Plant Doctor/Magic Room: Sensing Using Backscatter Networks

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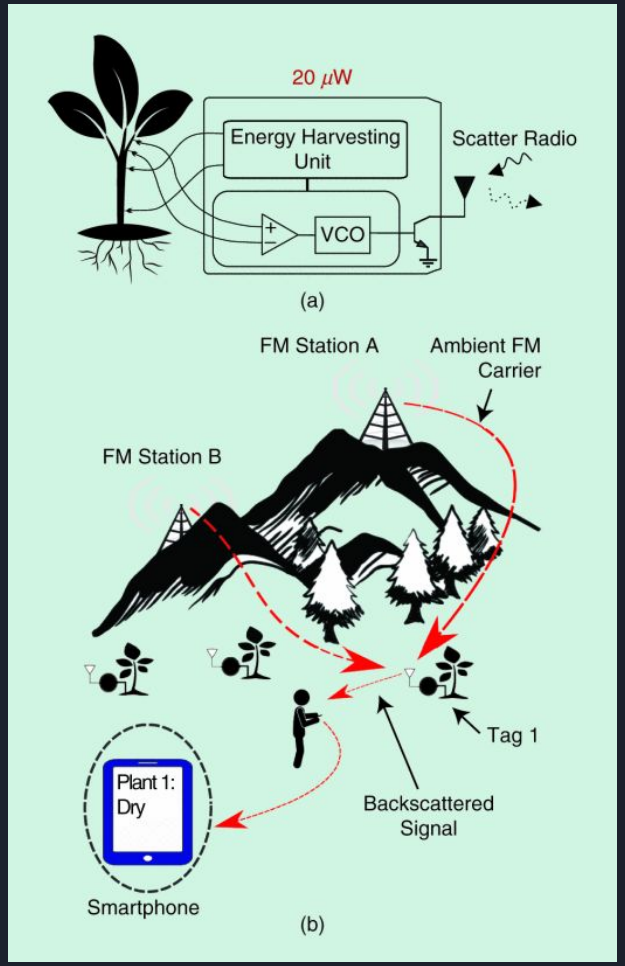
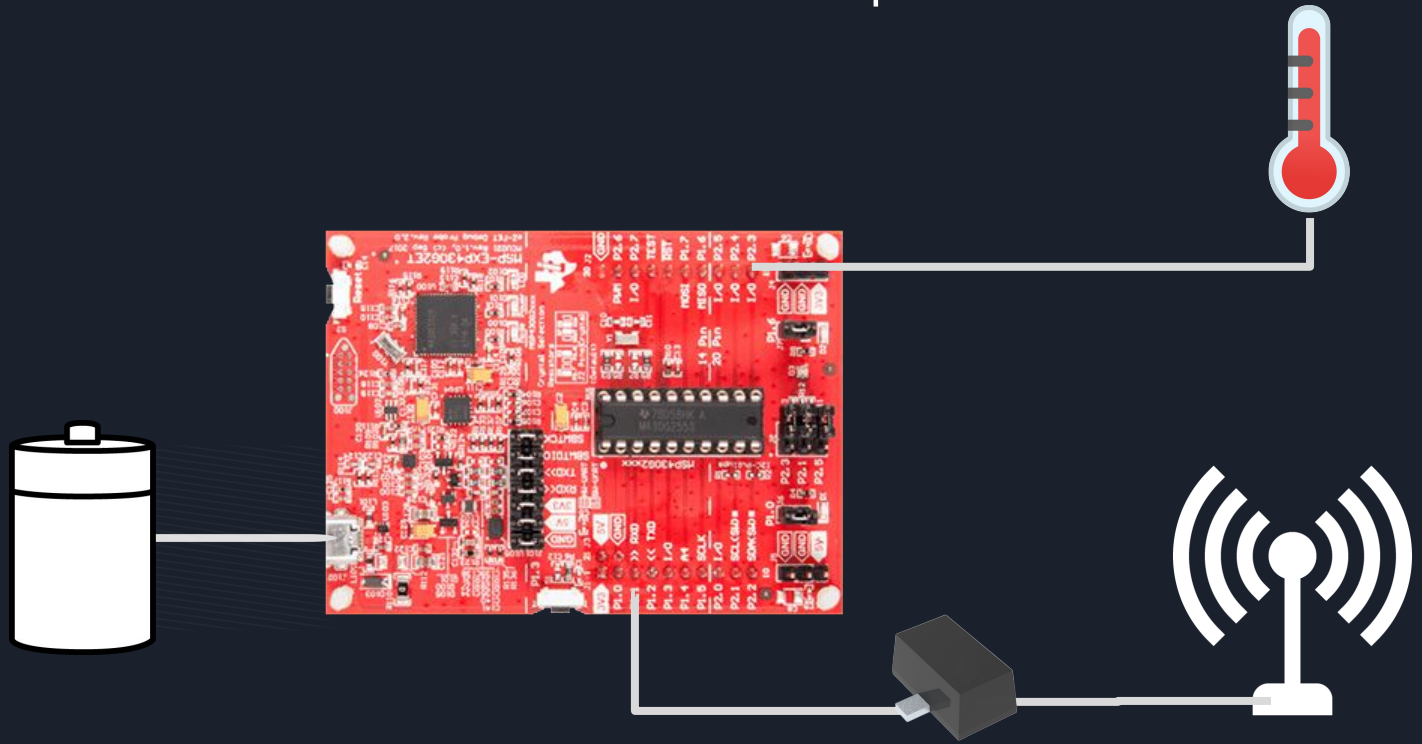
How do we transmit sensor data using low-power and low-cost techniques?

