CECS 346 Lab 3 – A Simple Traffic Light Controller with Moore FSM

Group 2

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Preparation:
You will need a LaunchPad, two push buttons or switches, two 10kΩ resistors, four color LEDs: red, yellow, green, and white, and four resistors for the LEDs (between 330Ω to 1kΩ).

Book Reading: Textbook Sections 2.7, 4.2, 6.5

Starter project: SimpleTrafficLight

Purpose:
The purpose of this lab is to implement a Moore finite state machine and use switches to control state transitions.

System Requirements:
In this lab, you will build two switch interfaces that implement negative logic, and four LED interfaces that implement positive logic with the following colors: white, red, yellow, green. The white LED is used for pedestrians: pedestrians can cross the street only when the white LED is on. The three color LEDs (R,Y,G) are used for traffic lights. The two switches are used to simulate two sensors: sw1 is the sensor for the traffic: ON: there is car on the street, OFF: no car on the street; sw2 is the sensor for pedestrians: ON: pedestrians need to cross the street, OFF: no pedestrians. You are required to define bit-specific addresses for inputs and outputs.

Hardware requirements:

1) Port E will be used to control 4 LEDs: white (PE3), red (PE2), yellow (PE1), green (PE0).
2) Port A will be used for the two switches: sw1 (PA2), sw2 (PA3)

System Functionalities:
The system starts with the green LED on and the other three LEDs off. The color LEDs will be aligned in thefollowing order green®yellow®red. At any time, green LED and white LED should not be turned on at the same time and only one of the green/yellow/red LED should be turned on.
You will use a timed Moore finite state machine (FSM) to implement the following functionalities. Try to minimize the number of states. **Use software loop to implement the delay.**

1) Case1: green LED is on.
   Stay on for 2 seconds and then check switches: If sw2 is pressed, turn off green LED and turn on yellow LED.
2) Case 2: yellow LED is on.
   Stay on for 1 second and then turn on red and white LEDs, turn off yellow LED.
3) Case 3: red and white LEDs are on.
   Stay on for 2 seconds and then check switches: If sw1 is pressed, white LED will be off for

0.5s off, then on for 0.5s, and red LED will stay on during this 1 second. After that, both red and white will be turned off, and green LED will be on.

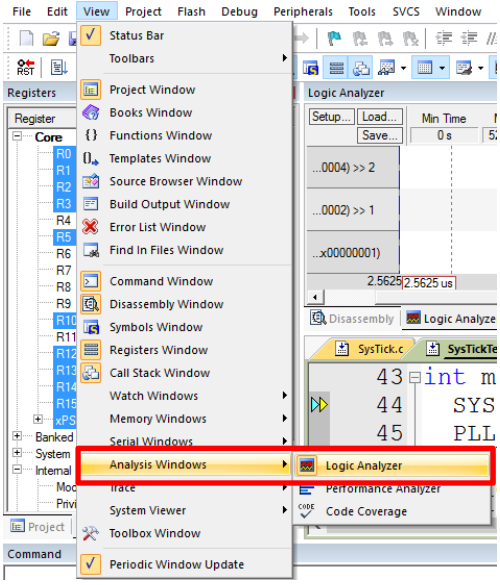
4) Repeat steps 1 to 3.

Logic Analyzer Simulation and Demonstration:

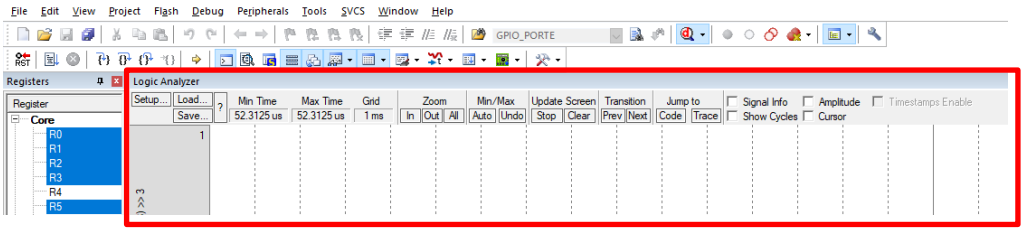
Test cases: please follow the instructions given below to test your embedded system in Keil uVision simulator and on board:

1) Start with green light on for a minimum of 2s
2) Press sw2 to observe the following light changes: green(2s)->yellow(1s)->red & white(blue).
3) Press sw1 to observe the following light changes: white(blue) off 0.5s, then on 0.5s and red is on during this 1s, then both red and white off and green on.
4) Start with green light on, press both sw1 and sw2 to observe the following light sequence for at least once: green(2s)->yellow(1s)->red/white(blue)(2s)->white(blue) off 0.5s, then 0.5 on, then off and green on.

