THE COOPER UNION
EE Capstone Senior Design
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Smart Shopping Buddy
Autonomous Shopping Cart Robot for a Hands-Free Shopping Experience

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Problem Statement

- Create an autonomous shopping cart robot that **follows the user** and **avoids obstacles** to enable people to live more of their lives hands-free.
- Utilize **groundbreaking UWB technology** for tracking and **Ultrasonic sensors** for obstacle avoidance to provide a superior tracking experience.

Example Use Cases

WHEELCHAIR USERS
USD 4.50 billion global wheelchair market size

HANDS-FREE CARRYING
Wide user base: Parents of young children, elderly, people wanting to carry stuff without a car

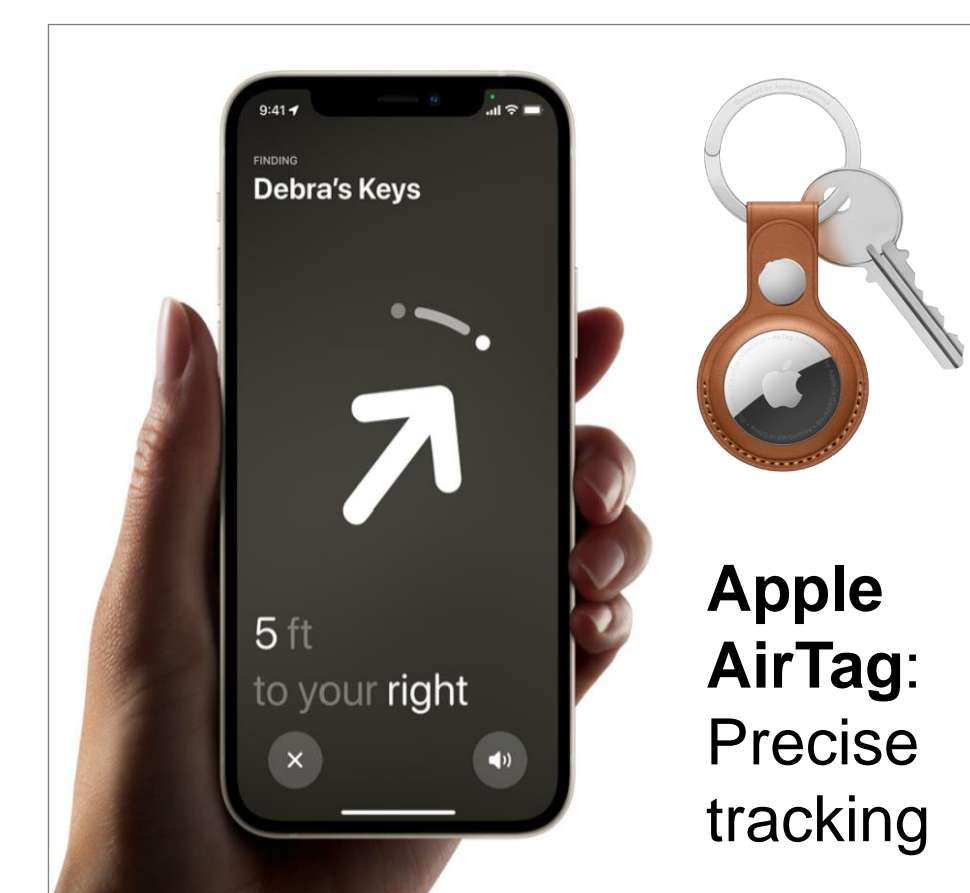**GARDENING**
Example of an industrial or personal application

PAINTING
Example of an industrial or personal application

What is Ultra-Wideband (UWB)?

UWB is a short-range wireless communication technology that enables both locational and directional accuracy to a **few centimeters!**

Examples of Ultra-Wideband Applications:

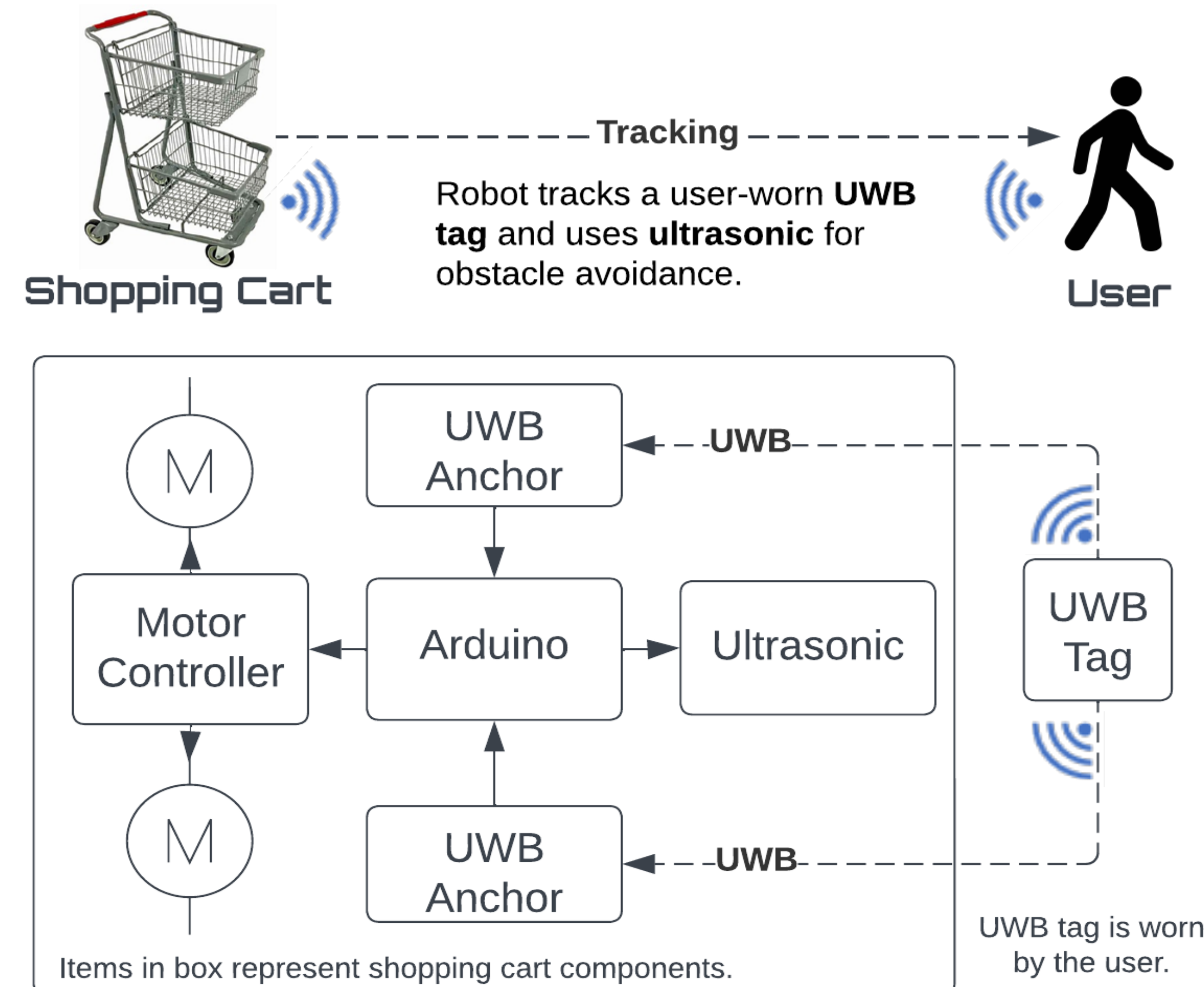**Apple AirTag:** Precise tracking

MTA: CBTC (Communication-Based-Train-Control)

**UWB is different from other wireless data transfers**:
- **Uses a pulse pattern** in the time domain whereas conventional wireless transmissions vary a sinewave's amplitude, frequency, or phase.
- **Pulse-based transfer** allows **Time-of-Flight** calculation to measure distance btw. Tx and Rx.
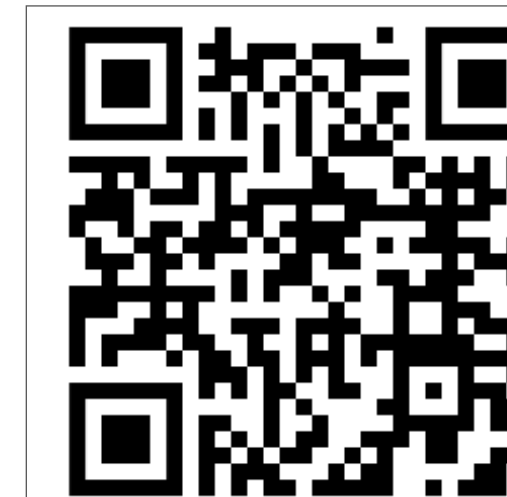
The Shopping Cart

Sensor Architecture:

Robot tracks a user-worn **UWB tag** and uses **ultrasonic** for obstacle avoidance.

Shopping Cart .... Tracking .... User

Items in box represent shopping cart components.

