Propeller Project: Spring 2023

Problem statement

You're tasked with the responsibility of designing an automated guided vehicle (AGV) that will drive along a path in a factory to imitate picking up some widgets made by machines in lane A and dropping them off for further processing at one of the machine locations in lane B. The robot must reach specified locations while following all the lane rules and should avoid obstacles (if any).

Describing the scenario

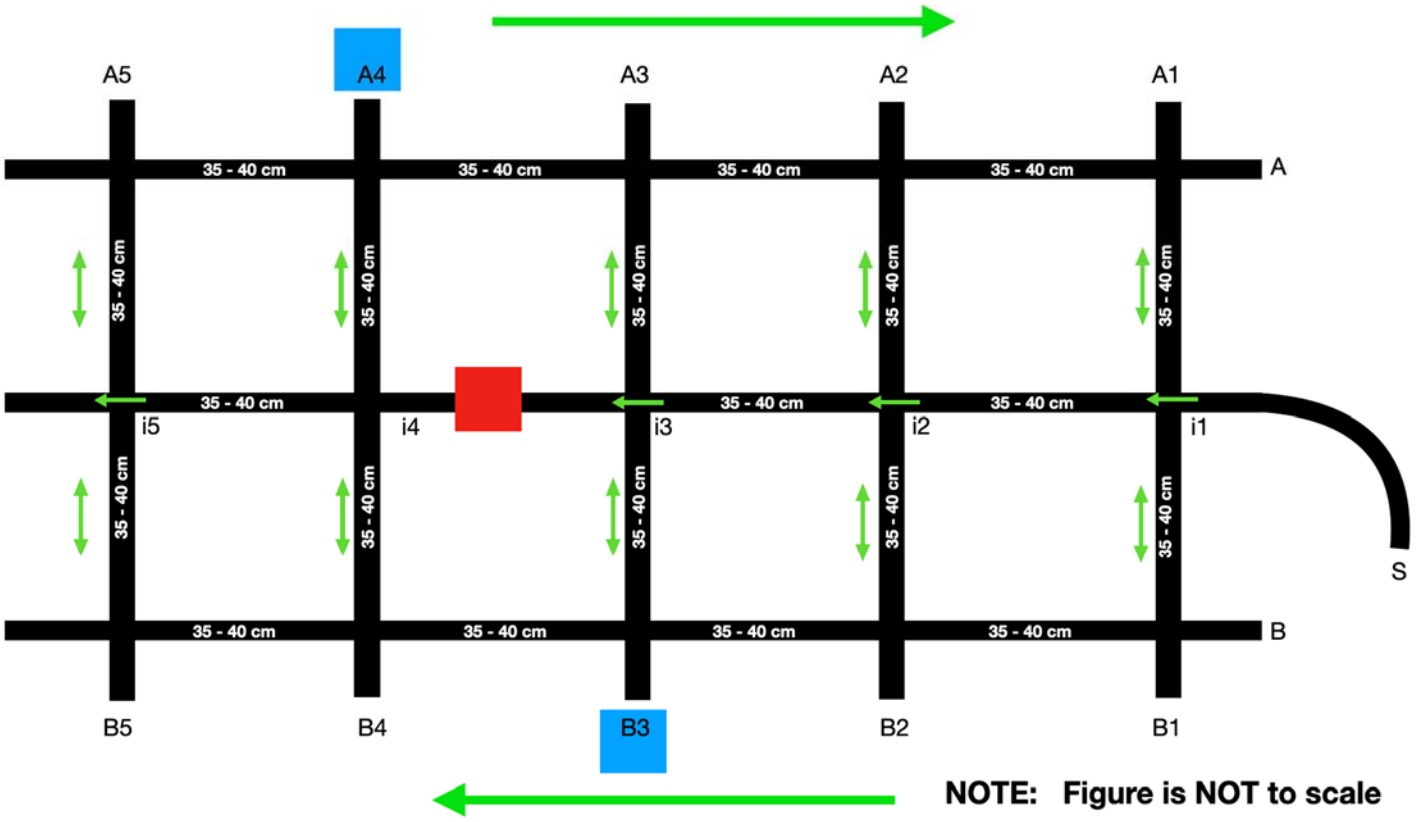

Figure 1: Lanes with a grid-like structure on a factory floor (The arena)

