RBE 2002: Unified Robotics II
B-Term 2020-21
Final Project

Last modification: December 5, 2020

Overview

For your project, you will program your robot to navigate a short course that you build. Navigating the course will require your robot to perform many of the functions that you've explored in this class, plus one or two new ones, all combined in new ways. Each group is expected to demonstrate their robot successfully passing the parkour via zoom. One robot and one demonstration per group is sufficient.

Format

This is the final project, and therefore, in this course, you can solve it in a number of ways. You are allowed to use all the components that we used in this class. You can solve the problem however you like to. In robotics, it is not uncommon to produce systems, that only work under very specific conditions *at first*. For this project, make sure you engineer a robust system, so that you definitely succeed in demonstrating your final project. You will be also expected to indicate each person's contribution to the project, and in some cases, grades might be adjusted accordingly. Ideally, you will divide up tasks, with each student contributing functionality equitably, or you will develop code together.

Arena

There will not be an arena available in FOISIE due to Covid-19. You will need to build the arena for your robot from materials that you should have lying around. You may also suggest modifications to meet your particular circumstances, but you must discuss them with lab staff. Figure 1 shows the parkour.

Ramp

You are in charge of building your own ramp. This will require an iterative process in which you build a ramp and subsequently try whether your robot is capable of passing it. I recommend programming a state machine, that allows your robot to drive straight when a button is pressed, and stops when the button is pressed again. You might even consider taking off a ball caster, but be aware of the instability that it introduces, and especially when you plan on transporting the object over the ramp. It is OK to make modifications to the robot (e.g. attaching tape along sharp edges of the robot chassis to ease passing the ramp), or the ramp (e.g. rounding off the edges of the ramp), to make your robot pass the ramp. The shape of the ramp can be freely chosen. There is no minimum inclination specified for the ramp, but please make sure that you do not let your robot just drive over a piece of flat cardboard.

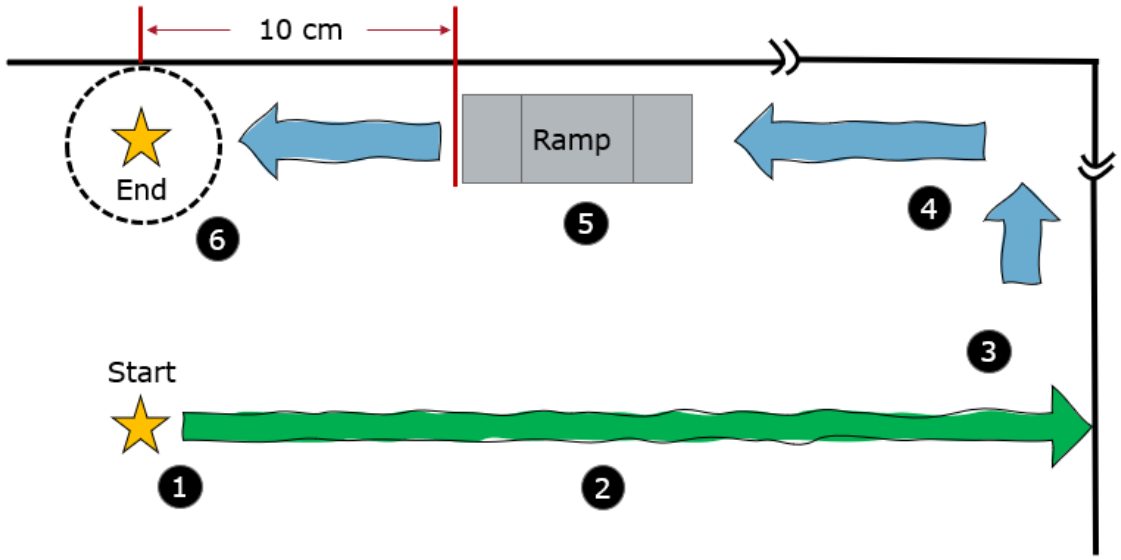

Figure 1: Robot parkour.

Objectives

Your robot has to do the following:

1. Load object onto the robot and press button
2. After one second, move straight until you collide with the wall, then stop
3. Remove object from robot, place another object onto the robot, press button
4. Rotate 90 degrees, follow wall around the corner
5. Pass the ramp, then continue to follow the wall for another 10 cm
6. Stop, and remove object from robot (if it is still on there)

You can choose the two objects freely, but you need to make sure that they are different, and also depict a challenge. If the objects stay on your robot independent of the acceleration, they are probably poor choices.

Rubric

Your group earns points for various tasks throughout the demonstration:

Task	Value
Robot waits 1 sec. after button press	1 pt
Robot collides with the wall and stops	2 pts.
Object does not fall off during collision	2 pts.
Robot rotates approx. 90 degrees	1 pt.
Robot follows wall	2 pts.
Robot follows wall around the corner	1 pt.
Robot passes the ramp	2 pts.
Object does not fall off when passing the ramp	4 pts.
Robot stops after 10 cm	2 pts.
Your robot passes the parkour at the first try	3 pts.
Total	**20 pts.**

Demonstration

You will demonstrate your system to the course staff before the end of the term. You'll be expected to show your system "live" via zoom. You will receive up to 17 points for accomplishing each of the tasks, plus 3 points for performing the tasks in "one shot," that is, from start to finish without intervention. Each group will have two attempts to demonstrate their robot and get full marks; for every attempt after that, they will lose one point from the "one-shot" category. If your robot cannot perform all the tasks in a single run, you may demonstrate individual tasks and still receive the appropriate credit. Manual intervention will disqualify the student from the one-shot bonus, but may be used to demonstrate other functionality (e.g., if your robot fails to follow the wall around the corner, you might move it back on track to receive points for everything but wall-following-around-the-corner).