Plant Doctor Overview

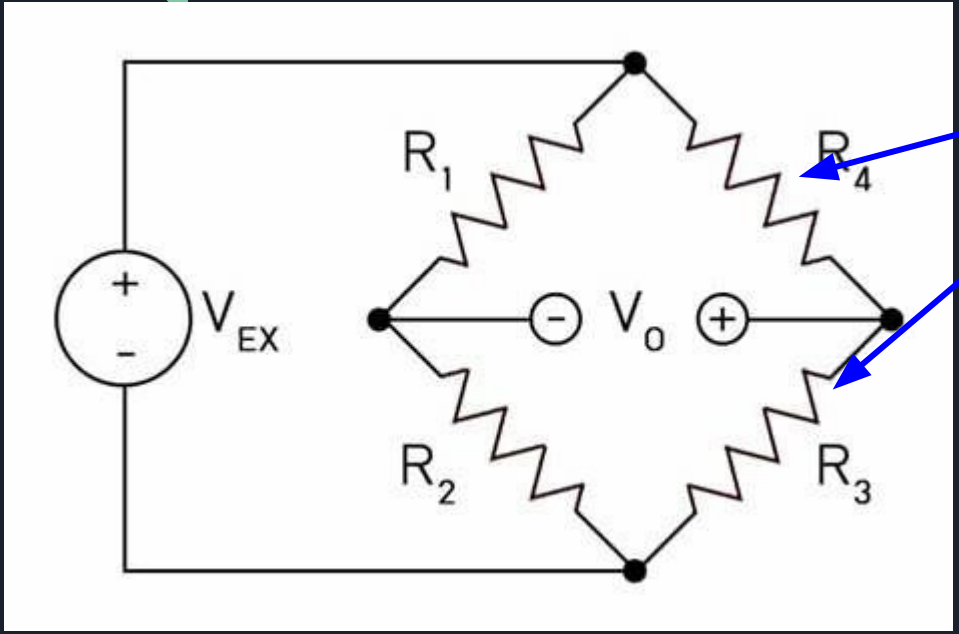
- Sensors and transmitters for agriculture take lots of power and are expensive to create and deploy
- Create low power & low cost wireless sensing for agriculture



