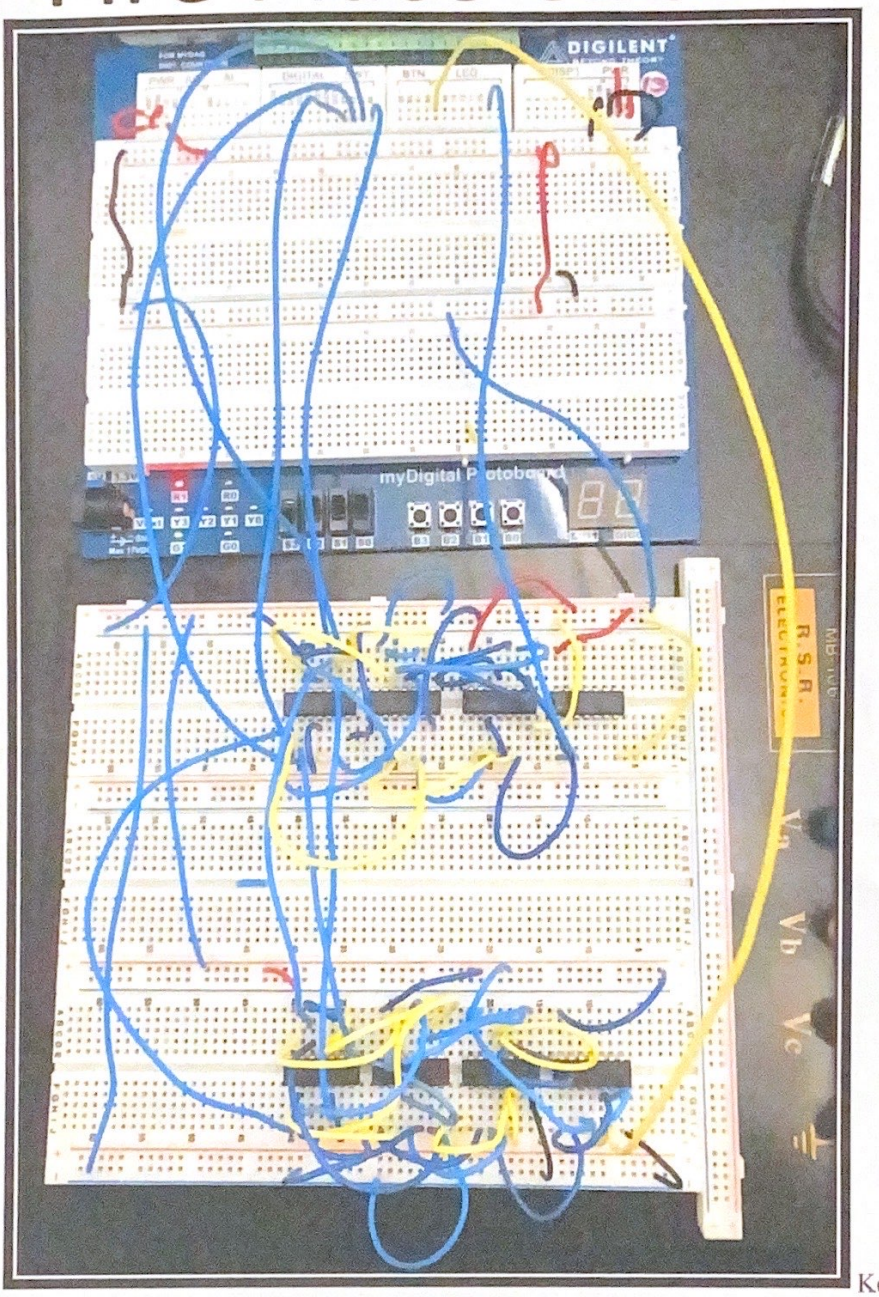
Fire Place Circuit



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Digital Electronics

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Introduction

In this project, students were to design, test and build a fireplace control circuit. The purpose of this project was to make a fireplace control circuit to determine whether or not a faulty sensor within the circuit exists. One of the skills learned was to work with NAND and NOR gates.

