EEE 158: Electrical and Electronics Engineering Laboratory V

Machine Problem 1: Colorful Lighting

Introduction

A single LED module is usually built to emit a single color; however, there are RGB LED modules that integrate three designs – one for each of the three primary light colors (red, green, blue) – into a single package. If each color is strictly ON or OFF only, then we get seven possible colors, with "black" being represented by all-OFF. However, by using modulation techniques we have learned in previous modules, it is possible to reproduce much more color combinations. Such LEDs are useful in applications like stage lighting and entertainment. *Disco, anyone?* :)

Tip: If you have dabbled in Web design, chances are you have encountered HTML color codes that look like this: `#eee158`. These are six hex digits with the first 2 being for red, the next 2 being for green, and the last 2 being for blue. A value of `0xff` for a color is the maximum; a value of `0x00` means that color is absent altogether.

Problem Specification

You are to display 5 different colors according to the last five digits of your student number, one color at a time. Each digit maps to a particular color, as shown in the following table:

Digit	HTML Color Code	Digit	HTML Color Code
0	`#7a1fce`	5	`#f44ce2`
1	`#4fe516`	6	`#10e96e`
2	`#16dde5`	7	`#f4a460`
3	`#e57c16`	8	`#dc143c`
4	`#ffd700`	9	`#b3b960`

If the same digit is immediately repeated, the next higher-digit color shall be used, wrapping around if necessary. For example, "`00000`" effectively has the same color set as "`01234`", while "`99093`" effectively has the same color set as "`90193`". If the first and last digit are effectively the same, the last digit shall be adjusted forward or backward until all previous criteria are satisfied. For instance, "`90089`" will be adjusted to effectively read "`90180`".

Technical Specifications

Note: For these specifications, a 0% potentiometer means full-counterclockwise; a 100% potentiometer, on the other hand, means full-clockwise.

- At system reset, the displayed color shall correspond to the first of the 5 digits, and remain there indefinitely at 50% brightness unless commanded otherwise. Taking the "`00000`" example, the color would be that for "`0`" and not for "`1`".

- Pressing `SW1` on the Explorer Board shall cause the brightness to vary directly with the potentiometer setting.
- Pressing `SW2` on the Explorer Board shall cause the colors to automatically change according to the following table.

Potentiometer %	`[0, 20]`	`(20, 40]`	`(40, 60)`	`[60, 80)`	`[80, 100]`
Period *for each color*	400 ms	800 ms	(Frozen)	800 ms	400 ms
Direction	Reversed	Reversed		Normal	Normal

- Regardless of the button pressed (`SW1` or `SW2`), changes MUST take effect within 100 ms. When neither switch is pressed, adjusting the potentiometer shall have no effect.
- The minimum PWM frequency MUST be 100 Hz.
- Debouncing MUST be employed on both switches. Potentiometer inputs MUST have some form of filtering and/or hyesteresis to guard against input noise.
- The ADC must have a minimum of 10 bits resolution; and use AVDD without multiplier as voltage reference.
- The following pin assignments shall be used:
  - `PA03` → "R" channel, active-HI
  - `PA06` → "G" channel, active-HI
  - `PB03` → "B" channel, active-HI
  - `PB02` → potentiometer
  - `PA00` → SW1, active-LO
  - `PA01` → SW2, active-LO

Assessment Policies

1. **This assessment will only be graded in-class.** There shall be no option to have this graded outside class hours; evidences like video recordings will not be accepted.
2. **Late submissions may either be accepted with deductions or outright rejected**, at the discretion of your handler. In any case, you must succeed in certain rubric items in order not to be issued an INC (see the Course Guide for details on this mechanic).

Rubric

<To be included in a future revision.>