Assignment Sheet: Design Proposal
ECE 2031: Digital Design Laboratory

Length:	**Body of the proposal (Introduction - Management Plan) is not to exceed 7 pages of text (typed, double spaced, not including figures – so you can have ~60 vertical inches of text total)** **11-point "Times New Roman" font, double-spaced** **1" top, bottom, and side margins**
Point Distribution:	**300 points; submit one proposal per group (all members will receive the same grade)**
Due Date:	**April 7th by noon in the ECE Communication Studio, Van Leer C448. Late work will be penalized as described in the course syllabus.**

Description of Proposal:

A proposal is a document that identifies a specific problem and states how the problem will be solved. Proposals outline **what** you will do, **how** you plan on doing it, and **why** that plan was chosen. Your proposal should be technically detailed! This means that you must be familiar with the topic and do some experimentation to ensure that what you propose is feasible.

Spring 2017 Design Challenge:

DE2Bots usually sense the world through their ultrasonic rangefinders, but those sensors do not work well in tightly-confined areas. In order to explore methods of safely and robustly using the DE2Bot in such areas, you will operate the robot in a simulated parking situation, in which the robot must locate and enter designated spaces. The end of this document contains a detailed description of the project requirements.

Project Requirements in Brief:

- From the entrance of a simulated parking lot, the DE2Bot should semi-autonomously enter parallel and perpendicular parking spaces after being "driven" to an appropriate location by a user.
- From the entrance of a simulated parking lot and given a space designation, the DE2Bot should fully-autonomously find and park in the specified perpendicular parking space.

Project "Decision Space": The Unique Features of Your Team's Design

(these considerations are excellent fodder for proposal material)

- **Technical considerations**
  - How will the user control the robot using the IR remote? What operations will be available, which buttons will perform those actions, and in general how will the robot behave?
  - Where will the robot need to be positioned relative to the parking space before semi-autonomous parking is activated? How will that position compare between the types of parking spaces?
  - How will fully-autonomous operation compare with the semi-autonomous movement? Is it worth sharing actions between the two modes?
  - Will you attempt to use the ultrasonic rangefinders or other robot capabilities in any way?
- **Demonstration considerations**
  - In what situations might the user intervene during autonomous motion?
  - How will the user correct the robot position if the initial driving is inaccurate?

Content and Organization

For the purpose of this course, organize your proposal into the sections outlined below and follow standard technical writing conventions.

- Use future tense ("will") to explain your proposed approach to solving the problem.
- You may use past tense for work that you have already completed by the proposal submission date.
- Avoid personal pronouns ("we" or "our"). Third person is commonly used in proposals ("the team will" or "the engineers will"), or use passive voice ("X will be done").

Executive Summary (The ES is similar to an Abstract—it's the entire proposal condensed into one paragraph)

- Define the problem being addressed so that the reader knows how you are approaching the problem.
- Discuss your team's unique approach that will be used to solve the problem.
- Explain the strength of your team's approach – why is your design the best?

Introduction (This section can be organized using descriptive subheadings if needed)

- Describe the design problem and the project requirements to ensure that your reader is prepared to read your specific proposal.
- Briefly describe your team's solution to the problem – enough to introduce the rest of the document's headings.
- Do not assume that the reader has read the ES.

Technical Approach (This section should be organized using descriptive subheadings)

- Describe the technical approach you are proposing, addressing the specific requirements explained in this document, in lecture, and in supporting documents.
- Focus on explaining **how** your team will solve the problem (how you will create, design, implement, test, verify, demonstrate, etc.) and **why** you have chosen that approach. Only stating your end goals will **not** convince your audience that your plan is worthwhile or feasible.
- If you have already done some experiments, include relevant results to support the feasibility of your design. Anything that you can prove is already working will increase confidence in your proposed plan.

Management Plan (Two subsections: project schedule, and contingency plan)

- The entire project schedule should be organized in a Gantt chart, which will make up the bulk of this section of the proposal. There will only be a small amount of text in this paragraph – a summary of major tasks and division of labor. If the Gantt chart is too large to fit in this section, put it in an appendix.
    - **The timeline should be realistic.** Don't propose a design that can't be completed within the time available.
    - **You should include division of labor.** Showing that your team is well-organized is one of the most effective ways to inspire confidence in your ability to complete your goals.
- Include your contingency plan, showing that you have considered what parts of your project might fail, and accounting specifically for how you will handle any problems that arise (if X doesn't work, you will do Y).

