Arrrgh!!!! Sharpen yer cutlasses and polish yer peg legs, me hearties, cuz there be a challenge in the wind.

**Purpose:**
The purpose of this project is to provide an opportunity to apply all that you have learned in CMPE-118 to solve an open-ended problem. Your task is to build a droid that will replace the gore and spectacle of a pirate battle. Your task is to navigate to the enemy’s Treasure Island, and return to your own safely; though you might have to dodge some ping-pong ball cannon shot.

**Background Briefing:**
The year is 1695. The East India Company, architect of the British Empire, is busy bringing riches of silk, gold, ivory, and spices back to Great Britain.

Their only obstacle: pirates.

Eager for plunder, English pirate Captain Henry Every and five other bloodthirsty pirate captains have teamed up to attack the East India Company’s fleet as it makes its annual voyage to Mecca. On the way, the ships must pass through the Straits of Bab-el Mandeb, or the “Gate of Grief,” the narrow passage between Yemen and Djibouti. This is where Captain Every hopes to win riches beyond his wildest dreams.

Each “ship” (aka ‘droid) will take turns being either a pirate ship or a part of the East
India Company fleet, as indicated by their respective flags (indicated by a red or green LED). Whoever defeats the other ship and captures their flag will go on to the next round, until the ultimate victor—pirates or East India Company—is decided.

**Project Specifications:**
The droid must be a stand-alone entity, capable of meeting all specifications while drawing power only from batteries. Your code must be flashed into the PIC32, and for setup purposes, you may be able to communicate to your droid using a standard terminal program. Once operational status is complete, the computer will be disconnected.

The field for the tournament consists of an 8ft square marked on the floor with 2” wide wall around the perimeter. Black tape marks the “coast line” as well as the home and opposing target “islands.”

The task is to navigate to the opposing island, cross through its center (marked by black tape), and then return to your own island. That is, you must capture the enemy’s treasure, and bring it back. Points are awarded for completing the task. You may also fire on the opponent using ping-pong balls, and points will be scored for each hit on the opponent.

Both droids will carry a standard 4” wide beacon that is transmitting an IR signal at 2KHz with a 50% duty cycle. (See the attached sketch of the machine specs for mounting
Each droid **must** have a set of locating holes to mount the beacons/targets (SolidWorks part provided) with at least 3/4” of depth from the top of the holes. The beacon must be at 11” off the ground, and must not be blocked by any part of your droid.

Your machines will be placed at random within on the starting arc (a 24” semi-circle centered on the edge of the field) in a random orientation. In a head-to-head match, two droids will be placed on their respective starting arcs at random locations/orientations.

Points are awarded as follows:
- Reaching opponent’s Island: 50 points
- Returning to your own Island: 100 points (150 for successful mission)
- Ramming opponent: 20 points
- Being rammed by opponent: -20 points
- (mutual collisions: 0 points for both)
- Each ping pong ball hit on opponent: 10 points
- Each ping pong ball hit on your droid: -10 points

Your robot is required to stay within the field (marked by 2” black tape), defined by keeping half of the robot within the black tape. Robots running aground (more than half the robot over the black tape coastline) will be disqualified. Your robot is required to detect collisions and resolve them (e.g. if the opponent ‘bot is blocking your path, you need to be able to maneuver around an immovable obstacle).

Robots are placed onto the field and have 2 minutes to retrieve the treasure and come back to their home island. The game ends immediately after the first ‘bot completes its task. If no winners result from completing the game, the droid with the most points at the end of two minutes wins. The tournament will be run in a single elimination fashion until just one robot remains.

Your machine is required to occupy a volume not to exceed 11” x 11” in horizontal dimensions and 11” in height when initiated. Your machine must contain the complete supply of balls to be used during the event.

The minimum requirement for a passing grade is that you are able to: (1) Navigate to the opponent’s island, (2) score two ping-pong ball hits on the opposing bot, and (3) return to your own island. There will be a dead (unmovable) ‘bot on the field during the min-spec check-off; you must be able to resolve collisions with it. Scoring does not affect grading, but will be used as the basis of a competition between teams. Once your machine has been activated, the operator may not touch it until the entire sequence is
complete. During operation, the machine is required to stay within the boundaries of the field, and back off collision objects as specified above.

You are limited to a total team expense of less than $150/bot. Parts scavenged and from the “box of freedom” don’t count against this total. Our intention is not to turn this into an arms race.

A report describing the technical details of the machine will be required. The report should be of sufficient detail that a person skilled at the level of CMPE118 could understand, reproduce and modify the design.

**Safety:**
The machines should be safe to the user, the lab and the spectators. For this project, excessively high velocity ball delivery will be discouraged (so go ahead and forget about that CO₂ PVC pipe launcher you were thinking about.) Voltages are limited to the rechargeable batteries in the lab (you may purchase your own if you’d like), and intentional jamming of the opposing robot or masking of your own beacon is considered foul play and not allowed. ‘Bots deemed unsafe will be disqualified.