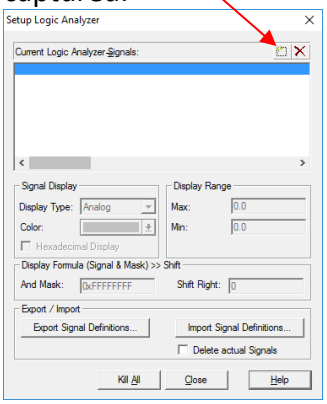
1) **Simulation**: Compile and simulate it with edXLab10 DLL(-dedXLab10 at the debug tab on options window) and Logic Analyzer. Screenshot all four cases listed above.
   <u>How to setup the logic analyzer:</u>
   First, set up the logic analyzer to observe bits PE0, PE1, PE2, and PE3. After starting debug session, click view à Analysis Windows à Logic Analyzer to open the Logic Analyzer. See figure below.



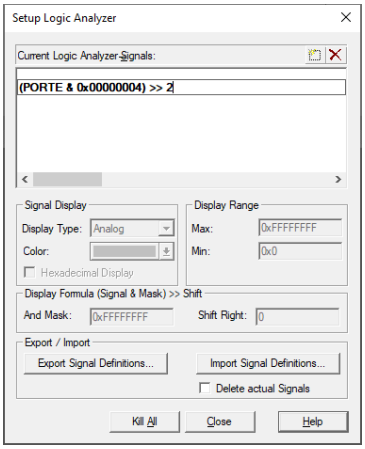
On the left top of the Logic Analyzer window Click **Setup** button to bring up "Setup Logic Analyzer" window.



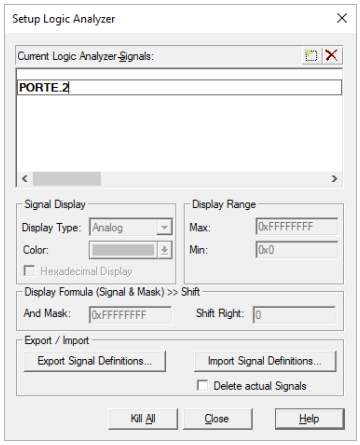
Then click **New (insert)** button on the "Setup Logic Analyzer" window to add signals to be captured.



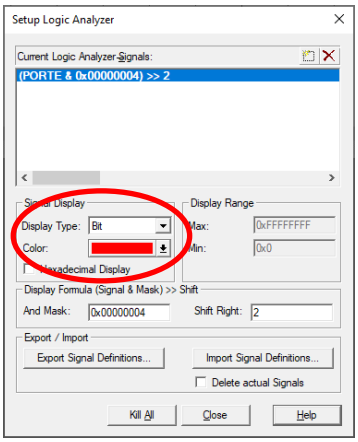
We need to capture four signals: PE3, PE2, PE1, and PE0. To capture PE2(Red LED) output, enter **(PORTE & 0x00000004) >> 2** or **PORTE.2** in the "setup Logic Analyzer" window and hit **Enter** when done. Then select the setting just entered and make sure Display Type is "Bit" and pick a color the matches the LED color. Close the window to finish current signal setup. Repeat the process to setup for PE1(Yellow) and PE0(Green). You can use Blue for the PE3.



or



After press "enter" and set the display type and color, setup window will look like this:



