Lab 5 – DC Motor and H-bridge
October 1, 2015

In this lab you will use the HCS12 microcontroller on the SSMI board to drive a DC motor using an H-bridge circuit.

1 Prelab Questions (complete prior to coming to lab)

Read this handout before coming to lab and answer the following questions:

1. We will use the TLE5602 H-bridge driver on the SSMI board to drive the DC motor. According to the datasheet for this device, what is the maximum current that it can deliver? What is the maximum supply voltage?

2. The maximum current flow through the motor occurs when it is just starting up, or when it is stalled. Look up the stall current on the webpage containing the description of the motor: [https://www.sparkfun.com/products/8910](https://www.sparkfun.com/products/8910).

3. There are two H-bridges on the SSMI board, marked U3 and U4. What two pins coming from the microcontroller control the H-bridge designated U4?

4. We are using the 9V power supply from your kit for this lab. What is the minimum voltage power supply that could be used? Look at the specification for “supply voltage” on the Electrical Characteristics section on the TLE5602 datasheet.

2 Connections

Use the 9V power supply from your kit to power the SSMI board. Before applying power to the SSMI board, hook up the following connections and show the instructor:

- Connect the 25KΩ potentiometer to pin AN02 such that it can supply a variable voltage between 0..5V to that pin.
- Connect the DC motor to pins 1 and 2 of connector J7.

As in Lab 4, write a C language program to initialize the A/D converter and continuously digitize an input voltage on pin AN02. To verify that the A/D converter is working, inspect the memory location corresponding to ATDDR0L and verify that the numbers being written to that location vary according to the potentiometer wiper position.

Sign-Off 1: Demonstrate your program to the instructor.

3 H-bridge Output

Write a C language program to generate a PWM output signal on Port T, pin 1. (PT0 should be set to output low.) Make the period of the signal equal to 1280 microseconds. The duty cycle is the portion of the period where the output is high (assume that it is stored in a variable called duty). The pseudo code for this program is something like this:
Initialize PT1 and PT0 for output
Initialize duty
While (true) do
  Turn on PT1
  Delay for the time corresponding to duty
  Turn off PT1
  Delay for the time corresponding to period minus duty
End while

Run the program and verify that the motor turns. The higher you set the duty value, the faster it should spin. Observe the output PWM signal on an oscilloscope.

The DC motor / wheel assembly has an optical encoder sensor. The sensor outputs pulses as the wheel turns. The pulse rate can be used to determine the actual rotational velocity of the wheel. For a description of the encoder see the webpage https://www.sparkfun.com/products/9209 or http://www.pololu.com/catalog/product/1217.

Connect +5V power and ground to the optical encoder circuit, and observe the two encoder output signals on the oscilloscope. From the observed output pulse rate, calculate the direction and the motor shaft speed in RPMs. Include the scope trace in your report.

Finally, change the program to make the motor spin in the other direction, by doing PWM on PT0 and keeping PT1 a constant low.
Sign-Off 2: Demonstrate your program to the instructor.

4 Motor Control

Change the program to sense the potentiometer and control the speed and direction of the motor. If the potentiometer is in the middle position, the motor speed should be zero. If the potentiometer is turned to the right, we want to drive the motor in the forward direction; with motor speed increasing as the potentiometer is turned more in that direction. If the potentiometer is turned to the left, we want to drive the motor in the reverse direction; with motor speed increasing as the potentiometer is turned more in that direction. (You should recognize this description from homework 5). Observe the following signals: PWM signal and encoder signal at a particular speed of your choice. Be able to calculate the RPMs at a particular setting for the instructor.
Sign-Off 3: Demonstrate your program to the instructor.

Include in your report:
1. The C language program, along with a corresponding flowchart or pseudocode.
2. A schematic of the circuit.
3. An explanation of the circuit and program.
Lab 5: DC Motor and H-Bridge

Name: ________________________________ Name: ________________________________

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