Project Title: **Collaborative Maze Search and Rescue**
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EECS 149/249A Project Charter, Fall, 2021

Project Goal
Create a cyber-physical system of robots to collaboratively explore and map a maze while looking for and recovering pre-described objects of interest.

Project Approach
This project will model each robot as a state machine reacting to distance to wall inputs, object of interest detection, and messages from other robots and control center describing recently discovered parts of the maze. Each robot will output controls to its locomotion actuators, its claw for manipulating an object of interest, and send updates to its internal representation of the maze to the other robots.

Resources
Our plan is to use Romi robots equipped with a servo-actuated gripper and **nRF52** as the processor controlling the Romi and the gripper arm. The robots would also need to wirelessly communicate with either each other in a decentralized way or with a central command center in order to update the maze map; this can be done either using Bluetooth or a Wifi capable board such as NodeMCU. The choice of the type of communication would depend on the data transmission speeds.

We have two possible approaches to making the maze. Both maze designs involve physical "walls" that are only either parallel or perpendicular to all other walls. This will make the goal of mapping the maze more reachable. Both maze designs are easily reconfigurable. The stand-up design will use plastic boards for walls and 3d printed stands to hold the walls up at the corners. The robots will use bump sensors or ultrasonic sensors to detect these walls. The flat design will use black tape on a white foam board background. The robots will use the reflectance "cliff" sensors to detect these walls.

We may use an ultrasonic sensor on a spinning stepper motor to get the distance to walls and other robots.

Schedule

- November 1: Submit Project Charter
- November 4: Choose between using BLE vs Wifi and wheel encoders vs AR tags.
- November 5: Determine materials needed to build the maze and make a list of needed materials.
- November 7: *Milestone 1*
- November 8: Get one robot to map a simple space
- November 14: *Milestone 2* Map a single robot's path within the maze

- maze, and report the locations of objects of interest in the maze without moving them out the maze.
- November 15, 17: Milestone Presentation.
- November 20: Get robots to collaboratively explore the maze, mapping paths within the
- November 30 : Get robots to recover objects from the maze.
- December 5 : Use recovered objects to open a door (if the previous task was done on time)
- December 15: Final Presentation and demo
- December 17: Project Report

Risk and Feasibility

The coordinated collaboration of mapping the maze may have some issues with redundant information being transmitted from the robots mapping an explored space, updating a mapped environment, and allocating tasks between mapping and retrieving objects.

If we use ultrasonic sensors, the ultrasonic sensors of different robots may conflict with each other.

Github Repository

https://github.com/MarkLindblad/search-and-rescue