Lab 3 - 2/21/22

Combining Logic Gates

EGT 245 - Digital Electronics

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<u>Introduction</u>

The purposes of this experiment are as follows: allow students to build a physical circuit using multiple different components, build familiarity with lab equipment and the mentioned components, and utilize the learned formulae to compute theoretical circuit values, then test those values against real-world models.

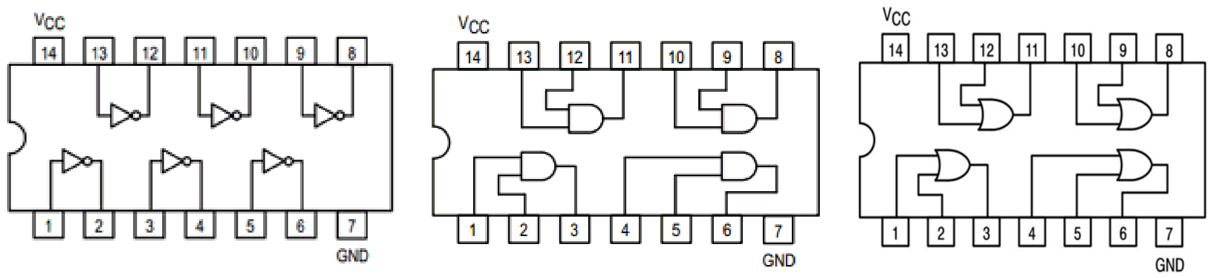
<u>Required Equipment & Components</u>

- 74LS04N (4 Channel NOT Gate IC)
- 74LS08N (4 Channel AND Gate IC)
- 74LS32N (4 Channel OR Gate IC)
- Breadboard with Jumper Wires
- SPST Switch (x3)
- 5V Power Supply

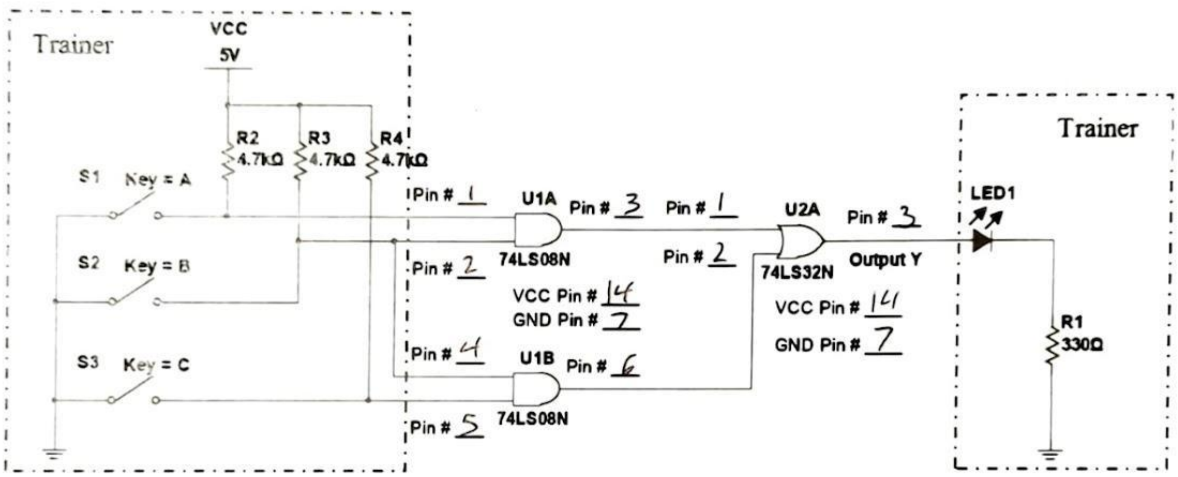
<u>Theory</u>

Each utilized IC contains four, independent, logic gates. The 74LS04N contains NOT gates, the 74LS08N contains AND gates, and the 74LS32N contains OR gates. Each AND & OR channel have two inputs; the NOT gate has a single input. In the case of the LS08, **<u>both inputs</u> must be *high* to create a *high* output** (A * B = C). For the LS32, **<u>either input</u> can be *high* to create a *high* output** (A + B = C). Finally, the LS04 simply ***inverts* the incoming signal** and drives the output in that new direction. In the first demonstration, three inputs (switches) will be connected to two AND gates, the outputs will be fed to an OR gate. In the second demonstration, two inputs (switches) will be independently inverted, fed into an AND gate, then inverted again. The switches will be toggled based on the sequences found in the truth tables below.

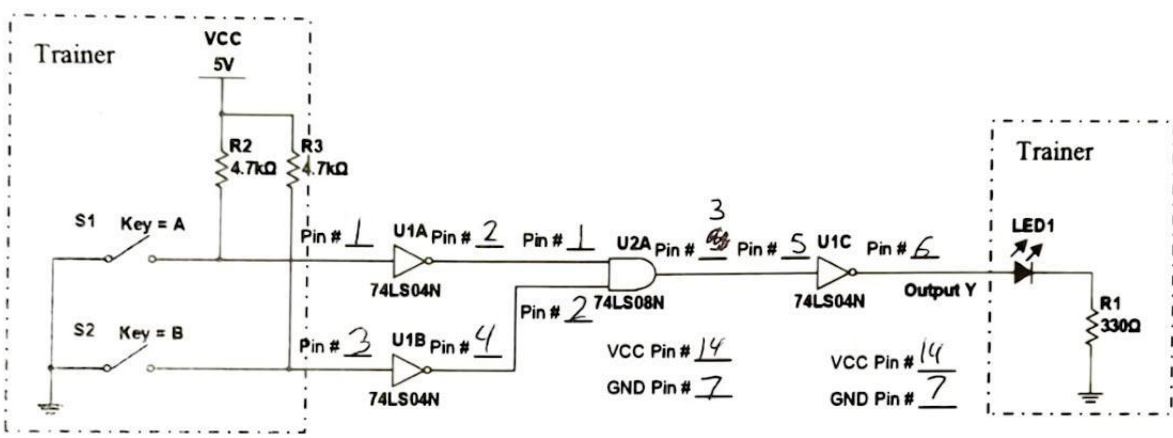
Component Layout



Assignment 1



Assignment 2



Experimental Results

Assignment 1			
Switch S1 (A)	**Switch S2 (B)**	**Switch S3 (C)**	**Output (LED)**
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1
Expression: (AB+BC)			

Assignment 2		
Switch S1 (A)	**Switch S2 (B)**	**Output (LED)**
0	0	0
0	1	1
1	0	1
1	1	1
Unsimplified Expression: $(\overline{\overline{A}}*\overline{\overline{B}})$ | Simplified Expression: (A+B)		

Conclusion

Through the use of AND, OR and NOT ICs, we were able to learn about the applications of boolean algebra. These applications would be seen in the form of logic gate-based LED circuits. Once the current passed through the logic gates using switches and returned their value the LED would light up depending on that said output. The boolean algebra that these circuits were derived from helps explain the logic that happens. For the first assignment the circuit's expression interpretation led to it being if either one of the two AND gates returned true then the output of the OR gate would be true lighting the LED up. In the second assignment the logic was that the input for the AND gate was passed through a NOT gate before. This led to the input being on the opposite level (0,1) from what it began, afterwards that output was then also sent through a NOT gate. In the end the expression simplified using De Morgan's theorem to an OR gate between the two inputs as they were, removing all the NOT gates. Overall, we believe that this lab was a great way to introduce boolean algebra and its applications.