Materials

Description	Quantity	Part #
Multisim	1	14.1
Breadboard	1	800949B-01
NAND Gate	4	IC 74LS00
NOR Gate	4	IC 74LS02
Wires	-	N/A

Design Brief

Client – Acme Fireplace Company

Target Consumer – The people and or customers

Designer – Keyur Rana

Problem Statement – There are frequent unnecessary shut downs and constant customer's dissatisfaction in the original design

Design Statement – To design, test and build a combinational logic circuit that meets the below detailed design specification

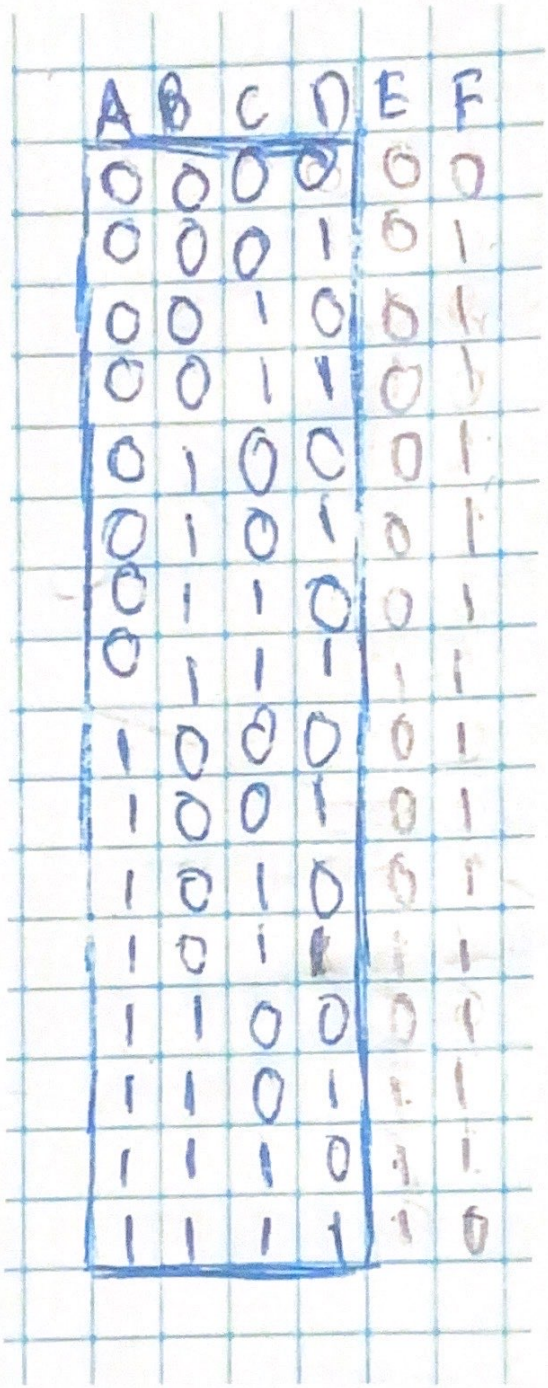
Constraints – The karnaugh mapping technique must be used to obtain the simplified logic expression for both outputs

- The circuit that controls the emergency cut-off value must be implemented using only 74LS00 two input NAND gates
- The circuits for the possible faulty sensor indicator must be implemented using only 74LS02 two input NOR gates

