

CMPE 443 PRINCIPLES OF EMBEDDED SYSTEMS DESIGN

LAB #005

“Motor Controller”

Motivation

In this experiment, you will work with the DC Motor and Motor Controller. With Motor Controller and PWM module on the LPC4088 board, you will be able to change the speed and direction of the DC Motor. The Motor Controller has two H-Bridges. Therefore, you will be able to connect a separate DC power supply to the motor to increase its power. Hence, in this lab, you will learn to:

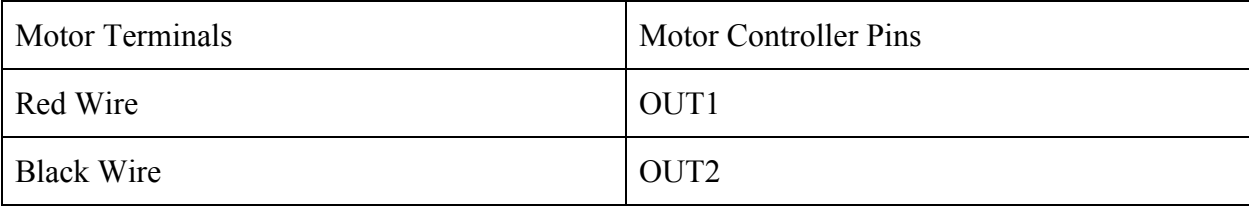
- use PWM in the motor control
- change the speed of DC motor
- change the direction of the DC motor's rotation

1) Problem Description

In this lab, you will use DC Motor, Motor Controller and Joystick. The speed of the motor and direction of the motor rotation will be changed according to the pressed Joystick button.

- When Joystick Left button is pressed, Motor rotation direction will be changed to forward.
- When Joystick Up button is pressed, Motor Speed will be increased.
- When Joystick Down button is pressed, Motor Speed will be decreased.
- When Joystick Center button is pressed, Motor will stop .
- When Joystick Right button is pressed, Motor rotation direction will be changed to backward.
- When Joystick no button is pressed, Motor will continue to perform the last action.

7 pts



- Two pin connections for giving power to motor controller and motor,
- One pin connection for changing the speed of the motor
- Two pin connections for changing the direction of the motor.

Motor Controller Pins	LPC4088 Pins
+12V	Vu
GND	GND
ENA	P29 (P1_3)

In this lab, P29 pin is used for PWM. You should determine the **2 pins** for the direction control. For this case:

- Write Pin Name of pins which will be used for changing motor rotation direction. _____ *1 pt*
- Write the Ports of these pins. _____ *1 pt*
- Write the MASK of these pins. (1 << Y) _____ *1 pt*

- You should connect these 2 pins to IN1 and IN2 pins of the Motor Controller. *1 pt*

The direction pins for the motor controller should be initialized as output.

- Initialize these pins in your **init** method in the main file. _____ *1 pt*

The direction pins values determines the direction fill the table with directions: *2 pts*

	IN1 = LOW	IN1 = HIGH
IN2 = LOW		
IN2 = HIGH		

3) Initialize Pulse Width Modulators (PWM)

8 pts

In the previous lab you initialize the PWM structure. However, in this lab you will work with a different pin and initialize PWM completely.

Initialize the current PWM pin.

- What is the IOCON register address of the P29 (P1_3) pin?
(*IOCON_MOTOR_SPEED_ADDRESS* in **Library/PWM.h**) _____ 0,5 pts
- Change the function of P29 (P1_3) pin as PWM. (*?) _____ 0,5 pts
- Enable PWM output for corresponding pin. _____ 1 pt

In previous lab, you did not use the some of the important registers of PWM. In order to use and understand PWM, the all parts of the PWM should be initialized. In **Library/PWM.c** file **PWM_Init** method:

- Reset The PWM Timer Counter and the PWM Prescale Counter on the next positive edge of PCLK _____ 1 pt
- Reset TC, when MR0 matches TC. _____ 1 pt

MR0 register is used for controlling the PWM Cycle Rate. The Peripheral Clock Frequency for the LPC4088 is set as 60 MHz. Whenever you change the value of MR registers, you should inform the PWM that you changed the MR register value.

- Enable PWM Match 0 Latch. _____ 1 pt
- Enable Counter and PWM and Clear Reset on the PWM. _____ 1 pt

Match Register values are changed in **PWM_Cycle_Rate** and **PWM_Write** methods too. Therefore:

- Enable PWM Match Register Latch in **PWM_Cycle_Rate** _____ 1 pt
- Enable PWM Match Register Latch in **PWM_Write** _____ 1 pt

Be careful, the match registers are different from the previous lab. Therefore, you should write different codes.

4) Changing Speed and Direction of Motor with Joystick

5 pts

In this section, you will write a code for performing these task (Do not forget to initialize the two chosen pin for changing the direction of the motor and do not forget to connect them):

- When Joystick Left button is pressed, Motor rotation direction will be changed to forward.
- When Joystick Up button is pressed, Motor Speed will be increased.
- When Joystick Down button is pressed, Motor Speed will be decreased.
- When Joystick Center button is pressed, Motor will stop .
- When Joystick Right button is pressed, Motor rotation direction will be changed to backward.
- When Joystick no button is pressed, Motor will continue to perform the last action.

Hint: If you do not use a control mechanism for decreasing and increasing the speed, you will not able to observe the mid-speed values for the motor. However, these values need to be observed during DEMO. Therefore, you can make empty For Loops for adding delay in your code as described in LAB1 document.