Automatically Characterizing Places with Opportunistic CrowdSensing using Smartphones

David Muchene

Computer Science Dept.
Worcester Polytechnic Institute (WPI)
Introduction

- Smart phones have a variety of new sensors
- Location is still the most widely used contextual information in most applications
- Need to abstract out the notion of “place” from location data
Contributions

- CrowdSense@place (CSP)
  - A framework that characterizes places using opportunistically acquired images and audio
  - Basic idea is that Images contain hints and CSP can extract these hints and use them in the classification
  - Classify into more categories than current approaches
- A novel modeling approach that combines image, audio, and traditional location sensors
Existing Approaches

- Discover places by mining user’s trajectory
- Label discovered places (e.g. mall, drug store)
  - Either User input, or by leveraging databases like Bing, Yelp or FourSquare
- Problem is that GPS/WiFi location estimates could have large margins of error
  - GPS is especially terrible indoors
System Overview

- Smart phone App and an offline server to process collected data
- App runs as a daemon and continually fingerprints WiFi Access points to detect places
- Opportunistically sample image and audio sensor
  - For example when a user receives a phone call
- Bootstrap the image and audio classifications using user input.
System Overview

- Indoor Scene Classification
- Object recognition
- OCR
- Speech Recognition
- Place modeling
System Overview

Figure 2. CrowdSense@Place processing stages.
Evaluation

- Recruited 36 users living in 5 locations
- Measured accuracy of place categorizations
- Used GPS data and Mobility
  - GPS data is fed into FourSquare
  - Mobility uses trajectory to do place classification
- Client was implemented using Android SDK 1.5
- Backend on Microsoft Azure
## Results

### Table 3. Confusion matrices of place categories for Mobility and CrowdSense@Place.
Future Work and Conclusions

- Finer place classification
  - Better use of the object and speech recognition
- Privacy
  - Perform more local computation to avoid leaking private information
- Applications
  - Better Local search, recommendations, targeted advertising, etc.
  - Understand large scale behavior patterns to gain insights about cities
References

- Automatically characterizing places with opportunistic crowdsensing using smartphones. Yohan Chon, Nicholas D. Lane, Fan Li, Hojung Cha, and Feng Zhao