This prelab document contains schematics and information you will need to conduct the lab. Review the prelab document and keep it handy while doing this lab.

Overview:

In this lab, you will control the speed and direction of a dc motor. You will use a reflectance sensor to change the direction of the motor once it has rotated 180 degrees or multiples of 180 degrees.

What is this lab about?

1. Interfacing a microcontroller to a dc motor using a dc motor driver integrated circuit. This includes sending pulse width modulation signals and a direction bit signal to the motor driver.
2. Configuring registers to setup a timer to perform pulse width modulation control of a dc motor.
3. Using a light reflectance sensor to control how far a motor rotates before stopping.
4. Using state machines to organize your code and enable more complex behavior.
5. Using interrupts to read the input from a rotary encoder while your main loop code performs other tasks.

How to Succeed With This Lab:

Read the prelab materials on the motor driver. Refer to the ATMEL 328 datasheet for information on configuring the timer registers. Design the state machine using the standard structure from previous labs.

Troubleshooting skills used:

1) Checking the PWM timer signals using the oscilloscope.

2) Using an LED to indicate the state of a sensor.

**SECTION 1 – Configuring Timer 1 for fast PWM**

Before you can begin working on the hardware, you will need to complete the answers to pre-lab questions.

**Note:** Pre-lab questions must be answered before receiving motor control hardware.

**Procedure:**

1. Load the code MotorA\_ping\_pong\_start.ino
2. Examine the code. Determine where you need to set up the registers for Timer 1 and insert your code into the function configureTimer1();
3. Run the code and observe the motor behavior. Notice how the LED attached to pin 12 changes from on to off as the disk rotates and the sensor sees a black (non-reflective surface) versus seeing a white (reflective surface).
4. Press SW1 and observe how the motor operation changes.
5. Press SW2 and observe how the motor operation changes.
6. Record your observations on the signoff sheet.

**SECTION 2 – Modifying code for ping-pong motion of motor**

Now that you have the motor turning, and before adding any more features, the first thing that needs to be done is to clean up the code so that it is easier to read.

The first step is to create a function called readAndConditionInputs(). Put the code for reading the switches and the QTR sensor into this function and call this function in your main loop.

isDownSw1 = !digitalRead(SW1\_PIN);

isDownSw2 = !digitalRead(SW2\_PIN);

prevIsDiskWhite = isDiskWhite;

isDiskWhite = !digitalRead(QTR2\_PIN);

isDiskB2W = (isDiskWhite && !prevIsDiskWhite);

isDiskW2B = (!isDiskWhite && prevIsDiskWhite);

digitalWrite(LED1, isDiskWhite); // mirror QTR1 sensor to LED1

digitalWrite(LED2, isDownSw2);

In this section, modify the code so that the motor changes direction each time it sees a change in the reflectance sensor. If when the motor wakes up, the sensor is on white, it will move until it sees a transition to black, then reverse direction. This results in the motor having a ping-pong motion where it keeps reversing direction when it sees a color change.

Note, the motor should not get stuck on one edge of the white to black disk, the motor should rotate a full 180 degrees before changing direction.

**Procedure:**

1. Modify to the code so that the motor reverses direction when it sees a transition from white to black or black to white on the disk.
2. Demonstrate your code to the instructor and get a signoff.

**SECTION 3 – Complete three full rotations, then change direction**

Modify your code so that the motor makes three full rotations (3x 360 degrees) and then reverses direction. Use only the reflectance sensor, do not use a timer or delay to guess at how long three rotations will take.

**Procedure:**

1. Modify the code so that the motor makes three full rotations and then reverses direction. The motor should go three full turns in the opposite direction and then reverse direction again. (slow ping-pong motion)
2. Demonstrate your code to the instructor and get a signoff.

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| LABORATORY CHECK OFFS | |
| **Section 1**  When SW 1 is pressed, the motor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  When SW 2 is pressed, the motor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Section 2**  Uses function readAndConditionInputs().  Motor does ping-pong motion (stays only on white or only on black and reverses direction)  **Section 3**  Motor makes three full rotations and then changes direction | \_\_\_\_  \_\_\_\_  \_\_\_\_ |
| Points | \_\_\_\_ |