ECE 128: FPGA Laboratory

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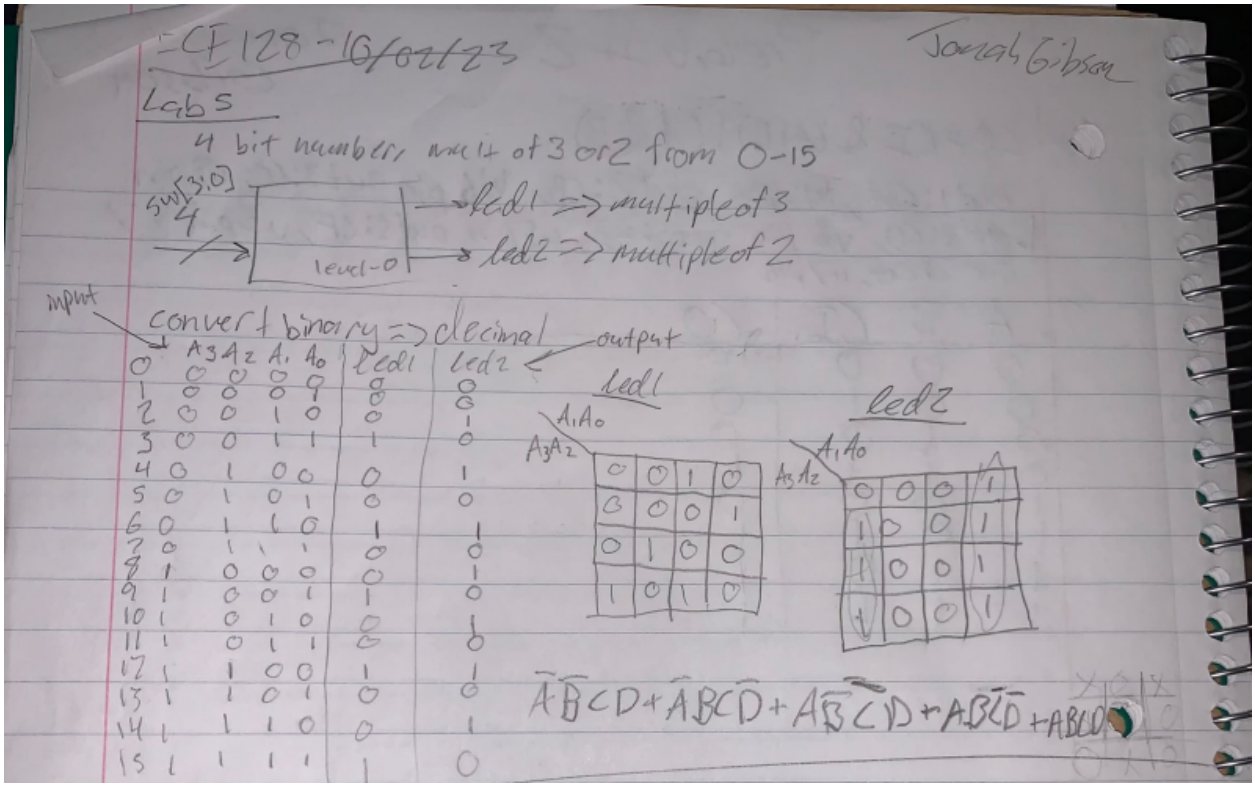
Lab #5: Multiples Detector

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 program that can detect whether a four bit input is a multiple of three, two or both. The program should then illuminate LEDs based on what the number is a multiple of. At the end of the lab, the board should be able to be interacted with to demonstrate the program's functions by using the switches to make a four bit binary number, with the aforementioned LEDs illuminating correctly. 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. Also, this lab 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

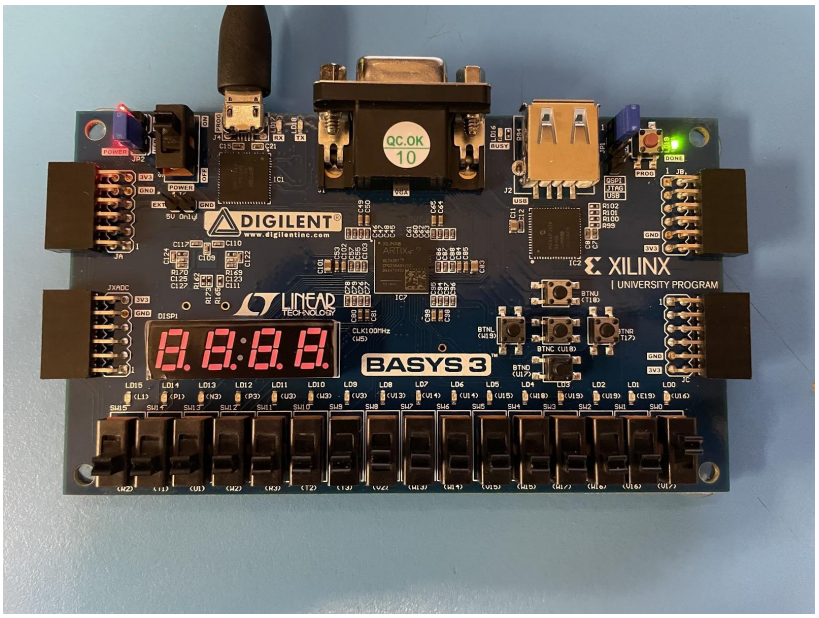
To begin this lab, it was necessary to draw a level-0 model to get a better understanding of what the system was and how it would be translated to the software and hardware in the lab. The written form of these diagrams can be seen below.

