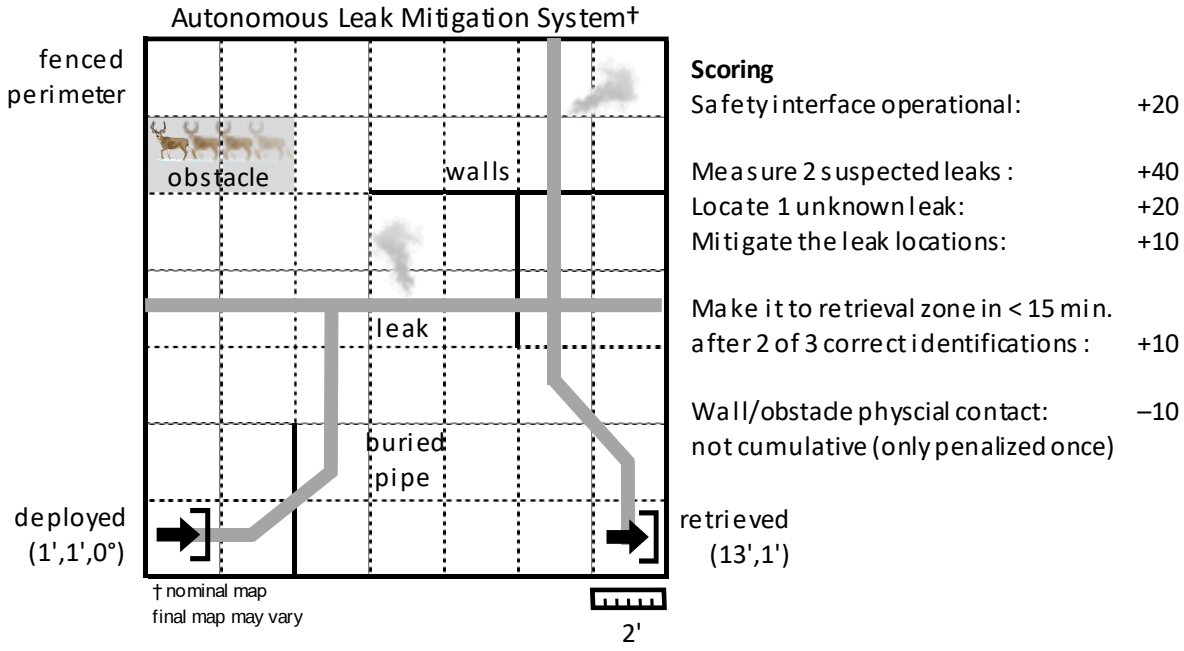
2023 Peter Gregson Design Challenge
Map and Rules



Rules

1. Robots must operate safely without endangering the users or the public. A pre-inspection of your robot will be performed, and only approved robots are permitted in the building/on the course.

2. No modifications to the course structure, obstacle, or features are permitted.

3. No pneumatic/hydraulic actuation, no gas/aerosol/liquid systems of any kind are permitted.

4. No voltages over 24V are permitted.

5. Only one physical robot can be deployed; it may then separate on the course if designed to do so.

6. Your team of 5 students is one group. One group is permitted 3 attempts on the course, or, a total of 15-minutes, whichever condition is fulfilled first.

7. Only parts provided in the initial kit and those paid for from the flexible budget can be used. Small hardware and 3D printed parts are also acceptable.

8. The diameter and height of the robot must be less than 50 cm.

9. The robot must be autonomous, no manual controls or commands are permitted when deployed. **Robots must be delivered and ready by 9am, Challenge Day. Modifications will NOT be allowed once the robot is delivered.**

Map Notes

10. Leaks will be water vapor produced by a humidifier, venting from holes in the play surface area. The pipe will be represented by aluminum metal ducking tape. The venting holes will be less than 1 inch in diameter and the tape will be between 1-3 inches in width.