Prior to competition your robot should not transcend space or time in any way, nor should your robot alter gravity within our Solar System. However, during competition, gravity and space-time may be altered at will.

**Evaluation:**
Performance testing procedures: All machines will be operated by one of the team members. There will be one round for grading purposes, and one round for entertainment purposes.

**Level 1:** Grading evaluation. Each machine will be graded based on its performance in the testing before the class competition at the end of the quarter. Each machine will have up to 2 minutes to win the match. Grading is not based on point value, but is simply a measure of successfully making it to the opposite island and returning.

**Level 2:** Class Competition. After a few trial runs, each group and machine will be entered into a single-elimination tournament. Each machine will receive points as outlined above for successful attacks delivered within the 2 minutes. Note that the tournament is a public demo, and be sure to invite all of your friends and family. We should have enough time to do double elimination or grudge matches.

**Grading Criteria:**
1. Concept (20%): This will be based on the technical merit of the design and coding for the machine. Included in this grade will be evaluation of the appropriateness of the solution, as well as innovative hardware and software and use of physical principles in the solution.

2. Implementation (20%): This will be based on the prototype displayed at the evaluation session. Included in this grade will be an evaluation of the physical appearance of the prototype and the quality of construction. We will not presume to judge true aesthetics (though we might comment on it), but will concentrate on craftsmanship and finished appearance.

3. Report (10%): This will be based on an evaluation of the written report. It will be judged on clarity of explanations, completeness and appropriateness of the documentation.

4. Performance (20%): Based on the results of the performance during the evaluation session.

5. Design Evaluations (30%): Based on check-off completion.

**Project Milestones:**

**First Review:** Tuesday, 14-February-2011, presented in class (using overhead projector or tablet). Note that this is done by each person in the class individually.

Generate 5 concepts of how you are going to build a droid that will successfully compete in the tournament. Sketch them all out, and deliver a sketch of your best two concepts to the professor at least 2 hours before class begins, include:
- Sketches
- Details where you have them
- Plan B in case things don’t work out the way you expect

**Check-off 1:** Friday, 17-February-2012, Presented to TAs or Instructor

Using the five concepts that you created for the first review, now that you are assigned to teams, come up with 5 team concepts for your design, how you are going to accomplish your project goals.

Deliverables are:
- 5 detailed TEAM concepts for solving the project.
Check-off 2: Tuesday, 21-February-2012, Presented to TAs or Instructor

Deliverables are:
- Time schedules
- Personnel assignments
- System Block Diagram
- Mechanical Design Sketches

Check-off 3: Friday, 24-February-2012, Presented to TAs or Instructor

Deliverables are:
- State Machine(s)
- Final Mechanical Design (Solidworks/Sketch-up)

Check-off 4: Tuesday, 28-February-2012, Presented to TAs or Instructor

Deliverables are:
- Working sensors (breadboard is ok) and schematics
- Actuators (breadboard is ok) and schematics

Check-off 5: Friday, 02-March-2012, Presented to TAs or Instructor

Deliverables are:
- Final sensors and final schematics
- Final actuators and final schematics

Check-off 6: Tuesday, 06-March-2012, Presented to TAs or Instructor

Deliverables are:
- Autonomous platform that can move and sense
- Reverse off of a collision sensor
- Keep itself on the field

Check-off 7: Friday, 09-March-2012, Presented to TAs or Instructor

Deliverables are:
- Robot that can autonomously locate Island and opponent and score points

Specifications Check-Off: Tuesday, 13-March-2012, Presented to TAs or Instructor

Deliverables are:
• Robot that meets minimum specifications

**Final Presentations: Wednesday 14-March-2012,** Finished, operational machines, fun performance for SOE audience. Public Demo will be held in Baskin 101, starting at 6:30 PM, post performance class gathering at 99Bottles for all 118ers and spouses/friends.

**PS:** With this many people in the lab, it is going to be very important that you keep the lab clean and not leave your things out. We will be assigning I/O boards and batteries to each team, and they will be yours until the project is over. An early trip over the hill to Halted will probably be very useful, and if you are going to order things from McMaster or Digikey/Jameco, gang your orders together to save on the shipping.

We will be bringing down our “box of freedom” with random parts that people have donated over the years, and if you happen to find surplus printers, or other random electronics that people no longer want, feel free to dismantle and put parts in. However, please discard all parts that are not salvageable in an appropriate e-waste container so as to reduce clutter in the lab.

Drive motors have, in general, been a make-or-break part of the project. I would strongly suggest you consider purchasing some gearhead motors from Jameco or MPJA.com. Ordering them early (ie: now) would ensure that you have a set that will work by the time you need them. I will post on the forum what I think are decent motors—gang the order together and you can get expedited shipping very reasonably.
The Pirate Straights

Start the game at 2.0 ft radius

1.0 ft minimum 18" separation

4 ft 2ft. radius

6" inner radius

Starting Arc

Pirate Island

East India Island

Land

8 ft