Microcontroller Sensor Setup

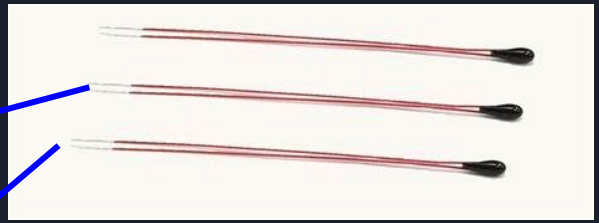


Temperature Sensing



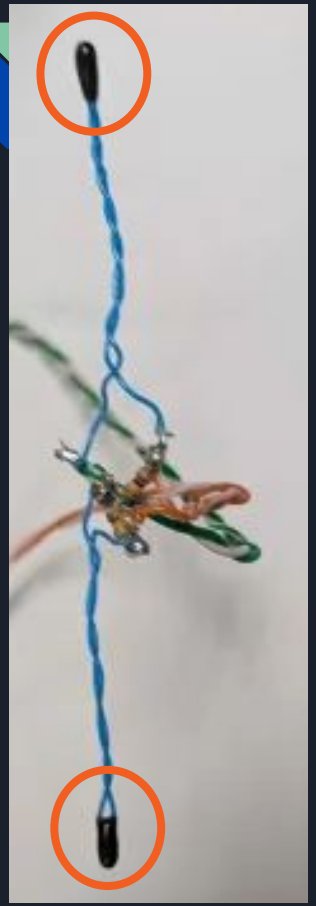
Wheatstone Bridge

Thermistors



- ✓ Comparative measurement
- ✓ High precision

How do we determine the temperature?



