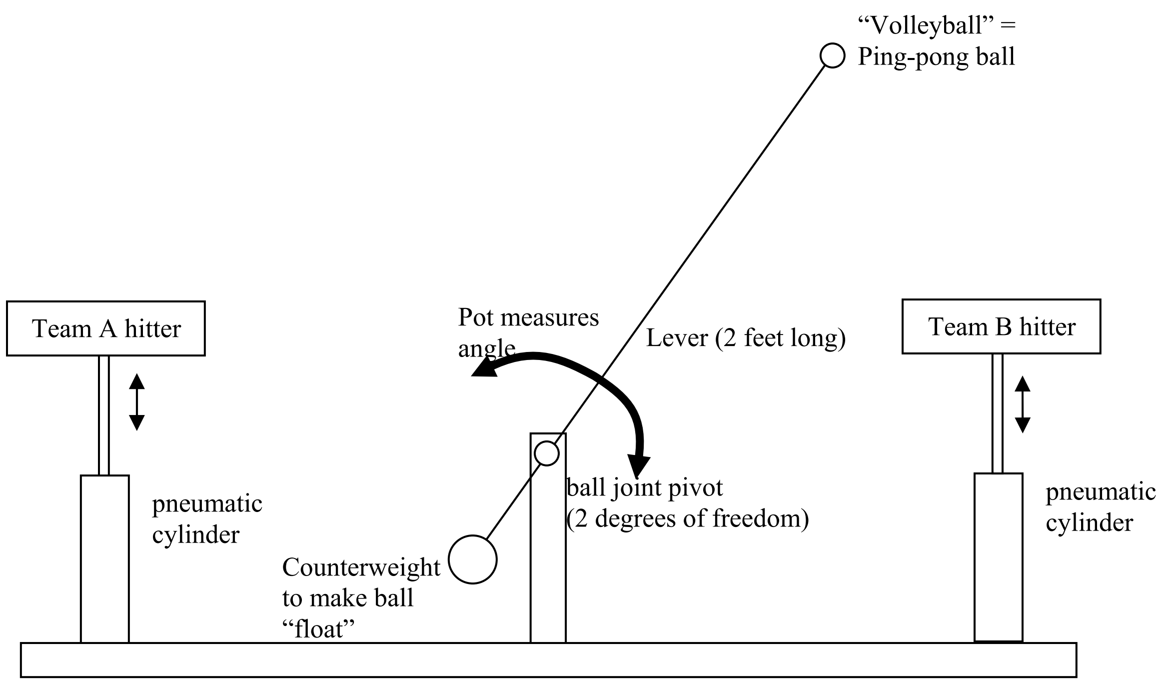
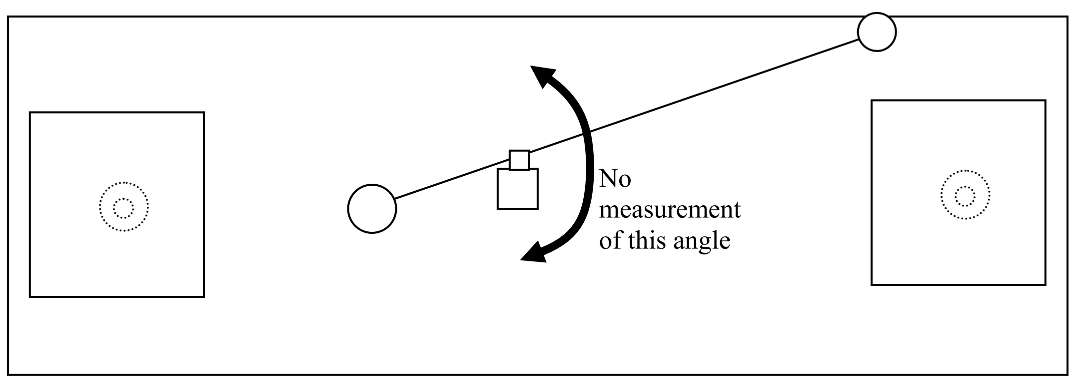
MAE 106 Mechanical Systems Laboratory
Final Project 2007

ROBOTLEYBALL

In honor of UCI's awesome men's volleyball team, your team (minimum of 2 people, maximum of 4 people) will design a robotic volleyball player. All teams will then compete in a tournament. The four teams that win their matches by the largest point margins in the first round will receive extra credit and then compete in the "final four" round, and then the championship round. <u>*The final project competition will be the day of the scheduled final Thursday June 14, 8-10 AM, room to be announced.*</u> The setup will be as follows:



SIDE VIEW



TOP VIEW

The basic idea is to use the data from the pot to time the motion of the pneumatic cylinder, in order to hit the ball over to the other player. The pneumatic cylinder will be provided to you and you will not be able to take it home. It will be fixed to the table top. The pneumatic cylinder will have a 6" stroke length. You will control the pneumatic cylinder using your own custom-written Matlab program, through a digital-to-analog port on the LabJack, which will interface to a servovalve for controlling the pneumatic cylinder. You will use the servovalve to let pressurized air into the cylinder, which will cause the piston to move rapidly. If you move the piston at the right time, it should hit the ball back over to the other player.

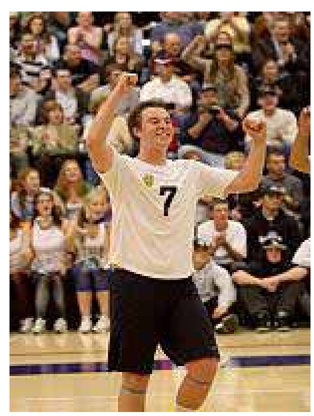
You must also build a "hitter" that mounts to the top of the pneumatic cylinder. The hitter can have any design you want, but must fit into an 8.5" x 11" x 8.5" space. You can incorporate a single actuator into the hitter, which must be the DC brushed motor available in the project kit. The actuator could be used, for example, to tilt the hitter based on information from a sensor that you incorporate into your robot. Notice that the court will be slightly wider than the hitter, so if the robot aims correctly, it can make the ball hit the corner of your opponent's court and get a point, although if the robot misaims and the ball lands outside the court you will lose the point.

You will be provided with a starter's kit (available beginning May 21 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.

In the first round, games will be played to 5 points using collegiate volleyball scoring rules. The first round scoring will be as follows:
First round game score = total # of hits during rallies + 5*(point margin of victory)

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

Time and Location:
The competition will take place in the MAE106 laboratory, EG2102, at the time of the scheduled final: Thursday June , 8-10 AM. See you bright and early!

Detailed Rules List

- You may not catch the ball and then throw it; you have to hit it. More precisely, the ball may not stay in contact with your hitter for more than 1 second for each hit.
- Multiple hits are OK, as long as the ball leaves after 1 second.
- To begin each match, the ball will be served to a randomly selected team by dropping the ball from the vertical position.
- After the first point, the ball will be served to the team that won the previous point by dropping the ball from the vertical position.
- Your hitter has to hit the ball, not the rod connected to the ball. If you hit the rod, you lose the point.
- To be considered "out" the ball has to land outside the court.
- Your hitter only has to fit in the size-restriction box at the beginning of the competition; it can unfurl
- You are not required to incorporate the brushed motor; but, you do receive points for overall design and effort; if you do not incorporate the motor, you should try to make up for it some other way in a clever design.
- The instructor and TA's reserve the right to change the weight of the ball during the competition to challenge the teams.
- If the instructor changes the weight of the ball, each team will have 1 minute to adjust their robot/computer code. Otherwise, you may not touch the robot between points.
- You may not incorporate additional actuators (besides the cylinder and brushed motor), but you can incorporate other sensors on your hitter.

Grading: The final project is worth 25% of your grade. You can score a maximum of 140 pts on your final project Your points will be based on:

1. The performance of your robot on the day of the contest
    - +10 pts if you have a plausible circuit and robot, but it doesn't work
    - +20 pts if your robot works
    - +30 pts if you finish in the final four
    - +40 pts if you finish in the final two
    - +60 pts if you win the competition
2. A written final project report (80 pts maximum)
    - The goal of the written final project report is to describe your design as clearly as possible, and the effort you put into building and testing the robot.
    - 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: Summary of the Design Strategy (20 pts)

a. Summarize the design approach that you took.
b. What type of controller(s) did you use and why?
c. What was unique about your design?

Section 2: System Description (30 pts)

d. Draw a diagram showing all of the parts of the system that you built, and how they are connected/communicate with each other.
e. Provide a circuit diagram of any circuits that you built, with equations, and/or a flow chart of how your computer code worked
f. Provide documented computer code

Section 3: Testing (20 pts)

g. What tests did you perform to calibrate/verify/improve performance of your robot? Include graphs of any data that you took to help optimize your design.

Section 4: Parts list (5 pts)

Section 5: Summary of contributions from each group member (5 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!!!