

Control: Once the vehicle takes off, no control is allowed, e.g., it is fully **automatically planned/controlled** on the map.

Timing: The vehicle must reach the destination in 8 minutes, or 0 point is received for timing (see judging criteria).

Team members: Each team may have 5-6 students.

Other rules

- If the vehicle is off the designated path, it should restart from the starting point, and the time is accumulative.
- Each team has 3 chances to play on the map and the shortest time is accounted for their final scores.

2.1 Judging criteria

Final report and presentation (20)	Detailed and well-explained final report and presentation are encouraged	20
Basic tasks (50)	Avoid the obstacles	10
	Reach the mid-point of the path	10
	Reach the destination	10
	Pick object A (orange)	5
	Pick object B (eraser)	5
	Unload objects A & B	5+5=10
Task: timing (30)	Fast 30 pts, medium 25 pts, slow (≤ 8 min) 20 pts, overtime (>8 min) 0 pts	Note: fast and medium will be determined at the last design review.
Task: intelligence (10)	(1) No added marks on the given map: 5 pts (2) Adaptability to a new map: 5 pts (a new map will be given at the final presentation with different tracking path and locations for the objects (similar obstacles may be given), other requirements: picking up and unloading objects A & B, <8 min, avoid obstacles, no added marks etc.)	Note: only marks for grasping is allowed on the map and marks can not be placed elsewhere; the hidden map has a similar size but a different route and locations for the obstacles and objects A&B.
Task: extra loading and grasping capability (10)	At the given old map, in addition to finish basic tasks, you pick up and unload objects C (a bottle of water~600 ml) & D (a pen) at two given locations. Within the medium time interval and without marks for grasping objects, pick up and unload C (5 pts), pick up and unload D (5 pts)	Note: each added mark for grasping C or D deducts 2 pts; medium $< \text{time} \leq 8$ min deducts 2 pts; overtime (>8 min) receives 0 pts for this task.

Similar to playing a game, you may complete the very basic tasks (70 pts), but you may also want to improve your speed, intelligence or other abilities (30 pts). All objects will be placed at their most stable orientation (low gravity center and minimum rolling) on the ground.

1. Concept Design

Conduct a conceptual design to implement a smart vehicle which can automatically avoid two obstacles after it leaves the starting point, and then find its path to the destination. Along the path to the destination, the designed vehicles need to grasp objects at two different locations and carry the objects to another designated point to unload along the path.

2. Prototype of the machines

Manufacture a prototype of the designed concept using the designed components and raw material.

3. Design Review (Tentative: Apr 22^{ed} and May 6th, 2022)

Two design reviews will be organized by the instructors and TAs to discuss the progress of the project, and exchange the necessary requirements, information, and suggestions.

4. Final project report

Write a final report for this project, including all details of the conceptual design and prototyping.

5. Oral presentation and a competition

Give an oral presentation at the end of the semester and we will have a competition for the prototyped vehicles.

2.2 Performance of Prototyped Machines

The grade of the prototyped vehicles will be determined based on several criteria described in the judging criteria provided above. The competition is scheduled tentatively on **June 3rd, 2022**.

3 Final Project Report Format

The final written report, a very important component of the course project is due on **June 10th, 2022 before 10:00 am**. You are required to submit an electronic copy of your entire final report (including all related documents, e.g., design review slides, presentation slides, etc.), in a single pdf file. Your final report must follow closely the project format given here. Your report will be partly graded based on how closely you follow the instructions in the project format.

The project format for the report is as follows. Starting with a cover page: include a title of your project together with your names, semester (Spring 2022), and the submission date (center all of these items). The final report must be typeset on an A4 paper with a 12 point times-new-roman font (double spaced with one-inch/2.54 cm margin all around), page numbered, and have the following sections:

Table of Content (with page number for all sections listed)

Abstract (about 200 words)

1. **Introduction.** Provide a short introduction of some related technical issues and the overall goal of your project.
2. **Concept Design.** Problem definition, concept generation and selection, the general mechanism of your design, material selection, CAD designed works and all other related issues.
3. **Manufacturing.** All details related to the manufacturing process for the prototype.
4. **Cost Estimation.** Estimate the cost for materials, manufacturing and other issues.
5. **Conclusion.** Provide a 100-150 words of concluding remarks.
6. **Cited References.** List only references that you are referring to in the text of your report.
7. **Nomenclature.** Define all symbols used in the reports.
8. **Acknowledgements.**

Appendix I. All sketches in concept design

Appendix II. All engineering draws with SolidWorks

Appendix III. Product Design Specifications

Appendix IV. Details of Prototyped machines

Appendix V. Other related works