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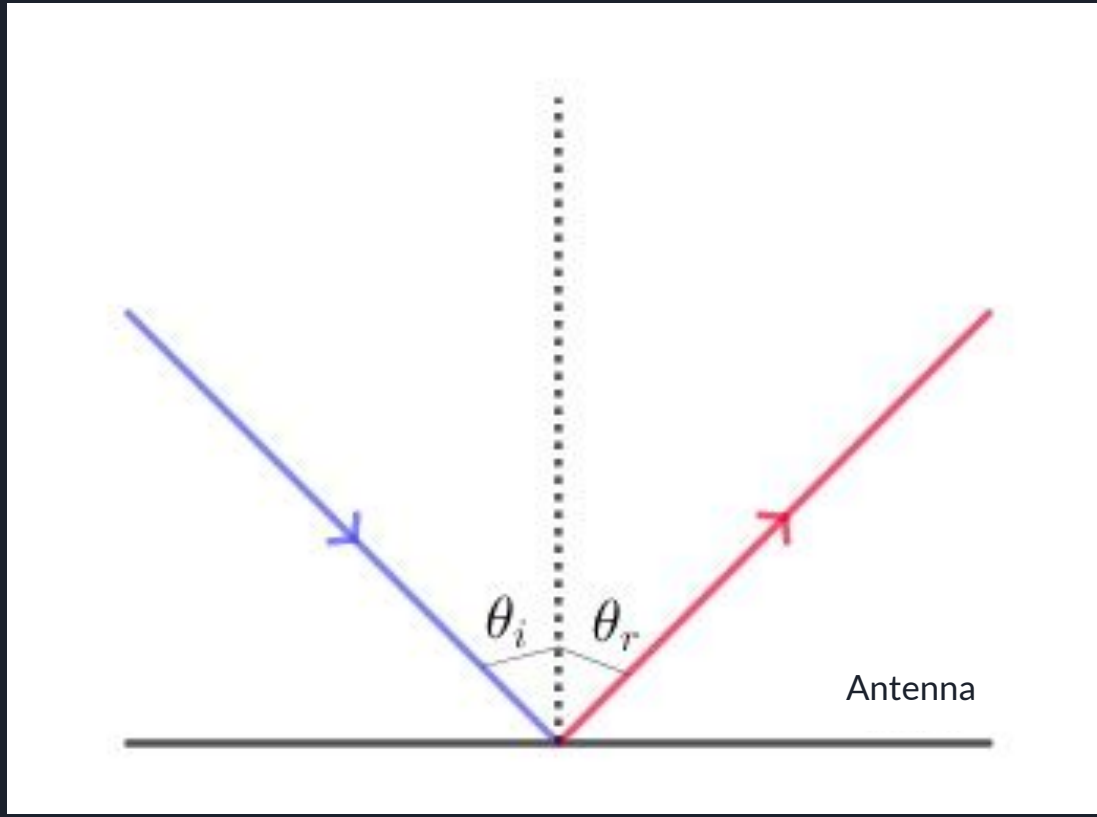
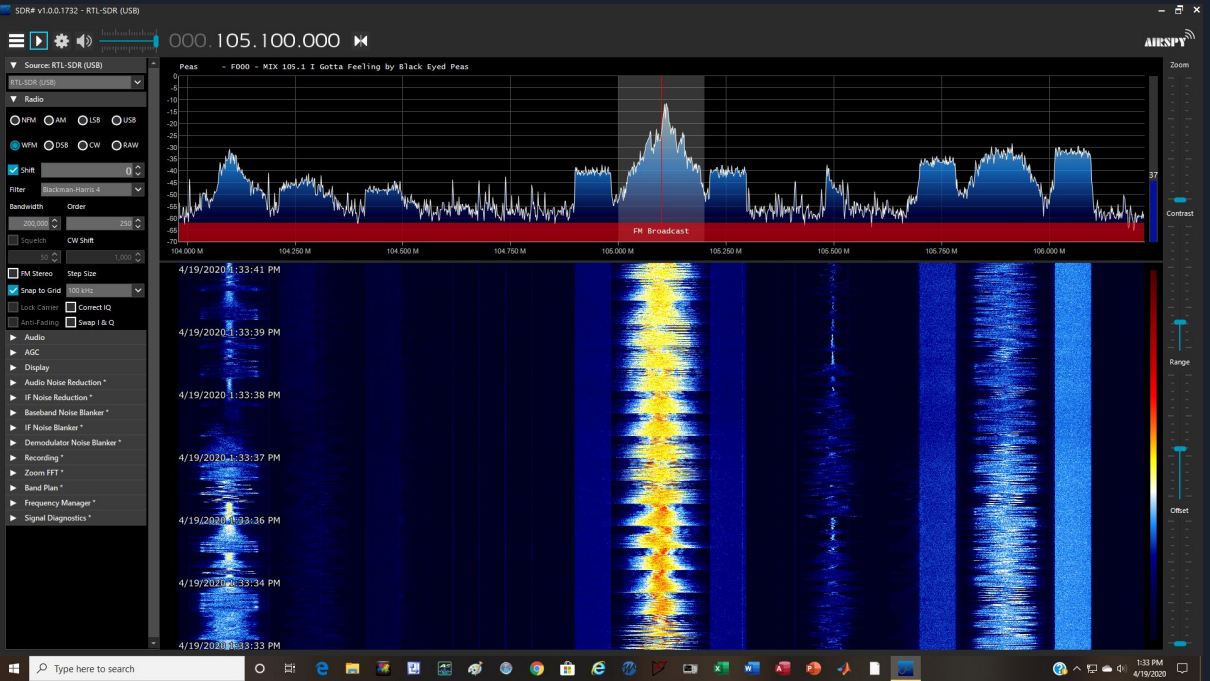
What is backscattering?

- Reflect with encoded information
- Uses existing waves
- Batteryless



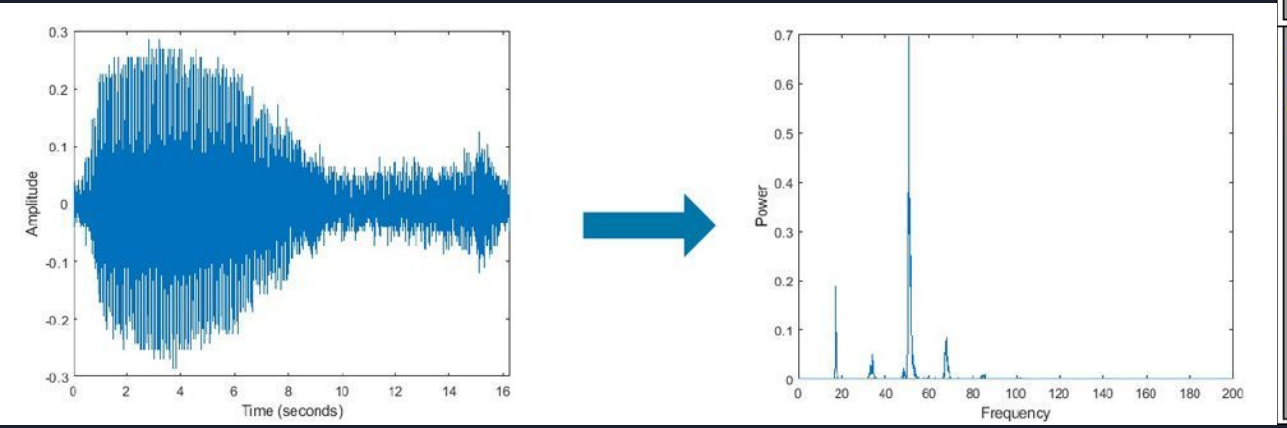
What is an SDR?