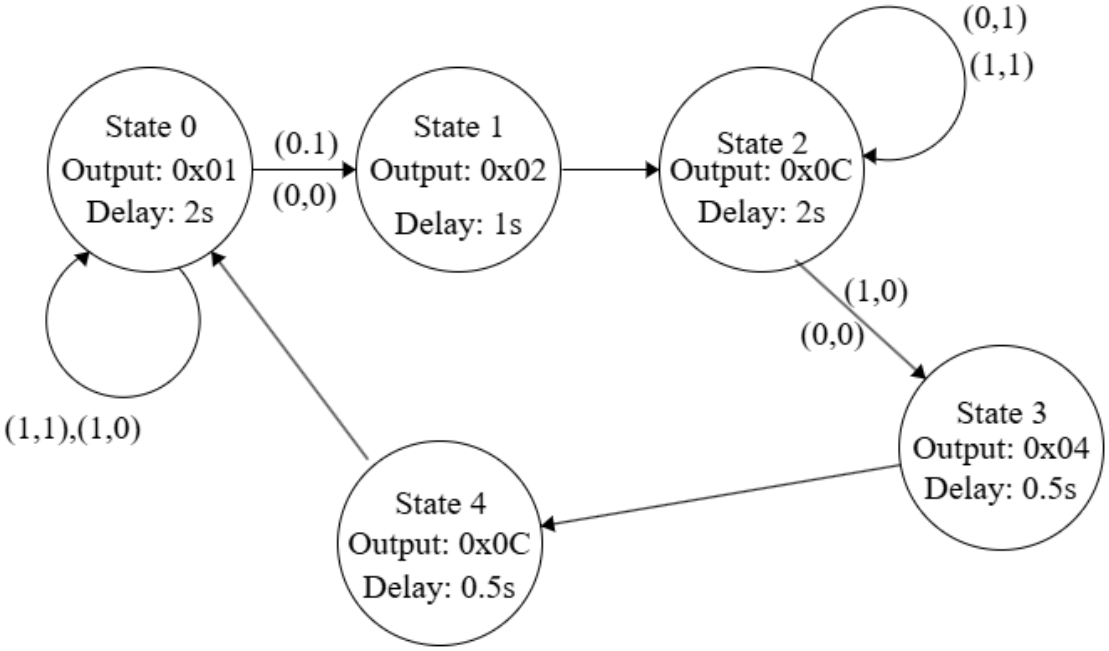
2. Download your program to Launchpad, test and demonstrate all four cases on board.

