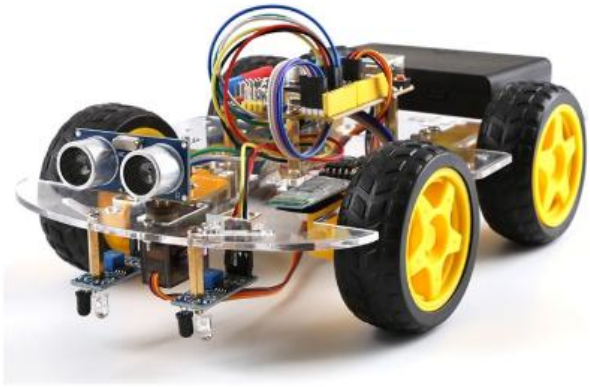
Problem Statement:

Firefighting Robots to the Rescue!

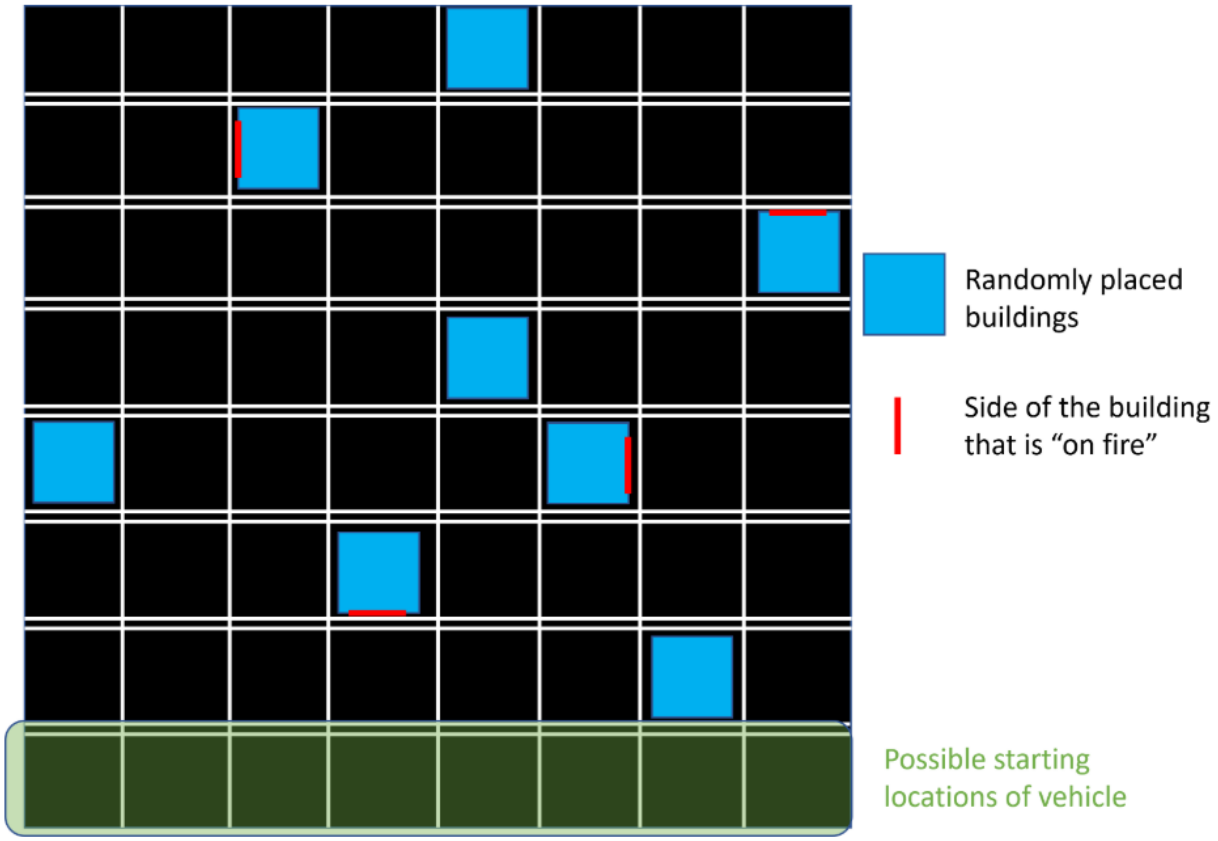
The goal of your team final project is designing an autonomous vehicle to find buildings on fire in an unknown environment and "fight the fire" by lowering a ladder onto the building. Once this is done successfully, the fire will be put out, and your vehicle can search for the next fire. Each final project team will be composed of 3-4 members.



