Integrated Term Project Draft

Problem statement

You're tasked with the responsibility of designing an autonomous robot that will drive around the streets of Manhattan to find enemy intruders (the enemies) among us who are troubling the civilians (the friendlies) in the city. The robot must lookout for the enemies and eliminate them by scouring through the streets while following all the traffic rules and should avoid obstacles (if any).

Describing the scenario

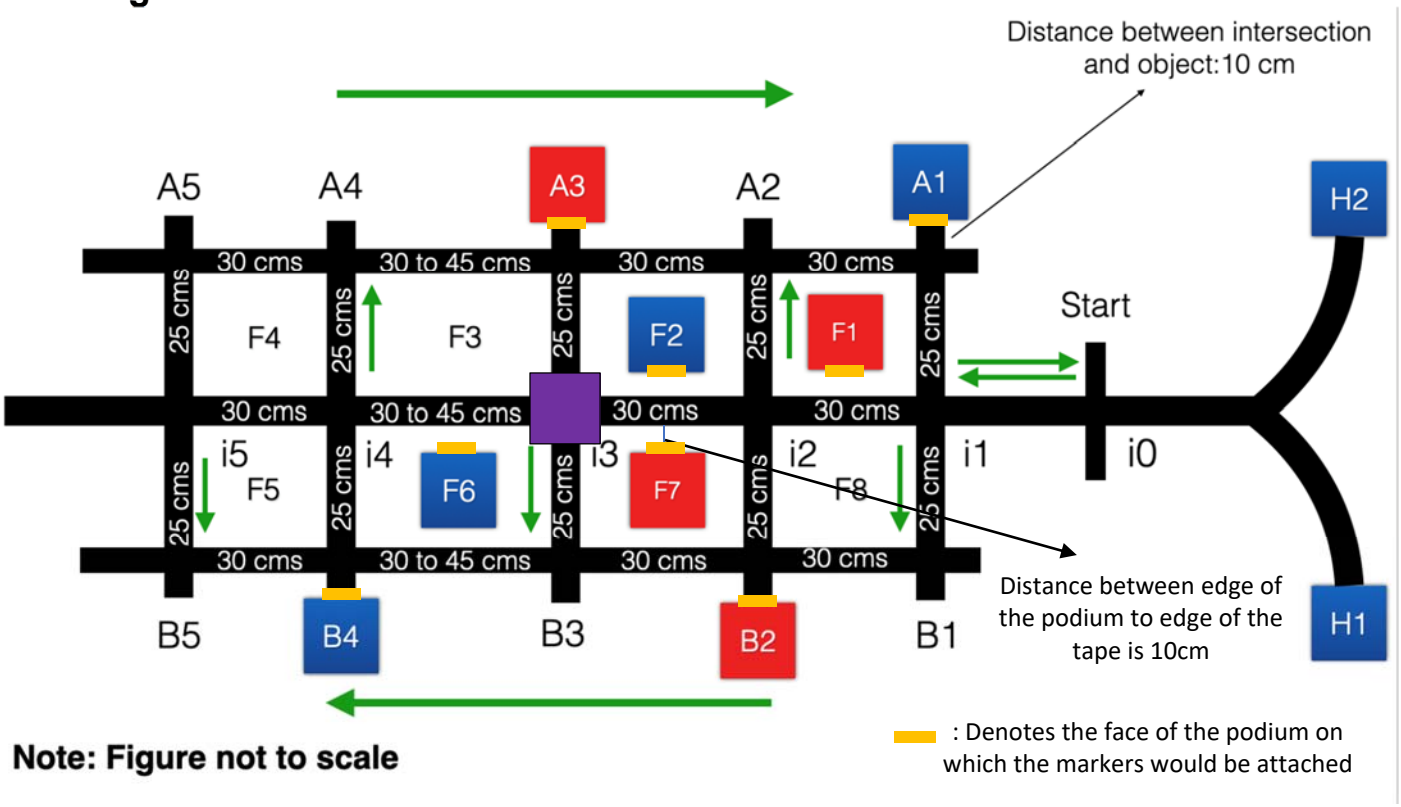

Figure 1: Manhattan streets with a grid-like structure (The arena)

- There are two safe houses for the robot to start your mission (denoted by H1 and H2).
- The curved black tape represents the path to exit from each safe house. The rest of the black tape represents the Manhattan streetscape with a grid-like structure. The width of the tape will be between 1.8cm to 2.6cm.
- There are a total of 16 intersections labeled i0, …, i5 (central intersections); A1, …, A5 (upper intersections); B1, …, B5 (lower intersections); where i0 is the start point. F1, …, F8 denote the boxed spaces in between the streets as shown in Figure 1.
- **One** obstacle (traffic congestion) will be **RANDOMLY** placed at either intersection i2, i3, or i5 (depicted in the image as a purple box at intersection i3 for illustration).
- The minimum height of the obstacles used (representing a car or podium) will be 20 centimeters.
- The green arrows represent the direction of the traffic flow on the indicated street (the direction is applicable to the whole length of the street).
- The central lane/street has **bi-directional** traffic.

