# Lab 3: Motor Control

## Demo Due: October 30, 2015

## Learning Objectives:

- Use an analog-to-digital converter to read a voltage
- Use pulse-width modulation (PWM) to control a motor

## Datasheets and References (on D2L)

H-Bridge L293B Datasheet

## Parts Needed for Lab (all parts are provided in your team's Parts Kit):

1 - H-Bridge L293B IC chip
1 - Robot/Motor Kit
1 - Battery Pack

# Lab Procedure and Demonstration:

## Part 1: ADC with LCD and PWM with Motors

### Description:

In this part, you will interface the ADC with the potentiometer on the development board. Additionally, you will interface the two DC motors using pulse-width modulation.

### Requirements:

***The first line of the LCD must output the voltage read on the potentiometer pin. This reading must come from the internal ADC of the microcontroller. Also, using <u>two</u> output-compare modules, control the direction and speed of two motors.***

### Hardware Design and Systems Integrator

1. Connect the H-bridge with the development board.
2. Designate pins to connect the output compare-modules to the motor.
3. Do not wire-wrap or make connections at this point. In the next portion, you will mount everything onto a robot.

### Software Design

1. Create a function which properly initializes the ADC and PWM modules.
2. Finish the code to complete the requirements.

### Quality Assurance

1. Test the potentiometer on the development board by verifying that it changes when spun using a digital multi-meter.
2. Test the H-bridge and motors using the function generator and DC power supply and verify that they operate correctly.
3. Test the output of the output-compare modules and verify using the oscilloscope that their duty cycles match up with the requirements. Take a screenshot using the oscilloscope.
4. Create a function that cycles each output-compare module through a variety of duty cycles to test controlling the speed of the motors. You should be able to spin each motor both forwards and backwards.

# Part 2: Controlling the Motors

## Description:

In this part, you will use the potentiometer to steer the two motors that will now be mounted on the robot. The robot will operate in stand-alone mode and now be powered by a battery instead of a computer.

## Requirements:

***The first line of the LCD must output the voltage read on the potentiometer pin. This reading must come from the internal ADC of the microcontroller. Also, use two output-compare modules to control the DC motors. These two output-compare modules will have their duty cycles controlled by the potentiometer pin. When the potentiometer pin is rotated left or right completely, then only the left or right motor should be on. When the potentiometer is in the middle, both the left and right motors should be on completely. Every other position for the potentiometer should represent fractional values for motor speeds. Additionally, a switch should be used to reverse the direction of the robot. The switch should cycle through states in this order: forward, idle, backward, idle. These requirements must be fulfilled while the robot is disconnected from the computer completely and is using the battery pack for power.***

## Hardware Design and Systems Integrator

1. Build the robot and mount the development board, LCD, and H-bridge onto the robot securely using whatever means necessary.
2. The H-bridge, LCD, and Motors will not move from these positions for the rest of the class, so make their connections permanent with connectors or quality wire-wrapping.
3. The battery pack should also be mounted securely onto the robot.

## Software Design

1. Using a state-machine implementation, control the motors according to the requirements. The robot should be transition between forward, idle, backward, and back to idle using a switch press.

## Quality Assurance

1. After connections have been made by the hardware design and systems integrator, make sure that these connections all pass the connectivity test using the digital multi-meter.