CSE 360/460 Intro to Mobile Robotics

Final Project:	Capture the Flag! IMR Grand Challenge 2013
Location:	VADER Laboratory, PL450
Competition Date:	7 May 2013, 1600-1900
Project Exit Interview:	8 May 2013 schedule TBD

A. Objective: In this final project, you will work as a team using the Create robot, the Sick LMS291 LIDAR, a digital camera, and the algorithms that you learned in class to develop an autonomous system capable of navigating a course and reaching a goal without any user input. The project is intended to test your understanding on several course topics, to include: rigid transformations, robot kinematics, LIDAR signal processing, color segmentation, feedback control, and temporal filtering.

B. IMPORTANT!!! The LMS291 costs almost $6000. It is not a toy. Please treat it with respect.

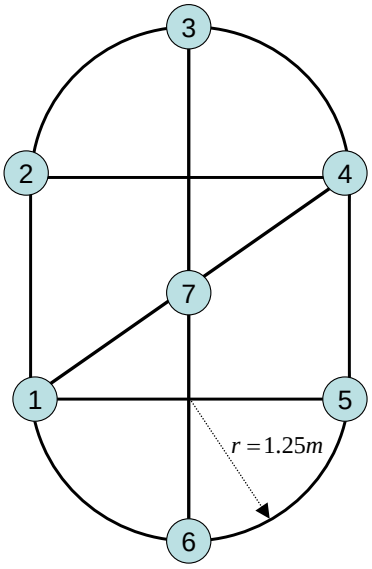
C. Project Overview:

1. In this project, the LMS291 will be connected to a workstation. It will transmit range and reflectivity packets to allow you to track **a single retro-reflector** affixed to the top of the Create robot. Using the resulting range and reflectivity measurements, this will allow you to estimate the position of the robot relative to the LMS291.
2. The role of the LMS291 is to act as an "indoor GPS." You should have demonstrated this successfully in the 4th lab session.
3. Using the position estimates, the Create will navigate a course provided a priori.
4. The route will be bordered by obstacles to demarcate the extent of the drivable road. No obstacles will be placed within the actual route, and the obstacles will not occlude the LIDAR sensor measurements.
5. Upon successfully traversing the route, the robot will use its camera to locate and capture a brightly colored flag.
6. Teams will be ranked based upon how quickly they traverse the route without contacting obstacles.

D. Further Details:

1. There will be 5 teams of 3-4 students, as listed in Part F. Prof. Spletzer will designate one student as the team leader. This student is expected to assume a leadership role with regards to project management. This includes coordinating group meetings and arranging lab times.

2. Each team will be provided with a dedicated notebook computer, an external USB camera, and a Create platform for use during this project.
3. The robot will have a single retro-reflector that can be used to track its position. Note that to estimate the robot's orientation, you will need to do some form of temporal filtering.
4. You will NOT know the exact initial position of the LIDAR. However, you will be allowed to use retro reflectors before each mission to calibrate the LIDAR with respect to a global coordinate frame.
5. You can assume that all points on the course will be visible to the LIDAR.
6. You WILL be allowed to place the robot yourself on the initial start point.
7. The route network (RN) that the robot must traverse is shown below. Note that the arcs both have a constant 1.25 m radius.



$\text{Point } 1 = (-1.25m, -1m)$

$\text{Point } 2 = (-1.25m, 1m)$

$\text{Point } 3 = (0m, 2.25m)$

$\text{Point } 4 = (1.25m, 1m)$

$\text{Point } 5 = (1.25m, -1m)$

$\text{Point } 6 = (0m, -2.25m)$

$\text{Point } 7 = (0m, 0m)$

8. Each segment will have a minimum clear path 68cm wide. This is 2X the diameter of the Create robot.
9. The route in terms of waypoints will be specified in a subsequent email in the near future.
10. In the vicinity of the last waypoint, there will be a brightly colored "flag" (pink ball). Your robot must capture the flag by striking the pink ball.
11. Note that the ball may be placed at any relative angle to the waypoint. While it will may be within the sensing *range* of the camera, it may not initially be in the camera's *field of view*.
12. A total of 3 missions will be conducted. The team which completes the greatest portion of the challenge in the lowest time will be the winner.
13. Collision with an obstacle is cause for disqualification for that mission. The instructor is the final judge as to whether a collision did occur.

14. To assist with your preparations, you should use the sample code for interfacing with the Create and Sick LIDAR from previous labs. Updated Matlab code for use with an external USB camera will be posted in the near future.
15. A Sick LIDAR will be available continuously in PL450. There will also be a lab sign-in sheet where you can schedule hours for PL450. I will post this on Course Site in the near future.
16. The iRobotCreate SDK enables you to develop algorithms in simulation. I strongly encourage you to take advantage of this capability in this project. This will minimize the amount of time you need to spend in the lab working with the hardware. If it doesn't work in simulation, it will not work in the real world.

E. Your Report: The team leader (or his designated representative) is required to meet with Prof. Spletzer on Wednesday, 8 May to provide an after-action-report covering the group's performance and lessons learned from the competition. No written report is required.

F. Teams: Team leader is shown in bold.

Team 1: Desmarais, **Hart**, Huang
Team 2: Demarco, Hau, **Khurana**
Team 3: Dunkers, Raseley, **Trephan**
Team 4: Benning, Daniels, **Shariati**
Team 5: **Abreu**, King, Smith, Wilt