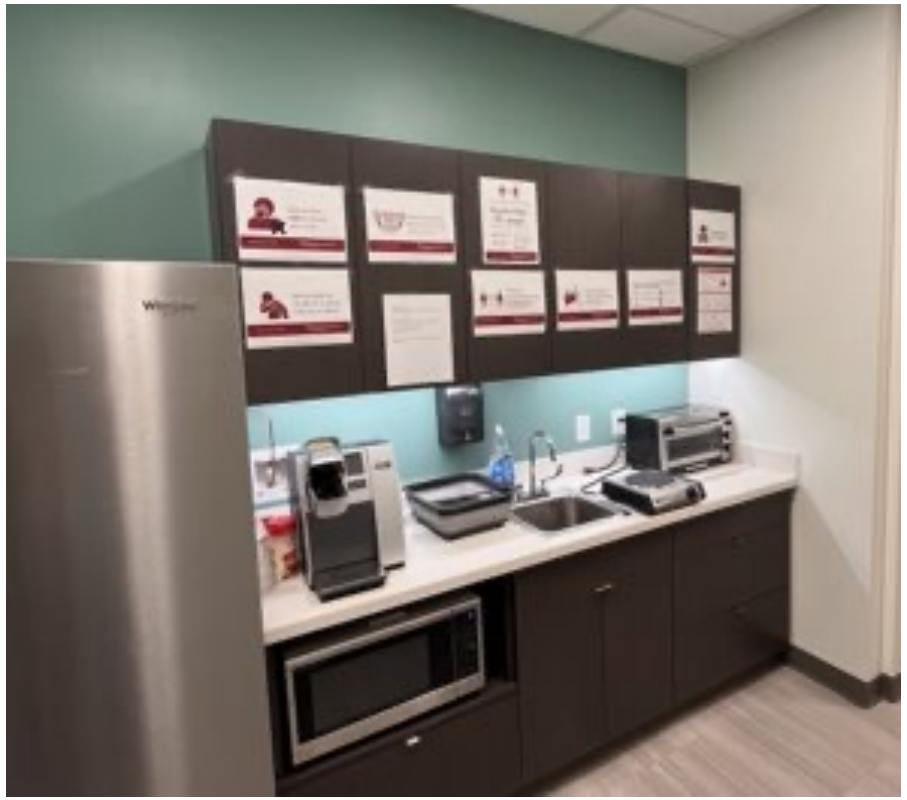
Project Topics

Ruiqi Wang, Yejin Lee, Jingwen Zhang

8/31/2023

Project Topics

- The course project is inspired by the **"Smart Kitchen"** project.
  - Collaboration with *Program in Occupational Therapy, Washington University School of Medicine.*
  - A combination of **AI and IoT** for Medicine.



Agenda

- Backgrounds and Implications of Smart Kitchen (Yejin Lee, PhD)
- Goals
- Project ideas
- Free discussion and Finding a teammate.