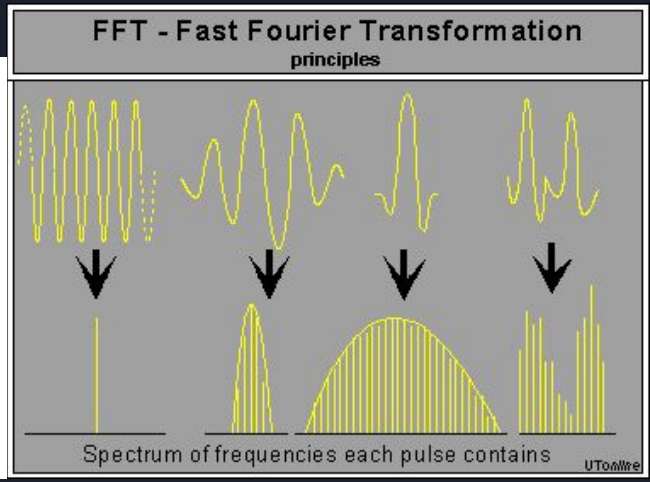
- Programmable Radio
- Write programs to process radio waves



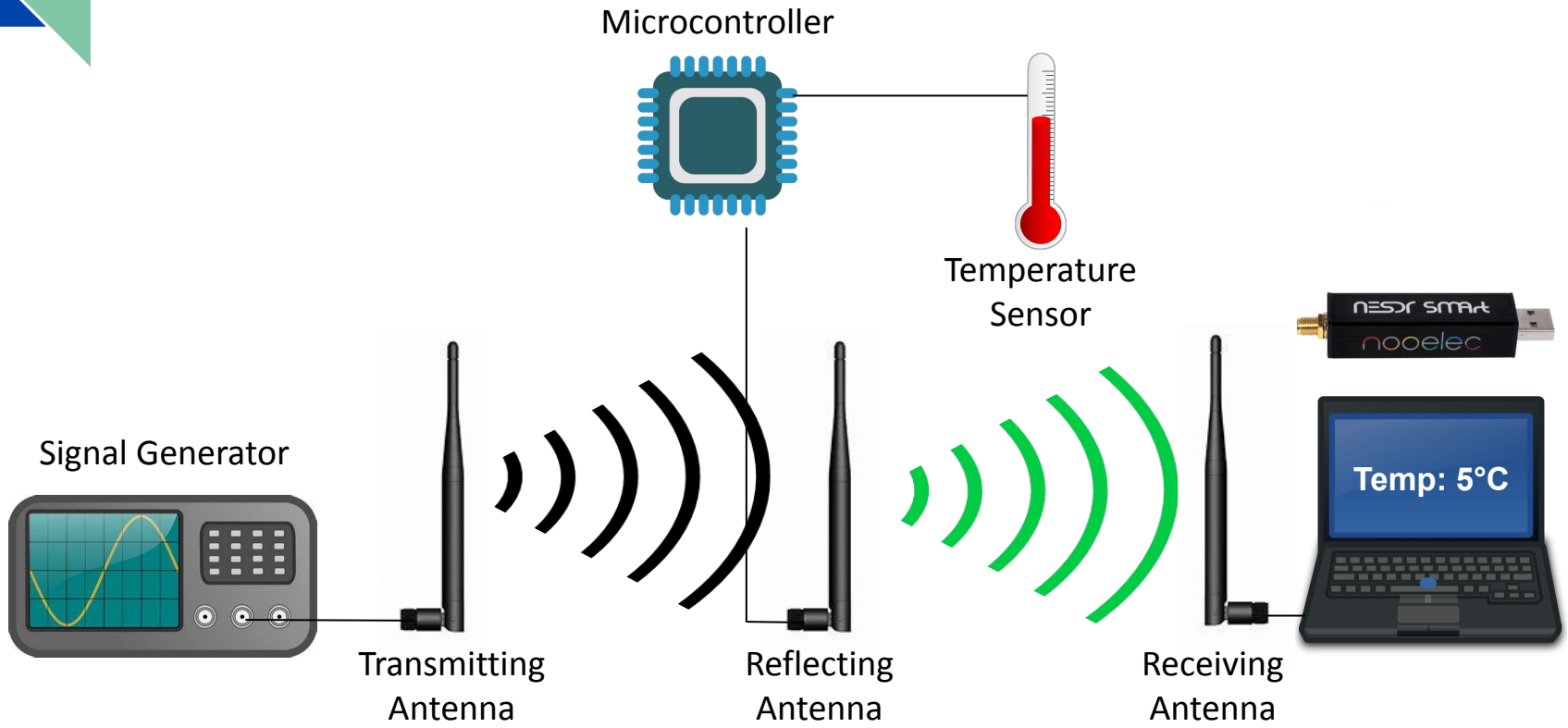
How to we detect the backscatter frequency?

