UNIVERSITY OF CALIFORNIA, SANTA CRUZ
BOARD OF STUDIES IN COMPUTER ENGINEERING

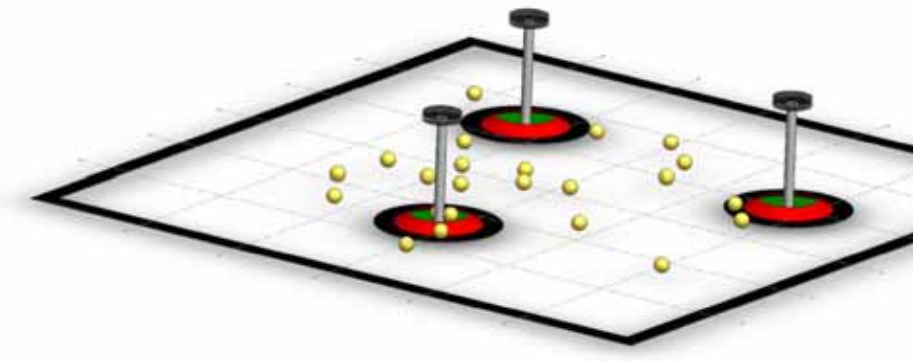
CMPE-118/L: INTRODUCTION TO MECHATRONICS

SLUG SPACKLER'S REVENGE: CADDYSHACK OPEN 2009

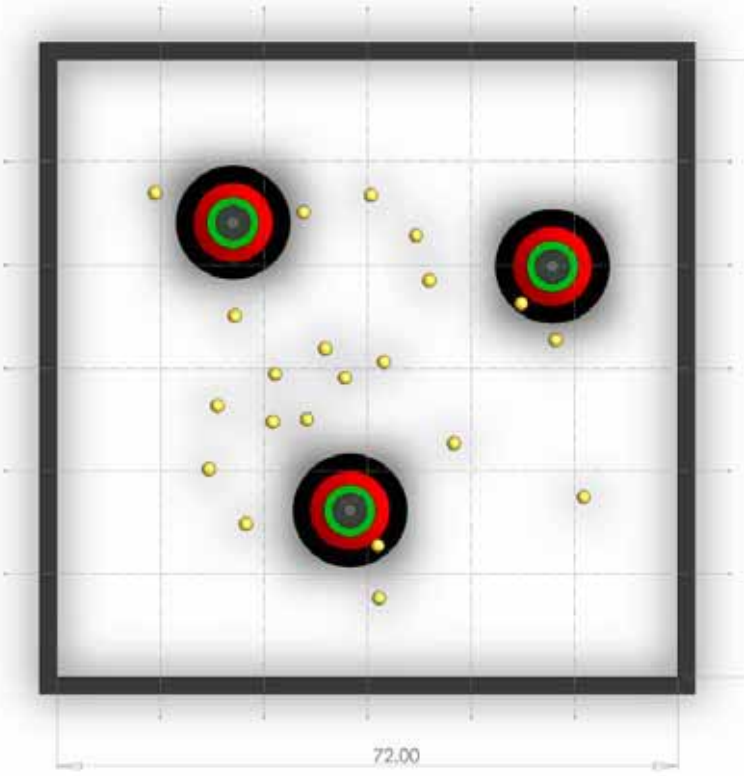
Purpose:

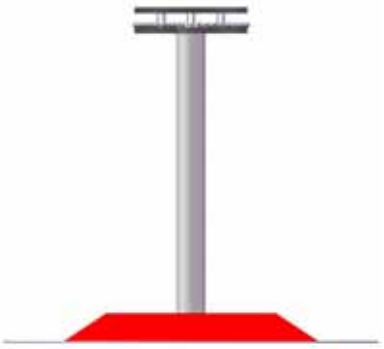
The purpose of this project is to provide an opportunity to apply all that you have learned in CMPE-118 to solve an open-ended problem. Your task is to build a droid that will reclaim the golf tournament from the dreaded gopher by dropping in ping-pong ball sized explosives down the gopher holes.

