ME331 Final Project, Spring 2025

(Team submission)

You will use your custom-built robot to complete several tasks including both autonomous and remote-control.

Part 0: Build your robot

Your robot is required to have the following components:

- Two TT-motors with wheels to drive the robot
- Distance sensor mounted on a servo motor to sense the obstacles near the vehicle
- (optional) RF module or IR receiver to receive commands from the ground station / remote controller

Chassis:

- You may use a 3D printer or any material to fabricate the chassis of your robot. Purchasing a basic kit is also allowed.
- Some reference for the chassis design can be found on Blackboard
- The components can be attached to the chassis with double sided tape, hot glue, or screws.

NOTE: The dynamics of the robot will be very different depending on the type of ground surface: e.g., cardboard, hard floor, or carpet. Please experiment in various conditions so you are ready to make adjustments.

Challenge 1: U-turn [30 pts] (Autonomous)

This task tests the basic ability for the robot to move straight and turn. The robot will be released approximately 2 m away from a wall. The robot must enter the target region, which is set as 30 cm distance from the wall. The robot must turn around and return past the start line, within 50 cm of the straight-line path, and stop.

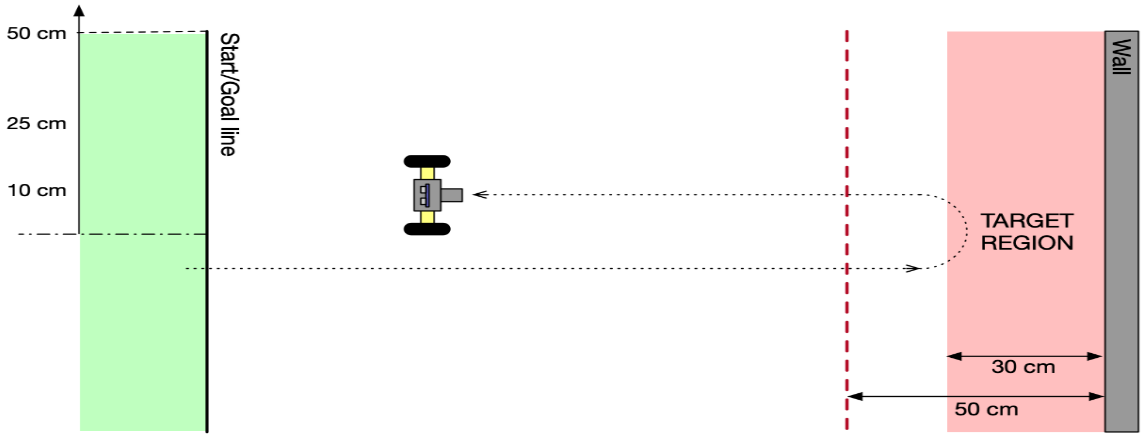
Scoring Rule 1:

- +30 pts for reaching the target region and stopping in the goal area
- +25 pts for reaching 50 cm distance, but not 30 cm from the wall (turns too early)
- +0 pts if the robot hits the wall

Scoring Rule 2:

- The robot must come back to within 50 cm of where it started, and then stop
- 50% of the score from Rule 1 if it does not come back to the above area

Challenge 1:



Challenge 2: Obstacle course [30 pts]

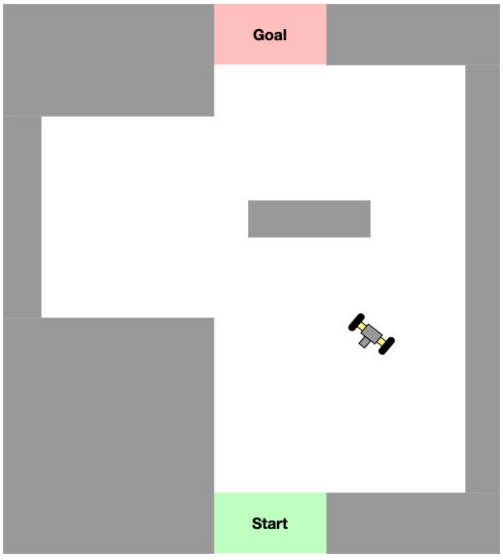
In this task, your robot is placed in a "room" with obstacles. The robot must find the goal and exit.

(Autonomous)-

- You have 3 chances to try this task.
- In each trial, the robot is given *2 minutes* to reach the goal.
- You can have extra trials with -1 pt penalty each.
- Do not hit the wall! -2 points for each collision
- Top three teams to achieve the shortest goal time will get bonus scores: +7, +5, and +3 for 1st, 2nd, and 3rd place.

