SANTA CLARA UNIVERSITY	ELEN 21L
	Fall 2022
Laboratory #2: Design Capture and Simulation	
For lab sections Monday-Friday October 3-7, 2022	

I. OBJECTIVES

· To familiarize yourself with the Altera Quartus II design program.

· To design a schematic, and simulate the circuit in the Altera Quartus II design program.

· To download the designed circuit onto the Altera FPGA and test your circuit on the FPGA.

PROBLEM STATEMENT

You are to design the controller for a light that functions both as an ordinary light and also as a motion activated light and alarm.
- o If the manual switch S is on, then the outdoor light, L, is on.
- o Besides the manual switch, there is a motion detector, $M1$, which activates this light.
- o If motion is detected but the light is already on because S is on, then a second output A, an alarm, is turned on.
- o The disable switch, D, **disables the motion activated light and alarm** but still allows manual control operation of the light using switch S.

II. PRE-LAB
(a) Read the problem statement and clearly identify the inputs and outputs for the circuit you are designing.
(b) Create the truth table for this system; include the light, alarm, switch, disable, and the motion sensor.
(c) Draw a schematic of this system.
(d) Read the references below which have information needed to implement your circuit using the Altera (Intel) Cyclone IV FPGA. In the lab your TA will demonstrate the implementation, and it will be much easier to understand the details if you have read the documentation in advance.
    a. Quartus Prime Introduction Using Schematic Designs p 1 - 36:
        i. Instead of following the instructions in *Section 7 Pin Assignment* for our labs, refer to Quartus_Tips.pdf for pin assignments, and in section 8 Simulating the Designed Circuit, you will only need to run a functional simulation (not a timing simulation).
    b. DE2_115 User Manual: pin assignments on pages 35-38.

III. LAB PROCEDURE

Design and simulate your motion circuit with the disable feature in Quartus II:

- Use a procedure similar to the tutorial to create the schematic from your pre-lab in the Quartus II program. Take a screen shot of the schematic for your report.
- Follow the procedures from the tutorial to run a simulation of motion circuit with the disable feature. Be sure to test all possible input combinations. Save screen shots of the simulation waveforms. This should match pre-lab tutorial.
- Make pin assignments to use the DE2-115 board switches for inputs and the LEDs for outputs. Use switches for both inputs *S* and *M*. Use LEDs for both outputs *L* and *A*. We will not be using the buzzer and motion detector used in the previous lab.
- Continue to follow the tutorial to download the circuit onto your FPGA, to test your circuit on the FPGA.
- Demonstrate your circuit to your TA.

IV. REPORT

The report should be completed with your lab group and each group should submit a report before the deadline specified by your lab assistant.

Write a short introduction and include results from each team member's prelab.

Describe the procedures your group took to complete the construction and testing of your motion sensor circuits.

Include your schematic, simulation results, and proof of successful download to FPGA.

Include answers to the following questions:

o In Laboratory 1, what would you have had to change to use three motion detectors such that any of three different motion detectors could turn on the light and could also turn on the buzzer if the light were already on because the manual switch S was on? Specifically consider the component changes or additions, the wiring changes, and the testing.

o Compare that to the changes you would need to make for the Altera FPGA implementation of a logic circuit using three motion detector inputs.