PWM and Interfacing Servo Motors

E.R.T.S. Lab

1   Lab Objective

1. Understand PWM operation in TMS4C123GXL.

2. Get acquainted with interfacing servo motors with the launchpad.

2   Pre-requisite

1. Lab 1 and Lab 2: Interfacing RGB LED and both the switches.

3   Relevant Theory

1. Reference material 1 : Please go through extra resource material which can be down-loaded from below the lab sheet.

2. Reference material 2: Please go through Student Guide and Lab Manual **Chapter15.**

3. You must complete the examples given in the above materials before proceeding to the problem statement.

4   Problem Statement

Part 1: In this lab you have to design RGB LED controller using SW1 and SW2 present in Launchpad board.RGB LED controller has two modes of operation. Auto mode and Manual mode At initial, when program is loaded controller will be in Auto mode. Combination of SW1 an SW2 has to be pressed to go to Manual mode.When Reset button is pressed, controller will go to Auto mode.

1. Auto mode

   - In Auto mode color of the RGB LED follows a pattern in a cycle.
   - The pattern must follow the color circle as shown in Figure 1.
   - In Auto mode SW1 will increase the speed of color transition and SW2 will decrease the speed.
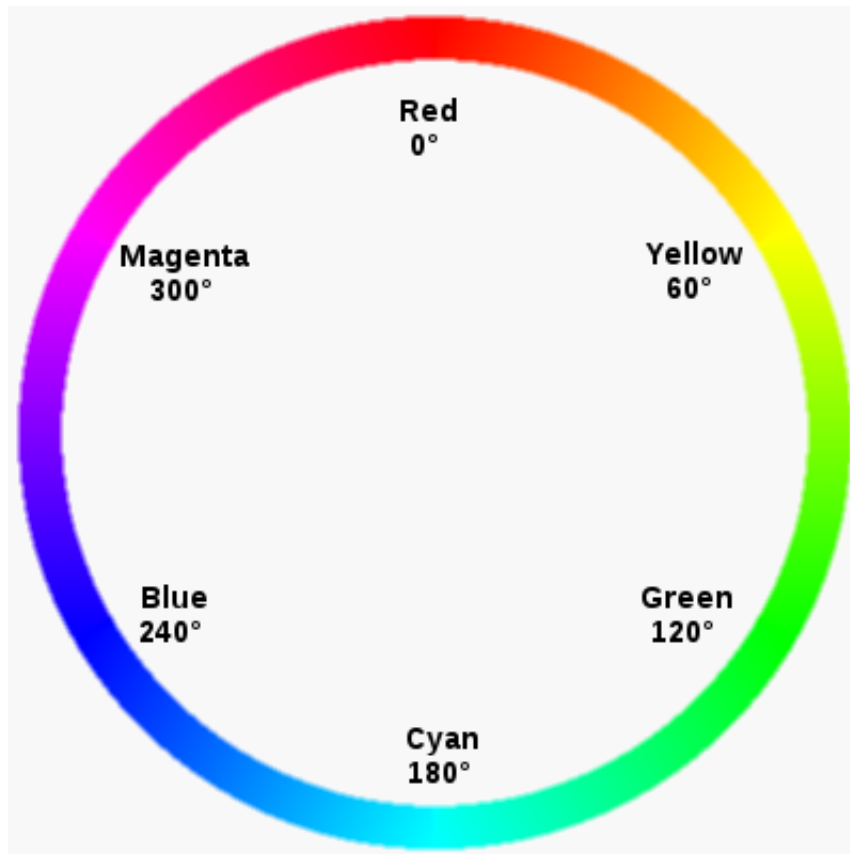
RGB Color Wheel *

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2. Manual mode

- In Manual mode, user must be able to select any one of the color from the color circle. For this intensity of any of the 3 LEDs must be controlled independently.

- Mode 1 (Red LED control) - When SW2 is pressed continuously(long press) and SW1 is pressed once controller goes to Manual Mode 1. In this mode, intensity of Red LED can be controlled using SW1 and SW2.

- Mode 2 (Blue LED control) - When SW2 is pressed continuously(long press) and SW1 is pressed twice controller goes to Manual Mode 2. In this mode, intensity of Blue LED can be controlled using SW1 and SW2.

- Mode 3 (Green LED control) - When SW1 and SW2 are pressed continuously controller goes to Manual Mode 3. In this mode, intensity of Green LED can be controlled using SW1 and SW2.

Part 2: Interface a servo motor and control it using a switch.

1. When switch 1 is pressed the motor should rotate by ten degrees clockwise.

2. When switch 2 is pressed the motor should rotate by ten degrees anti-clockwise.

3. While doing the above two actions check for limits of the servo motor. It should no move beyond the operating range.

4. Also use the debouncing method that you have learned in lab 2 for interfacing the switch.

5   Assembly of Hardware

For part 1 external hardware connections are not required.
For part 2 connect the pin PD0 as PWM input to Servo Motor.

1. PF0 - SW1

2. PF1 - R of RGB

3. PF2 - B of RGB

4. PF3 - G of RGB

5. PF4 - SW2

6. PD0 - PWM Output

6   Procedure

1. Include all the header files. Ensure that the following header files are present.
   include "driverlib/pwm.h"
   include "driverlib/timer.h"
   include "driverlib/interrupt.h"

2. Configure the PORT Pins as PWM outputs and configure the PWM generator depending on the PWM pin used.

3. Enable the PWM output state.

4. Enable the PWM generator.

5. For Part 1 -
   Depending on the color wheel switch on the respective LEDs. Do not turn off the LED completely by assigning 0 value to it as it causes it to turn ON with a high intensity. Instead assign a minimum non-zero value to it so as to reduce the intensity.

6. For Part 2 -
   Calculate the value of PWM period.
   eg. In this code PWM base frequency is taken as 50Hz. The total period of Servo Motor is $1/50 = 20$ ms.
   The oscillator frequency is 40MHz. This value is divided by 64. The answer is further divided by the PWM base frequency(50Hz). Thus Period=12500.

7   Demo and Submissions

- Draw the state chart for the implementation of RGB LED controller.

- Show the output of two modes in part 1 and operation of servo motor when each switch is pressed in part 2 to the TA.