EELE 371 - Microprocessors Laboratory
Extra Lab #01 - LED Control Via Potentiometer
Difficulty: Hard
Grading:_____

Lab Description

In this lab you will turn on the RGB LED on the Freedom board using Pulse-Width Modulation (PWM) controlled by digitizing a potentiometer value by an Analog-to-Digital Converter (ADC). This lab is OPTIONAL.

Outcomes

After this lab you should be able to:

- Explain what Pulse-Width Modulation is
- Explain what an Analog-to-Digital Converter does

Deliverables

The deliverable(s) for this lab are as follows:

- Display seven colors on the RGB LED (White, Red, Green, Blue, Yellow, Orange, and Purple) (3 pts)
- Blink the blue LED at specified frequency using PWM (4 pts)
- Control either the frequency, brightness, or color of the RGB LED with a potentiometer (5 pts)
- Upload your source code to the D2L DropBox (3 pts)

Pre-lab Work (read before lab)

If you have any questions about the lab please get help from one of the instructors.

Lab Work and Demonstrations

Part 1 - Turning the RGB LEDs on and off

There are a few steps involved in turning an LED on. The KL25 Sub-Family Reference Manual on D2L will be of much use for this lab. There are three chapters that will be good to look at: 11, 12, and 41. FRDM-KL25Z Pinouts (Rev 1) is a document on D2L that will help you figure out what pins are connected to the LEDs. It also will let you know what the pin multiplexer (Chapter 11) should be set as.

The general process is:

1. Turn on clocks to the correct ports
2. Set up the pin control registers for the correct pins of the correct ports
3. Configure the GPIO correctly

Demo #1 - Show your instructor each of the possible colors on the RGB LED (White, Red, Green, Blue, Yellow, Orange, and Purple)

Part 2 - Using PWM to adjust the frequency of the blue LED

Instead of turning on the LEDs via a one or a zero on a pin of a GPIO port, it is possible to use the Timer-Pulse-Width Module (TPM). Unless the previous part of the lab where all of the LEDs were used, in this section the blue LED will be the focus. The blue LED is nice because it is connected to Port D pin 1 (PTD1) which is easily accessible via the Freedom board pin headers. This makes checking the frequency fairly straightforward. Section 5.7 of the Sub-Family Reference will be useful for figuring out what clocks the TPM needs.

Demo #2 - Show your instructor the blinking the blue LED at 2 Hz and confirm the frequency using an oscilloscope.

Part 3 - Using an ADC and a potentiometer to control a property of the RGB LED

The KL25Z also has an analog-to-digital converter (ADC). This is useful if you end up needing to build your own sensor where you measure in a voltage and need to process that value digitally. For this lab you will need to wire up a potentiometer to the ADC. You can then use the measured voltage drop across it to adjust a property of the RGB LEDs like frequency, color, or intensity by modifying the values in the TPM.

Demo #3 - Show your instructor changing a property of the RGB LED (frequency, color, intensity) with a potentiometer

Lab Grading

_____ **Demo #1 (3 pts)**

_____ **Demo #2 (4 pts)**

_____ **Demo #3 (5 pts)**

_____ **Uploading source code to DropBox (3 pts),** ***graded outside of lab***