Deliverables: -

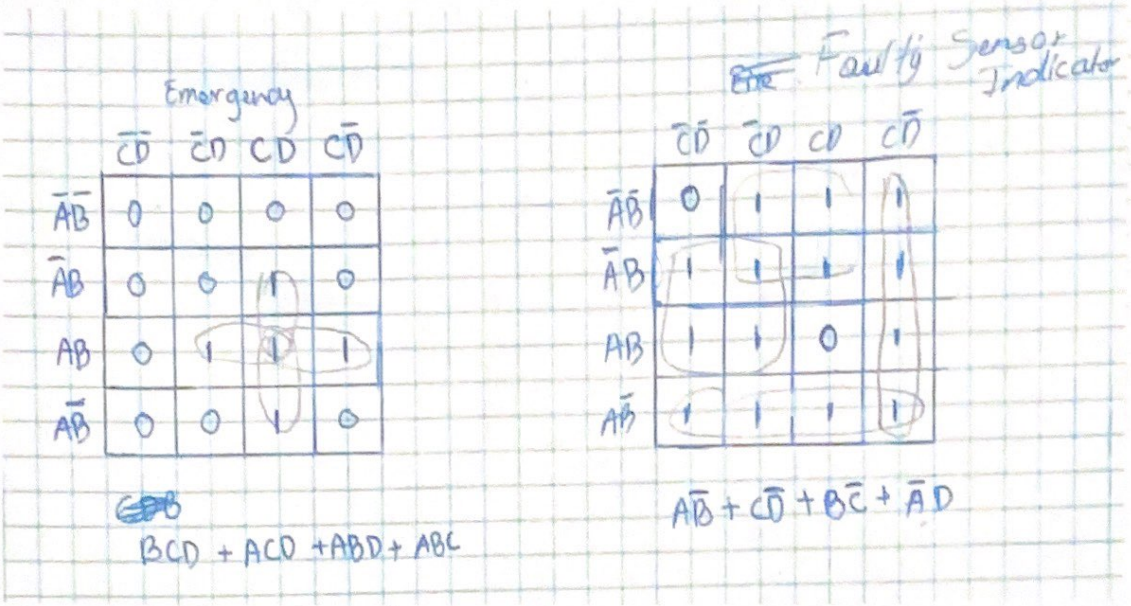
- Multisim
- Breadboard circuit

Evidence of Analysis – 1 Truth Table for both Outputs



A	B	C	D	E	F
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0	0	1
0	0	1	1	0	1
0	1	0	0	0	1
0	1	0	1	0	1
0	1	1	0	0	1
0	1	1	1	1	1
1	0	0	0	0	1
1	0	0	1	0	1
1	0	1	0	0	1
1	0	1	1	1	1
1	1	0	0	0	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	0

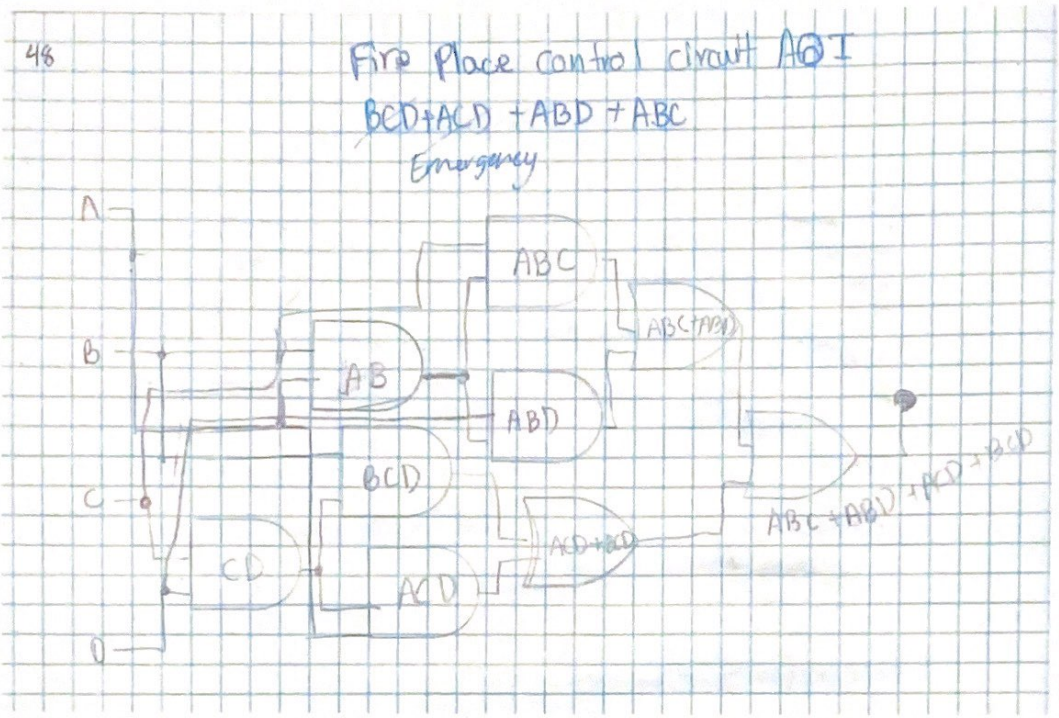
Evidence of Analysis – 2 K-maps for both Outputs



