Lab 2: Feedback Control of a Ping-Pong Ball

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1 Exercise 1

In this exercise we interfaced the Raspberry Pi with a sonar sensor. We connected the sonar to the Raspberry Pi and then completed the provided code to read the distance measurement from the sensor. We converted the pulse readings to distance and printed data on the terminal and then demonstrated the program to the lab instructor.

1.1 Circuit

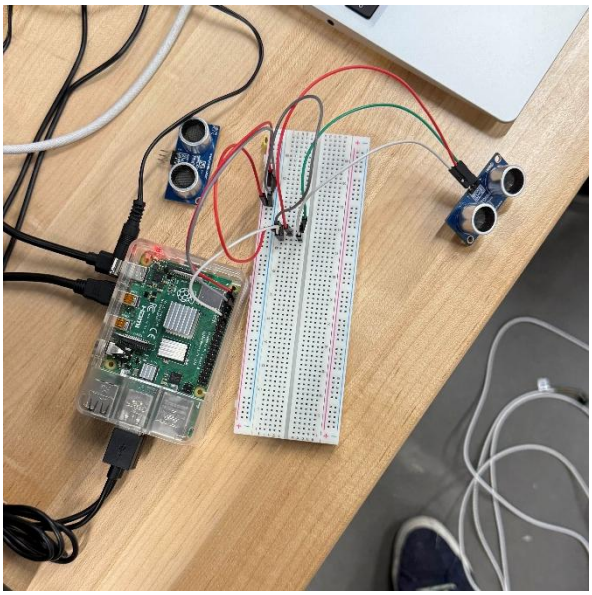


Figure 1: Demo for exercise 1

1.2 Screenshots & Tables & Results

```
Distance: 4.4648 cm
Distance: 4.2644 cm
Distance: 4.4709 cm
Distance: 4.2428 cm
Distance: 4.3019 cm
Distance: 4.2449 cm
Distance: 4.4847 cm
Distance: 4.2732 cm
Distance: 4.4673 cm
Distance: 4.3239 cm
Distance: 4.2015 cm
Distance: 4.4215 cm
```

2 Exercise 2

In this exercises we interfaced the Raspberry Pi with a sonar sensor and a fan and used a Proportional Integral and Derivative (PID) control algorithm to make a Ping-Pong ball hover at a specific height. We built the circuit from the lab handout and then completed the provided code to have the fan adjust its speed to keep the ball at a specified height. We then demonstrated the program to the lab instructor