The Arena:

The arena is a 8' x 8' square region composed of interlocking black foam floor tiles, with the following features:

- Single white lines divide the arena in one direction, double white lines in the other
- Your vehicle will be randomly placed somewhere in the bottom row. Once the starting location is determined, it can be hard coded into the vehicle's program or sent to it over serial.
- Buildings (i.e. boxes) will be randomly placed in the other rows
- The buildings "on fire" will emit an infrared pulse out of a square opening on one side of the box.
- A break beam sensor will be placed across the edge of the roof above the square opening to detect if your vehicle's ladder is placed successfully on the roof. If so, the infrared pulse will cease.



Rules for qualifying designs

- Teams must demonstrate (through the milestones described below) that their vehicle is capable of detecting "fires", moving towards them, and "fighting" it by lowering a ladder onto the roof. Any team that does not pass the milestones may not qualify for the final competition, at the instructor's discretion.
- Electrical energy is limited to four 1.5V batteries (AA) and one 9V battery per vehicle. Batteries may be replaced after each trial.
- No modifications to circuit components (including microcontroller PCBs) are allowed.
- The microcontroller PCB must be well protected. There must be minimal risk of other parts of the vehicle or objects in the environment touching it.
- Total vehicle mass cannot exceed 900 grams.
- Dimensions cannot exceed 20cm x 20cm (width × length) at the beginning of the trial. Any larger structures must be deployed after the trial starts.

- No use of un-tethered/irretrievable projectiles.
- No water, liquid, chemical, biological, or nuclear capabilities. Any electrical, compressed gas, or otherwise potentially dangerous components must be approved by the instructor beforehand.
- Given components per team: 4 continuous rotation servos, 2 wireless radios, 2 QTI sensors, plus any components stocked in the Fab Lab (no hoarding please!).
- Purchased parts not to exceed $300 per team. Each team must maintain a budget and a Bill of Materials (BOM) that includes both purchased and borrowed items.
- Each team must have a team name that reflects their design or strategy somehow.

Grading:

There will be several Milestones that must be reached along the way, which will contribute to the final project grade. The milestones will be posted as separate assignments on Canvas. Percentages listed below are percentages of the final project grade (which itself is 35% of the overall course grade).

- **Milestones**
    - **Milestone 1** (Friday March 22): Vehicles must be able to drive in a straight line and count the number of single or double line crossings (10%)
    - **Milestone 2** (Friday April 12): Vehicles must receive driving commands from a base station and demonstrate out-of-bounds indicator (10%)
    - **Milestone 3** (Friday May 3): Vehicles must detect the IR signal and successfully lower and then raise their ladder (10%)
- **Competition** (Tuesday May 21)
    - Innovation: Every team MUST develop at least one significantly unique feature sub-system (15%)
        - Mechanical, electrical, and systems innovations encouraged
        - Innovation does not have to improve your system's performance in competition
    - Competition results (25%):
        - No attempt at completing the task autonomously results in a max grade of 80

        - Failed attempt at completing the task autonomously results in a max grade between 80-100
        - Successfully completing the task autonomously results in a max grade between 100-120 based on time of completion

- **Report** (due Wednesday May 22) (30%)
    - Include a summary slide that highlights key features and innovations
    - Report should document your innovation so a student with your background can reproduce it

1. Include: equations, part models, schematics, algorithmic descriptions, etc.
2. Describe the motivation behind your design
3. Describe its strengths and weaknesses
    - Brevity is important in writing good reports
    - Overall schematics and heavily commented code should be included in an appendix; important code snippets should be included in the text of the report and discussed briefly, highlighting only a few key points
    - General neatness and ease of use as a design/reference document will be taken into consideration
    - Open Single Constraint Argument:

1. Suggest a modification to the rules/constraints,
2. Explain what additional innovation this would allow you to create,
3. Provide some initial technical justification for your explanation