P-Loc: A Device-free Indoor Localization System Utilizing Building Powerline Network

Tian Zhou[+] , Yue Zhang[+], Xinlei Chen[*], Hae Young Noh[*], Pei Zhang[*], Lin Zhang[+] , Khalid M. Mosalam[#]

TBSI Tsinghua-Berkeley Shenzhen Institute + Carnegie Mellon University * Berkeley UNIVERSITY OF CALIFORNIA #

Abstract: To deal with the occupant indoor localization problem, we propose P-Loc, which utilizes the existing powerline network inside the building as the antenna to sense the occupants.

Motivations

❒ **Occupant indoor localization**

- User preference, occupancy estimation & space optimization

❒ **Limitations of current methods**

Global infrastructure based: GPS …

✗ Blockage of satellite signals within a building.

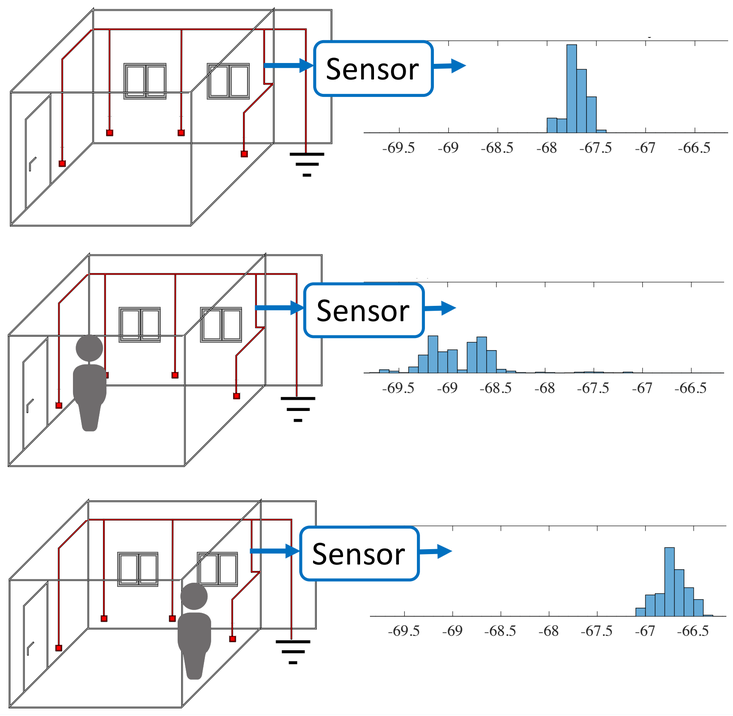
Local infrastructure based: Camera, PIR, UWB…

✗ Large deployment and maintenance costs.

- Wearable based: Smartphones…

✗ Easily forgotten and needs charging.

Powerline - Viewed as Antenna



Human body movement -> Signal changes along the antenna

Sensing module

❒ Signal injection

- Which wire? Live, neutral, **earth**
- Inject a periodic signal into the earth wire for **safety**
- Follow Chinese regulation

System Overview

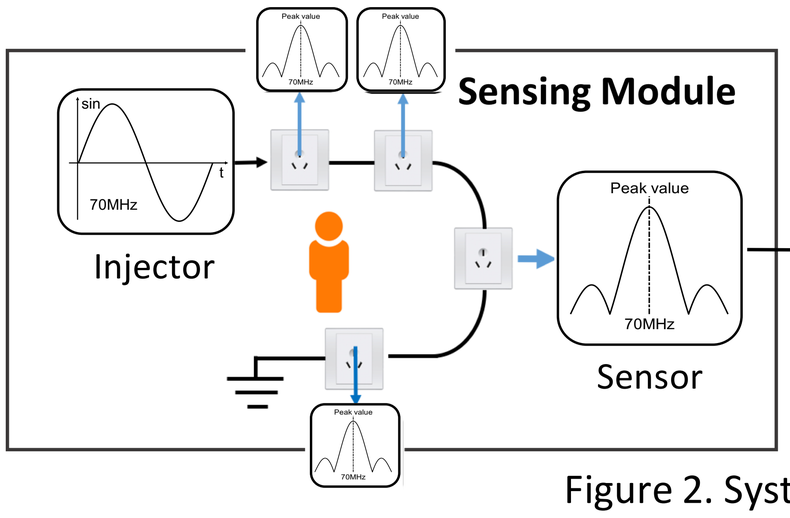


Figure 2. System Overview

Feature extraction

❒ Environmental change removal

❒ Location feature extraction

Decision making

❒ Location classifier

❒ Trace prediction:

✓ **Map compensation** (HMM).

