# SLUG-O-LÉTE: THIS AIN'T NO BULL 2011

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 bullfight by replacing both the bull and the toreador. As the bull, your task is to gore (ram) the toreador; as the toreador, the task is to place ping pong ball *banderillas* into a target on the back of the charging bull.

Field
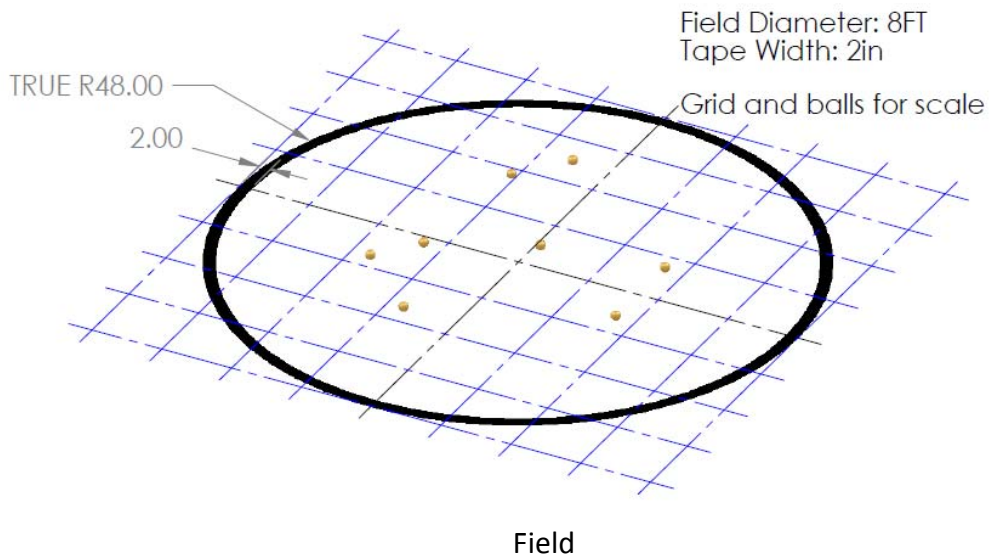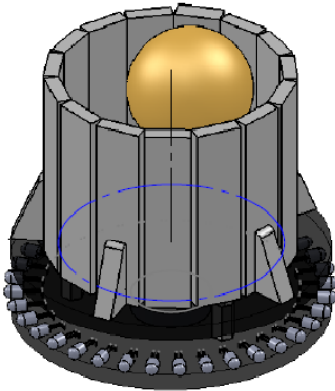
Target
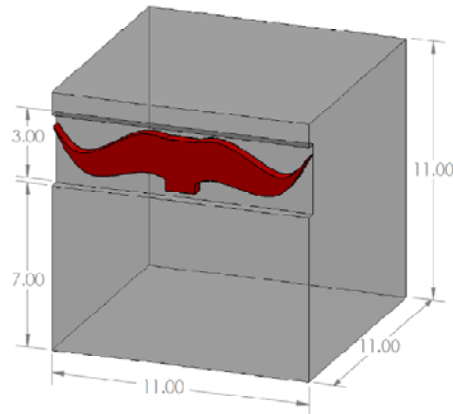
Volume/Horn_Specs

Background Briefing:

The current economic crisis has hit Spain and Portugal especially hard. So hard, in fact, that they cannot currently afford their national pastime: the bullfight. In addition, they continue to face international opprobrium from the UN and animal rights groups for what they consider to be a beautiful performance art.

Stepping into the breach, UCSC has decided to offer a technological solution that will satisfy both groups. The Mechatronics class will design droids to re-enact the traditional bullfight – and all its excitement – at a fraction of the budget and no harm to the bulls.

Your droid must be able to act as both bull and toreador. When you are the bull, your job is to locate the toreador, and gore him (again and again) using your horns. When you are the toreador, your job is to avoid being gored and to disable the bull using your ping pong ball *banderillas* by placing them into a target on the bull's shoulders. The most famous of toreadors, Manoléte, was gored to death in the ring. Your droids, the Slug-o-létes, will demonstrate how it's done – and that ain't no bull!

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 ring for the tournament consists of an 8ft diameter circle marked on the floor with 2" wide black tape (outside of the tape marks the limit of the ring). Your droid must have a switch on it to change its status from BULL (RED) to TOREADOR (GREEN), and this

status must be indicated by an appropriately colored LED. Your droid must have one set of horns (they can be removable) on the front of the droid between 7" and 10" above the floor. A tail is completely optional.

Additionally, as toreador, your bot must have a clear target between 7" and 10" above the floor, at least as far out as your wheels/base. 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 details.)

The target for the ping pong balls is a 3.15" diameter cup, 2.5" tall, sitting on top of and centered on the IR beacon. The cup is made out of foamcore, and a deadening material will be placed inside to keep ping pong balls from bouncing out. Each droid **must** have a set of locating holes to mount the beacons/targets (SolidWorks part provided) with at least ¾" of depth from the top of the holes.

Your machines will be placed at random within the field and in a random orientation. In a head-to-head match, two droids will be placed in the field at random locations/orientations. In BULL mode, your task is to gore the toreador by ramming him with your horns. After 5 seconds, your droid should back away from the toreador, and then re-gore at will. In TOREADOR mode, your task is to avoid being gored and to place ping pong balls into the receiver on top of the BULL before time runs out. If a BULL receives four balls into his receiver, or a TOREADOR is gored four times, or either player leaves the ring, the game is over.

Points are awarded as follows:
    1st ball / 1st gore = 20 points
    2nd ball / 2nd gore = 30 points, etc.
    Any player leaving the field before 2 minutes immediately loses.

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 and resolve them (e.g. as BULL you can only pin the TOREADOR for 5 seconds before releasing him).

Robots are placed onto the field and have 2 minutes to gore and pique. If no winners result from the four touch rule, the droid with the most points wins. Immediately after, the match is replayed, with the role of BULL and TOREADOR switched. 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) in BULL mode, gore, release after 5 seconds, and re-gore a static (unmoving) toreador, and (2) in TOREADOR mode, locate a static (unmoving) bull, and drop at least two ping pong balls into his target. 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.

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 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.

Prior to competition your robot should not transcend space or time in any way, nor should your robot alter gravity within our Solar System.

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 in both modes. Grading is not based on point value, but is simply a measure of successfully making two balls into the target, and goring twice.

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. Each pair will immediately replay with their roles reversed.

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: Wednesday, 09-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, 11-February-2011, 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, 15-February-2011, Presented to TAs or Instructor

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

Check-off 3: Friday, 18-February-2011, Presented to TAs or Instructor

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

Check-off 4: Tuesday, 22-February-2011, Presented to TAs or Instructor

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

Check-off 5: Friday, 25-February-2011, Presented to TAs or Instructor

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

Check-off 6: Tuesday, 1-March-2011, 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, 4-March-2011, Presented to TAs or Instructor

Deliverables are:

- Robot that can autonomously locate BULL/TOREADOR and score points

Specifications Check-Off: Wednesday, 09-March-2011, Presented to TAs or Instructor

Deliverables are:
- Robot that meets minimum specifications

Final Presentations: Thursday 10-March-2011, Finished, operational machines, fun performance for SOE audience. Public Demo will be held in TBD, 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" 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.