Background of Smart Kitchen

Yejin Lee, PhD

Project Goals



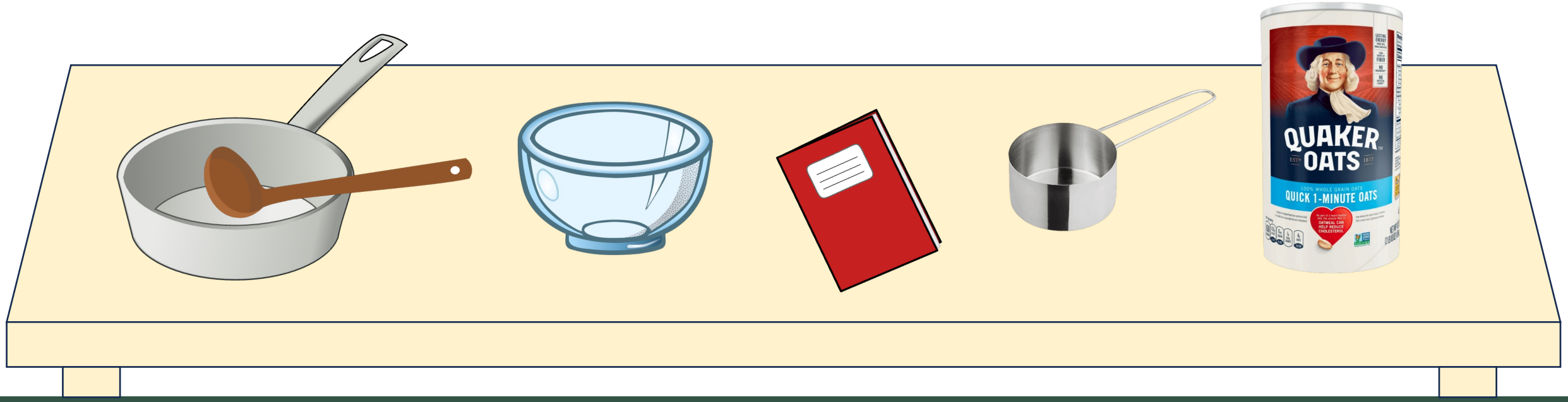
Goals

- To cook an oatmeal, we need to collect the correct tools.

Items Required	Distractors
• Oats • Salt container • Pan • Spoon • Measure Cups • Bowl	• Book • Screwdrivers • …

Goals

- To build an IoT system that can detect **if the required items are correctly taken on the table**.
  - ***True*** if all the required items are on the table without distractors.
  - ***False*** if any required item is missing or any distractor is on the table.
    - **What is missing and what is not needed?**

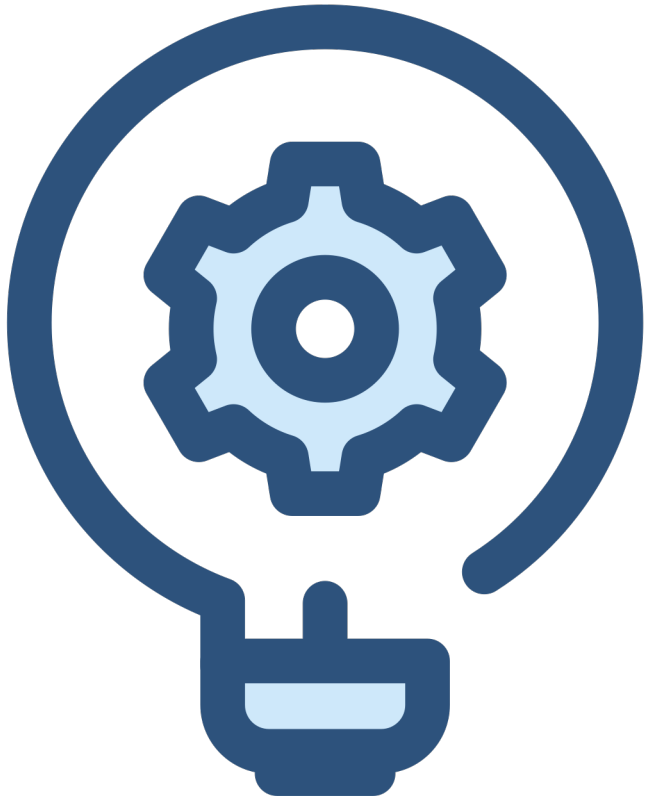


Testcases

Here are some standard cases to verify the effectiveness of the system. For example, on the table, there are:

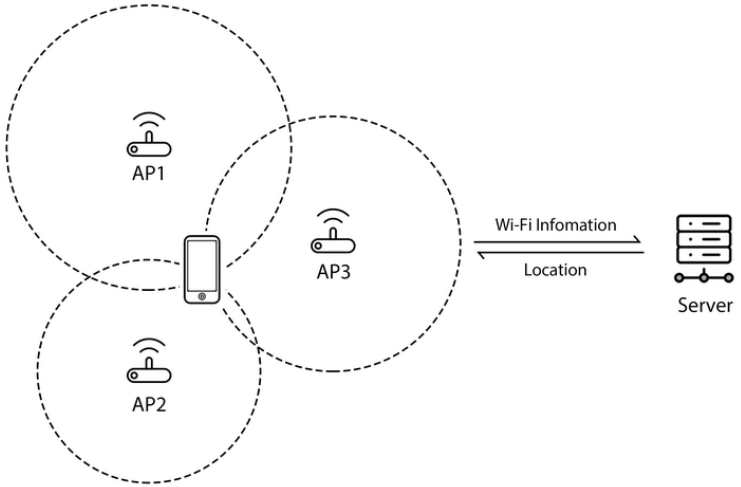
1) One required item.
2) All required items.
3) One distractor.
4) All required items and some distractors.
5) Put all the required items on the table and then remove one.

