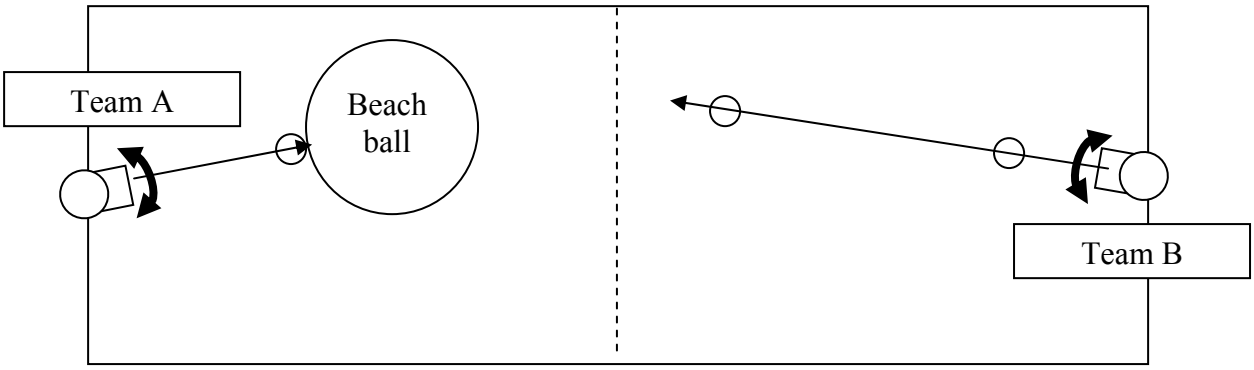
MAE 106 Mechanical Systems Laboratory
Final Project Initial Description 2009

CROSSFIRE

Your team (4 people on a team unless a TA or Prof. Reinkensmeyer gives an exception) will build a robotic player for the game crossfire. Your team will then compete in a tournament with the 4 other teams in your lab section. The 9 winners of the lab sections will advance to the grand finale, which will be held on the last day of lecture during the lecture time.



TOP VIEW

The basic idea is to try to move the beach ball to your opponent's side by shooting small foam balls at it. The loser will be the person with the ball on their side after one minute. You will get a kit with a motor and you must actuate the shooter (an air gun controlled by a pneumatic valve, which will already be built for you) with the motor to make it rotate. The air gun will have a proximity sensor that will electronically indicate the presence of the ball when the ball is in front of the sensor. The table will be 4' wide by 8' long. You must be able to install your drive for the shooter in three minutes, or you will disqualified. You will have to control the pneumatic valve and your motor using a LabView program that you write

You will be provided with a starter's kit (available beginning April 13 from Dave Hartwig, EG 2118). Key elements in the starter's kit will be a small, DC brushed motor, power amplifier, op amp, and potentiometer.

IMPORTANT NOTE: You must program the computer to automatically control the robots. You may not teleoperate the robots using a potentiometer. In other words, once the game begins, you cannot touch any part of your robot.

MAE 106 Mechanical Systems Laboratory
Final Project Details

Phases

- Phase 1 of the competition will be a round-robin competition between all the groups in your lab section during Week 9 (Week 10 for the Monday lab) i.e. May 26-June 1. The winner will be the team that scores the most victories, with the tie-breaker being the team that won in any head-to-head competition.
- Phase 2 of the competition will be a single-elimination tournament on the last day of Lecture June 4, during the regular class time. Since there are 9 lab sections, 9 teams will advance to Phase 2. The two teams that had the fewest victories in the lab sections will first battle, to reduce the field to 8 teams. We will then have a single elimination tournament with the remaining 8 teams.

