



# 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
  - Remarkable precision necessary to discern
  - Such precision unlikely on cheap phones
- ❖ **Localization needs to be logical**

## Hypothesis

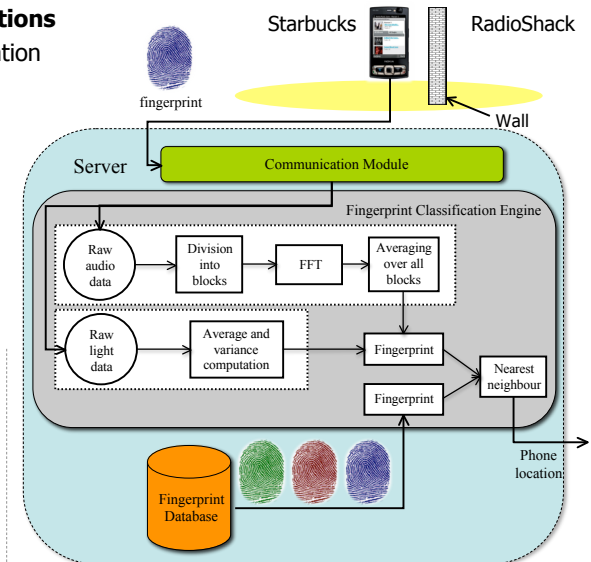
Its possible to localize phones by sensing ambient data such as sound, light, images, ...

## 2. Intuition

- ❖ **Proximate locations likely to have diversity in ambiances**
  - Not profitable to spatially cluster businesses with similar look & feel
  - Ambiance diversity available by design

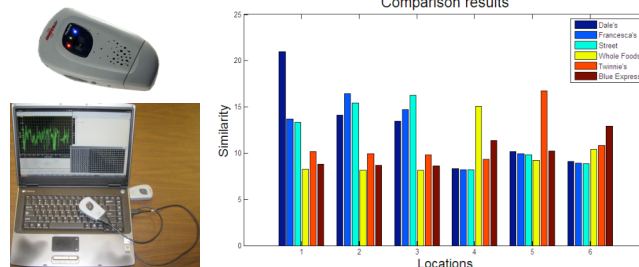
## 3. SurroundSense: Basic Idea, Architecture, Algorithms

- ❖ **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 nodes 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



Fingerprint matching works well in Duke Campus

## 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 ...