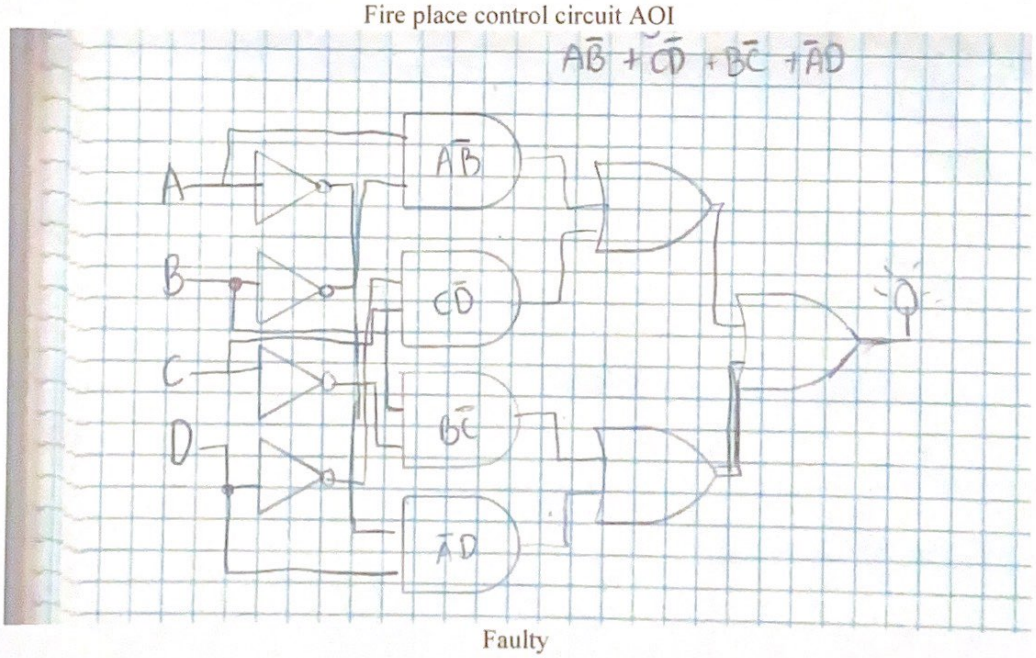
The two K-maps for Emergency and Faulty Sensor

Evidence of Working Design – AOI sketch of both circuits (Simplified)

