GOAL

The goal of this lab is to understand how various motors operate using AVR microcontrollers.

BACKGROUND

DC MOTORS

Direct Current motors are often used when high speed is preferred over torque. The direction the motor rotates is based on the polarity of the DC voltage being applied. This separates DC motors into two categories: Unidirectional and Bidirectional. Unidirectional motors focus on using only one polarity forcing the motor to rotate in only one direction. Bidirectional motors allow the rotation to be reversed by swapping the polarity of the voltage being applied.

Fig. 1. Clockwise and counter clockwise operation

STEPPER MOTORS:

Stepper motors are generally the opposite of DC motors. They sacrifice speed in order to gain some of the highest torque possible. Another advantage over DC motors is that they are able hold their positions firmly when they are not turning due to their high holding torque. This is often why stepper motor are useful for applications that require constant starting and stopping.
especially if there is a strong force present on the motor. To compensate, a DC motor would need a braking system to perform the same tasks efficiently.

Datasheet for Stepper Motor:  
https://faculty.unlv.edu/eelabs/docs/equipment/2138812_DC_motor.pdf

**SERVO MOTORS**

Servo motors have higher resolution for position control. They can be directed to move from a specified range of degrees. This gives them a much smoother motion and more precision than compared to a stepper motor.

**PRELAB**

**Answer the questions**

1. What does each pin for L293D and ULN2003 used for?

**EXPERIMENTS**

**1. DC Motor**

1. Write a code to interface DC motor with L293D.
2. Modify the code to vary the speed of the motor.

Keep in mind that if both PC2 and PC1 are set to 1 then both conditions should be active.

**IMPORTANT: THE VOLTAGE RATING MUST NOT EXCEED WHAT YOUR MOTOR IS DESIGNED TO TAKE. KNOW YOUR VOLTAGE RATING!!**

This lab assumes the voltage rating of the motor is 5V.
2. Stepper Motor
1. Write a code to run stepper motor in Clockwise and Counter Clockwise.
2. Make sure the clockwise speed is faster than the counter clockwise speed
3. Create a new program where the stepper motor will step exactly 5 steps in the clockwise direction, stop and then step exactly 7 steps in the counter-clockwise direction.
3. **Servo motor**
Write a code to run the servo motor from 0-90, 90-0.
# POSTLAB

Include the following elements in the report document:

<table>
<thead>
<tr>
<th>Section</th>
<th>Element</th>
</tr>
</thead>
</table>
| 1       | Theory of operation  
*Include a brief description of every element and phenomenon that appears during the experiments.* |
| 2       | Prelab report |
| 3       | Results of the experiments |

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Experiment Results</th>
</tr>
</thead>
</table>
| 1          | a. Code with comments  
b. Code for variable speed  
c. Picture of the wired circuit |
| 2          | a. Code with comments  
b. Code for 5-7 steps  
c. Picture of the wired circuit |
| 3          | a. Code with comments  
b. Picture of the wired circuit |

<table>
<thead>
<tr>
<th>Question no.</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explain the operation of L293D</td>
</tr>
<tr>
<td>2</td>
<td>Stepper Motors are often classified into two types: unipolar and bipolar. Which type does this lab use? Explain the difference between the two types</td>
</tr>
<tr>
<td>3</td>
<td>Give an example where using one type of the three motors discussed in the lab would be beneficial over using the other two types. (i.e. when would a DC motor be better to use over a stepper and servo motor)</td>
</tr>
</tbody>
</table>

| 5 | Conclusions  
*Write down your conclusions, things learned, problems encountered during the lab and how they were solved, etc.* |