Tack: Learning Towards Contextual and Ephemeral Indoor Localization With Crowdsourcing

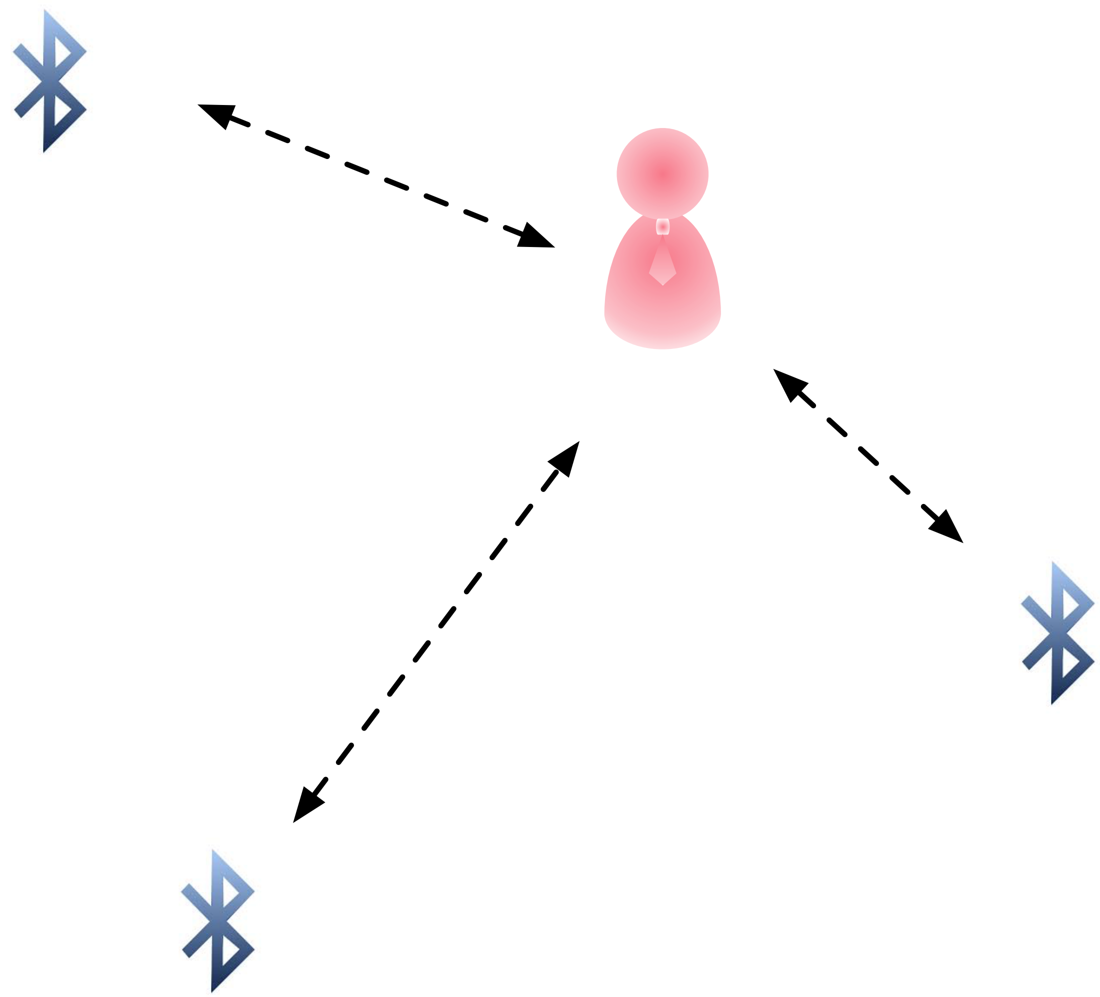
Liyao Xiang
ECE Dept.
Nov. 24, 2017

Indoor Localization

- Traditional localization infrastructure is costly.
- Most user devices are common smartphones.
- We want accurate and cheap indoor localization solutions!