- Convert to frequency domain signal
- Determine peaks of frequency signal to estimate the backscatter frequency





Full Backscattering Setup



Plant Chamber

- Chinese money plant with LED grow lights, sensors, and temperature controls
- Flat, broad leaves work well with thermistor clips

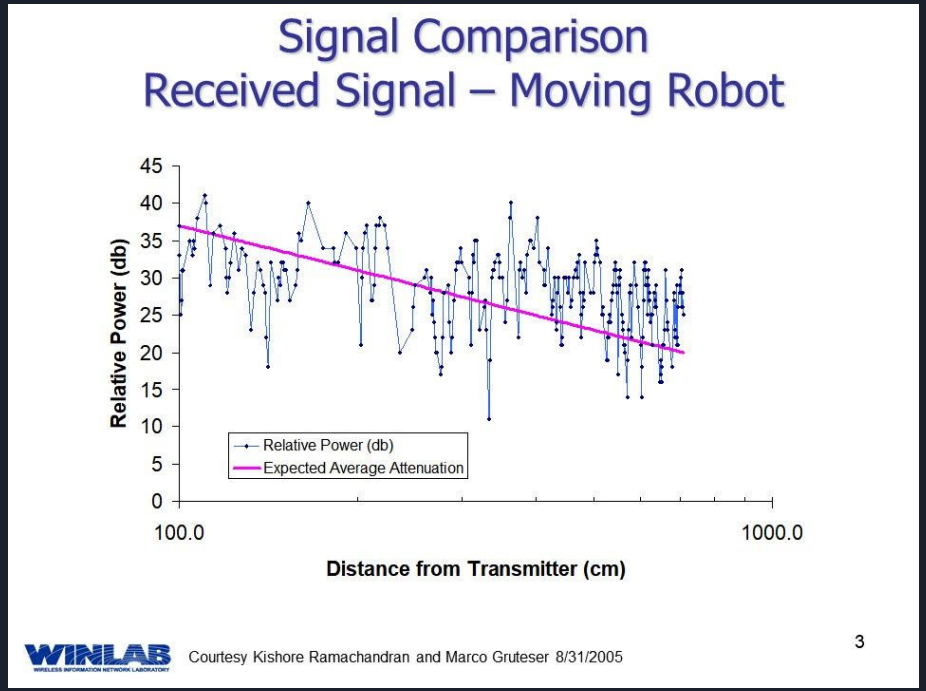
Future Plans

- Take new measurements
  - Capacitive (leaf moisture)
  - Electromagnetic
  - Ultrasonic
- Create multi-sensor networks
- Create, send, and receive digital signals
- Larger controlled plant chamber

