Lab #2 – Feedback Control of a Ping-Pong Ball

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1. **Exercise 1**

   <u>1.1 Circuit:</u>

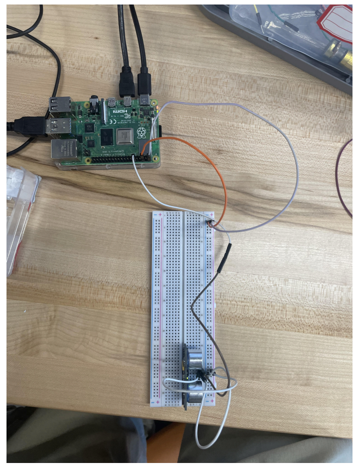

Figure 1.1.1 - Sound Sensor Circuit

<u>1.1 Summary:</u>

In Exercise 1, we learned how to use a sound sensor to measure the distance of objects from it. For each distance reading, the sound sensor is set to output initially, which sends out a ping. After a brief amount of time, the sound sensor is set to input, where the ping from earlier is read after bouncing off an object. The time between these two is then converted to distance in centimeters.

2. **Exercise 2.1**

   <u>2.1 Circuit:</u>

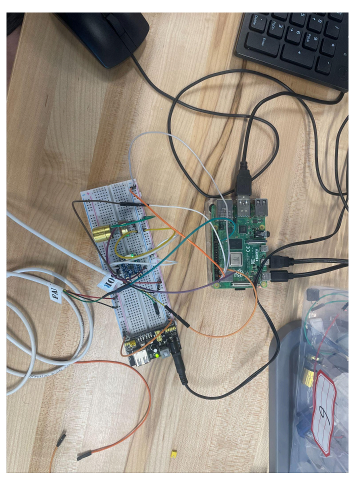

Figure 2.1.1 - PID Circuit with Sound Sensor

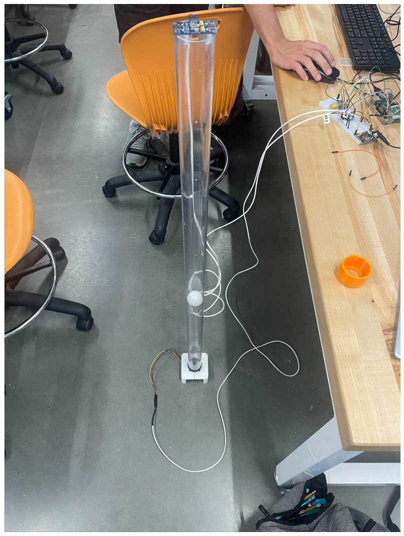

Figure 2.1.2 - Balancing Ping Pong Ball

2.1 Summary:

In Exercise 2, we used the sound sensor we learned about in Exercise 1 in combination with an adjustable ADC converter and DC motor to suspend a ball at specific heights in a tube. The distance from the bottom of the tube ranged from 10cm to 90cm, with the ball being suspended by the DC motor powered fan. To suspend the ball, we used a Propotional Integral and Derivative (PID) algorithm. To get the correct values for the PID algorithm, we did trial and error tests to adjust variables P, I, and D.

3. Supplemental Questions

1. Briefly summarize what you learned from this lab.

In this lab, we learned how to use a sound sensor to implement feedback control. We learned how to measure the distance between a sensor and other objects with signals from a sound sensor. Using this knowledge, we were able to suspend a ping-pong ball in a tube by using feedback control with the sound sensor. The sound sensor would measure the distance from itself to the ball and adjust the fan using a PID algorithm to keep the ball suspended. Additionally, an ADC converter was used to make the height of the ball adjustable according to a potentiometer.

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

The P, I, and D variables scaled the additions of the current error, cumulative error, and rate of error to the total PID value, respectively. This total PID value would be used to adjust the PWM for the fan. Since the fan is a DC motor, the speed would be changed and the ball would move to the desired position.

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

We used trial and error testing to reach our desired P, I, and D values. We began with the P value until the ping pong ball was able to oscillate in the tube. After, we began to adjust the value of D to reduce the oscillations. We did not need to adjust I to remove any errors as the ping pong ball hovered at the desired locations after the P and D adjustments.

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 person communication. I/We also certify that this assignment/report has not previously been submitted for assessment anywhere, except where permission has been granted from the coordinators involved.

Author-1 Signature ______________________

Author-2 Signature ______________________