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Laboratory #2: Design Capture and Simulation

For lab sections April 18-21, 2017

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.

- If the manual switch S is on, then the light L is on.
- Besides the manual switch, there is a motion detector, M1, which activates this light.
- If motion is detected but the light is already on because S is on, then a second output A, an alarm, is turned on.
- The disable switch, D, **disables the motion activated light and alarm** but leaves manual control operation of the light using switch S.

II. PRE-LAB

(i) Read the problem statement and clearly identify the inputs and outputs for the circuit you are designing.

(ii) Create the truth table for this system; include the light, alarm, switch, disable, and the motion sensor.

(iii) Draw a schematic of this system.

III. LAB PROCEDURE

Getting Familiar with Altera Quartus II software:

Work through the following Altera tutorial to get familiar with schematic entry and compilation (pages 3-20), pin assignment (page 24), and programming and testing (pages 31-41):
ftp://ftp.altera.com/up/pub/Altera_Material/12.1/Tutorials/Schematic/Quartus_II_Introduction.pdf

The link below gives details on waveform simulation methods (pages 3-12):
ftp://ftp.altera.com/up/pub/Altera_Material/13.1/Tutorials/Verilog/Quartus_II_Simulation.pdf

The link below gives details on pin assignment tables (pages 35-38 and pages 48-49):
ftp://ftp.altera.com/up/pub/Altera_Material/12.1/Boards/DE2-115/DE2_115_User_Manual.pdf

Design and simulate your motion circuit with Disable in Quartus II:

- **General guidelines**
  - 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 your motion (with disable) circuit. Save screen shots of the simulation waveforms. This should match pre-lab tutorial.
  - Make pin assignments to use the on-board switches for inputs and the LEDs for outputs. You will also connect the motion detector power and its output to an input pin on the board. The buzzer needs to be connected to an output.
  - Continue to follow the tutorial to download the circuit onto your FPGA, to test your circuit on the FPGA.
  - Demonstrate the lab to your TA.

IV. REPORT

To be completed with your lab group and turned-in before the beginning of the next lab.

Write an introduction about what your group accomplished during the lab.

Include your graded pre-labs.

Write the procedures your group took to design and simulate the schematic.

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

In Laboratory 1, what would you have to change to have any of three different motion detectors turn on the light and turn on the buzzer if the light is already on because of S? Specifically consider components, wiring, and testing. Compare that to the changes you would need to make for the Altera FPGA implementation.