Lab 3 | Online Edition

Background:

PWM is a common way for microcontrollers to produce an analog voltage. The actions of microcontrollers and their peripherals are often controlled by manipulating the values of the registers of these components. This lab is intended to help understand those concepts through the manipulation of the registers of the timers that in turn control the PWM pins on the arduino uno. We will once again be using the TinkerCAD simulator to run this lab experiment.

Content:

Initial Setup:

1. Navigate to TinkerCAD and log in with your GT email
2. Use this link to the lab circuit?

Lab:

The objective of this lab is to use a push button to increment the amount of power coming out of a pin to adjust the brightness of an led (or just see the voltage change).

Background Knowledge:
Interrupts: If you have not completed the week 2 lab go back and do that now as you need to know how to set up an interrupt handler for this lab.

Setup:

- Set the pins to the correct mode then using the information from the datasheet fill in the blank sections of the setup() block
    - Note that Timer 0 controls pins 5 and 6, Timer 1 controls pins 9 and 10, and Timer 2 controls pins 3 and 11. For this lab we will be using Timer 2A, which is pin 11.
- Output compare can be inverting or non-inverting. The desired timer mode is fast PWM. The prescaler can be any valid configuration. Note the way the value of the output compare register is set.
    - Set TCCR2A's bits based on the composition given at the top of section 15.11.1 of the datasheet.
    - For information on setting the output compare mode refer to section 15.11.1 table 15-3
    - For information on setting the timer mode refer to section 15.11.1 table 15-8
    - Set TCCR2B's bits based on the composition given at the top of section 15.11.2.
    - For information on setting the prescaler refer to section 15.11.2 table 15-9
    - Once you get the lab up and running try it with the voltage monitor and different prescalers to see how changing the prescaler affects the output.
    - Composition of OCR2A is in section 15.11.4
- Set up you interrupt to trigger when the button is pushed
    - Refer back to lab 2 for information on setting up an interrupt

Interrupt Method:

- Have the interrupt method increment the value that goes into the output compare register by whatever value you desire
    - Note that when using fast pwm the 8 bit output compare register takes in a value from 0 to 255. Values higher will overflow losing bits above 8, so you may want to account for that.

Running the Simulation:

- When the button is pushed/released (Depending on if you set your interrupt to rising or falling) you should see the led grow in brightness/the voltage increase on the monitor.

ATmega328P:

The arduino uno is based on ATmega328P microcontroller and has the same 3 timer setup which are controlled in the same way. Therefore we can look at the datasheet for the ATmega microcontrollers to find the format of the registers that control the timers on the uno. To save a bit of time skip to section 12-15 which explains the timer you'll be controlling in the lab. To complete the lab the only required readings are the register descriptions for the timers, but other sections such as modes of operation will give a better understanding of what the timers can do.