Detailed Rules List

- You will have 3 minutes from a "go" signal to set up your project. If you are not set-up after 3 minutes, you team forfeits.
- The canon holds 12 balls. You will not be allowed to re-fill it.
- The competition will last 1 minute. The winner will be the team taht does not have the ball on its side when 1 minute is over.
- When the referee gives the go signal, you can hit the keyboard or mouse once. You may not touch the key board, mouse, or your robot after that. If you touch any part of the equipment, you will automatically lose.
- The sensor will be mounted on the canon.
- You can only power your motor using the power supply on you final project nerd kit.
- You can use a laptop, or you can use the computer provided in lab.
- You may not incorporate additional actuators (besides the cylinder and brushed motor).
- You must check-out a connector from Dave Hartwig. This connector will have 4 pins.

PLEASE SEE THE SEPARATE PIN OUT DOCUMENT ON THE COURSE WEB SITE. THE BELOW IS INCORRECT.

- ~~The first two pins will allow you to receive information from the sensor. Pin 1 is sensor signal (0 to 5 volts). You will want to connect this to you circuit or an AD input on the LabView data acquisition module (and thus to the computer). Pin 2 is sensor ground.~~
- ~~The second two pins are for controlling the valve. Pin 3 connects to the valve, which requires 0 volts to stay closed, and 5 volts to open. You will want to connect your circuit or the DA output or Digital output of the LabView data acquisition module to Pin 3. Pin 4 is valve ground.~~

Grading: The final project is worth 25% of your grade. A score of 100 points is an "A+", but you can also get extra credit. Grading is based as follows:

1. Mechanical verification (6 pts max)
2. The performance of your robot on the day of the contests (20 points)
    - +10 pts if you have a plausible robot, but it doesn't work
    - +20 pts if your robot works
    - +10 extra credit pts if you win your lab contest

- +10 ec pts if the representative from your lab wins the final contest
- +10 ec pts if you finish in the final 4 in Phase II
- +10 ec pts if you finish in the final 2 in Phase II
- +10 ec pts if you win the competition

So, if you win the competition, you will get 40 extra credit points, and your lab section will get 10 extra credit points. Hopefully this will motivate your lab section to help you out for the final competition.

3. A written final project report (74 pts maximum)
   One write-up should be turned in per project group.
   Your final project write-up should have the following sections. Start each section on a separate page.

   Section 1: System Description (30 pts)
   a) Draw a system diagram showing all of the components you used, and how you interconnected them
   b) Draw a system diagram showing the transfer functions of the relevant parts of your robot
   c) Include any labview code you used, or a diagram of the circuit you used, with documentation on how it works.

   Section 2: Testing and Gain Selection (40 pts)
   a) Show at least 3 plots of the performance of your machine with different gains, and, based on these plots, explain why you chose the gains you did.

   Section 5: Summary of contributions from each group member (4 pts)

   NOTE: If you feel that one of your group members did not participate in the group, please email me a message. I will adjust the person's participation score as appropriate.

INTRODUCTION by Matt Traum

There it sits, glistening in the morning sunlight. Representing weeks of tears and tedium, a P-controlled car capable of maintaining constant velocity sits upon the drywall track. Every battery has been charged in full, every MOSFET has been tested and retested, and even Op-Amp has a particular gleam to it. The gauntlet was tossed down ten weeks before, and now this tiny warrior is ready to meet the challenge: steady velocity control.

The signal is given. The little racer is off! With calculated precision it accelerates to its predetermined velocity. It passes the first photo gate as it's tires meet the edge of the cliff, the 30 degree sheer incline that must be traversed. The motor screams with all its will as the small warrior climbs the mountain before it. Like the Little Engine that Could, the car puffs its way to the summit.

At the top there is a brief flat rest and beyond, the treacherous downhill. The car begins its decent, nearly slipping on the slick drywall surface. At the bottom, it manages to clear the second photo gate and is free to head for home. Like the finish of a marathon, the termination of a long journey, or the closing scene of a romance novel, the little fighter drives to victory. Its motor purrs with the satisfaction of a task completed and well done. The end of the track is centimeters away; almost within reach.... WHAM!!!