

Lab 19: Helpful Robot Proposal Lab

16-311: Introduction to Robotics

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Learning Objectives

1. Design a robotic system to solve a problem of your choice.
2. Put into practice concepts of systems engineering as covered in class.
3. Think critically about design choices and options for your system.

1 Problem Statement

Propose a robot that could help in a pandemic and explain its design aspects.

This is an individual lab.

As technology has improved, robots have been developed for a wide range of applications. For this assignment, you are tasked with proposing a robot that could help in a pandemic. You choose how exactly the robot helps. It could be in a hospital, completing every day tasks, improving mental well-being, etc. For the purpose of this assignment, a physical robot is requested.

You will generate a report that explains your robot and its subsystems and includes trade studies for key components.

2 Required elements

2.1 Introduction [5 points]

Explain the problem that you are targeting and your proposed solution. Length should be about 1 paragraph. You should make your problem statement clear, as well as provide reasoning for why it is an important problem.

2.2 Requirements and Constraints [10 points]

List the requirements for your robot. List enough requirements to fully describe all the things your robot must do to solve the problem described in the previous section. Next list the constraints of your robot. You should consider all aspects of your robot's functionality when listing your constraints. Be specific, include numbers that describe your requirements and constraints when applicable. For example, 'Robot should move' is not very specific, but 'robot should be able to safely navigate the environment at 1 m/s' is more specific.

2.3 Overall Design Depiction [10 points]

Draw a model of your robot and point out key features. 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.

2.4 Subsystems [20 points]

Decide on how your robot will be divided into subsystems. For each subsystem, explain what it should do in and contextualize it in terms of the whole system. Explain the requirements/constraints of each subsystem. These should be based on the overall requirements/constraints you came up with and should be specific enough to inform your trade studies. Again, be specific about the requirements and constraints.

2.5 Trade Study 1 [15 points]

Choose some aspect of your robot (for example the central computer, a motor, a communication aspect) and present at least 2 different parts or protocols as options. Both options must be reasonable contenders for the aspect of your robot. Be specific about each option (for example include links or images) and include a brief description. Choose 3 metrics to rate each option in and explain why these metrics are important to the function of the part and how it functions in the subsystem. Rate each of the options on these metrics. If there are more considerations between the two, list these out as well. Explain which option you would choose and why based on the metrics and considerations.

2.6 Trade Study 2 [15 points]

Same requirements as above for a different aspect of your robot. You may choose to reuse some of the metrics as above if they still make sense for the new aspect.

2.7 User Interface [10 points]

Explain how the operator(s) and end user(s) will interact with your robot. Why have you designed the user interface in this way? Are there any risks that your robot might hurt someone or something? How will you mitigate these risks? How will your robot default in a failure state?

2.8 Implementation Plan [15 points]

Create a plan for how you would implement this robot. What subsystems can be implemented simultaneously? What are the dependencies of the robot implementation?

What To Submit

Submissions are due on Gradescope by the date specified in the Syllabus.

1. Compile your answers and images into one .pdf and submit on Gradescope.