UWB tag is worn by the user.

Tracking algorithm triangulates the location of the user relative to the cart with three UWB sensors:

Range 1

Tag
(worn by user)

Range 2

Anchor 1
(mounted on cart)

Anchor 2
(mounted on cart)
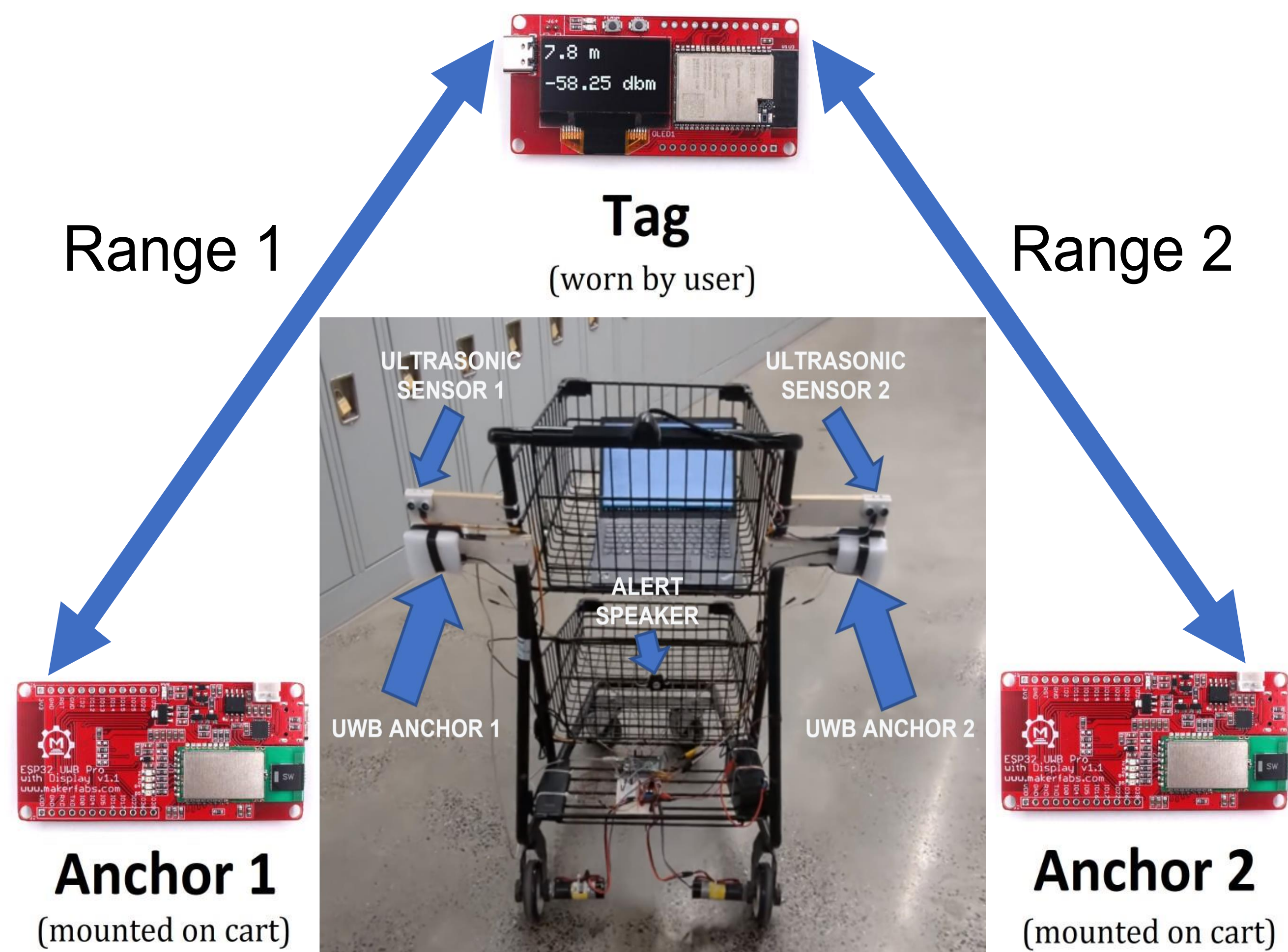
Real World Test

Scan the QR code to see the cart in action!

Video Link:
https://youtu.be/4n23PwxU1b8

Reflections

- During our test in public spaces, people responded with curiosity and interest.
- Many people commented or asked questions about the shopping cart.
- While future work includes implementing a more robust obstacle avoidance system, this project demonstrates the benefit this type of product can bring to people's lives.