Computer Systems Design Lab

SYSC 4805 (Fall 2022)

Instructor: Dr. Mostafa Taha
Carleton University
Department of Systems and Computer Engineering

Project Description

Autonmous Snowplow

The task of your robot is to clear the snow off an area enclosed by a closed black path. The area will contain some fixed obstacles and some moving obstacles. The robot is required to complete its task without hitting obstacles. In our indoor testing arena, the black path is a black painter's tape, the obstacles are boxes and other moving robots, and the snow is simulated with lightweight, plastic balls.

You should build your robot after the following specifications.

- The area of the testing space is roughly 6 m^2. This can be a square space of almost 2.5 x 2.5 meters, or any rectangular space of a similar area.
- The diameter of each snowball is 42.6 mm.
- The maximum robot size: Width x Length x High = 216 x 252 x 150 mm. Given that the actual robot is 176 x 232 x 79.5, this means that the plow can extend in width by a maximum of 40 mm (20 mm in each direction), and extend in length by 20 mm.
- The use of a plow is optional, but strongly recommended. You have to design a unique plow for your robot to control pushing the snow spheres in the desired direction to eventually push the snow outside the highlighted perimeter.
- The robot can start from any position inside the perimeter.
- The maximum allowable robot speed is 30 cm/s.
- The maximum allowed operation time to clear the snow is 5 minutes.
- Lab 5 and Lab 6 should be utilized to prepare the project proposal. Lab 12 for demonstration. Hence, the actual development time is 5 labs (Lab 7 to Lab 11). Each team should assign a unique activity per member per week. **A team with 3 members should have 15 unique activities. A team with 2 members should have 10 unique activities**.
- No development is allowed on Lab 12 itself (Dec. 1 and Dec.2). This lab time is dedicated for testing and evaluation.
- The order of testing will be randomized, during the lab time.
- Development should use the distributed version control system GitHub: https://classroom.github.com/classrooms/114966737-sysc4805-fall2022

The team will be graded based on the remaining number of snowballs within the area after the simulation time is complete and the number of times the robot hits an obstacle. Each hit of an obstacle will be equivalent to missing 20 snowballs.

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Project Proposal (Due by Friday, October 14 @ 11:59 pm):

One document per team, maximum of **15 pages**, uploaded to Brightspace.

- (20%) Project Charter.
  - Give your team a name from the list of colors: https://en.wikipedia.org/wiki/List_of_colors_(compact)
  - (10%) Overall objective (one paragraph approx. 200 words).
  - (10%) Overall deliverables (Milestone deliverables, and final deliverables).
- (40%) Scope:
  - (15%) A list of requirements, following the requirement language (precise engineering requirements).
  - (15%) A list of activities that cover all the requirements, organized in a WBS (use a project lifecycle).
  - (10%) Testing Plan: a set of testing that covers all the requirements (success criteria).
- (20%) Schedule:
  - (10%) Schedule Network Diagram (connect the activities with respect to dependency and time).
  - (10%) A Gantt chart over the remaining labs with activities, milestones and contingencies.
- (10%) Cost:
  - (10%) Cost Baseline figure (Assume 50$/hour/developer).
- (10%) Human Resources
  - (10%) Responsibility Assignment Matrix (for each activity, assign one responsible and one approver).

Progress Report (Due by Friday, November 11 @ 11:59 pm):

One document per team, maximum of **20 pages**, uploaded to Brightspace and your GitHub repository. The progress report should include all the information in the project proposal, plus:

- (40%) Update the Project Proposal document, addressing all the raised concerns.
- (10%) The overall Architecture of your system.
- (10%) Statechart of the overall system.
- (10%) A sequence diagram (or diagrams).
- (10%) Demonstrate the use of a watchdog timer.
- (10%) An updated Planned Value Analysis figure.
- (10%) A working code on the GitHub repository with 3 committed activities per student.