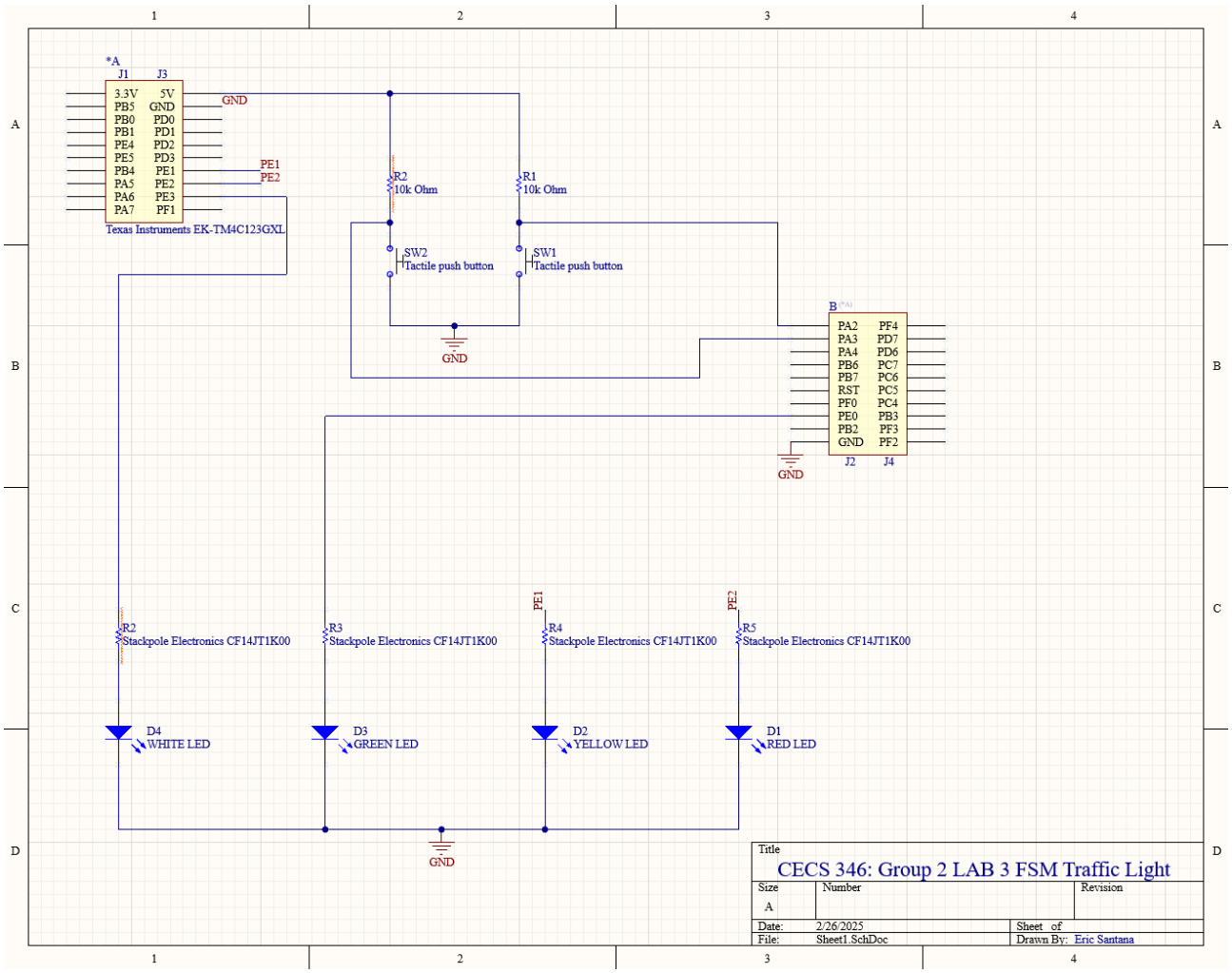
Deliverables:

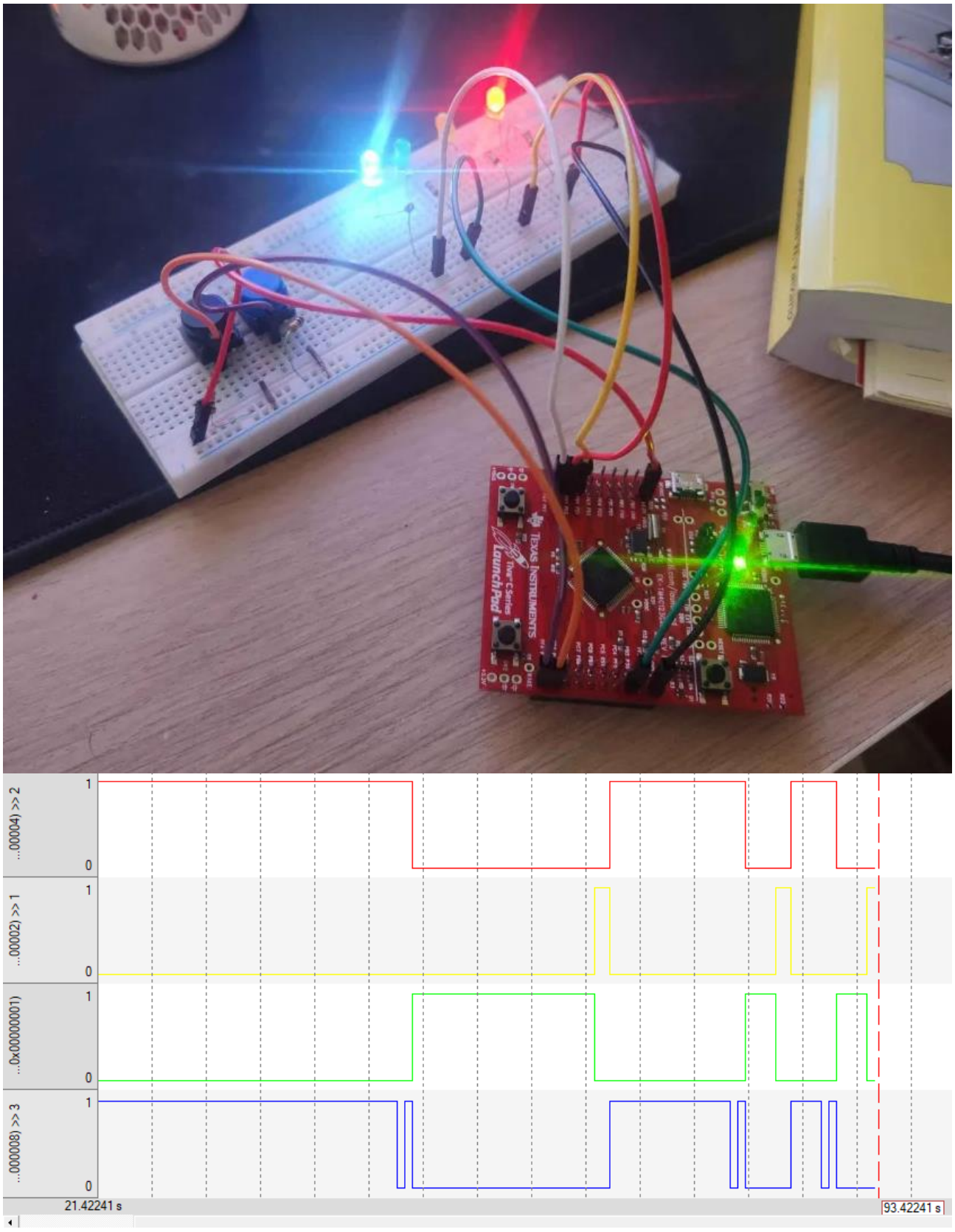
1) Simulate it with logic analyzer showing all 4 outputs.
2) Demonstrate your lab on board.
3) Submit a lab report (Word Document or PDF file) that includes the following items:
   a. Team members' names
   b. State table for your Moore FSM
   c. State diagram for your Moore FSM
   d. Schematic and photo of your hardware system
   e. Screen shot of logic analyzer outputs
4) Software source code: CECS346Lab3.c.