Evaluation & Results

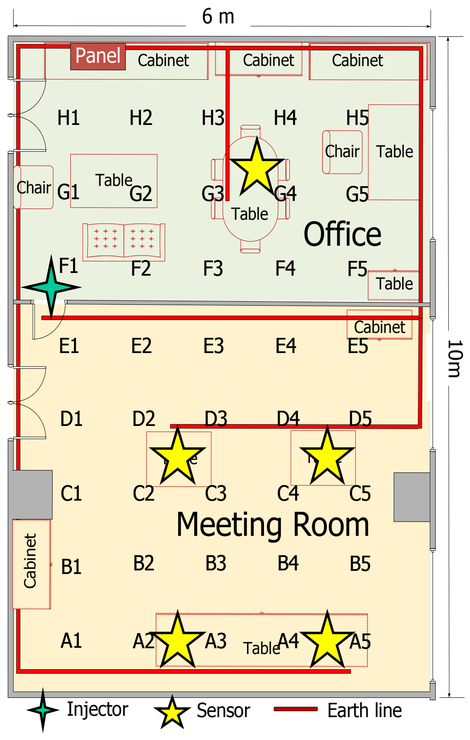
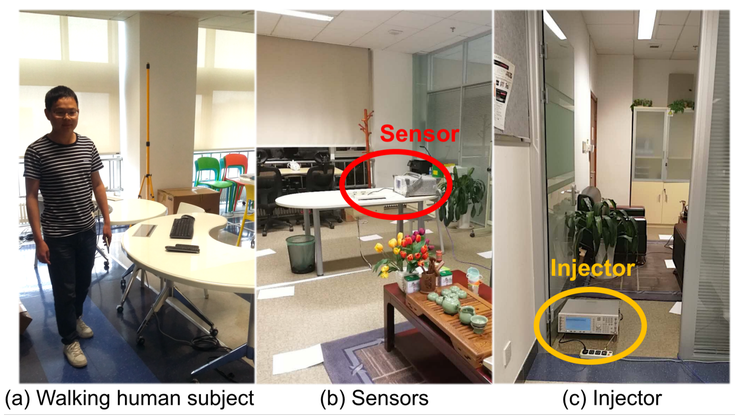
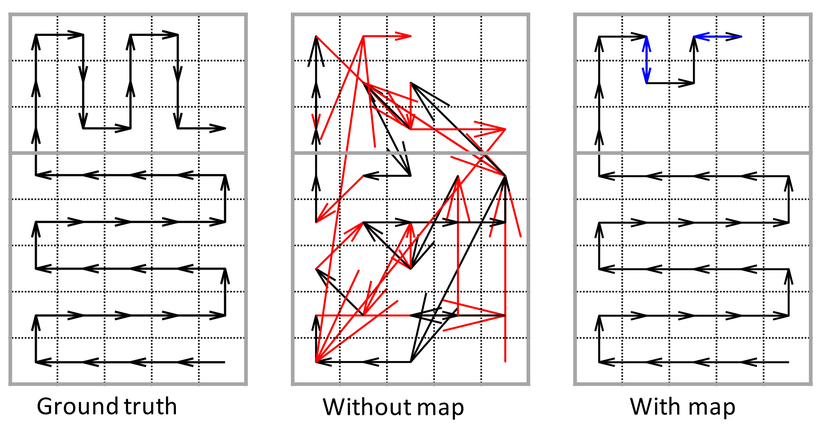


Figure 3. Deployment



(a) Walking human subject (b) Sensors (c) Injector

Figure 4. Experiments



Ground truth Without map With map

Figure 5. Tracking result

❒ Testing area

- Top floor of Tsinghua Rohm Building
- A meeting room and an office room
- 38 cells (1.2m × 1.2m)

❒ Data collection

- A 70MHz, 10dBm sine wave injection
- Sensors are placed at 5 sockets (power spectrum analyzer of 4Hz)
- Occupant moves along a predefined trace

❒ Performance

- Without map: 67.86%
- With map: **92.86%**

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

UC Berkeley • Caltech • OSU • Stanford • UC Davis • UC Irvine • UC Los Angeles • UC San Diego • UNR • USC • U Washington

peer.berkeley.edu