ECE 128: FPGA Laboratory

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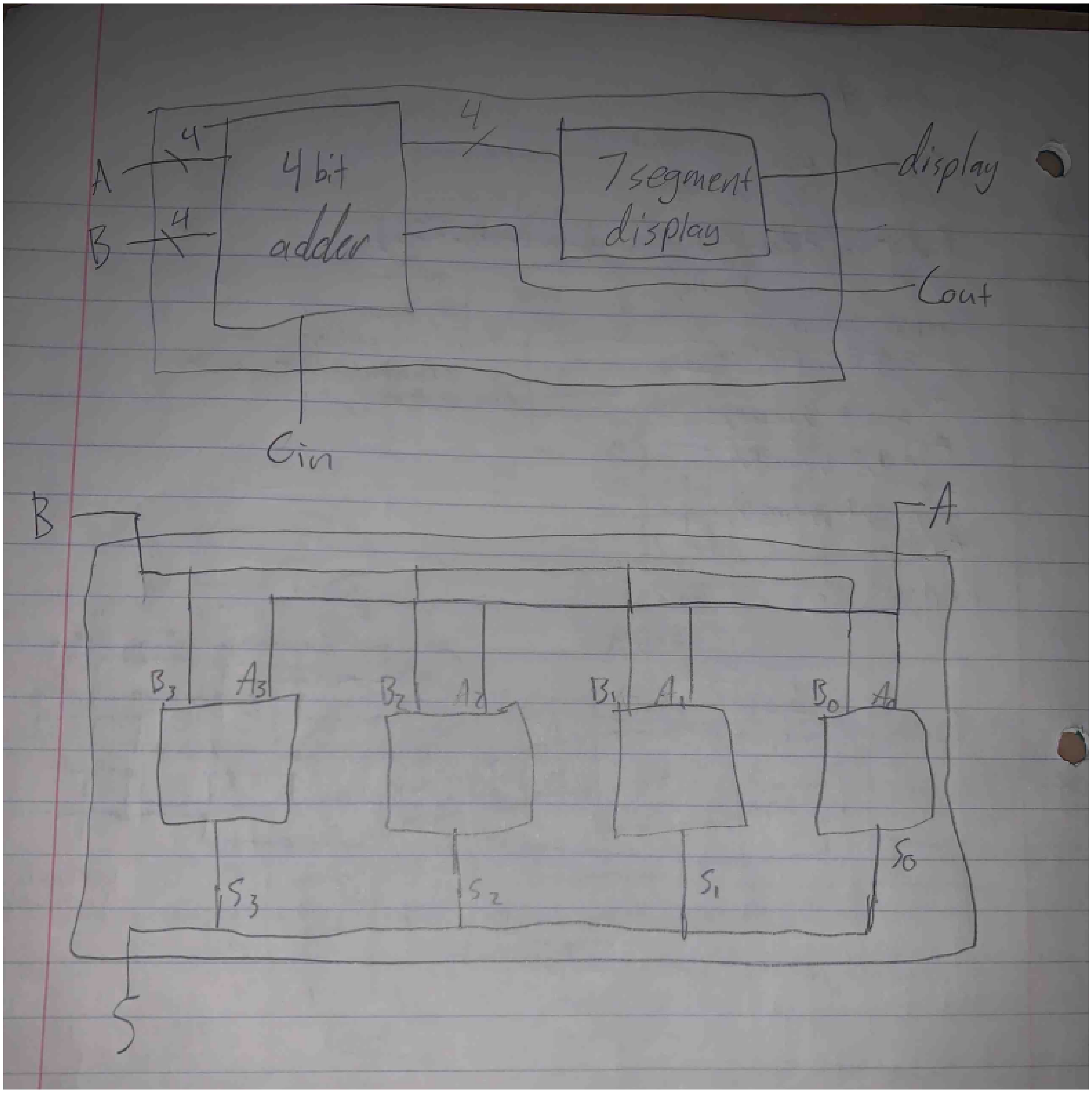
Lab #4: Four Bit Full Adder With Sum/Carry Option

1. Objectives

The objective of this lab is to be able to confidently use the Xilinx and Vivado software to design, build, and troubleshoot a four bit full adder with three inputs, A, B, and a carry in CI, as well as two output for the sum and the carry out on our provided boards. The difference between the previous lab and this lab was that for this lab, we had to provide the capability of switching between displaying the sum or the carry bit on the LCD display. At the end of the lab, the board should be able to be interacted with to demonstrate the adder's functions by using the LCD display to show the sum of two four bit binary numbers in decimal form. Then, we assigned another switch to swap between the sum and the carry bit on the display. This lab is important because it allows the students to gain a better understanding of how to implement a vital piece of hardware that will be used throughout their careers, as well as seeing an adder in real life, as opposed to the theory we are taught in the classroom. Also, this lab shows how to use prior projects as sub modules in future projects, and takes the student through the process of altering previous work to have a new, yet similar, output. While it is not the easiest lab we will tackle, it is one of the most important labs, as it contains many fundamental topics of the course.

