Microprocessor-Based Systems (E155)

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Lab 2: Multiplexed Display

Requirements

Display two independent hexadecimal numbers on your dual seven-segment display. Use the DIP switch on your board to control one number and another DIP switch wired into your board to control the other. You must use a *single* seven-segment decoder module to drive the cathodes for both digits on the display, which therefore must be wired for multiplexed operation. Also, display the sum of the numbers on five LEDs on your utility board.

Discussion

Time-multiplexing is a techniquie to share a common expensive hardware resource for several purposes at different times. For example, the multicycle processor in E85 multiplexed the memory for both instruction and data access and multiplexed the ALU for R-type instructions, branch calculations, and program counter increments. In this lab, you will time-multiplex your seven-segment decoder module to run both halves of a dual display.

A convenient way to control which half is active is to turn ON the common anode of only one display at a time. The anode requires substantial current, more than an FPGA output pin can drive. You can use a transistor to drive the large current. The lab has a stock of 2N3906 PNP transistors suitable for this purpose. Be sure to limit the base current.

Choose a suitable speed to switch between halves of the display. If you switch too slowly, your eye will notice the flicker. If you switch too fast for the electronics, the two digits will bleed together.

Hints

Look at your RTL schematic in Quartus (Tools → Netlist Viewers → RTL Viewer). Understand why your code produces the hardware you see. Be sure your combinational logic doesn't have any registers. Be sure none of your logic has latches or tristate buffers.

The oscilloscope is handy for tracking down timing problems.