

CS/EE 3700-- Lab Assignment #1

Wiring demo due in your lab during the week of January 28th
Schematic and simulation due on Thursday January 31st, 5:00pm
Hand in printed material to the box outside the SoC office

This Lab Assignment will introduce you to the Xilinx ISE tool, to the lab kits, and to the 7400-series chips. You will wire wrap a small circuit on the XST board which you will demonstrate to the TA during your lab.

The circuit you will build is a three-way light controller. Imagine that you have a light in a large room with three doors. There should be a light switch by each door, and flipping a switch at each door should toggle the light. That is, if the light is currently off, flipping any of the three switches should turn it on. If it's on, flipping any of the three switches should turn it off.

If you've read Chapter 2 you will notice that this is exactly the circuit described in Section 2.8.1. The only change from the circuits in the book is that I want you to build this circuit using only NAND and INVERTER gates, and I want you to build this using the red switches and LEDs from your lab kit (not the built-in versions on the XST board), and the gates in the 7400-series parts, not the Xilinx part. You will NOT need to plug the XSA-50 (the Xilinx board) into the XST for this lab!

There's an *Introduction to the Lab Kit* document on the class web site that talks about the components in the lab kit, and the process of wire wrapping sockets to the XST board. It also talks about how to use the switches, how to wire the LEDs, and how to wire the LEDs using the 906 and 907 buffers. It also describes a procedure that walks through designing and wiring a lab. It does this in terms of a tool that we don't use any more, but it's still a good read. One of these days I'll update it to ISE.

There is also a new tutorial on the class web site that walks you through the procedure for using ISE to design a schematic and simulate that schematic. It also tells you how to get the 3700 Lab Kit library that has schematic symbols for the red switches, the LED packs, and the 74HC906 and 74HC907 buffers that we use to drive the LEDs.

So, the actual assignment is: Use the red switches (in the style described in the Introduction to the Lab Kit), the LEDs, and a 906 or 907 driver as the input and output devices. Use NAND and Inverter gates to build the logic for a three-way switch as described in section 2.8.1. Use the 74HCxx parts for the logic.

We don't have symbols that correspond exactly to the 74HCxx chips, so we'll use logic gates from the Xilinx Logic category (see the ISE tutorial). In particular, the following Xilinx gates correspond to the 74HCxx gates that you can use. Note that I've listed both the "regular" and the "DeMorganized" version of the gate. Please use the best representation for the circuit!

- 74HC00 2-input NAND = nand2 or or2b2
- 74HC04 inverter = inv
- 74HC10 3-input NAND = nand3 or or3b3
- 74HC20 4-input NAND = nand4 or or4b4
- 74HC30 8-input NAND – nand8

The ISE tutorial shows a simple schematic that includes a switch (with the gnd and pullup connection), a 907 buffer, and the LED that is driven by that buffer. Your circuit will look similar except that it will have three switches as input, some NAND/Inv logic in the middle, and then a buffer and LED at the output.

Procedure:

1. Read the Introduction to the Lab Kit handout.
2. Work through the ISE tutorial to get an introduction to how that tool works.
3. Design a schematic for the three-way switch circuit using the components in the 3700 Lab Kit, the Logic, and the General categories in ISE. Make sure to use a title_3700 block on your schematic, and spend some time making a neat schematic. Neatness counts!
4. Simulate that circuit using a Verilog testbench. Fill in the Verilog test code with your own initial block with commands that demonstrate that your circuit works.
5. Use the schematic as a guide and wire up the circuit on the XST board. I find it helpful to annotate the schematic with pin numbers that you need to wire up. You can do this in the schematic editor, or just on a printout in pencil. To find the pin assignments for the 74HCxx parts you'll need to look up the data sheets on the class web site.
6. Double check your wiring. Did you remember power and ground connections for the components on the board? Did you wire up the LEDs and switches as described in the Introduction to the Lab Kit handout?
7. Demonstrate your working circuit to your TA in your lab in the week of January 28th.
8. Print out your schematic, your testbench code, and the resulting testing waveform. Hand those in to the 3700 homework box by Thursday Jan 31st at 5:00pm.