The Tower



The Playing Field





Background Briefing:

Thirty years after Carl Spackler lost both his mind and his war with the gopher at the Bushwood Country Club, the tenacious gopher has once again emerged to rein destruction and chaos on the unwitting golfers heading for the UCSC tournament. This time, the gopher has gone too far, and needs to be retired with extreme prejudice. After much consulting and scheming (and frankly because they could not afford anyone else), they decided to hire the mechatronic class to design robotic droids to exterminate the gopher using explosives dropped into the holes.

Your mission has a familiar ring: wait for the appropriate time, and with great skill and patience, watch for the gopher and roll your deadly ping-pong ball explosive into his hole. In order to insure that the gopher bites the dust this time, at least two ping-pong ball explosives mush be dropped into each hole. This will be Slug Spacklers Revenge, and this time, the gopher is toast!

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 HC12, 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 court for the tournament consists of a 6ft x 6ft area marked on the floor with 2" wide black tape. Placed at random within the floor area will be three tower/targets, consisting of a circular ramp, 9" in diameter with a 6" cutout in the center. Each ramp has a 2" wide circular black tape ring on the outside, and at the center of the target is a 1" diameter rod that is 12" tall, and is topped by a 4" wide beacon that is transmitting an IR signal at 2KHz with a 50% duty cycle. See the attached sketch of the playing field for details.

Your machine will be placed at random within the field and in a random orientation. It will be placed in such a way that your droid can clearly see all three tower/targets (that is, no beacons will be in line between your droid and another beacon). In a head-to-head match, two droids will be placed in the field at random locations. Your task is to place two ping pong balls into each target before the allotted time runs out. When any two balls are placed within the opening in the tower/target base, the beacon on that tower will shut off. When all three targets are off, the game is over.

Points are awarded as follows:

- 1^{st} ball into any lit target = 20 points
- 2^{nd} ball into target = 30 points (target beacon shuts down)
- All subsequent balls into targets = 0 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. Your robot is required to detect collisions

are resolve them (that is, if you run into a tower/target or other robot, you must back off to clear that object).

Robots are placed onto the field and have 2 minutes to shut off each tower/target by putting two balls into the open base (they may be rolled, dropped, thrown, fired, etc.). If beacons remain lit at the end of two minutes, the droid with the most points wins. The tournament will be run in a single elimination fashion until just one 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 put one ball into each of *two different targets*. 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 of collision objects.

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 CO_2 PVC pipe launcher you were thinking of). Voltages are limited to the rechargeable batteries in the lab (and you may purchase your own if you'd like), and intentional jamming of the opposing robot is considered foul play.

Prior to competition your robot should not transcend space or time in any way.

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 disable two tower/targets. Grading is not based on point value, but is simply a measure of successfully making two balls into two different tower/targets.

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 shots delivered within the 2 minutes. Note that the

tournament is a public demo, and be sure to invite all of your friends and family.

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, 10-February-2009, 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: Thursday, 12-February-2009, 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, 17-February-2009, Presented to TAs or Instructor

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

Check-off 3: Thursday, 19-February-2009, Presented to TAs or Instructor

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

Check-off 4: Tuesday, 24-February-2009, Presented to TAs or Instructor

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

Check-off 5: Thursday, 26-February-2008, Presented to TAs or Instructor

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

Check-off 6: Tuesday, 2-March-2009, 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: Thursday, 4-March-2009, Presented to TAs or Instructor

Deliverables are:
- Robot that can autonomously locate tower/targets and score points?

Specifications Check-Off: Tuesday, 10-March-2009, Presented to TAs or Instructor

Deliverables are:
- Robot that meets minimum specifications

Final Presentations: Wednesday 11-March-2009, Finished, operational machines, fun

performance for SOE audience. Public Demo will be held in Jack Baskin Engineering #152, starting at 6:30 PM.

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-Carr or Digikey/Jameco, gang your orders together to save on the shipping. We will be bringing down our "box o' freedom" that has 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.