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EE-102 Section 3
Lab Work 3
26.02.2021

Design Methodology:

My design is a safety system of kettle. There are two inputs for two situation and there is one output. I used one Quad 2-input OR gate (74LS/HC32) and one 4-bit counter (74HCT163) to design this system. One of inputs (1A) symbolizes whether water is boiled or not, and other input (1B) symbolizes the kettle is overheated or not. If at least one of them satisfy condition, then safety system will work and shut kettle down. So this condition is my design's output (1Y)

Inputs:

Water boils or not (it boils = 1 , not boils = 0)

Overheats or not (Overheated = 1 , not overheated = 0)

Output:

Safety system working or not (Kettle stopped = 1 , kettle keeps running = 0)

Components:

74HCT163 4-bit counter

5 LEDs

Lots of jumper cables

74LS/HC32 Quad 2-input OR gate

Signal Generator and Signal cable

DC power supply and cables

Oscilloscope and oscilloscope probe

Gate Connections:

74HCT163 4-bit counter

2 -> Signal Generator (+)

16 -> DC power supply (+)

14,13 -> 1A,1B on OR gate (-)

8 -> Ground (-)

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74LS/HC32 Quad 2-input OR gate

1A,1B -> 14,13 on counter

14 -> (+)

1Y -> output LED (-)

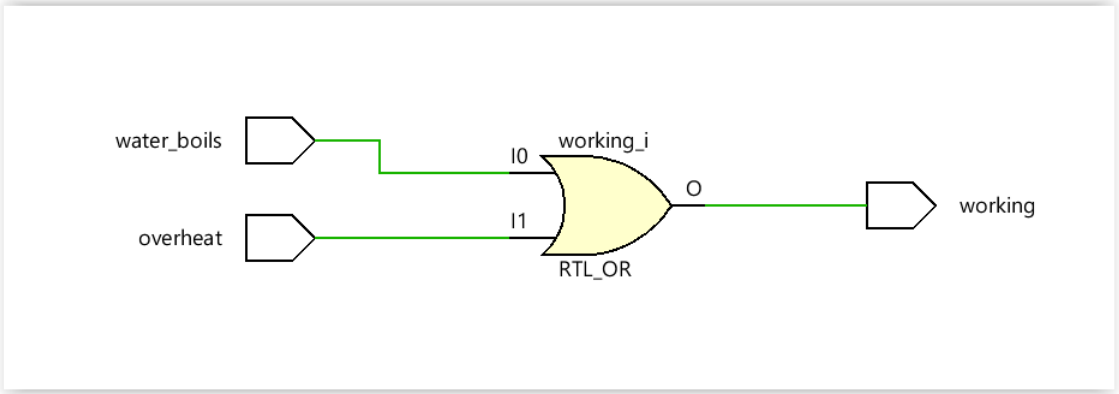

Figure-1 : RTL schematic of logic system

q0 (1A)	q1 (1B)	q2 (not used)	q3 (not used)	Output (1Y)
0	0	0	0	0
1	0	0	0	1
0	1	0	0	1
1	1	0	0	1
0	0	1	0	0
1	0	1	0	1
0	1	1	0	1
1	1	1	0	1
0	0	0	1	0
1	0	0	1	1
0	1	0	1	1
1	1	0	1	1
0	0	1	1	0
1	0	1	1	1
0	1	1	1	1
1	1	1	1	1

Figure 2 : Truth Table of Logic Design (Counter LEDs)

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Results:

Our counter and output of gates is working as we expected.

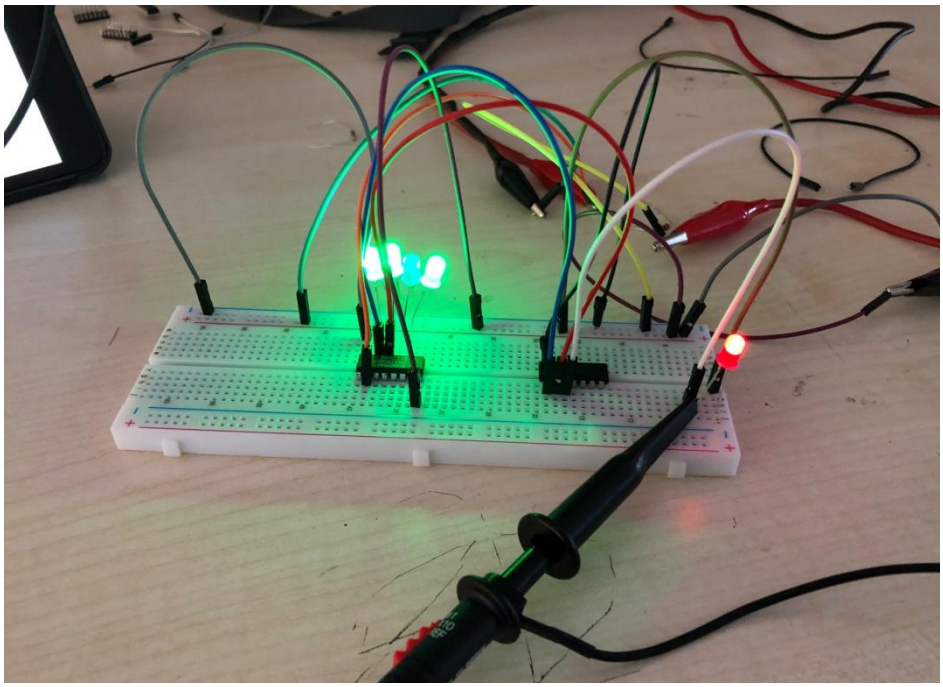

Figure 3: (1 OR 1 = 1) (First two green LEDs are inputs, red LED is output)