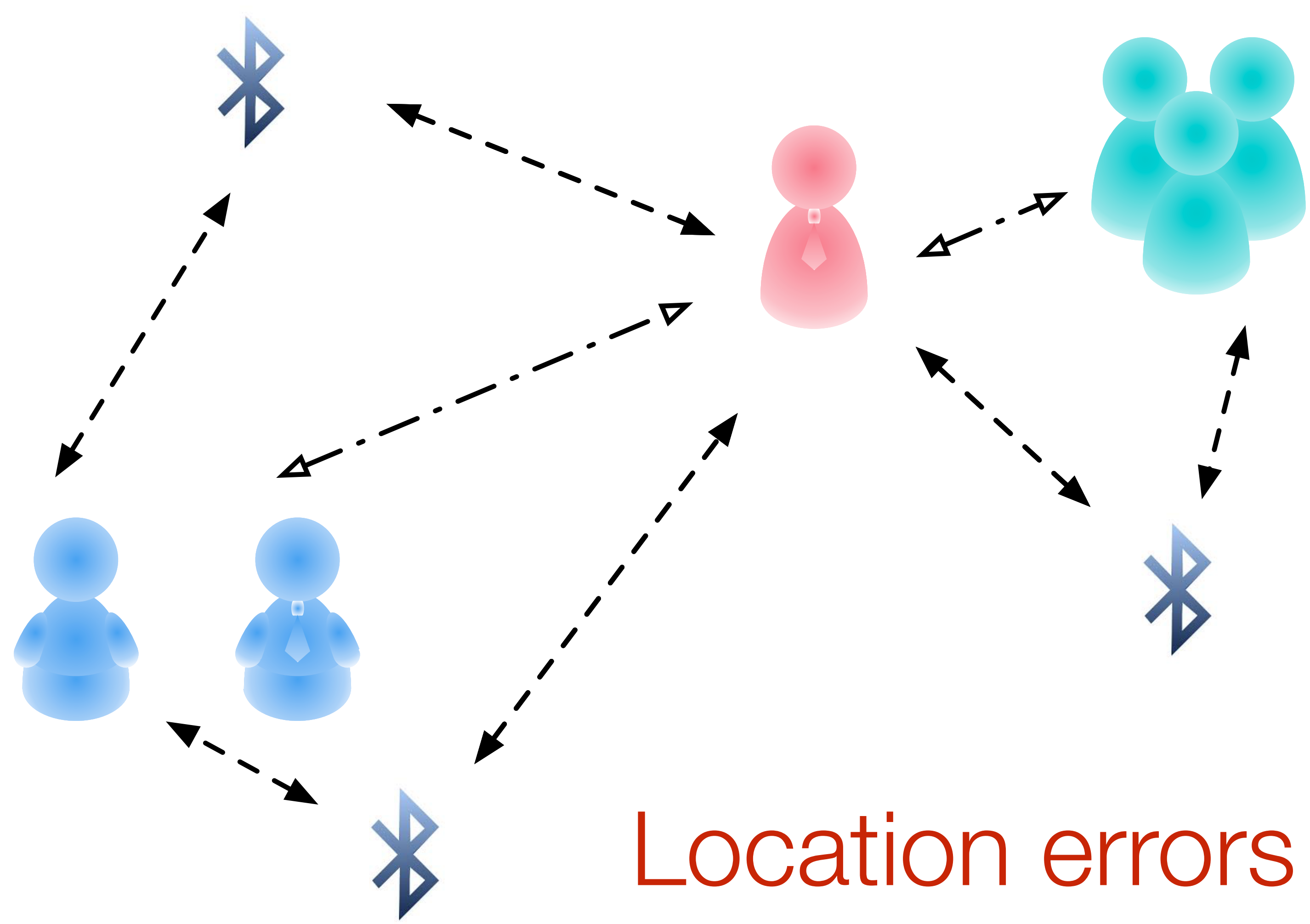
Localize by Bluetooth Signals

- Bluetooth transmitters (<10$, 50+m range)
- Users detect Bluetooth signals for positioning.



Localize by Crowdsourcing

- Use encountering info to further enhance accuracy.



Location errors propagate!

