CS223 Laboratory Assignment 5

Traffic Light System

Section 1: Nov 27, Mon 08:30-12:20 in EA-Z04
Section 2: Nov 28, Tue 08:30-12:20 in EA-Z04
Section 3: Nov 29, Wed 08:30-12:20 in EA-Z04
Section 4: Nov 27, Mon 13:30-17:20 in EA-Z04
Section 5: Dec 1, Fri 08:30-12:20 in EA-Z04
Section 6: Nov 28, Tue 13:30-17:20 in EA-Z04

Location: EA Z04 (in the EA building, straight ahead past the elevators)
Groups: Each student will do the lab individually. Group size = 1

Preliminary Design Report

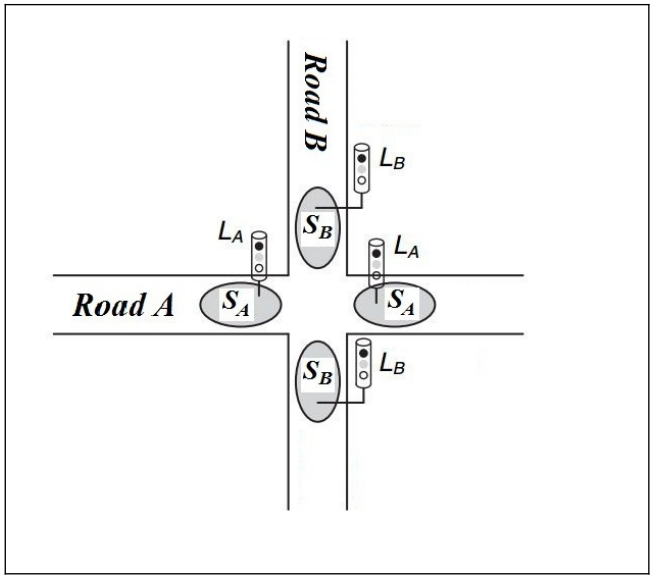
A number of tasks in the today's lab need prior preparation. These advance designs and Verilog models should be prepared in advance, and assembled neatly into a Preliminary Design Report. You should make your report as neat as possible, using A4 paper, with a printed cover page and printed pages for the Verilog codes. The pages of the report should be stapled together in the upper lefthand corner. If you handwrite anything, it should be neat and legible. Of course you will need a copy of your designs and Verilog programs with you at all times in the lab: to work with, to refer to, to possibly correct and change, to discuss with the TA, to use in debugging. The Preliminary Design Report will be turned in before labs start.
If you are not familiar with the steps in the design flow, using Xilinx ISE (Simulation, Synthesis, Implementation, Generation of Programming File, Downloading to FPGA board), then you should read and study the tutorial http://www.cs.bilkent.edu.tr/~baray/CS223QuickStart.html in preparation for your time in lab this week. It contains many things which will be helpful to you at all stages of the lab work. The preliminary design as described above is needed in all future labs.
A cover page which includes the following (in order from the top): course name and code number, the number of the lab, the name, ID number, and the date of you submit the report. Please use as possible as less papers to prevent wasting of papers. Save the planet.

[30] Traffic Light System

In a community, people need stop signs and traffic lights to slow down drivers from going to fast. If there were no traffic lights or stop signs, people's lives would be in danger from divers going too fast. These devices also play a role in road safety. While accidents still occur at intersections, these crashes may be been prevented by the drivers yielding to the traffic lights and improving the traffic lights timings. To reduce danger at the intersections, time for switching red light to green light and green light to red light should be regulated carefully. Studies show if the both lights are red for 3 seconds before either light turns green again prevent huge amount of accidents in traffic.

Traffic light system is similar to the example in pages 124-129 in the text book. The roads in which intersect are Road A and Road B. There are sensors SA and SB installed in each road to sense the traffic. Each sensor will be TRUE if traffic present and FALSE if the road is empty. There are two traffic lights LA and LB to control the traffic. The lights may change every 3

seconds depending on the sensors. If a sensor output is TRUE the lights will not change until it is set to FALSE. If a light is green and sensor is false it will turn to yellow and then red. Both lights will be red for 3 seconds and then red light will turn yellow 3 seconds and then turn green.



a) Sketch your improved Moore machine state transition diagram, state encodings, state transition table, output table, next state and output equations and your Finite State Machine schematic.
b) How many flip-flops you need to implement this problem?
c) Redesign your outputs using decoders.

Simulation

Enter Verilog module to Xilinx ISE software and select simulation mode. Prepare a testbench using the Verilog Test Fixture of the ISE software. In the simulation, try all possible variation through SA and SB sensors and observe the LA and LB traffic lights.

[70] Implementation on FPGA

In this part you are going to implement your code on FPGA and have a demo.

1) Slow down the clock to at 3 seconds to see the change in the lights.

2) Use LEDs on BASYS board for outputs of LA and LB traffic lights.
Red : *** (three leds)
Green: ** (two leds)
Yellow: * (one led)

3) The SA and SB sensors will be two left most buttons. The sensor will be active when as long as the button set to 1.

Now test your code and show the result to your TA.

Cleanup!

Clean up your lab station, and return all the parts, etc. Throw away any parts that do not work. Save your project on a flash memory stick. Delete the Xilinx Project you created and any files you created today, so that the computer is in the same state that you found it. Now turn off the computer, and leave your lab workstation for others the way you would like to find it—clean and organized.