LECTURE 12: SENSING PRESENCE

Sensing Presence vs Sensing Location

- X,Y,Z vs Proximity
- Location is mostly a solved problem outdoors
- Presence is mostly associated with indoors spaces
- Indoor areas require a new approach

Infrastructure vs Infrastructure-less

- Existing infrastructure
  - WiFi
  - Cellular
- New infrastructure
  - Bluetooth (Beacons)
  - Specialized Wifi
  - Other
- No infrastructure needed
  - Geo-Magnetism
  - Dead reckoning (existing sensors in device)

WiFi

- Triangulation / Trilateration (based on access points)
- Fingerprinting (requires at minimum an initial scan)
- Uses existing infrastructure (likely)
- Mobile device initiated vs Access Point initiated
- Specialized hardware/software from manufacturers
- The more overlapping access points the more unique the fingerprint
- Updating fingerprints important for changing environments

Bluetooth Low Energy (LE)

- Beacons (iBeacons)
- Bluetooth without beacons
- Requires new infrastructure (beacons)
- Low power
- Beacons advertise themselves, receivers detect advertisement
- Apple’s solution (iBeacons) focuses on 4 proximity states: Unknown, Far, Near, Immediate

RFID

- Radio-frequency identification
- Broad range of frequencies
- Different frequencies have different costs, regulations, range
- Infrastructure needed, tags and readers
- Usually tags are cheap and small, powered temporarily by reader which receives identification data

Geo-Magnetism

- Based on anomalies in magnetic fields
- Buildings have unique magnetic landscape based on interaction between geo-magnetic fields and the steel structures
- No infrastructure needed
- Uses magnetometer available in most smartphones

Acoustics

- Uses echolocation
- Device emits a sound and listens for the echo which is distorted based on shape and size of room
- Each space has a unique “soundscape”
- Need to filter out transient and background noises

Sensors

- Dead reckoning
- Inertia
- Uses sensors that are likely already in device, accelerometer, gyroscope,etc
- Easy to lose proper track of position and direction
- Likely best as a auxiliary to other technologies

Combination

- Many commercial solutions are a combination of multiple technologies
- Usually a combination of WiFi fingerprinting and bluetooth beacons
- Apple and Google use WiFi fingerprinting and device sensors

Indoor location

- Interesting problem space to compare various technologies
- Lots of startup companies utilizing different technologies to provide indoor positioning systems
- Largest number focused around WiFi and Bluetooth beacons
- Retail a major focus
- Cost vary
- Many utilize a combination of WiFi and Bluetooth
- Bigger companies getting involved, mostly by purchasing startups
- Accuracy varies among technologies
- Need an interior map to make worthwhile

Group Activity

- Split into groups
- Come up with an application requiring presence detection
- Answer following points:
  - Purpose
  - Intended audience
  - What technology would you want to try?
  - Anticipated issues
  - How would you address privacy concerns?