Formatting:

1. Follow the template online, which has pre-set margins, headings and subheadings, and fonts.

2. Experiment with using bullets and numbered lists, if appropriate. You do not always have to organize your text in paragraph form. Organization should be effective, clear, and audience-appropriate.

3. Include as many descriptive figures as possible. They do not count against the page limit.

4. Attach an evaluation sheet (on top) signed by all team members before submitting.

Your Design Task for Spring 2017

Figure 1 below shows the tentative setup for a simulated parking area. The actual area will be available in the lab for more precise measurements starting March 27th. In general:

- There will be a row of spaces inside the lot ("perpendicular" parking), and a "street" outside with spaces ("parallel" parking).
- Both types of spaces will be 45 cm long (in the direction the parked robot faces) and 35 cm wide. Spaces will be separated by 2.5 cm wide tape, which will not be included in the space dimensions.
- The perpendicular spaces will be numbered in the direction shown below, starting at 1 and going up to the number of spaces. There will be at most seven perpendicular spaces.
- Any number of spaces can be occupied by static, robot-sized objects. Which spaces are occupied will change between demos.

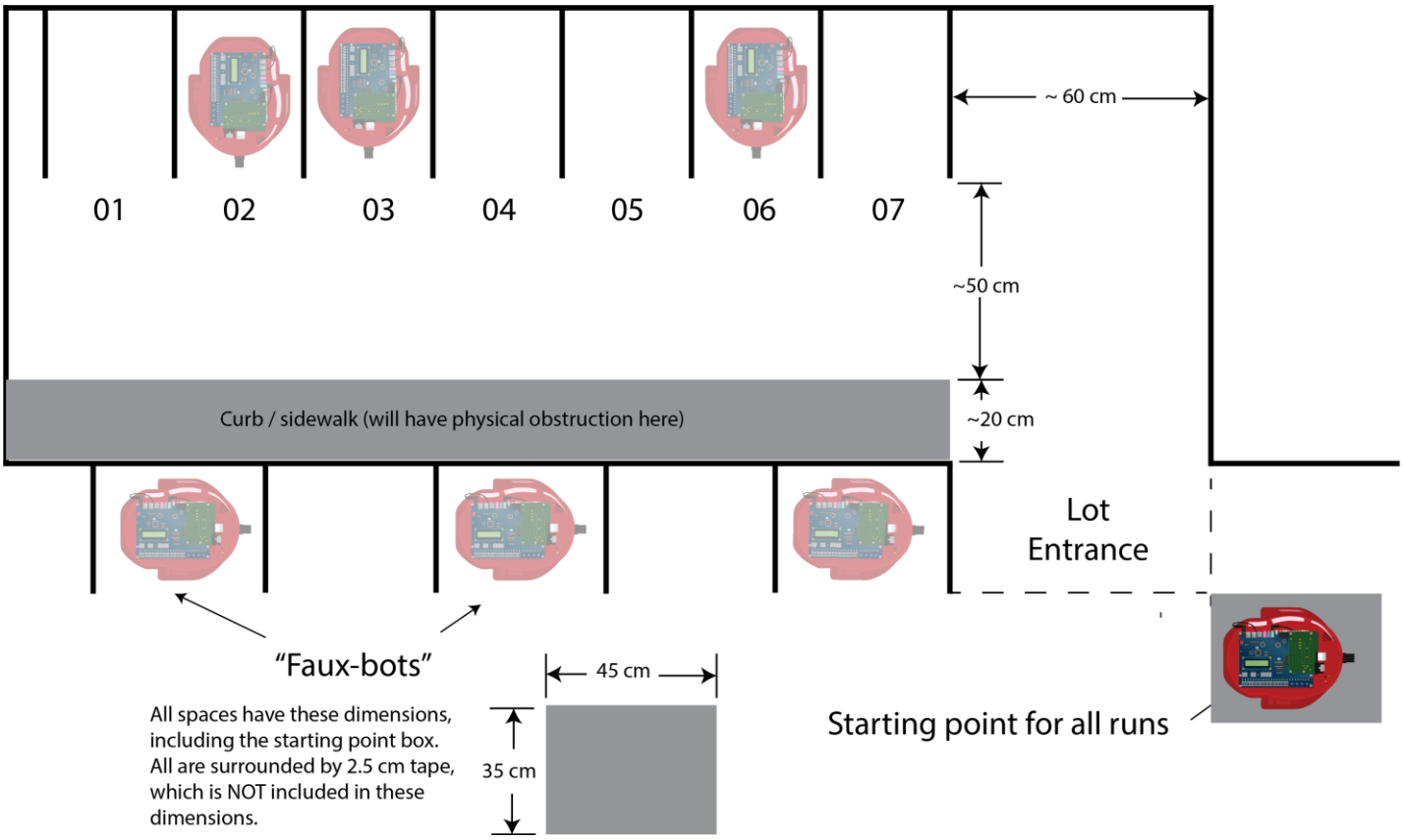

Figure 1. Anticipated arragement of parallel and perpendicular parking spots for the spring 2017 project.

Within this parking area, the three goals of the project are to:

1. Use the IR remote to manually "drive" the robot near a parallel parking spot, then press a button on the remote to initiate an automated parallel parking maneuver into that space.
    - "Near" can be defined by the team, but a) must not be within the space and b) must be in the 'driving' orientation (facing left in the diagram above).
2. Repeat the above process with a perpendicular parking space (manually driving near it and finishing with an autonomous movement).
3. Park in a numbered space fully-autonomously.
    - The robot, at the starting point, should accept the number of the desired parking spot, and then find the correct spot and park in it without further user input.

Parking Details:

- The robot must finish in the appropriate orientation for the type of parking space it is using.
    - Facing forwards or backwards does not matter.
- There are no limitations on the types of movement the robot can perform; i.e. it does not have to move "like a car".

Demonstration Details:

- At the beginning of the demo, the team will place their robot within the designated starting area.