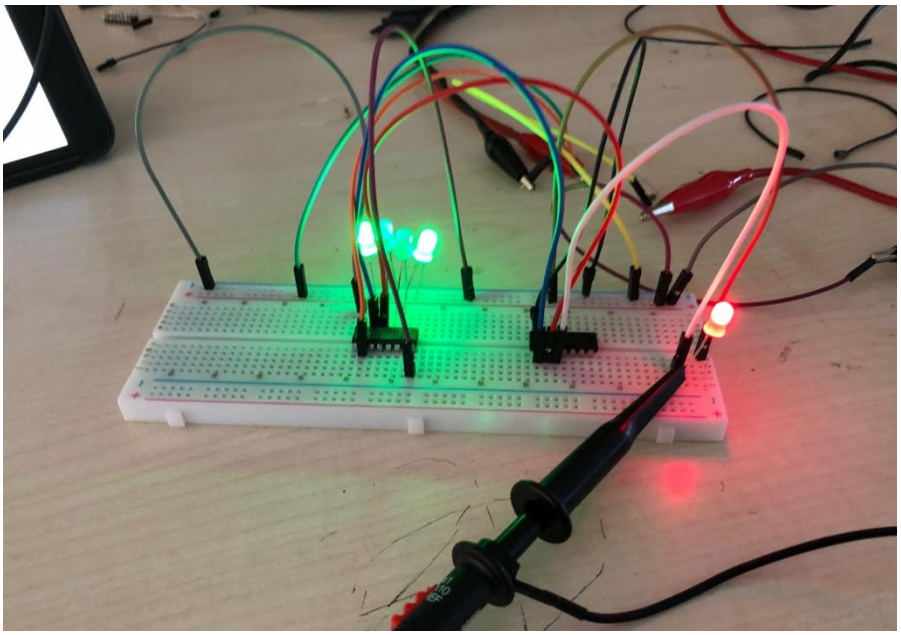

Figure 4: (1 OR 0 = 1)

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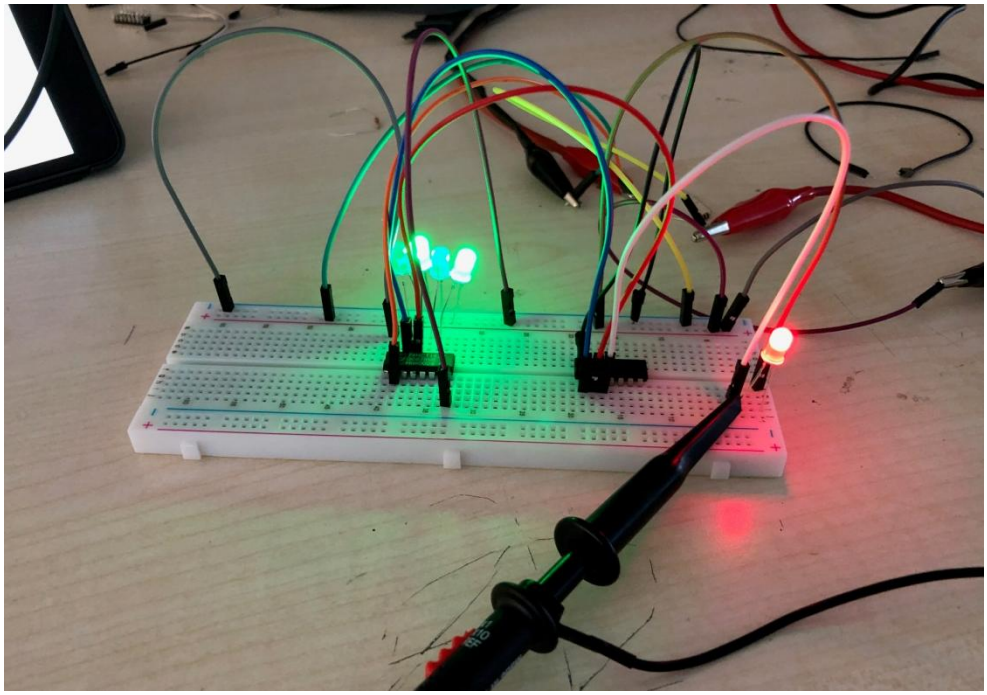

Figure 5: (0 OR 1 = 1)