11. The obstacle will be moving at a maximum speed of 0.1 m/s, translationally between the ghosting regions shown on the map. It will have a maximum diameter of 20 inches and will return a LiDAR signal between a height of 10 to 30 cm off the floor surface.

Scoring

12. **[20 pts]** Awarded if the robot has an operational LED light system to alert users of safe ranges to targets, walls, or obstacles. The light interface color must be in the visible spectrum, and, have at least 3 threat levels—far (no threat, x >= 4 ft.), near (potential threat, 2 ft. < x < 4 ft.), and close (collision threat, x =< 2 ft). The direction of the threat must be identified in at least 2 directions, forward and backward. More directions and threat indicator levels would be beneficial.

13. **[40 pts]** Maximum awarded if the robot reaches 2 suspected leak locations and confirms leak presence by flashing a light or other suitable indicator (e.g. red). If no leak is detected, a safe condition indicator must be activated (e.g. green). The locations are shown in the map at the location of the gas exhaust. Each suspected leak is at a unique position [X, Y, Theta] and there are 20 points awarded per correct identification at each location. Only 1 of the 2 locations will be leaking.

14. **[20 pts]** Maximum awarded if the robot locates 1 unknown leak location along the buried pipe and relays the outcome to the indicator interface listed in the previous point. Detection range tolerance must be ±1’ or better; 20 points for leak detected and relayed at correct position.

15. **[10 pts]** Maximum awarded if the robot correctly mitigates each leak. To do this, the robot must determine the leak or no-leak status and indicate this to the users. In the event of a confirmed leak, the robot must slow the leak, covering the venting holes. The attempted mitigation must be ±1’ or better tolerance, i.e. evident within a 2-foot diameter circle centered at the vent hole. Each correct mitigation will award the team 5 points.

16. **[10 pts]** Maximum awarded for swift operation as leak mitigation is a time-sensitive task. Time is of the essence and robots that perform at least 2 of the 3 detection events within 15 minutes will be awarded 10 points.

17. **[-10 pts]** Any physical contact with the fence or obstacles results in forfeiting a maximum of 10 points as the robot will be deemed unsafe. Accordingly, the vehicle should have an obstacle detection and path planning routine active. This deduction happens only once per attempt; i.e. attempt 1 hit does not carry-over to future attempts 2 or 3. Negative points are non-cumulative.

ADDITIONAL DETAILS TO REMOVE AMBGUITY FROM STUDENT QUESTIONS

- Clarification Added: June 30, 2023

a) The LEDs indicating Leak and No-Leak, must be correct within 1’ and will be marked as follows:

Actual Condition	No Leak LED	Leak LED	Result
No Leak	0	0	INCORRECT
No Leak	0	1	INCORRECT
No Leak	**1**	**0**	**CORRECT**
No Leak	1	1	INCORRECT
Leak	0	0	INCORRECT
Leak	**0**	**1**	**CORRECT**
Leak	1	0	INCORRECT
Leak	1	1	INCORRECT
	0 = LIGHT OFF	1 = LIGHT ON	

b) Once an LED flash is observed, it will be counted and cannot be retracted at that site.
c) INCORRECT detections (i.e. wrong LEDs going off at any time) in the 1’ radius will received no points.
d) Only correct identifications within the 1’ radius as detailed in requirements 13 and 14 will get points, with no false/random/erroneous LED flashes as noted in the table above.
e) Indeterminate situations, where the state of leak cannot be determined by the client, i.e. both LEDs firing in the 1’ radius, receive no points. This is not a leak detection system that works.
f) Accumulated LED observations in the 1’ radius of a location are reset on a new trial.

- Rule Amendment: July 10, 2023

The class voted in favor (90.7%) of a minor Change to the Rules as follows:

Scoring Point 13 addendum: Green LED (no-leak) can be on when entering 1' radius of suspected leaks. A single LED/color change is permitted in the 1' radius and the updated or last color activated is used to determine leak status (G=NL, R=L).