Lab 6: DC Motor Control

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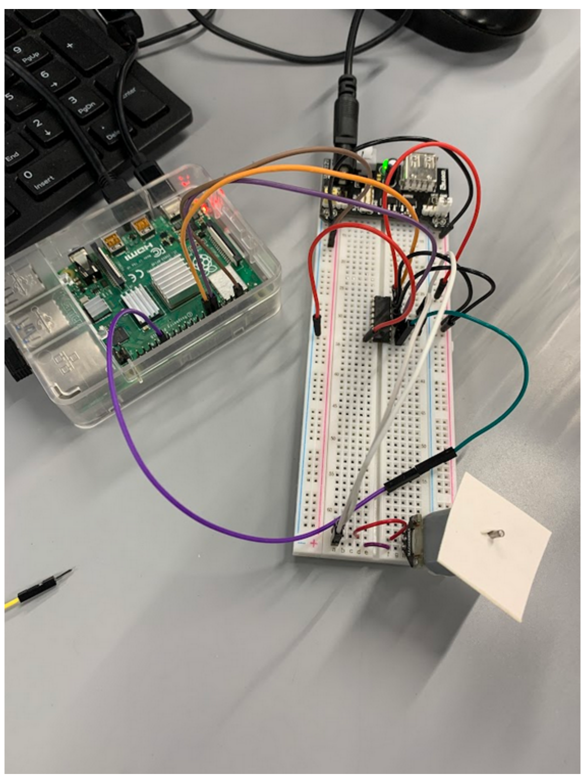
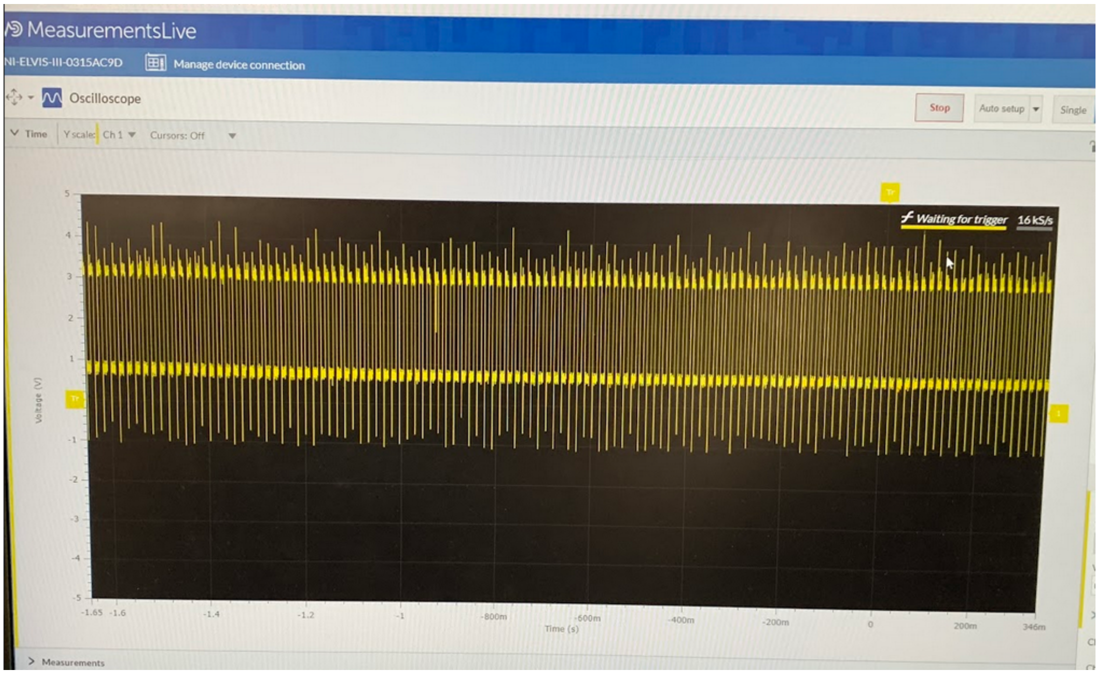
1 Exercise 1