- After the robot is placed, the team will be shown the two spaces that they are expected to park in semi-autonomously.
    - Those two spaces will not change during the demo.
- The space to park in fully-autonomously can be requested any time the robot is within the starting area.
    - That space might change each time it is requested, e.g. if fully-autonomous parking is re-attempted.
- The entire demo can take at most eight minutes.
    - The demo begins once the two fixed parking spots are indicated.
    - The demo ends either after eight minutes, or when a team member tells the proctor that they are done.
    - Time does not pause during the demo (barring extenuating circumstances such as needing to repair the demo area, fire alarms, etc.).
- The team may make at most four attempts at parking (each referred to as a "trial"). Ideally, only three attempts will be necessary (one for each parking space / method), but one failed attempt will only negatively affect the time taken to complete the demo.
    - Each trial must begin with the robot in the designated starting area.
    - A trial ends when a team member physically interacts with the robot, or the demo ends.
    - Any previous attempts at a particular parking spot will be ignored, even if the final attempt is less successful than previous attempts.

Scoring Information

Specific scoring details for the demo will be described in a separate document, but some general information necessary for the proposal follows.

Note that the demo ***score*** is not the same as the demo ***grade***. The demo score has an arbitrary scale, and will be "curved" to appropriate grades. For example, if a perfect demo resulted in a score of 800, then 800 would be a grade of 100%, but a score of 200 would *not* be a grade of 25%. Even a low (but acceptable) score will result in a grade of 70% or more.

General scoring notes:

- Each of the three trials will be weighted equally.
- Colliding with obstacles will incur penalties. More than a few collisions will result in sufficient penalties to effectively disqualify the attempt.
- The robot must be completely within the parking space and in the correct orientation for full parking credit, but imprecise parking will earn some amount of partial credit.
- Almost all of the demo score will be from the parking accuracy, but approximately 10% will be awarded for efficient completion. Successfully completing all three trials with two minutes remaining (i.e. in six minutes) will award the maximum credit. Finishing with less time will award proportionally less credit. Finishing faster will have no effect.