- Friendlies (4 in number) / enemies (4 in number) will be randomly placed on the map during your demonstration. In Figure 1, for illustration, these are marked as blue boxes (friendlies) and yellow boxes (enemies).

Task descriptions

- Your robot must use **2 microcontrollers**: 1st- Raspberry Pi or similar and 2nd- Arduino Uno/ Propeller Activity Board.
- The robot will start at either one of the safe houses.
- The robot must always follow the path (black tape).
- The robot must reach i0 (start position) and should **NOT** stop at any time during its full run.
- The robot must move towards the friendlies/enemy's locations to reach them while avoiding obstacles on its path. It should provide an indication of reaching each location by some means (e.g., LED, piezoelectric buzzer, etc.). Note: Reaching locations would mean stopping in front of the location (i.e., the corresponding intersection for the objects placed at A1-A5, B1-B5 and the corresponding street segment for objects placed on the sides of the middle lane) and providing **different** and **clear** indications for friendlies and enemies.
- The robot should knock off the enemies from their car (or podium) by a mechanism attached on their robot. It should **NOT** hurt the friendlies.
- The friendlies/enemies locations will not be revealed for hard coding of the solution, instead it must be found by means of a camera mounted on your robot. You will be provided with Aruco tags (fiducial marker) by default, (Tag Ids corresponding to friendlies would be in the range of 0-9; Tag Ids corresponding to enemies would be in the range of 10-19). However, as a flexible and open-ended solution strategy, you are **free to use your own** kind of markers: color markers, shape markers, etc. (If you want to use your own markers inform us about it at the start of your demo, provide us your markers, and we will change the markers for you at the start of the demo).
- You will be assigned only those locations that you can reach without breaking any traffic rules.
- The friendlies/enemies are represented by cylinders and would be mounted on a platform (representing car or podium). The Aruco tag will be stuck on one face of the platform. The size of the default tags will be provided will be 1in×1in

Please refer to the following links for the dimensions of the friendlies/enemies and platforms they will be mounted on:

https://www.amazon.com/Midwest-Products-4421-Micro-Cut-Basswood/dp/B00IZ94BG2/ref=sr_1_8?keywords=carving+blocks&qid=1650600835&s=home-garden&sr=1-8

https://www.amazon.com/Kansoo-Teaching-Material-Unfinished-Cylinders/dp/B081Z7ZVTV/ref=sr_1_5?keywords=cylinder+blocks&qid=1650601763&sr=8-5

Note: the platform will be resized into a multiple 2×3×2 cubic inch cuboids from the 2×3×12 cubic inch block

Deliverables and Grading (Total: 100 points)

1. Line following robot - **16 points**
2. Can the robot detect friendlies and enemies- **24 points (3 points for each indication)**
3. **Knocking out enemies – 40 points (10 points for each enemy knocked out)**
4. **Motion of the robot: 20 points**
    - Robot moves smoothly **without** any jerky motion: **10 points**

    - Robot does **NOT** have a wavy motion for line following (swaying left and right): **5 points**
    - Robot moves at a good speed and is **NOT** too slow: **5 points**
5. **Knocking out a friendly would result in the loss of 10 points per friendly.**
6. If your robot breaks traffic rules for any segment by travelling in the direction opposite to the allowed direction, **5 points will be deducted** for each such incidence.

The project will be graded out of 100 points, out of which 80 points will come from your experimental demonstration and the remaining 20 points will come from your project report.

Due: The demo will be held from 9am to 12noon on May 16, 2022, Monday. All reports are due by 9am May 16, 2022.

Note

- IR remote control allowed only for deliverables 3 and 4
  (Max points = 70% of the points for those tasks)
- Autonomous control preferred (100% of the points)
- Performing an action (monitor, compute, indicate, etc.) on the go requires using dedicated cores for such actions

For any questions, please feel free to reach to out the TA's:

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