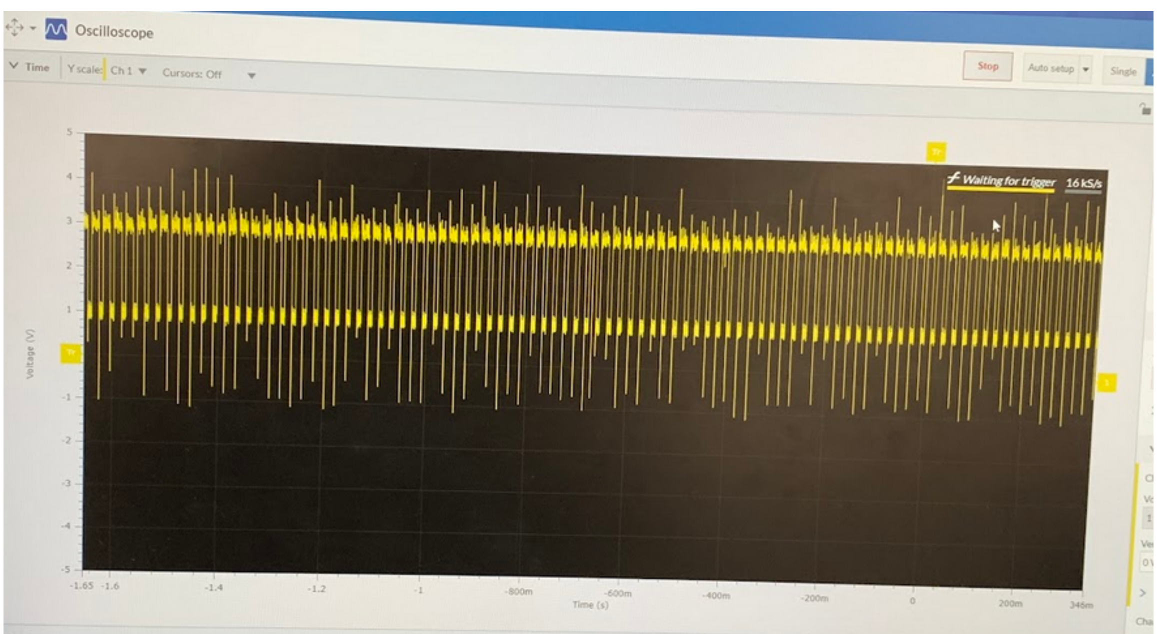
Using the “pwmWrite” function, we can control the rotational speed of our DC motor through a high level of abstraction. Connecting our controller IC to 2 digital pins allows us to control the direction of the motor through an H-bridge of transistors. These two pins will control the “A and D” or “B and C” transistors making a short unlikely and simplifying the input controls. Without a component to toggle the direction change of the motor through some other input, our switching was done by changing the two input values and recompiling our program. If our inputs were opposite, we would see motor movement (LOW-HIGH for clockwise, HIGH-LOW for counterclockwise) and if they were homogeneous, our motor would halt and brake. The switch in direction can be seen in each waveform; the direction of our current will switch through the motor and the waveform will flip on the x-axis.



Circuit 1



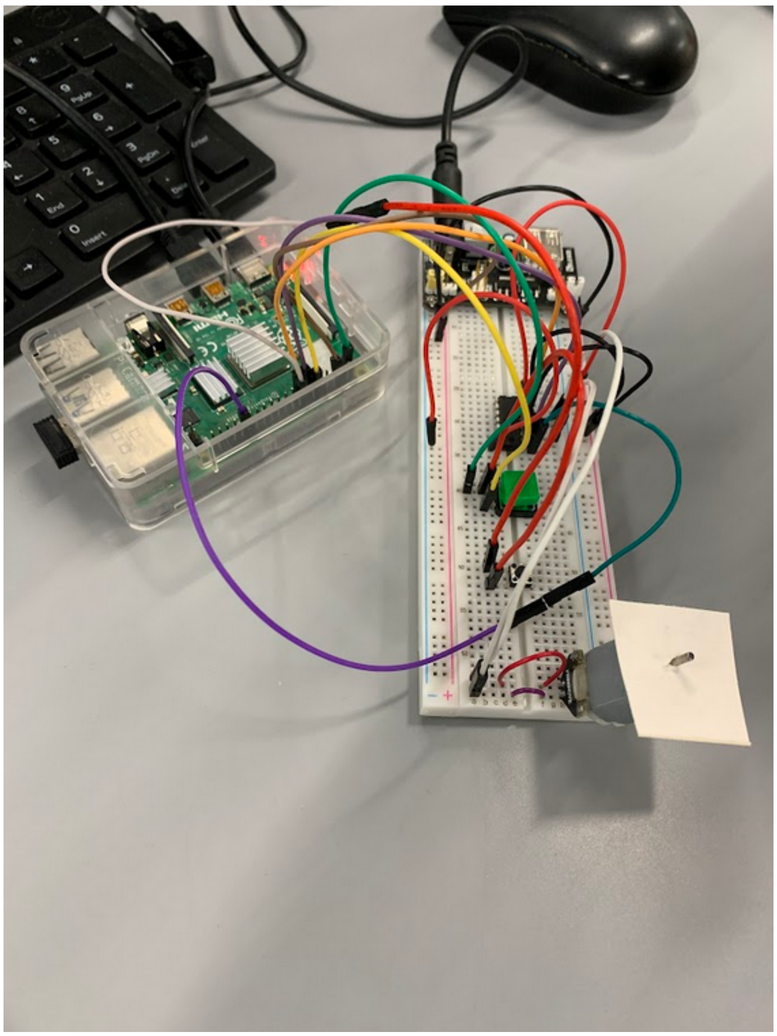
Waveform for Circuit 1 (Clockwise)



