SurroundSense: Mobile Phone Localization Using Ambient Sound and Light

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1. Goals
- Mobile phone Apps need location:
  - Location expresses relevance of information
  - E.g., Location-specific advertising, GeoTagging data, MicroBlog ...
- Physical Localization unsuitable
  - GPS accuracy around 30m
  - Cannot distinguish two adjacent contexts
  - E.g., Is user located in Starbucks, or adjacent RadioShack
- Localization needs to be logical

Hypothesis
It's possible to localize phones by sensing ambient data such as sound, light, images, ...

2. Intuition
- Proximate locations likely to have diversity in ambiences
  - Not profitable to spatially cluster businesses with similar look & feel
  - Ambiance diversity available by design

- Develop photo-acoustic fingerprint for different locations
  - Fingerprint consists of sensed sound/light from user's location
  - A database of fingerprints stored on a server
- Phone transmits sensed photo-acoustic fingerprints
  - Client-server communication in real time
- Phone location computed
  - Using simple classification algorithms

4. Prototyping
- We used Tmote motes on behalf of mobile phones
  - Equipped with light sensor and microphone
- Mobile phones expected to be more powerful
  - Better audio sensing (Larger freq. range than 20-250Hz)
  - Better light sensing with camera

5. Ongoing Work
- Porting SurroundSense on Nokia N95s
- Sophisticated fingerprint generation
  - Images, accelerometers, compasses, P2P ...
- Energy implications
- Exhaustive training and testing
  - Correlation to time of day, lighting, sub-store localization ...

Fingerprint matching works well in Duke Campus