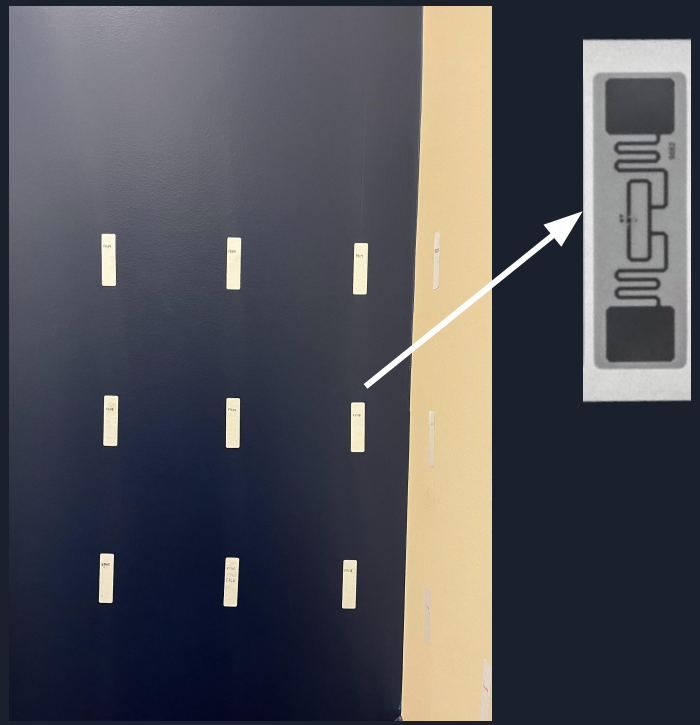
How do we localize people without devices?

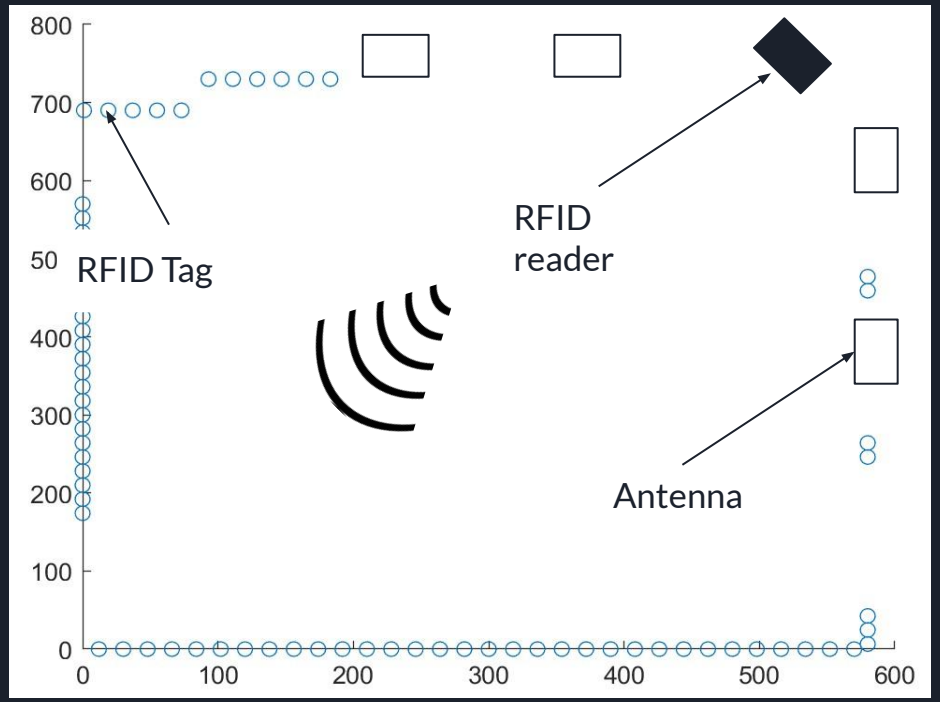
Magic Room Overview

- RFID tags absorbs & reflect signals
- Signal data => very messy
- Goal: estimate the location of people inside a room based on this data