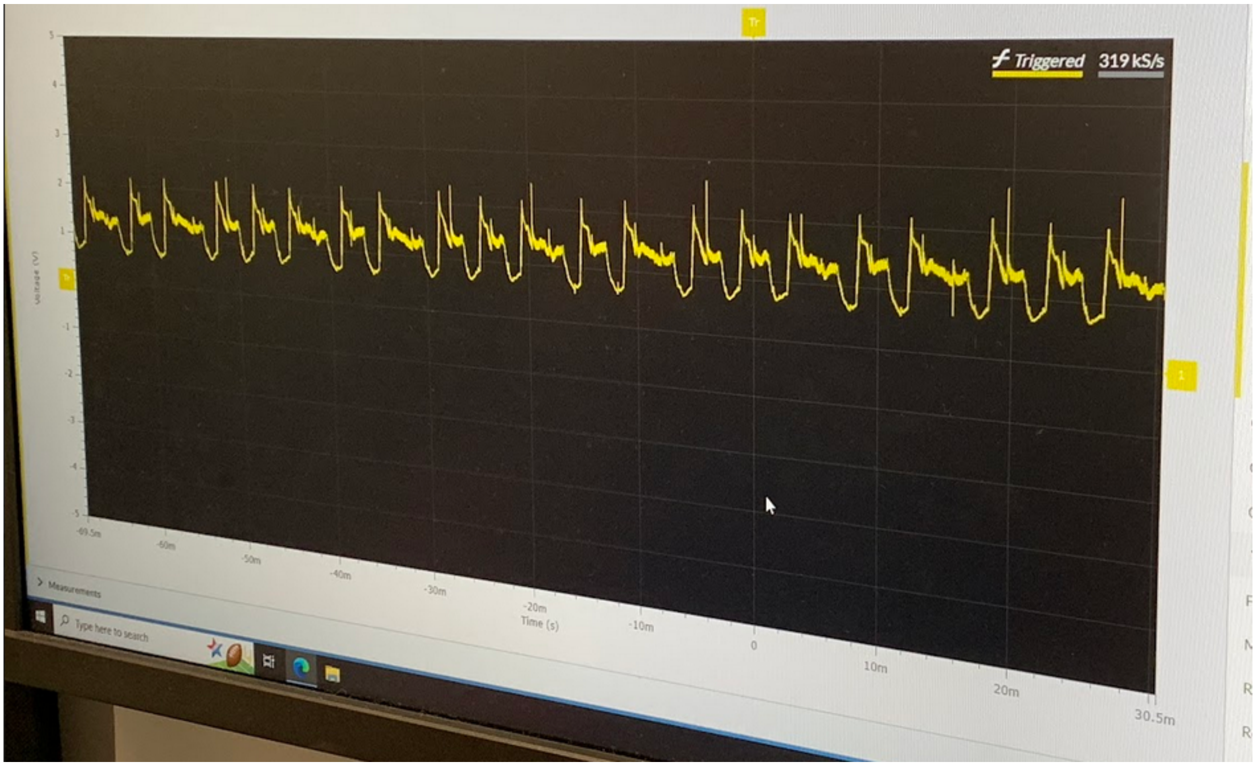
Waveform for Circuit 1 (Counter-Clockwise)

2 Exercise 2

Like in Exercise 1, we can control the speed of the motor through a variable integer from 0 to 1024 (8-bit unsigned integer). Using interrupts to control each button with behavior determined by a state enumerator, we can turn the motor on and off with one button and increase the speed with another. We can write our speed counter integer to our motor and increment it to increase our speed with each press. When this number is over 1024, it will stay at 1024 with each subsequent press. The other button (which turns off the mother by changing both pins to “LOW”) will also reset the counter so that the motor will be at its minimum speed when returned to the “Running” state.