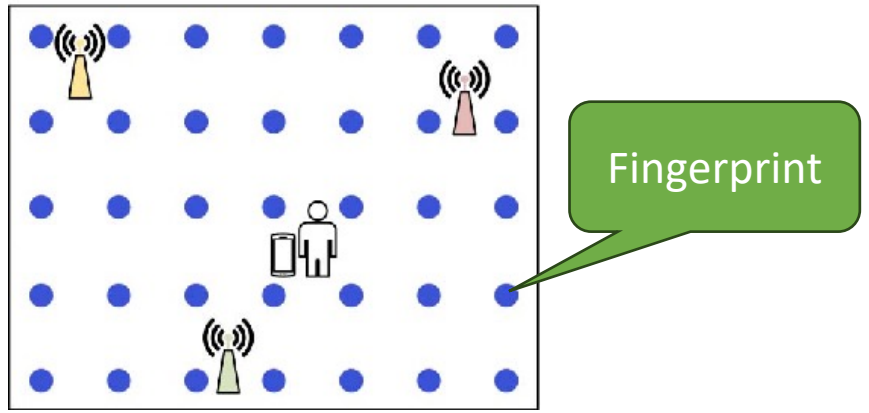
Project Ideas



1. Localization using wireless sensors

- Attach wireless transmitters and use signal strength for localization.
- Related wireless technology:
  - Bluetooth, RFID, etc.
- Related methods:
  - Trilateration-Based Localization, Fingerprint-Based Localization, etc.





Example: Contact Tracing with BLE Beacons

- **BLE: Bluetooth Low Energy** 
- Contact tracing (CT) has been shown feasible to prevent the spread of COVID-19
  - Identify and notify the people (healthcare workers in the ICU) who had close contact with the infected person.
  - An important step in CT is to determine the location of the participants.

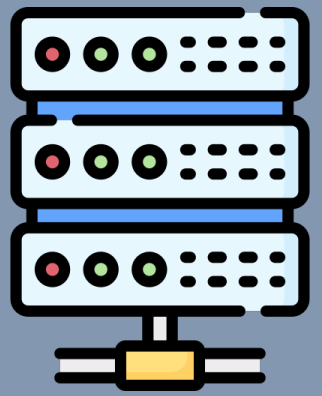
Example: Contact Tracing with BLE Beacons