State	00	01	10	11
State 0	State 1	State 1	State 0	State 0
State 1	State 2	State 2	State 2	State 2
State 2	State 3	State 2	State 3	State 2
State 3	State 4	State 4	State 4	State 4
State 4	State 0	State 0	State 0	State 0

Group 2 FSM


State 0
Output: 0x01
Delay: 2s
(0.1)
(0,0)
State 1
Output: 0x02
Delay: 1s
State 2
Output: 0x0C
Delay: 2s
(0,1)
(1,1)
(1,0)
(0,0)
State 3
Output: 0x04
Delay: 0.5s
State 4
Output: 0x0C
Delay: 0.5s
(1,1),(1,0)


*A
J1
J3
3.3V
5V
PB5
GND
PB0
PD0
PB1
PD1
PE4
PD2
PE5
PD3
PB4
PE1
PA5
PE2
PA6
PE3
PA7
PF1
Texas Instruments EK-TM4C123GXL
GND
PE1
PE2
R2
10k Ohm
R1
10k Ohm
SW2
Tactile push button
SW1
Tactile push button
GND
B
PA2
PF4
PA3
PD7
PA4
PD6
PB6
PC7
PB7
PC6
RST
PC5
PF0
PC4
PE0
PB3
PB2
PF3
GND
PF2
J2
J4
GND
R2
Stackpole Electronics CF14JT1K00
R3
Stackpole Electronics CF14JT1K00
PE1
R4
Stackpole Electronics CF14JT1K00
PE2
R5
Stackpole Electronics CF14JT1K00
D4
WHITE LED
D3
GREEN LED
D2
YELLOW LED
D1
RED LED
GND
Title
CECS 346: Group 2 LAB 3 FSM Traffic Light
Size
A
Number
Revision
Date:
2/26/2025
Sheet of
File:
Sheet1.SchDoc
Drawn By:
Eric Santana


...00004) >> 2
...00002) >> 1
...0x00000001)
...000008) >> 3
1
0
21.42241 s
93.42241 s