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Final Report (Due by Friday, December 9 @ 11:59 pm)

One document per team, no maximum length. The final report should include all the information in the progress report, plus:

- (25%) Update the Project Proposal document to incorporate comments and include any changes. Clearly identify the contribution of each member.
- (25%) Control Chart(s) with at least 5 runs per requirement.
- (25%) Results of testing system testing, happening in Lab 11, in addition to the customer testing on Lab 12.
- (25%) A complete, well-commented working code on your GitHub repository.
- Upload the report to your GitHub repository to have a complete project repository.
- Export the Git Repository to a .zip file.
- Upload both the report and the .zip file to Brightspace, for department purposes and bookkeeping.

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In-Lecture Presentation (During the last four lectures)

Each team gets 15 mins (13 mins presentation + 2 mins for questions).

Slides are to be uploaded on Brightspace at the time.

- Lecture 9, Nov. 21: L1 Groups 1 to 5.
- Lecture 10, Nov. 28: L1 Groups 6 to 10.
- Lecture 11, Dec. 5: L1 Groups 11 to 12 and L2 Groups 1 to 3.
- Lecture 12, Dec. 9: 21, L2 Groups 4 to 5 and L3 Groups 1 to 3.

The grading rubric of the in-lecture presentation is as follows:

PRESENTATION COMPONENTS		**SCORES**		
Introduction	Got attention? Provided a preview of presentation?	□ Yes	□ Partially	□ No
Preparation	Preparation apparent? Practice apparent? Members equally well prepared?	□ Yes	□ Partially	□ No
Organization	Good organization? Easy to follow?	□ Yes	□ Partially	□ No
Creativity	Did the group show creative thinking/innovation in the method of development and in the presentation?	□ Yes	□ Partially	□ No
Technical aspects	Innovative solutions? Justification of choices?	□ Yes	□ Partially	□ No
Project objectives	Clear and complete explanations?	□ Yes	□ Partially	□ No
Presentation style and delivery	Language appropriate and clear? Members know their material or read notes? Use appropriate volume, body language (posture, gestures, etc.)?	□ Yes	□ Partially	□ No
Visual Aids	Usefulness? Appearance (Professional look, fonts large enough)?	□ Yes	□ Partially	□ No
Conclusion	Ended with summary?	□ Yes	□ Partially	□ No
Overall team cohesiveness	Connected to each other? Attentive when group member spoke? Met time requirements?	□ Yes	□ Partially	□ No

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In-Lab Demonstration

Two testing arenas will be set in the lab. The entire lab (Lab 12) will be dedicated to testing. No further development is allowed in Lab 12.

Each team gets 15 mins (10 demo + 5 code review).

The grade will be mainly based **on the number of snowballs cleared off the perimeter**, in addition to the following grading rubric:

DEMONSTRATION		**SCORES**		
Functionality	The implementation works.	□ Yes	□ Partially	□ No
	The implementation is robust and reliable.	□ Yes	□ Partially	□ No
	The implementation is accurate with respect to the project plan. If changes were brought to the plan, students are able to justify the rationale.	□ Yes	□ Partially	□ No
Quality	The code is well organized and commented.	□ Yes	□ Partially	□ No
	The implementation considers multiple factors (i.e. performance, health/safety, usability, aesthetics, reusability, expandability, and efficiency).	□ Yes	□ Partially	□ No
	Team members indicate clearly the source of the software they make use of and acknowledge that the code use from others cannot count for more than 25% of the code in their project.	□ Yes	□ Partially	□ No
	The students show proof of appropriate testing performed.	□ Yes	□ Partially	□ No
Utility	Implementation fulfills purpose or design intent.	□ Yes	□ Partially	□ No
Explanations	Team members are able to answer general questions about their solution.	□ Yes	□ Partially	□ No
	Team members are capable to reply point/very specific questions about their solution.	□ Yes	□ Partially	□ No
Extras	The implementation goes beyond minimum requirements. Innovative solutions are used to solve the problem and/or the project makes use of additional components and their impact is justified and demonstrated.	□ Yes	□ Partially	□ No