Lab 10: Student Defined Lab

16-311: Introduction to Robotics

Contents

Learning Objectives

1. Design a robotic system to solve a problem of your choice.
2. Put into practice any of the topics discussed in class.
3. Design and test metrics for a robotic system.

1 Problem Statement

Propose a robot that could compete in and win one of the upcoming summer Olympic events.

Your team will design and implement a portion of a robotic system that could be built to compete in the summer Olympic games (if they allowed robots). You should choose and event, design the robotic system, then choose a portion of the design and implement it. You can choose how the robot moves and accomplished the event. You are restricted only by the rules of the Olympic event that you choose, and the technologies that currently exist (the robot must be implementable now).

You will generate a report that explains your robot, your implementation, and the evaluation of your implementation based on metrics of your choosing. You will introduce the overall design of the system, and the specific design and metrics of one subsystem of the robot. You will then implement the subsystem of the robot and then evaluate your own implementation based on your metrics and how the implementation performs against the other metrics listed in the Evaluation [20 points] section.

2 Required elements

2.1 Introduction [10 points]

Select an Olympic event for your robot to compete in from this list. Explain how your robot will compete in this event and why a robot is an ideal candidate for the event.

2.2 Robot System Description [15 points]

Describe the overall design of your robot. Describe what your robot does and how it will operate during the event. Describe what your robot does from the start of the event to the finish. How will it's different subsystems interact during this time?

Draw a diagram of what the robot will look like (like you did for Lab 19). Make sure to include labels for the major features and parts of the robot. You should include multiple views of the robot, front, side, etc., and label the views. If you choose to hand-draw this diagram, ensure that it is neat.

2.3 Implemented Subsystem Description [25 points]

Describe the subsystem you will be implementing for this lab in detail. This subsystem should use one of the topics we discussed this year. Make sure to describe in detail how the subsystem will operate and how this operation contributes to the overall system. Please describe your plan for implementation of this subsystem.

This is also where you should list the metrics that your implementation of this feature will be judged against. You should list five metrics. Each metric should be rooted in a real world requirement that is derived from a task or constraint of the event you're competing in. For each metric list

- The real world inspiration
- The derivation from the inspiration
- What the metric is
- How you will show how this metric has been met

These metrics should be reasonable and comprehensive for you key feature. If they're not reasonable or far too simple (i.e. the robot should move) they will not be counted for this section or for the Evaluation [20 points] section. If you would like to discuss your metrics and ensure they count come to OH or post on Piazza!

2.4 Implementation [30 points]

In this section please demonstrate and discuss you implementation. This can be in the form of screenshots, videos, diagrams, words, etc.

Your implementation must be from one of the following categories:

- **Cardboard Prototypes** Your cardboard prototype must show major features and motions. If the part should move, so must the cardboard prototype. Since you're working in teams, each partner can choose to work on a section as long as you can prove that they could fit together (like we did for Rube).
- **CAD Models** CAD models must be detailed models of the robot system or subsystem with though put into where all major parts will go.
- **Software** The software you choose to implement must complete one major function of the system, like the vision system. It is not acceptable to write a single simple python function. You may use any packages or other programs you want as long as you cite the code and it's does not trivialize your implementation.

- **Circuit Board Designs** If you choose to design the circuitry for your implementation ensure you have all necessary components and explain fully what the circuit should do and why you've chosen the parts and layout you chose. This should not be a board that simply has a power source and an LED power indicator, it should be more complex than this.

- **Circuit Prototypes** Your circuits can be physical (if you happen to have the necessary components) or modeled through a software like tinkerCAD. This shouldn't be a simple LED circuit. Show your circuit working and any code needed to program any microcontrollers.

- **Webots simulation** The Webots simulation can use pre-defined robots if your implementation is more software focused, or can be a rough model of the robot that shows it's motion if your implementation is more mechanical based.

If you have questions about an implementation category, or have another category you think should be allowed, please ask on Piazza. Your implementation section will be graded on effort expended. For general guidance, we expect the general effort level to be the same as you have had to put into the other labs in this class.

2.5 Evaluation [20 points]

In this section please answer the following questions

1. Why is this a robot?

2. How does this robot fit the sense/plan/act model of robotics?

3. How does your implementation use one of the topics we discussed in class this semester?

Next, you should also include proof that your implementation meets the metrics described. If your implementation could not meet your metrics, you may explain why this happened, and how you would redesign/implement the system to have it meet metrics (this will earn you partial credit if you're unable to meet metrics).

What To Submit

Submissions are due on Gradescope and Autolab (if applicable) by the date specified in the Syllabus.

1. Compile your answers and images into one .pdf and submit on Gradescope.
2. Upload any code or models you have in a zip file to autolab.