(Remote)-Robots with the v1 motor shield cannot do this version

- You have 3 chances to try this task.
- In each trial, the robot is given *1 minute* to reach the goal.
- You can have extra trials with -1 pt penalty each.
- Do not hit the wall! -2 points for each collision
- No timed bonus available

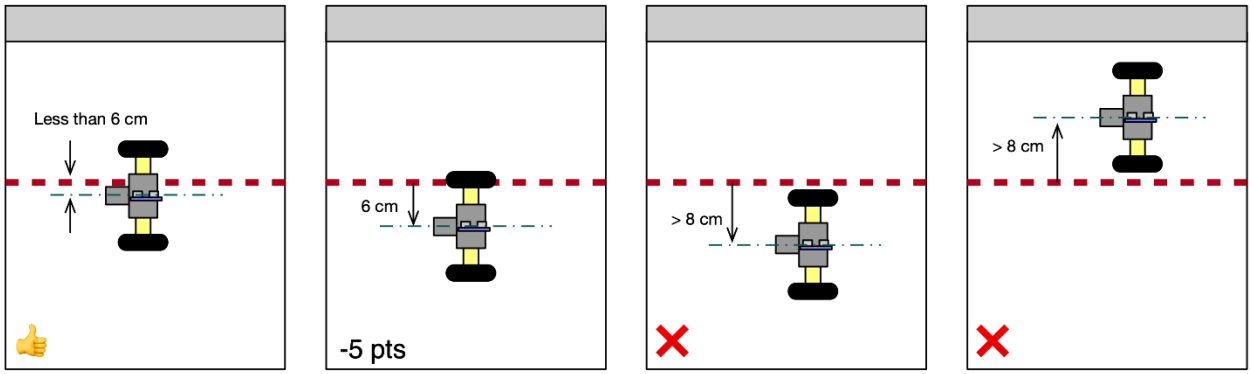


You may select one of the two for the final challenge.

Challenge 3A: Wall following with PD [30 pts] (Autonomous)

In this task, your robot must move along a wall. The wall may be straight or slightly curved but you can assume it to be smooth. The robot must maintain a 30 cm distance away from the wall, and be able to move forward for approximately 5-8 m.

- -5 pts if the robot centerline distance is ± 6 cm from the reference line
- No points will be given if centerline distance exceeds ± 8 cm from the reference line



Challenge 3-B: Object retrieval [30 pts] (Remote allowed)

In this task, the focus is on the mechanical aspect of the robot. your robot must go through an obstacle course, “pick up” an object of your choice (e.g., empty soda can), and bring it back to the starting point.

1) Object successfully picked up (it has no contact with the ground) [15]
2) Object transported back to the start within 2 minutes (autonomous) / 1 minutes (remote) [15]
3) Object transported back to the start within 4 minutes (autonomous) / 2 minutes (remote) [10]

Documentation [10 pts]:

Submit the following on Blackboard. Due **Tuesday, May 13, 11:59pm**

1) Code for each challenge, with a unique name (e.g., `Challenge1_teamname.ino`).

   Please keep in mind that proper documentation is required in your code. Refer to the **Academic Integrity Guidelines** on the next page

   Each sketch must include information in the header (your team name, a title, references). Your code should be neat (use control-T) and should include comments.

2) A short report which includes the following
   a) Parts List spreadsheet to include
      - Part name
      - Source of part (provided, purchased/cost, fabricated)

   b) Pictures of your robot (front, side, top)

   c) Description and links to references and sources used in this project (both code & circuitry).

   d) Brief write-up by each team member, describing the major contributions they made to the success of this project

Demonstration dates (all at SciTech)

- Tuesday, April 29 during class time
- Thursday May 1 during class time
- Tuesday May 8, 10:30am (final exam period for section 001)

Extra demonstration date for section 001

- Tuesday May 13, 4:30 (final exam period for section 002)

Academic Integrity Guidelines

The midterm project is a **team** project. From the syllabus:

> *You are responsible for making certain that there is no question that the work you hand in is your own. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently*

That said, discussion with your classmates is allowed and encouraged. Use your judgment, and please do not hesitate to ask for guidance if you are unsure

Not permitted are things such as

- Sharing code
- Having another student wire your circuit

Permitted are things such as

- Sending a link to a helpful website
- Having someone look at your code, on your PC, to help you debug
- Having someone look at your circuit to help you locate wiring problems

Using outside sources is also permitted. From the syllabus:

> *When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form.*

Please note that in this case "someone else" is not permitted to be a classmate

Note that copy/paste code from online sources, including AI-generated code, will likely not work without some modification. It is very difficult to debug code that you have not written. Therefore we recommend that you write code "from scratch" as much as possible, and use online sources mindfully

Expectations for attribution in your code

- You will include links to sources used. Cite them in the comments at the top of your code and in your report
- In the body of your sketch, you will include comments that identify code that was obtained from the referenced sources
- If you are using AI-assisted code generation, you **must** do the following
    - Include all prompts you used to generate the code. These should be included in your report
    - You may only use text-based prompts
    - Include link to the AI source