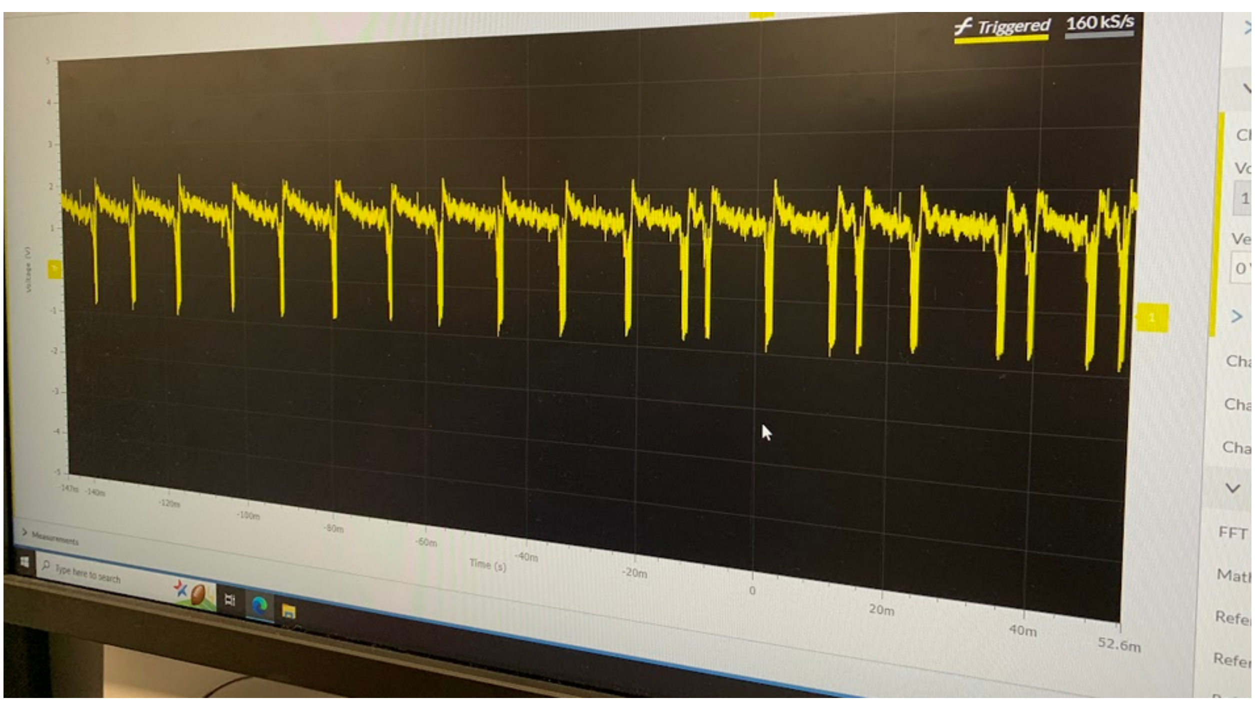


Circuit 2



Waveform for Circuit 2 (Low)

Waveform for Circuit 2 (Medium)



Waveform for Circuit 2 (High)

3 Supplemental Questions

1. Briefly summarize what you learned from this lab.

Within the first exercise, a DC motor along with its control chip and an external power source are implemented in order to create movement in the motor. By using commands such as pwmWrite() we are able to directly control the movement of the motor through our program and by setting different values for inputs, such as setting one as HIGH and the other as LOW or vice-versa, we were able to directly control the direction the motor is spinning, whether it is clockwise or counter-clockwise. Within exercise 2, two different buttons are added within the circuit that allow for the motor to be turned on and off with one button, and for the speed to be controlled by the other. By utilizing interrupts to detect button input, button one sets the two input states to either be the same, causing the motor to stop, or by setting them to be different, causing the motor to begin rotating. By detecting an input from button two, the program will increment the speed that the motor is spinning by changing the value of pwmWrite() with each button press.

2. From the screenshots of your ELVIS Oscilloscope in Exercise 1 and 2, what do you observe? Explain how the duty cycles are changed in the PWM signals for different speeds of the DC motor.

Within exercise 1, both of the recorded ELVIS waveforms are extremely similar to one another, which should be the case as the duty cycle is not changing between the two different orientations. All that is different between the two different cases is the direction the motor is spinning, not the spin speed which would be the factor changing the duty cycles.

Though, in exercise 2, we do see a significant change in the duty cycles between different motor speeds. Within the first test at a lower spin speed, it can be seen that the duty cycle is overall lower, with the signal retaining a lower voltage for a longer period of time relative to the higher voltage. With a duty cycle that is retaining a lower voltage, we should expect the motor output speed to be lower as well, which is what is observed for this first test. At the medium speed, less of the duty cycle is staying at that lower voltage and more of the signal is staying at the higher voltage, which would cause the motor to run faster than the previous test, and at the highest speed tested, a large majority of the duty cycle is in the higher voltage, supporting the statement that as the duty cycle grows larger, the motor speed will increase as well.

3. Is the DC motor control open-loop or close-loop in this lab? Justify your answer.

Within this lab, the DC motor control is operating in an open-loop fashion, as there is no data being collected from the motor in order to change behavior. In both of the circuits, the motor is told to spin only from the code in exercise 1, and behavior is modified through the use of buttons in exercise 2. In neither of these exercises is any data retrieved from the motor in order to control its movement.

4 Ideas & Suggestions (Optional)

Ideas: N/A

Suggestions: N/A

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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REFERENCES: N/A