LAB Seven-Segment Display NAND NOR Decoder

Instructor: Professor Izidor Gertner

CS 343 Spring 2017

Due by 11:59 PM March 13, 2017

(REVIEW)

Please Review: Seven-Segment Display NAND NOR Decoder

Objective:

1. You will create a circuit that can output to the seven-segment display on the DE2 Board. This exercise will give you the experience of creating a unique circuit from scratch.
2. All results you displayed in the previous lab using LEDs, in this lab display using seven segment display.

About the Seven-Segment Display

A seven-segment display contains 7 segments that can turn on and off, depending on the signal it is receiving.

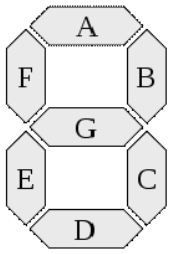

Figure 1: Seven-Segments of the Display

As you can see in figure 1, the seven-segments of the display are labeled with letters to help distinguish each of the segments of the display. Since there are seven segments in the display, you need 7 different circuits controlling each segment.

	Input				Output						
Digit	X_3	X_2	X_1	X_0	A	B	C	D	E	F	G
0	0	0	0	0	ON/0	ON/0	ON/0	ON/0	ON/0	ON/0	OFF/1
1	0	0	0	1	OFF/ 1	ON/0	ON/0	OFF/ 1	OFF/ 1	OFF/ 1	OFF/1

Figure 2: Example of Partial Truth Table for 7 Circuits with 4 Inputs

Figure 2 shows a part of a truth table for 7 circuits with 4 inputs. The seven circuits have their output labeled as one of the lettered segments of the seven-segment display. The output has a value of ON or OFF, depending on what the display should show.

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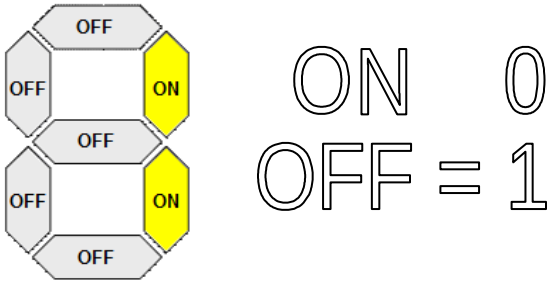

Figure 3: Seven-Segment Display Showing a 1

Figure 3 shows an example of a seven-segment display showing a 1. On the DE2 Board, the ON value is equal to a 0, while the OFF value is equal to 1.

To help with design and implementation of Boolean functions you may use the following

HELPFUL Links

1. Logic Friday

http://www.sontrak.com/

2. Espresso heuristic logic minimizer

https://en.wikipedia.org/wiki/Espresso_heuristic_logic_minimizer

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Step 1: Chart Out The Truth Table

You need to create a truth table as shown in Figure 2 for all 16 outputs of the 7 circuits. The table will be provided for you to print out and include in your report on blackboard. Print it out to design and draw your designs. You will need to bring this with you when you test the board.

Step 2: Write the BOOLEAN Equations in SoP/PoS (Product of Sums)/(Sum of Products)Form

From the truth table, find the equations needed for each of the segments. ***To help in this step you may use Helpful links above.***

Step 3: Switching Circuit Design Review)

Draw your circuits in PoS/SoP form (Product of Sums)/(Sum of Products). Then convert them to only use NAND or NOR gates. ***To help in this step you may use Helpful links above.***

Step 4: Build

A. In 7 different BDF files (one for each segment circuit), use Quartus to build the circuits that you designed. You should then convert all the circuits into symbol files to combine in an 8th BDF file.

OR

B. In 7 different VHDL files (one for each segment circuit for use later as component) then use Quartus to build the circuits that you designed. You should then convert all the circuits into components to combine into an 8th VHDL file.

Step 5: Simulate

Make sure that your circuit has the same output response as your truth table by running a vector waveform simulation.

Step 6: Pin Assignment: Click here for pin assignment manual

Create a new text file to add your pin assignments. Assign 'x0' to SW[0], 'x1' to SW[1], 'x2' to SW[2], and 'x3' to SW[3]. Assign output 'A' to HEX0[0], 'B' to HEX0[1], etc…

Step 7: DE2 Board Testing:

Bring the chart from step 1! After finishing steps 1 through 6, you should be ready to test on the DE2 Board. You need to bring your entire project folder on a USB flash drive.

Step 8: Display all results from the previous labs using seven segment display

Step 9: Writing the Report:

After finishing the above steps, write a report following the format below. Be sure to answer all the questions in the report. You should use submit it through black board as a PDF File. Create

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a movie to demonstrate your lab.

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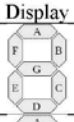
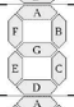
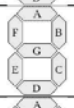
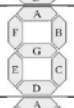
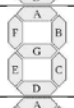
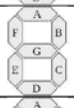
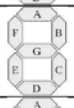
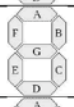
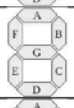
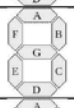
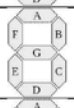
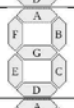
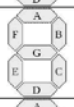
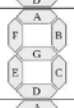
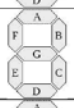
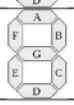
Fill in the display to help you determine the output as ON or OFF.

		Input				Output						
Letter	Display	X_3	X_2	X_1	X_0	A	B	C	D	E	F	G
		0	0	0	0							
		0	0	0	1							
		0	0	1	0							
		0	0	1	1							
		0	1	0	0							
		0	1	0	1							
		0	1	1	0							
		0	1	1	1							
		1	0	0	0							
		1	0	0	1							
		1	0	1	0							
		1	0	1	1							
		1	1	0	0							
		1	1	0	1							
		1	1	1	0							
		1	1	1	1							

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Report Format:

- Objective: (10%)
  - What is the goal of this lab?
- Functionality and Specifications: (20%)
  - What is the truth table of the circuit? (10%)
  - What is the Boolean function of each segment circuit? (5%)
  - Include a screenshot of all 7 circuits from Step 4. (5%)
- Simulation: (30%)
  - Include a screenshot of the vector waveform from step 5 after producing the output.
- Conclusion (30%)
  - Was creating the circuit to display your name a simple task?
  - Did you find it rewarding to see the letters of your name on the DE2 Board?
  - Did this assignment improve your ability to design circuits with NAND or NOR gates?
- Appendix: (10%)
  - Include the text of the pin assignments file.