Probabilistic Inference

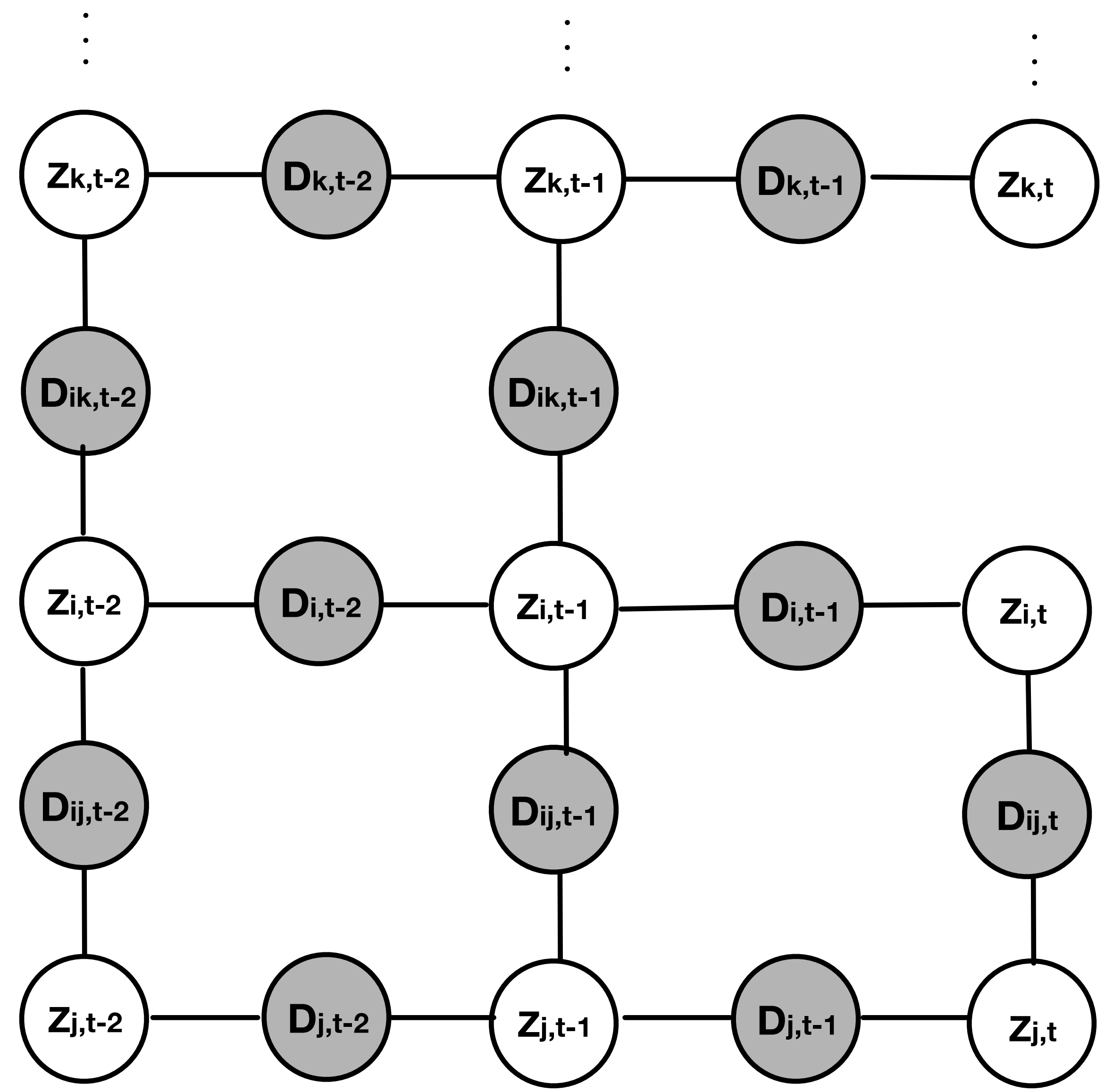
- User/Bluetooth transmitter locations as clear nodes, and their encountering state with other users/transmitters as dark nodes.

Probabilistic Inference

- Update the most likely position of the clear nodes repeatedly with probabilities conditioned on the state of dark nodes.