BLE
Beacon



Anchors
Raspberry Pi Zero

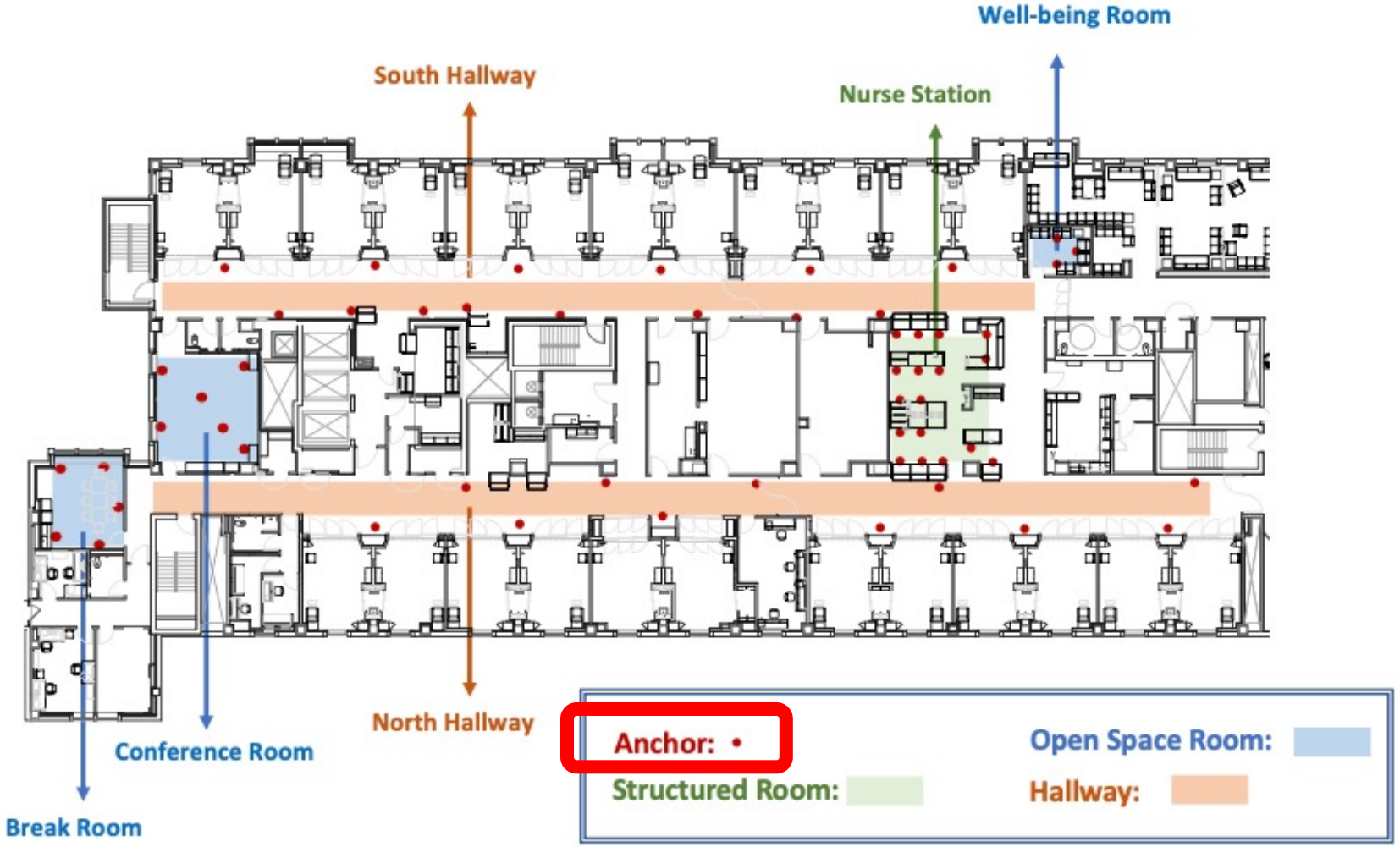


Server

Contact Tracing

Example: Contact Tracing with BLE Beacons

Floor plan of the ICU units

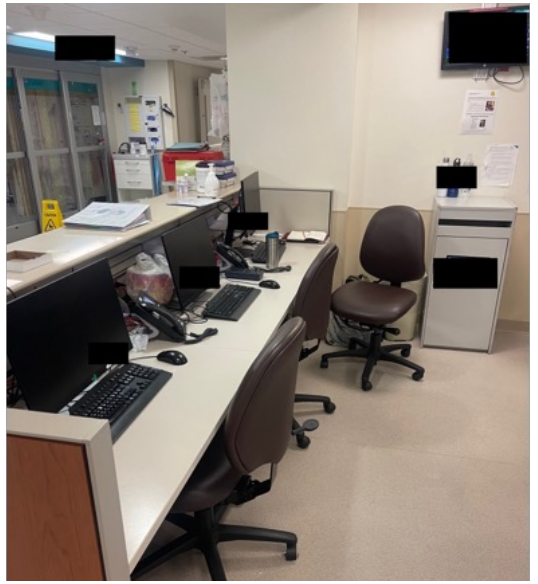


Example: Contact Tracing with BLE Beacons



Mobile workstation

- Signal strength ➔ Proximity



Nurse station

- Fingerprint ➔ Location

1. Localization using wireless sensors

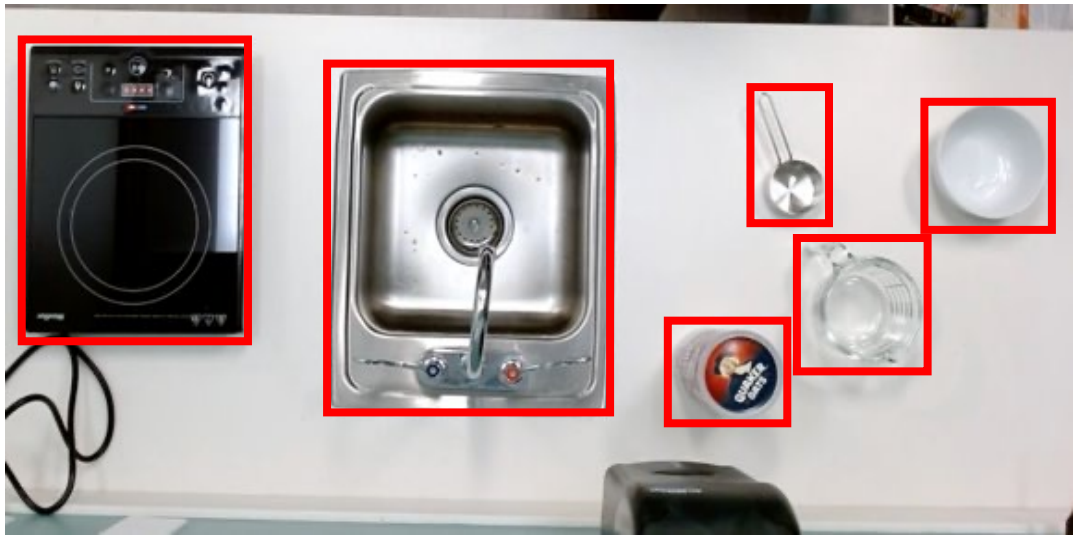
Exploratory Challenges:

- How to minimize the impact on the normal use of the tools?
- Is battery needed? How long will the battery last for the radio of your choice?

Related Lecture: 9/21 - Contact Tracing (Jingwen)

2. Localization using computer vision (CV)

- With a camera, we can localize the items using CV and deep neural networks (DNNs).
  - **Related CV topics:** Object detection, object tracking



2. Localization using computer vision (CV)

Exploratory Challenges:

- What if the items on the table are visually blocked or overlaps?
- Object detection often detects a pre-defined set of objects. What if there are distractors that the object detector has never seen?
- Is the latency of the system feasible for the application?

Related Lecture: 9/7 - Computer Vision Tutorial (Ruiqi)

3. Other solutions

- You are *not required* to choose from the two solutions.
- Feel free to explore any other AI and IoT related ideas and propose during the Proposal Presentation.
  - For example, other localization techniques (e.g., angle of arrival) and innovative solutions (e.g., multi-camera, combination of wireless sensors and CV).
  - Questions and discussions are encouraged on Piazza.

Proposal Presentation is on **Tuesday, September 19**

Reminders

- Everyone should be on a **three-member** team
- Use **Piazza** to “Search for Teammates!”

- Email TA (ruiqi.w) your team members by **Tuesday, September 12**
  - One email per team
  - Join one group on Canvas > People > Groups.
- We will help make sure everyone has a team.

Reminders

- Important dates can be found in Schedule and slides.
  - Project proposal, Demo 1, Demo 2, Final Demo and Project Report.
- More details will be covered on next Tuesday's (9/5) Project Guidelines lecture.



Topics covered in this class are current or past research projects of Professor Lu's group. If you are interested in doing research on AI for Medicine, please contact Professor Lu for independent study opportunities.

Find your teammates…

- Use the rest of this class to share your ideas and find your teammates…

