HERIOT WATT UNIVERSITY

B31DD1 Embedded Systems

Lab 2 – PWM and Motors

Please bring a hard copy of this for the lab and submit it before the deadline.

Task 1 PWM Generation

The Arduino Uno/ATmega328P has three timer/counter for PWM (Pulse Width Modulation) wave output. Each Timer/Counter has two comparators (OCRxA and OCRxB), which generate two PWM waves on different pins. The Arduino Uno can output PWM wave from six pins (3, 5, 6, 9, 10, 11). The Timer/Counter 0 controls the PWM output of digital pins 6 (related to OCR0A) and 5 (related to OCR0B).

Write a C programme to generate 3 different PWM waves on a single pin using Timer0. The waves are 61.04 Hz with different duty cycles:

a) 0% duty cycle; b) 25% duty cycle; c) 62.5% duty cycle; d) 87.5% duty cycle.

Use a switch to loop these, i.e., first button press yields a 25% duty cycle PWM, second is 62.5% PWM, third is 87.5% PWM, and fourth is 0%.

Observe the generated PWM waves through an oscilloscope, checking the different duty cycles. Please demo this task to one of the TAs and let her/him sign below. You are expected to show and explain the codes and answer questions during the demo.

TA' Signature:

Name: _____   Date: _____

Task 2 DC Motor Control

l293 H-Bridge is provided to drive the motor through the microcontroller. Connect the circuit as below and develop a C programme to

- o   Use the PWM waves generated (on pin5 or pin6) in Task 1 to control the speed of a DC motor, and a switch to loop these different speeds.
- o   Use an extra switch to also change the direction of the motor.
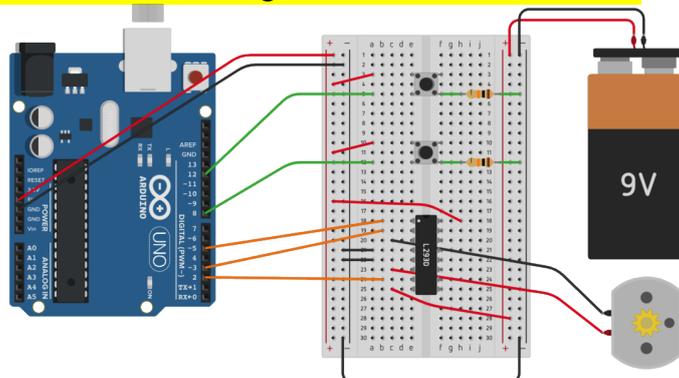
TA' Signature:

Name: _____   Date: _____

Bonus (Optional) - Continuous motor speed control using a potentiometer.

Use a potentiometer to control the speed of the motor. When changing the potentiometer, the speed changes accordingly. You will need to study how to read potentiometer reading (e.g., http://www.learningaboutelectronics.com/Articles/AVR-potentiometer-circuit.php) from an analog pin and convert it to an int value between 0-255 for OCRxA/OCRxB, which decides the duty cycle of the PWM for motor speed control.

Once finish, please demonstrate to one of the TAs and let her/him sign below.

TA' Signature:

Name: _____   Date: _____

Task 3 Servo Motor Control

Since a servo motor has a motor driver built in, it just has three input wires:
- Orange = PWM input
- Red = Vcc (between 4.8V and 6V is standard)
- Brown = Ground

PWM=Orange (⎍)
Vcc = Red (+)
Ground=Brown (–)
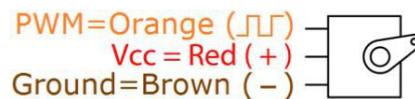
The position of the shaft of a servo motor is controlled by the duration of the High signal in one period. The period for most servo motors, including the TowerPro SG90 given, is 20ms. To set the angle of the shaft to a value between -90 and 90 degrees, we have to send a pulse whose duration varies between 1ms and 2ms (-90 degrees correspond to 1ms, 0 degrees to 1.5ms and 90 degrees to 2ms).

User Timer1 to generate PWMs to control the servo motor to -90, -45, 0, 45, 90, 45, 0, -45, -90, -45,…… degrees with a short delay between two angles.

TAs' Signature:

TA1: Name: _____   Date: _____

Bonus (Optional) - Continuous servo position control using a potentiometer.

Use a potentiometer to control the position (angle) of a servo. When changing the potentiometer, the position changes accordingly.

Once finish, please demonstrate to one of the TAs and let her/him sign below. You are expected to show and explain the codes and answer questions during the demo.

TAs' Signature:

TA1: Name: _____   Date: _____

Deadline of Lab2: Submit following by 30th October 2019
- Hard copy of this lab document with the tasks **signed** by the TAs.
- Your source codes of these 3 tasks (zip file named with "Lab 2 – Your Name.zip", e.g., "Lab 2 - Sen Wang.zip") via Vision -> Assignment.