Magic Room Setup

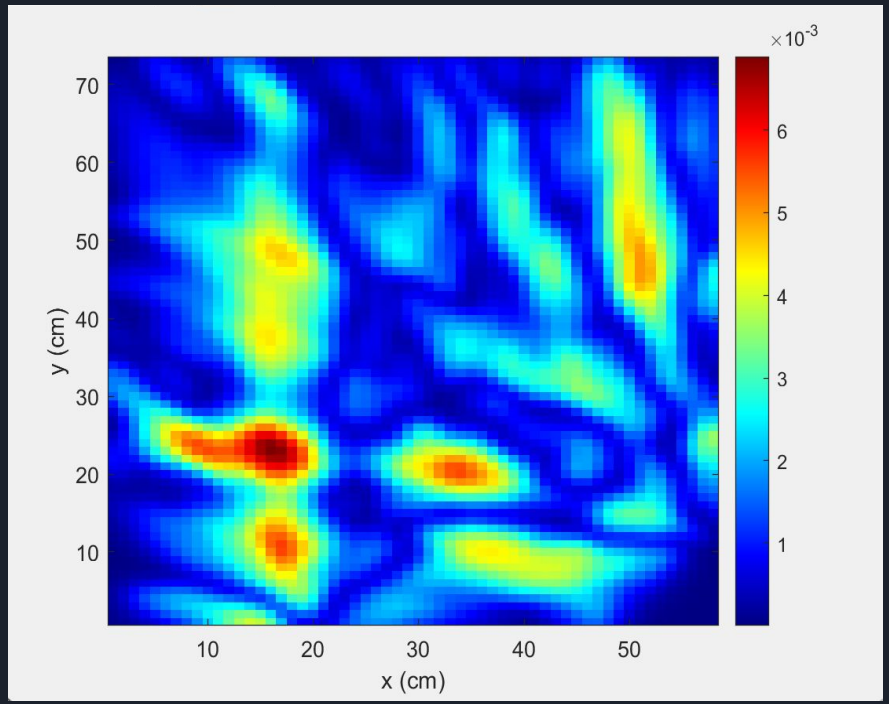




How is a person's location approximated?

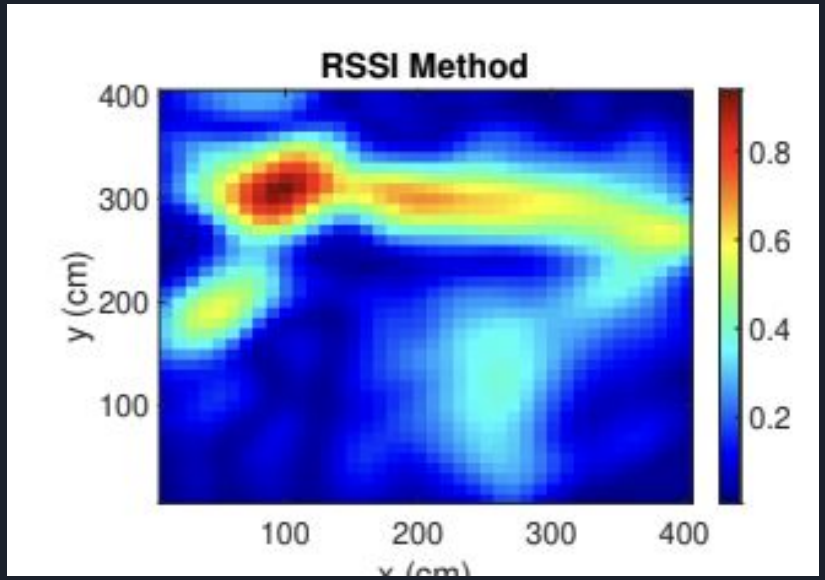
- Get measurements when room is empty and compare to current readings
- Filter out RFID tags
- Form heatmap by weighing RSSI measurements by distances from tag to antenna

Results



Future Plans

- Remove noise from current signal heat maps
- Utilize machine learning to analyze the heatmaps
- Improve room setup



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