Probabilistic Inference

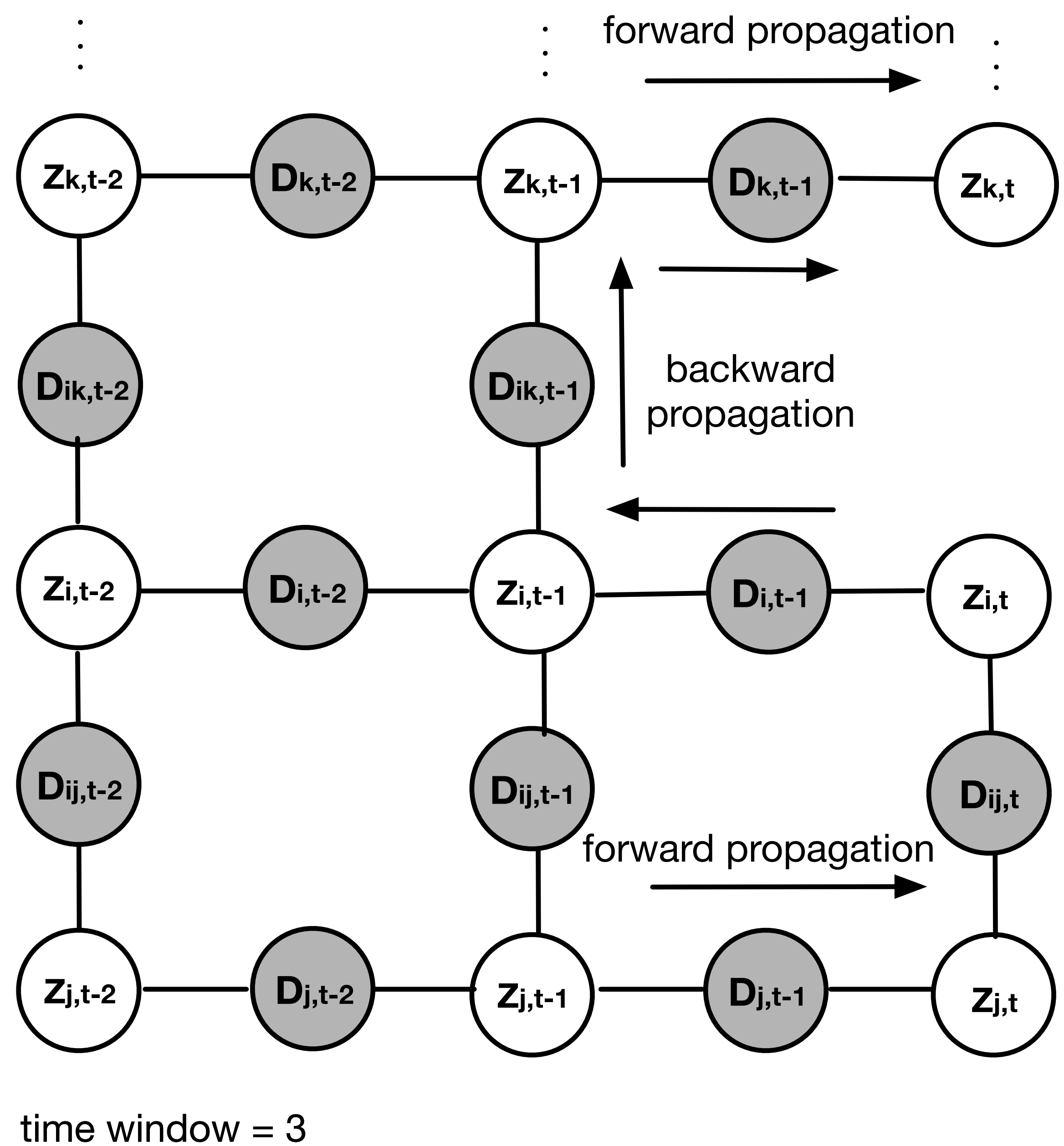
- Expand the inference to incorporate each node's history.

