CSE 490/590

Summer 2014

BASYS 2 Board Project #2

Proposal due Monday, June 23, 2014
Project due Monday, June 30, 2014 at 2:00 PM

For your design project, you may select from any one of the following or submit a proposal for your own project. Your design can be implemented using structural Verilog, behavioral Verilog, schematic capture, or any combination of these. It must be downloaded to the BASYS 2 board as a nonvolatile design stored in the board's onboard flash memory. The project you select must be registered using the project registration form on the course website no later than Monday, June 23, 2014.

Documentation & Submission Requirements

Submit your Verilog source code (*project2.v*) or schematic (*project2.sch*), bit file (*project2.bit*), documentation describing how to use your project and details about the design (*project2_docs.pdf*), and a README file with additional pertinent information regarding the project (*README*) electronically on *timberlake.cse.buffalo.edu* using the submit command (***submit_cse490 filelist***) or (***submit_cse590 filelist***) where *filelist* is a space delimited list of your files. If the files were submitted successfully, a message will be displayed confirming successful submission.

Electronic Lock

Design an electronic combination lock. A four digit code can be entered by using the pushbuttons and slider switches. The slider switches select which of the four digits is being entered. Switches 0, 1, 2, and 3 should be used, with switch 0 selecting the least significant digit and switch 3 selecting the most significant digit. When the switch is in the high position, the corresponding digit is selected. When the switch is in the low position, the corresponding digit is not selected. When a switch selects a digit, the initial value on that digit is 0. Buttons 3, 2, 1, and 0 are used to increment the value on the selected digit(s). Each time a button is pressed a button is pressed, 2^{BTN} is added to digit where *BTN* is the button that is pressed. For example, button 0 is pressed three times and button 2 is pressed once, 7 will be entered for the selected digit(s). When the correct combination is entered and the device unlocks, the LEDs will flash. Pressing the buttons 20 times without correctly entering the combination will deactivate the device for 10 seconds. The seven segment display will be used to display the state of the lock. The states are: LOC (locked), UnLC (unlocked), and PAUS (deactivated). The seven segment display should NOT display the combination as it is entered. When the device is unlocked, it can be locked by moving DIP switch 4 from the low to the high position. The entire code must be entered within 20 seconds (from the first button press to the last button press). The combination for your lock should be the your two digit seat number in CSE 490/590, followed by the number of digits in your username, followed by the sum of the first three digits mod 10. For example, if your seat number is 59, and your username is *csestaff*, your combination would be 5982.

Guessing Game

Design a two player guessing game. The game starts with the four digit seven segment display illuminated with "PL 1" indicating that player #1 should enter a number between 0x0000 and 0xFFFF. The number is entered as follows. The slider switches select which of the four digits is being entered. Switches 0, 1, 2, and 3 should be used, with switch 0 selecting the least significant digit and switch 3 selecting the most significant digit. When the switch is in the high position, the corresponding digit is selected. When the switch is in the low position, the corresponding digit is not selected. When a switch selects a digit, the initial value on that digit is 0. Buttons 3, 2, 1, and 0 are used to set the value on the selected digits. Each time a button is pressed a button is pressed, 2^{BTN} is added to digit where *BTN* is the button that is pressed. For example, button 0 is pressed three times and button 2 is pressed one, 7 will be entered. As the number is entered, it should be displayed on the seven segment display. Once the value is entered for a digit it should keep displaying that digit until the complete four digit number has been entered. After the number has been entered, player #1 should move switch 4 from the low position (player #1) to the high position (player #2). The seven segment displays are used to indicate this by displaying "PL 2". It is now player #2's turn. Player #2 repeatedly enters four digit numbers until he or she correctly guesses the number entered by player #1. The procedure for entering the four digit number is the same as it was for player #1. When the complete four digit number has been entered, switch 5 can be used to latch or register that value as a guess. Moving switch 5 from the low to the high position will latch the number and then it can be moved back to the low position to allow another four digit number to be entered. When an incorrect number is entered, the display should indicate if the guess was too high ("2 HI") or too low ("2 LO"). When the correct guess is entered the LEDs should blink in celebration, and the number of guesses required should be displayed on the seven segment display. To play the game again, the user should hit any button.

Message Board

Design a circuit which will scroll a message across the seven-segment display. The data is entered via a keyboard. The scroll rate should be variable, and can be changed by the user. The scroll rate should be set using the 4 push buttons and/or the slider switches.

Video Controller

Design a video controller which should be able to display characters on a VGA display in different colors. The characters displayed should be input by the user using either the keyboard, push buttons, and/or slider switches.

16-Bit RISC Microprocessor

Design a 16-bit RISC microprocessor that adheres to the ISA on the projects page of the course website. As part of the design, one must consider how memory will be implemented, how programs and data will be loaded into memory, and how to view memory to verify program correctness after it the program executes.

Your Own Design

If you desire, you may come up with your own project, but your idea must be approved by Dr. Schindler. Your idea must be submitted for approval on using the project registration form on the course website. You will receive email indicating whether your proposal was approved. If it was not approved, feedback will be provided so you can amend your proposal and resubmit.