Ubiquitous and Mobile Computing
CS 403x: CrowdSense@Place

Yo Karita
Steven Ireland
Johnny Hernandez

Computer Science Dept.
Worcester Polytechnic Institute (WPI)
Motivation

• Location sensors: Most successful and widely used sensor in mobile computing
  • Local Search
  • Point-Of-Interest services
  • Navigation
  • Geo-tagging
• Location data and “Place”
  • Giving context to location
  • Link locations with categories or actions
• Location and Context based apps
• Activity recognition
CrowdSense@Place

- Framework for categorizing locations
- Uses opportunistically collected data
  - Phone calls, check email, browse the web, etc
- Analyze image and audio data to infer hints
  - Image data: Written text, objects
  - Audio data: Spoken words
- Places are categorized using most dominant topic
CrowdSense@Place

- Existing Approaches
  - Point-Of-Interest databases
  - Location based community-generated content
- Problems
  - GPS Inaccuracy
- Solve this by relying on other sensors
Related App

- Application improves point-of-interest search recommendation
- Both use audio data from microphone
- VibN requires users to analyze audio clips
- Techniques in CSP could be applied in VibN’s manual stages
Sensors Used

- **Opportunistic Sensing**
  - Camera
    - Takes pictures of the area
  - Microphone
    - Records conversations/sounds in the area
- **Identifying “Places”**
  - WiFi
    - Uses radio fingerprinting of nearby access points
  - GPS
    - Location tied when encountering a place for the first time
Methodology

- Smartphone Client
  - Background process
  - Privacy configuration
- Server Side Classification
  - Object recognition
  - Indoor scene classifier
  - OCR
  - Speech recognition
  - Sound event classifier
Privacy

- Users have rights to control sensitivities
- All data stays in the smartphone for 24 hours
- Remove all data collected for previous 1, 6, or 24 hours
- Pause data collecting
  - For upcoming time interval
  - Location based
Results

- Outperforms GPS and Mobility by 40% and 22%
- 69% Overall Accuracy
- Better at distinguishing college and workplace than Mobility alone
- Food and Shopping locations have good OCR detection
Accuracy

- Hard time differentiating between entertainment and food
- Some locations have more than one category
Classifier Effectiveness

- GIST and OCR had the strongest discriminative value
- Object detection only effective outside
- Speech recognition and sound classification have weak discriminative power

Figure 6. Accuracy of different classifiers used by isolation.
Limitations and Future Work

- Finer grain categorization can occur with specific place hints
- Better privacy protection
- Better suited to incrementally learning information over long time scales
Potential Uses

- Enhanced recommendation services
- Crowdsourced point category maps
- Category to category behavior patterns
Questions?