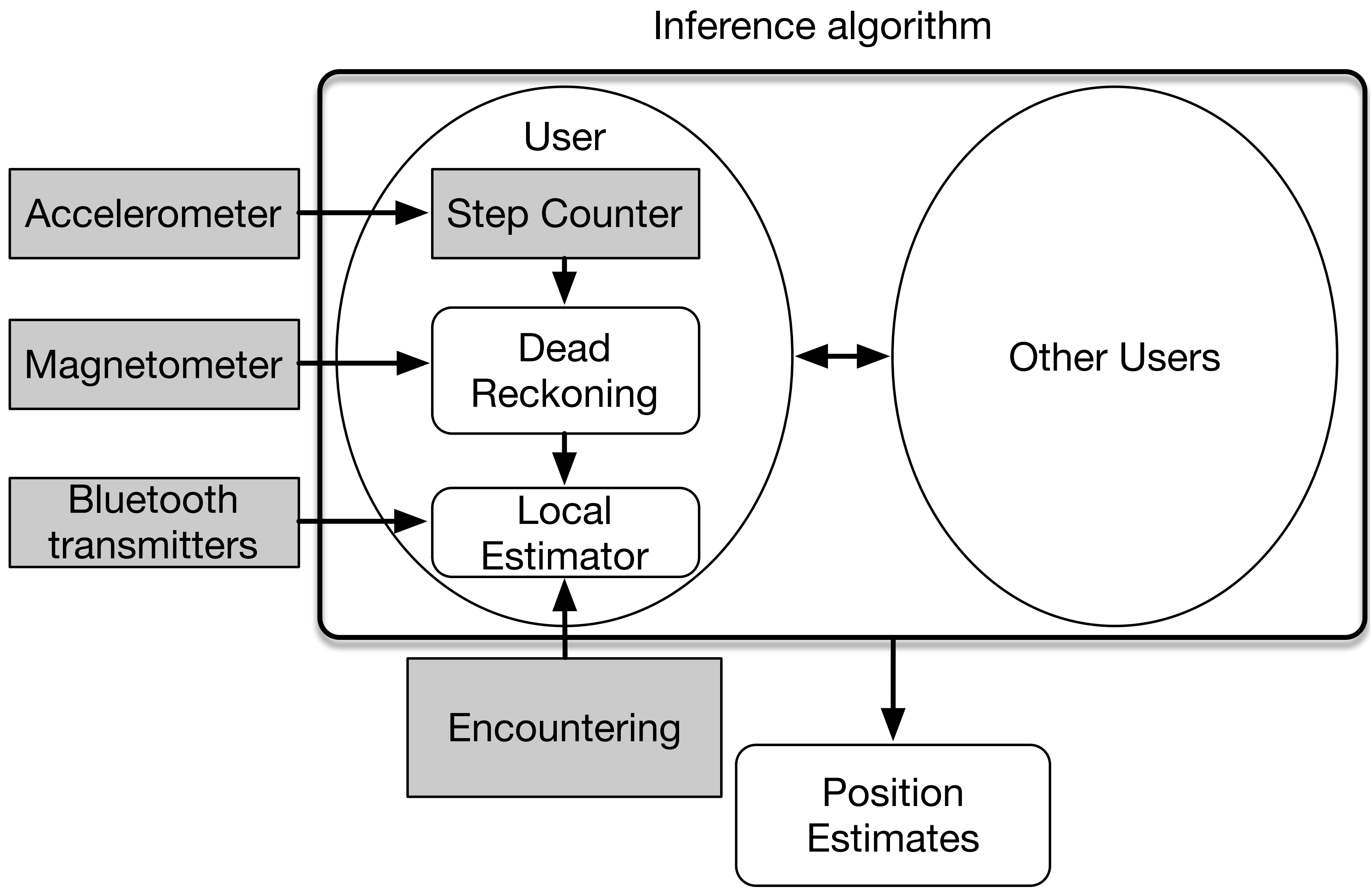


time window = 3

Probabilistic Inference

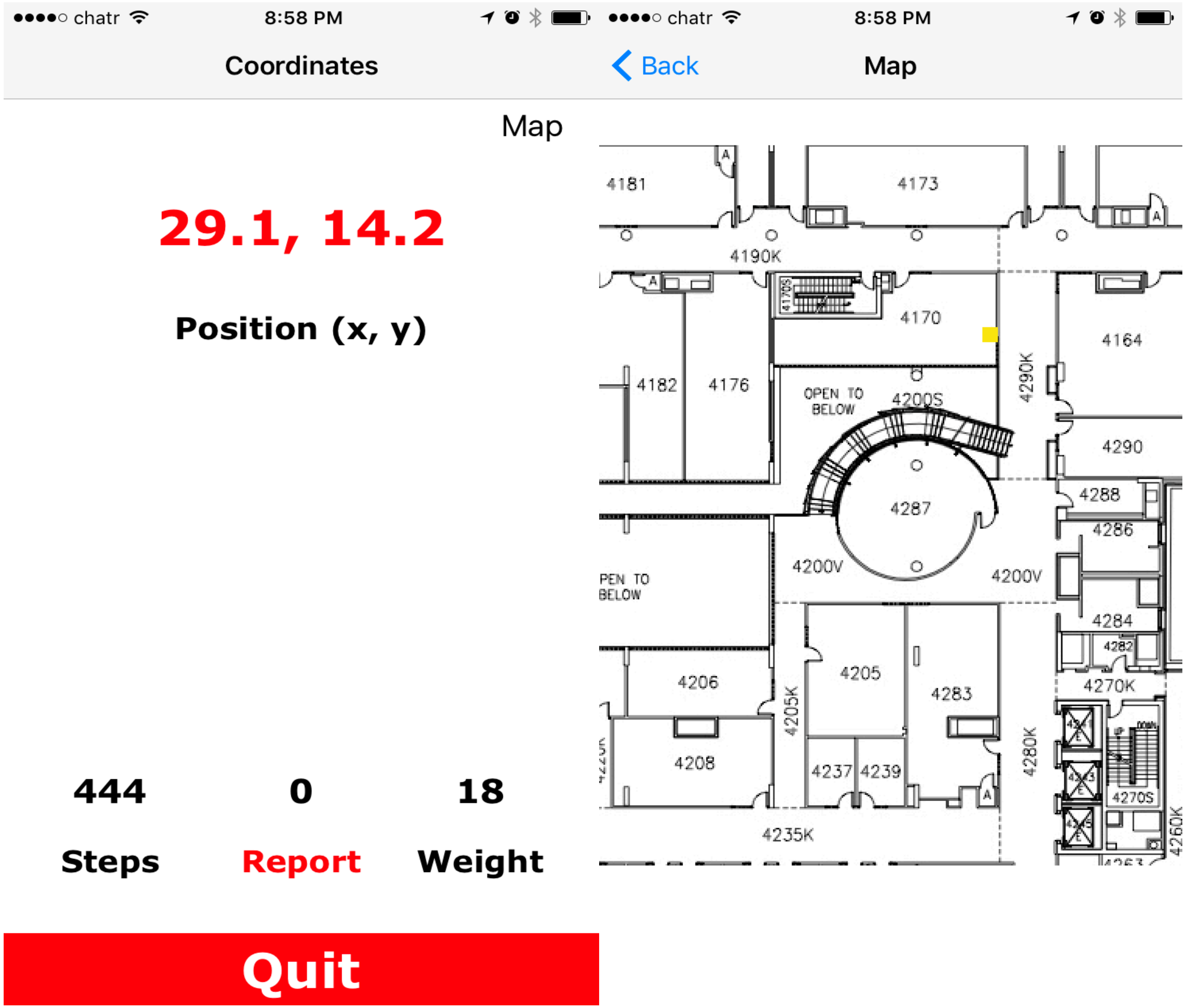
- We not only estimate current locations, but also correct history locations.
- The more information included, the more accurate localization.