2.1 Circuit

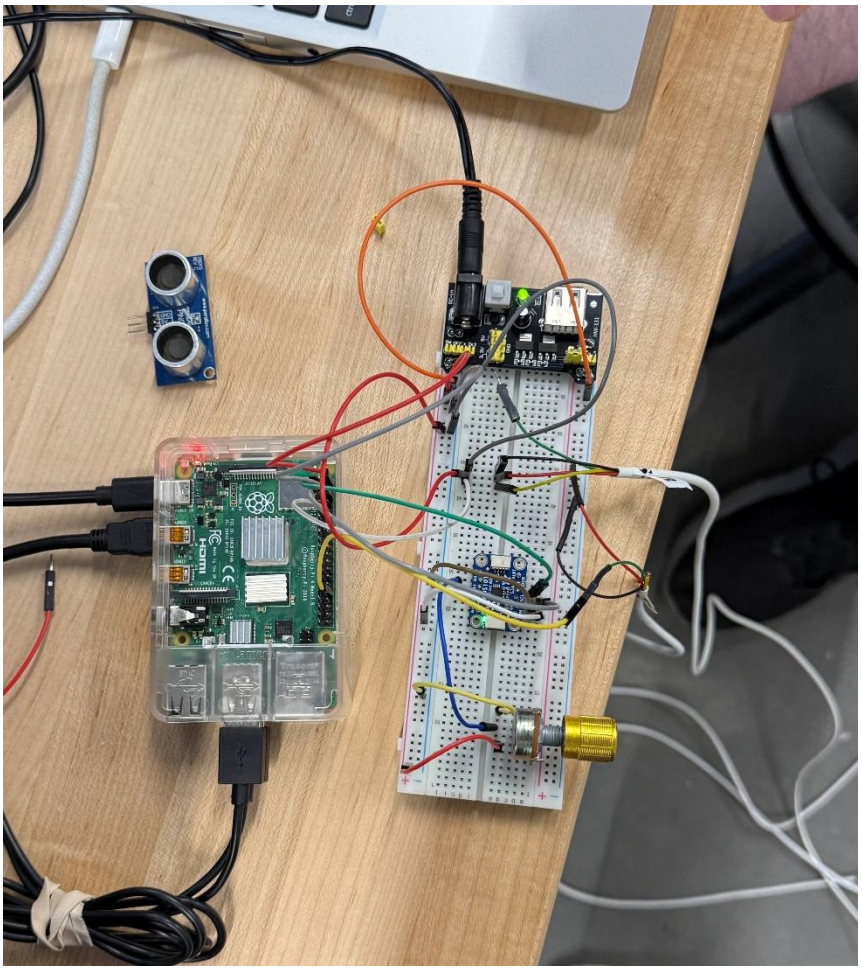
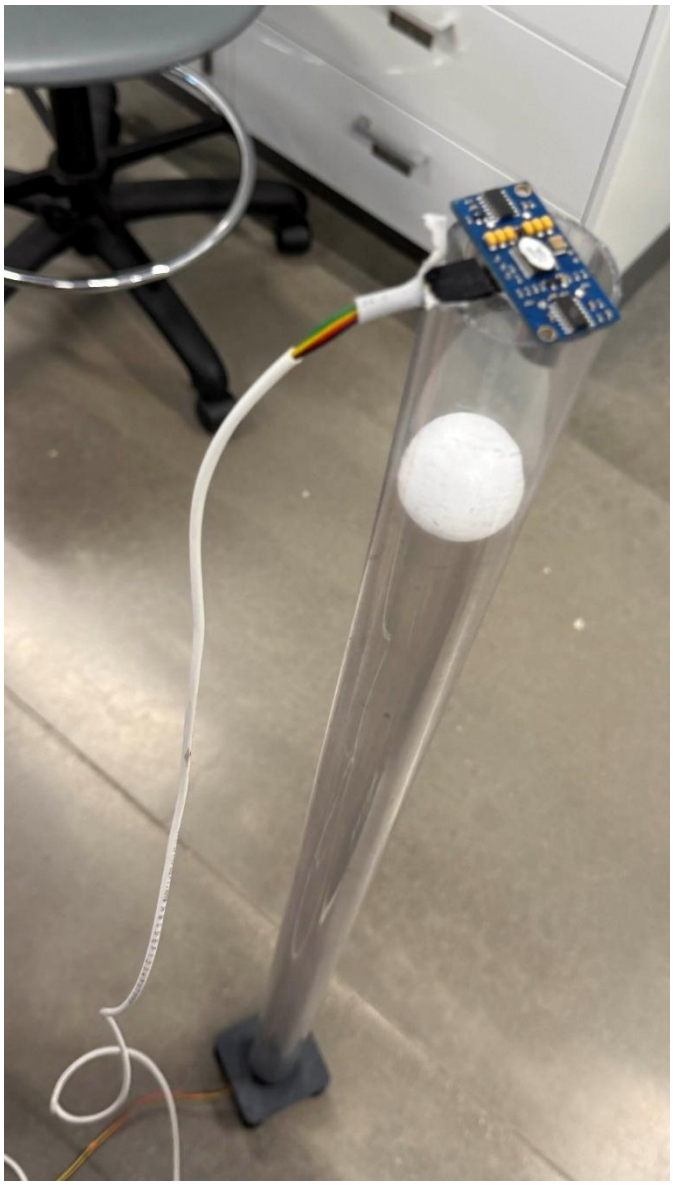


Figure 3: circuit for 2



3 Supplemental Questions

3.1 Briefly summarize what you learned from this lab.

In this lab, we learned how to interface the Raspberry Pi with a sonar sensor and a fan and also learned how to use a PID loop. We used the sonar sensor to measure distance and gained experience with testing a PID loop but tuning it to have a fan keep a Ping Pong ball in the air. This in turn gave us practical exposure to real-time control systesms

3.2 In PID control, how will the values of the P, I and D parameters affect your control performance?

The P portion of the PID loop is based on error. This is typically the difference between the goal and the current value. The farther you are away from the goal the less strength on changing the value will be. The I portion is an integral that will help force the value towards its wanted value as time goes on. The D portion helps it to predict future values to make the curves smoother.

3.3 How did you decide the values of the P, I, D parameters to achieve a good control performance?.

First, we changed only the P value to get the ball to where we wanted it to be. Then we changed the D variable to help dampen some oscillations and get the movement smoother. After the D variable was in a place we were comfortable with, we started changing the I variable. The I variable was very finnicky, so we kept it small. We then slowly messed with the values changing them up and down to see the effects until we found values that made the response quick but not oscillate much.

ACKNOWLEDGMENTS

I certify that this report is my/our own work, based on my/our personal study and/or research and that I/we have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I/We also certify that this assignment/report has not previously been submitted for assessment anywhere, except where specific permission has been granted from the coordinators involved.

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