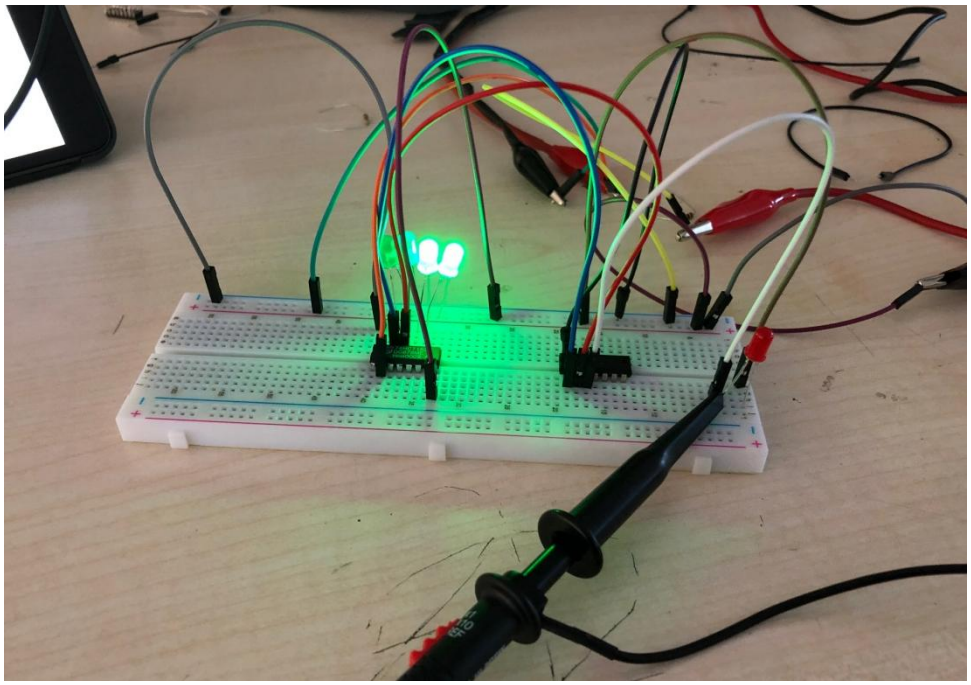

Figure 6: (0 OR 0 = 0)

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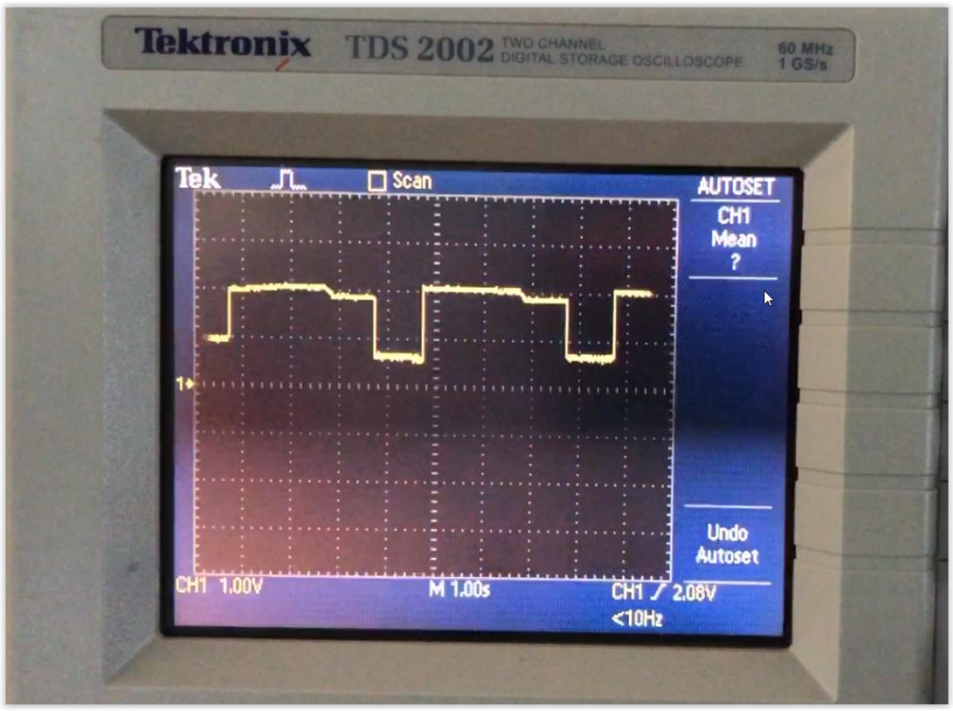

Figure 7 : Signal Waveform

We connected our output LED's legs to Oscilloscope Probe and we can see our circuit is working as we expected. It corresponds with our truth table.

Conclusion:

In this experiment, we learned how to design combinational logic circuits with physical components such as 4-bit counter and quad 2-input OR, AND gates. It was challenging lab. Some of components was not working so we need to change these components with working ones. I realized that designing combinational logic circuit with VHDL is easier than designing with using breadboard. In this lab, I tried to understand datasheets of electronic components. That was interesting experience. Also this lab was contained a lot of breadboard usage and we learned how to use breadboard and jumpers better and effectively because if we use jumper for every connection, circuit will be so complicated and we used less jumpers and more breadboard parallel lines.