authentication

- Dates
- Tags
- URLs
- Buddyicons

- Flickr APIs Terms of Use

- API Keys
- Developers' mailing list

API Methods

activity

- flickr.activity.userComments
- flickr.activity.userPhotos

auth

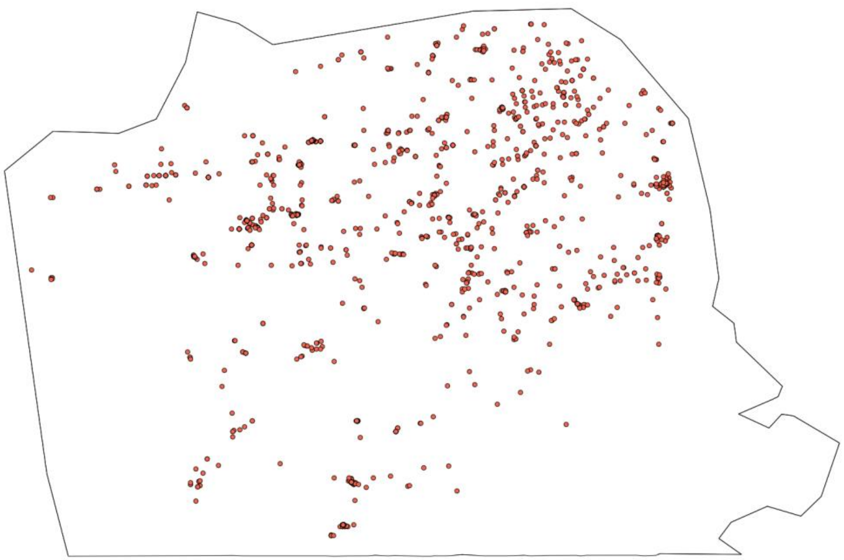
- flickr.auth.checkToken
- flickr.auth.getFrob
- flickr.auth.getFullToken
- flickr.auth.getToken

auth.oauth

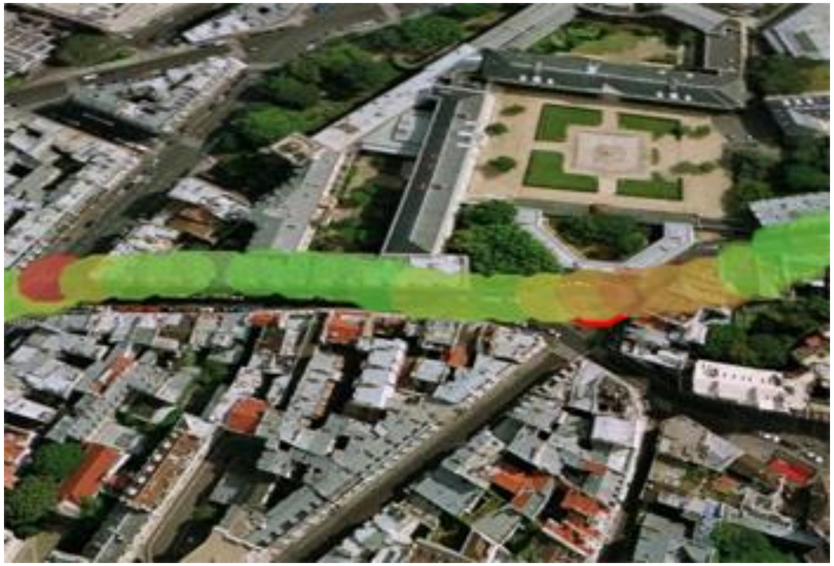
- flickr.auth.oauth.checkToken
- flickr.auth.oauth.getAccessToken

Challenges (1)

- Data sparsity



- Data representativeness



Challenges (2)

- Limitations associated with the available APIs, e.g:
  - In Foursquare, view friends of an individual but can not view the check-ins of a specific user
  - In Flickr, limit at 3600 queries per hour and per key
- Motivation
  - contribution-focused data may require:
    - acquisition of specific devices (e.g. sensors)
    - more efforts
  - for social network data
    - Establishing and maintaining a network is a one motivation

→Need for (further) motivation

Challenges (3)

- Incompleteness due to limited quality control

- Location uncertainty due to:
  - accuracy of the device used for location recording
  - processing done at the crowdsourcing platform that can filter or modify geographic information
  - the credibility of the user generating the data who can change geographic coordinates intentionally
  - the difference between user and content locations e.g. a Flickr photo showing Mount Everest with coordinates on a another mountain

Addressing the challenges (1)

- Collaborative filtering (CF) for addressing data sparsity
  - commonly used in recommendation systems
  - idea behind: similar users make ratings in a similar manner for similar items.

  →similarity is determined between users and between items, a prediction can be made to the rating of a user about future items (Nakamura and Abe, 1998)

- Data pre-processing for addressing the uncertainty
  - *Filtering* outlying data items and those of obviously wrong locations or values
  - *density of contributions* as one indicator of the level of certainty

Addressing the challenges (2)

- Integrating data from multiple sources for addressing data representativeness, incompleteness, and sparsity

  – But addressing also the problems due to the integration

    e.g. Conflicting information solved by a voting strategy (Li et al. 2013)

  – Evaluate different integration approaches to choose most effective and best performing

Addressing the challenges (3)

- Implementing incentive mechanisms for addressing the motivation challenge:

- Choose suitable incentive mechanisms from available proposals (examples in Quinn and Bederson, 2011)

- Further examples:
  - Crowd-sourcing platforms imparting reputation to contributors indirectly
  - Providing interesting applications based on contributed data with additional features for contributors, and advertising these features

Conclusion

- Crowd-sourced data have a high potential to support mobility analysis.
- However, several challenges need to be addressed.
- Our future work will concentrate on challenges related to integrating data from multiple sources:
  - Applying ontological modelling approaches for simplifying the integration
  - Integrating social network activities of a user from different social platforms to fill the gap caused by using only one source

Thank you for your attention

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