ECE 272 LAB 2
Spring 2018

Basic combinational logic and the MachX03
Jonathan Carney

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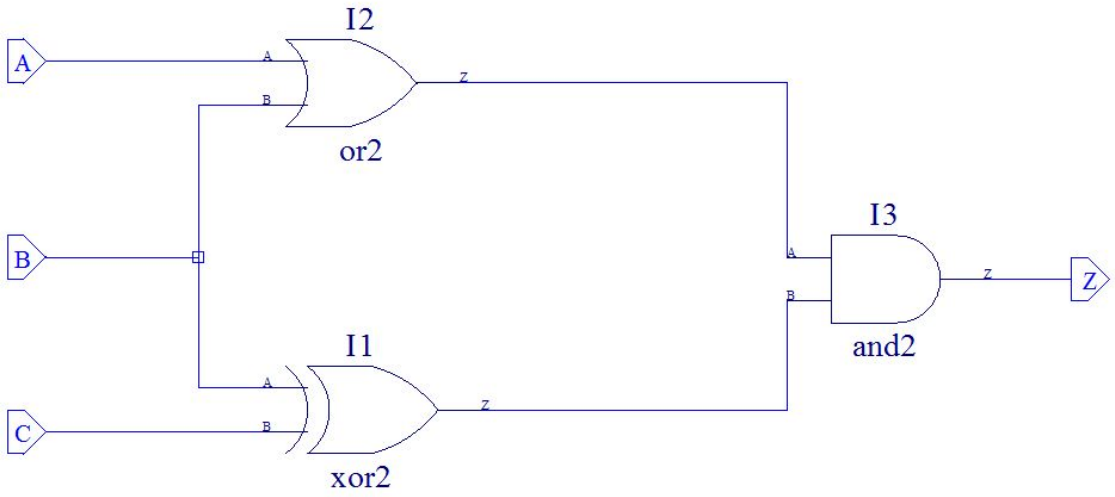
Grading TA: Lyubo Gankov

1 Introduction

This section of the lab introduces the concept of an FPGA, which is the type of programmable chip we will utilize in this class. Field programmable gate arrays or FPGAs allows designers to code in digital logic as opposed to having to individually build in different logic gates. This allows for much more versatile applications from one chip. FPGA's can be programmed using HDL to simulate several hundred thousand logic gates, making it much more efficient for them to be used in lab as opposed to manually arranging logic gates. This lab introduces us to an FPG, soldering, and utilizing lattice diamond software.

2 Design

Design that is to be drafted in lattice diamond



The first design portion of this lab was drafting the above schematic in diamond. This entailed learning how to use lattice's drag and drop and circuit drawing feature. Then input and outputs on the lattice board had to be determined, below is a table of the pins utilized. And whether they were put as pull up or pull down values.

I/O	Input A	Input B	Input C	Output Z
Pin	L3	L2	M2	H11(this corresponds to the LED on the board)
Pull mode	Down	Down	Down	Up

The second portion of this lab was building a push button board and connecting it to the FPGA. This was fairly straightforward and mostly involved simple soldering.

3 Results

Truth table of expected and actual outputs that were observed in lab.

a	b	c	Expected output	Actual output
0	0	0	1	1
0	0	1	1	1
0	1	0	0	0

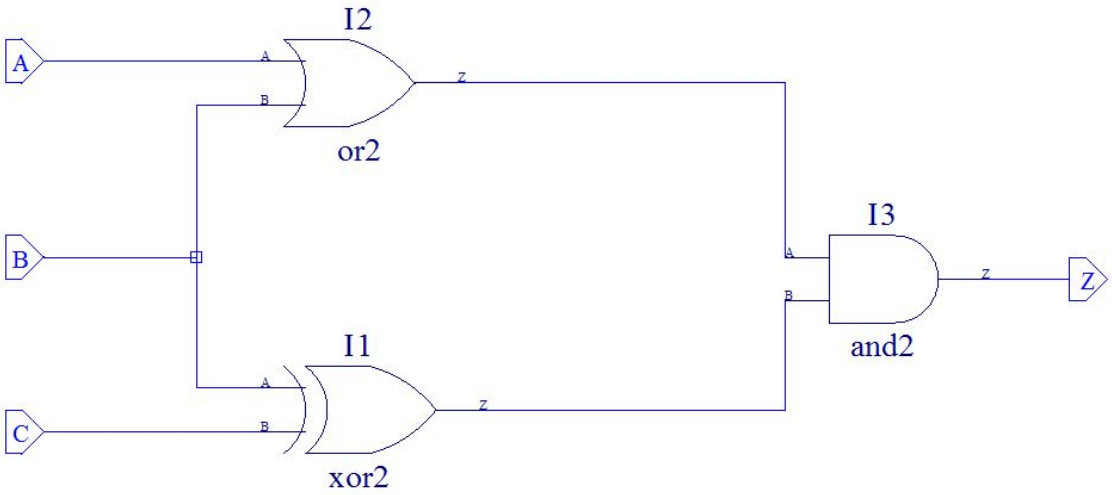
1	0	1	1	1
0	1	1	1	1
1	0	1	1	1
1	0	0	0	0
1	1	0	0	0
1	1	1	1	1

The above table shows results from inputs a,b, and c, all of which are active high values that become a low value when a corresponding button in pressed on the button board that was made during lab. The output correspond to whether or not an led was glowing given a certain button combination.The truth table meets all expected values, therefore the design was implemented successfully.

Lab Notes

This lab went fairly well for me, the largest challenge came before lab with setting up a VMWare workstation on my laptop. Understanding pull modes took me a little while but other than that the programming was very straightforward and the lab easy to follow.

Study questions:



1.
2. I encountered a problem understanding what was meant by pull up and pull down values. After a conversation with the TAs i understood that the button board was active high and therefore it was significant when the signals were broken not when they were received. After this explanation I was able to understand when to use pull up and pull down modes.

3. Discrete logic ICs are used in industry when it would be impractical to use something similar to an FPGA. Simple logical applications don't call for a multidollar FPGA when you could accomplish the same thing with a few simpler parts.
    a. Citation: https://www.edn.com/electronics-blogs/benchtalk/4441764/Designer-s-Notebook--Discrete-Logic
4. I would use an FPGA over a PLA if I were prototyping a new microcontroller to put into a system that controlled a vehicle's headlights dependent on weather, the FPGA gives me more input/output pins to work with and allows me to rapidly change the logic within it as i update my design. However, It would be much simpler to manufacture PLA's that would do the same job as this already completed FPGA and to place them into production models, due to their lower cost.