2. Introduction

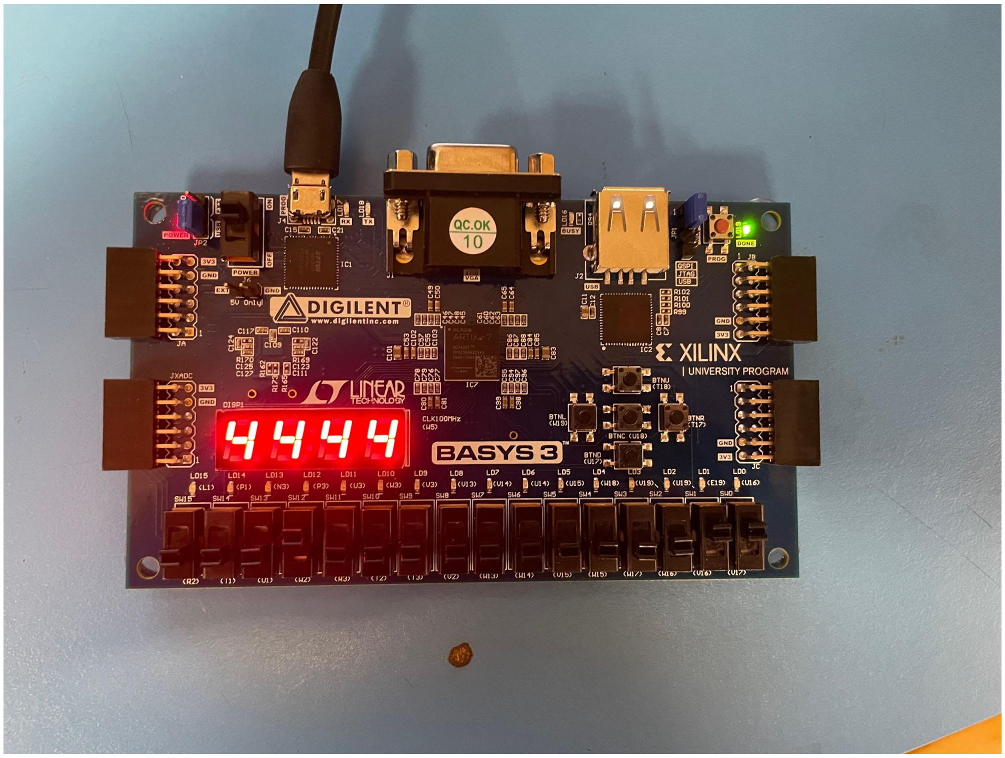
To begin this lab, it was necessary to draw a block diagram and gate level model to get a better understanding of what the adder and seven segment display were and how they would be translated to the software and hardware in the lab. The written form of these diagrams can be seen below.



Pictured: Gate level model for a four bit full adder. You can see the three inputs going into the adder, and the outputs Cout and Sum.

3. Results

In the end, we were able to get our project working as intended, and ultimately got it approved by the TA.



Pictured above: the functioning implementation of the adder on the board. As you can see, the first four switches are making the binary number 0001, and the four right-most switches are making the binary input of 0011. When they go through the adder to the LCD display, the binary result, 4, is shown.

My partner and I ran into a few problems with this lab, but we were able to work through them. Most of the mistakes we ran into were syntax issues within the code, and were easily fixed with some assistance. The communication of ideas between my partner and I also contributed to the amount of time it took to complete the assignment. Furthermore, we were unable to get a functioning behavioral simulation, but after discussing at length what the possible problems were with the TA, he was as stumped as us, as our code all looked correct. He told us that it would suffice to turn it in as is, and checked us off.

4. Conclusions

In the end, I was able to get every part of this lab working as intended. As mentioned in the “Results” section, I had a few hiccups along the way, but I was able to overcome them by getting some help from Professor Naher, as well as looking deep into the program with my partner. This resulted in me being in the lab longer than I had hoped, but I was able to work through it in a timely fashion nonetheless.

5. Contributions

I worked on this lab in collaboration with Carl Chang, and we took turns using the keyboard to make edits and changes to our file. That being said, I would say I did the majority of the work involved with this lab, and am proud of the success I found.

6. Appendices

The code for our project is available on GitHub.