- The robot starts at the home location S.
- The width of the tape will be between 1.8cm to 2.6cm.
- There are a total of 15 intersections labelled i1, …, i5 (central intersections); A1, …, A5 (upper intersections); and B1, …, B5 (lower intersections).
- The green arrows represent the directions the robot is allowed to move on a given path.
- The lanes S, A, and B are unidirectional (direction allowed to move is shown in figure).
- The 'A' lane is called the pickup lane, where the robot must pick up the widget from a machine location at A1, …, A5.
- The 'B' lane is called the drop-off lane, where the robot must drop the partially processed widget at a machine location B1, …, B5.
- One or more obstacles may be introduced dynamically while the robot is traversing through the arena. As an example, an obstacle may be introduced while the robot is moving in the center lane, in response the robot must change its course accordingly. In Figure 1, the red box between i3 and i4 depicts an obstacle.

- The minimum height of the objects used (representing some artifact on the shop floor) will be 20 centimetres.
- The desired pickup and drop-off locations will be randomly assigned. In the figure above, the blue box at A4 represents a pickup location and the blue box at B3 represents a drop-off location. (This is just an example for illustration purposes here, random locations will be assigned during the demo)

Task descriptions

- You will be directed to place your robot at home location S.
- The robot must always follow the path (black tape), moving along in the correct heading.
- The robot must first move along the center lane and only then enter the pickup or drop-off lanes.
- The robot must detect intersections and provide an indication of the detection (using an LCD display, seven-segment display, etc., **on the go without stopping**).
- Upon detecting any obstacle along its path in the center lane, the robot must change its course to avoid it. The obstacle may be placed dynamically while the robot is in motion (for example, if the robot is at i2 and driving toward i3, the obstacle could be placed anywhere between i3 and i4 so that the robot can change its course at i3). This obstacle may be introduced multiple times.
- The robot must show a **visible decrease in its speed** upon entering the lanes A and B.
- The robot must check all the pickup locations (lane A) for objects (representing partially processed widgets); and should provide an indication by some means (e.g., LED, piezoelectric buzzer, etc.) when it detects a widget for pickup and **stop for 2 seconds**.
- For all empty pickup locations (lane A), the robot should not stop and continue to indicate intersections (using an LCD display, seven-segment display, etc.) on the go without stopping.
- After picking up the partially processed widgets, the robot should continue its course to drop-off the material at the machine location in the B lane and **display the distance between the pickup and drop-off locations** (using an LCD display, seven-segment display, etc.) in centimeters (as nearest multiple of 40).
- While travelling in the pickup and drop-off lanes, the robot must **always be checking for any dynamic obstacles** (that might be introduced in front of the robot) and must stop and indicate if there are any, as long as the obstacle is present. Once the offending obstacle departs, the robot should continue along its path.
- Right before starting your demo, you would be given the information about your team's pickup and drop-off locations (boxes of height at least 20 cm will be placed on those locations)
- You will be assigned pickup and drop-off locations from among A1-A5 and B1-B5, respectively, such that you will be able to reach them without breaking any lane rules.

NOTE:

- The minimum height of the objects used (representing some artifact on the shop floor) will be 20 centimetres.
- The objects representing pickup and drop-off locations will be placed 15-20cm away from lanes A and B, respectively.
- Dynamic obstacles that are introduced in the front of the robot will be 5-10cm in front of it.

Deliverables and Grading (Total: 100 points)

1. Line following robot - **15 points**
2. Detect and indicate intersections - **20 points** (2 points will be deducted for each missed intersection or mis-detected intersection)

3. Detect, avoid, and maneuver around an obstacle - **10 points**
4. Visible speed reduction in lanes A and B - **10 points**
5. Reach the randomly assigned pickup and drop-off locations and provide an indication - **20 points (10 each)**
6. Calculate and indicate the distance travelled from the pickup and drop-off locations - **10 points**
7. Detect, indicate, and stop at dynamic obstacles introduced in the lanes A or B - **15 points**

Note 1

- 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.

Note 2

- 80% of the overall grade for the project will come from the demonstration.
- 20% of the overall grade for the project will come from the project report.
- A team member who is absent during project demo will receive a grade of 0 for project demonstration. Any team or team member who report late for project demo will be penalized in project demo grade. Any significant delay (over 15 minutes) will result in a grade of 0 for project demonstration.
- Late submission of project report will not be accepted and will be awarded a grade of 0. Project reports will be due at 10am on the day of project demonstration.

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

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