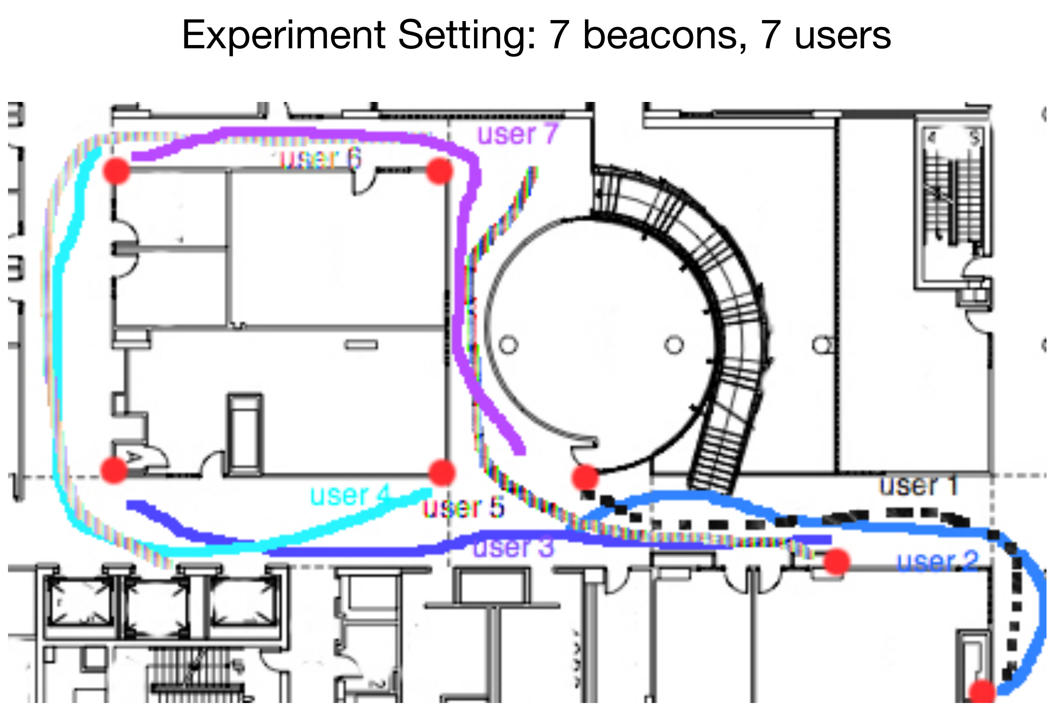
Architecture

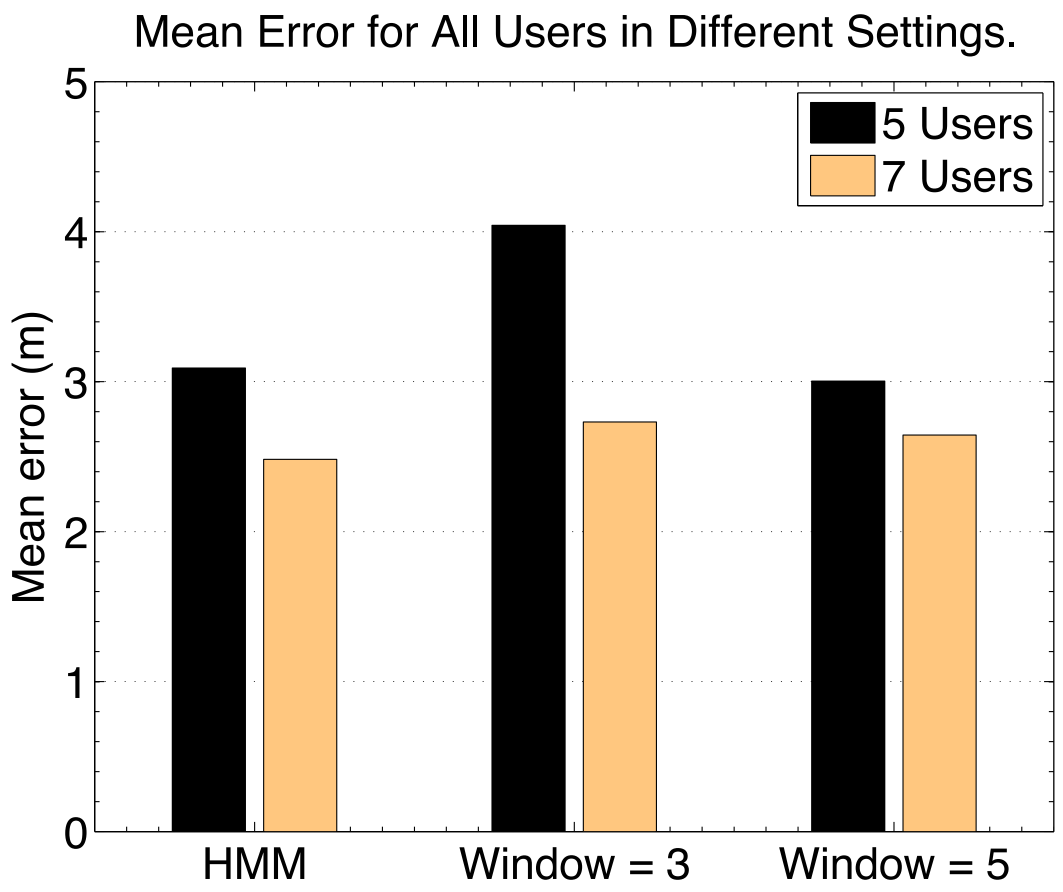
With code-level optimization, common smartphones can support our algorithm.



User Interface

Run on iOS.





Mean/(STD)	WiFi	1 User	4 Users	7 Users	10 Users
1%-dropping time (s)	80.62	198.33	185.0	172.25	153.75
Localization latency (s)	–	0.34/0.14	0.44/0.11	0.58/0.13	0.73/0.18

Results

Tested on iPhone 6S.

Tack: Takeaway

- inexpensive (< 10$ transmitter costs, > 2 years)
- accurate (2~4m)
- energy-saving (40% less smartphone battery)
- easy to deploy

Thank you!

Any questions?