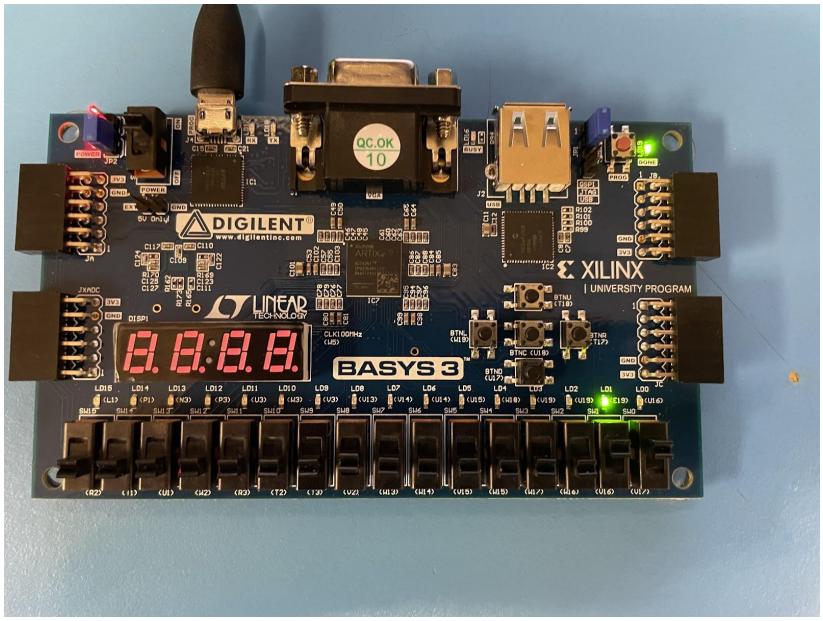


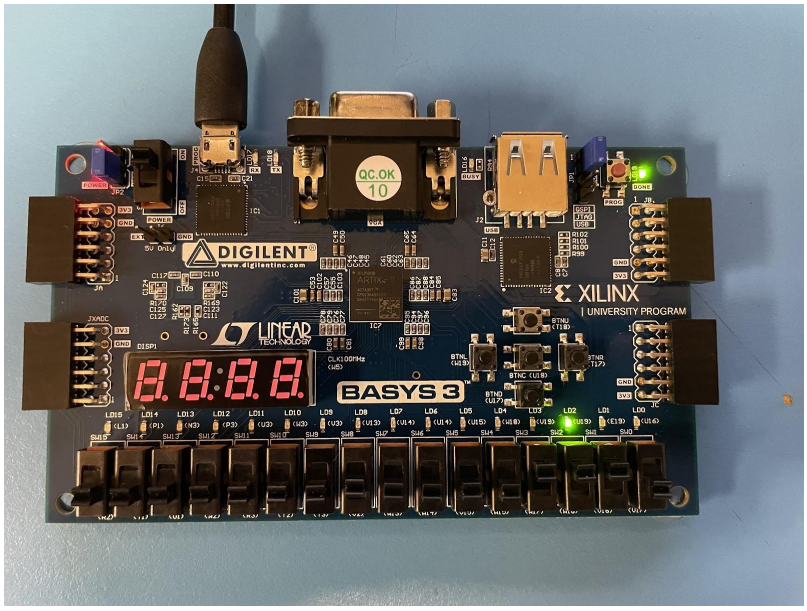
Pictured: Gate level model for the system. You can see the one input going into the component, and the outputs led1 and led2. Also pictured is the truth tables.

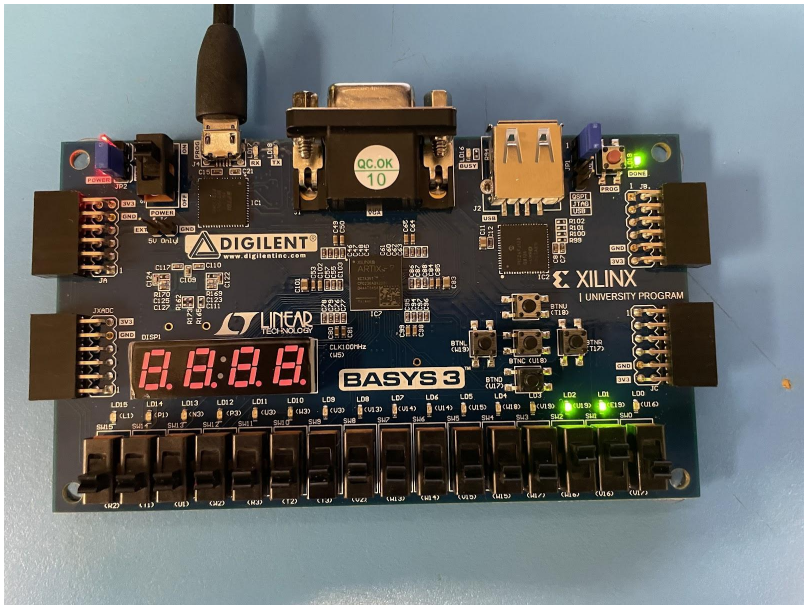
3. Results

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 program on the board. As you can see, the first picture shows the switches making the binary number 1, which is not a multiple of 3 or two, so no LEDs are illuminated. In the second picture, the number 3 results in one LED being lit. The third picture shows the number 14 lighting up a different LED to depict a multiple of 2. Finally, the last one shows the number 6 activating both lights.

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.

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. This week, I would say our contributions were relatively equal.

6. Appendices

The code for our project is available on GitHub at https://github.com/jwg424/lab5.git