Emergency



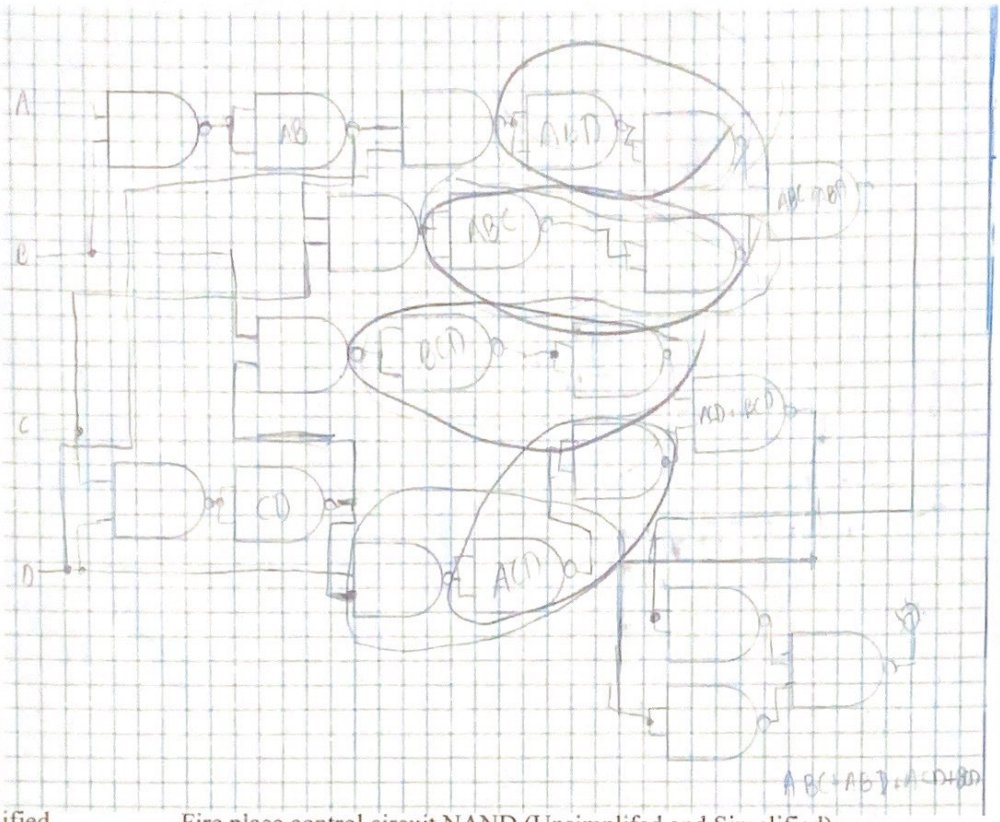
Fire place control circuit AOI



Faulty

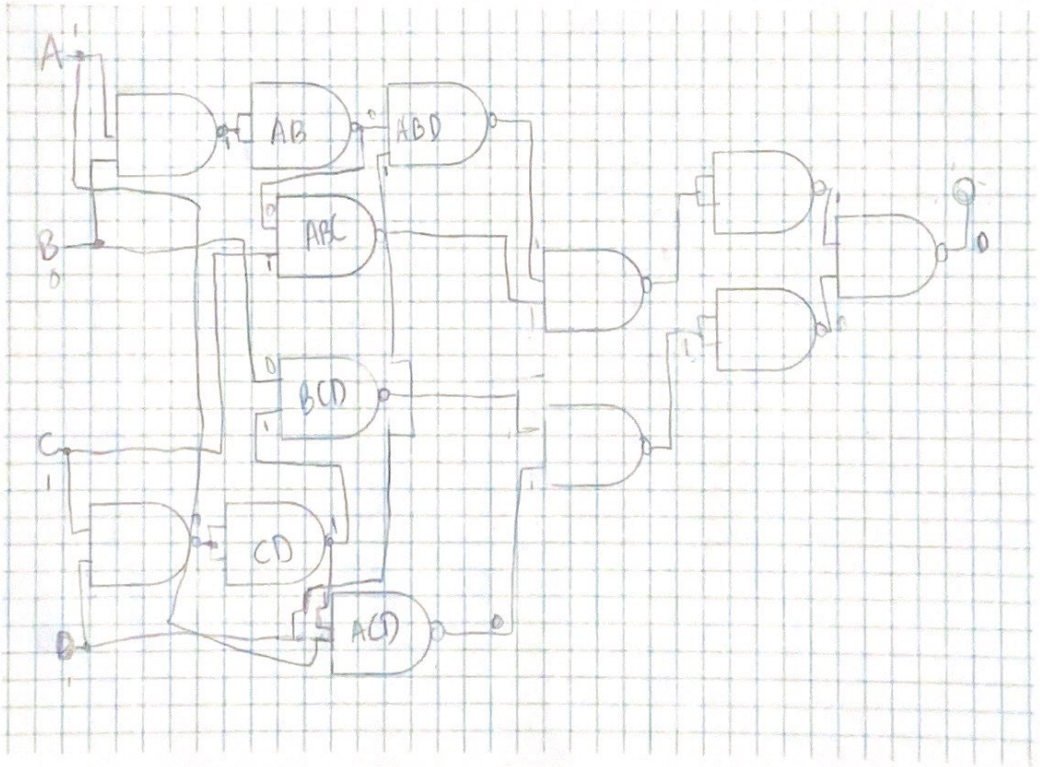
Evidence of Working Design – NAND (Original and Simplified)

Unsimplified



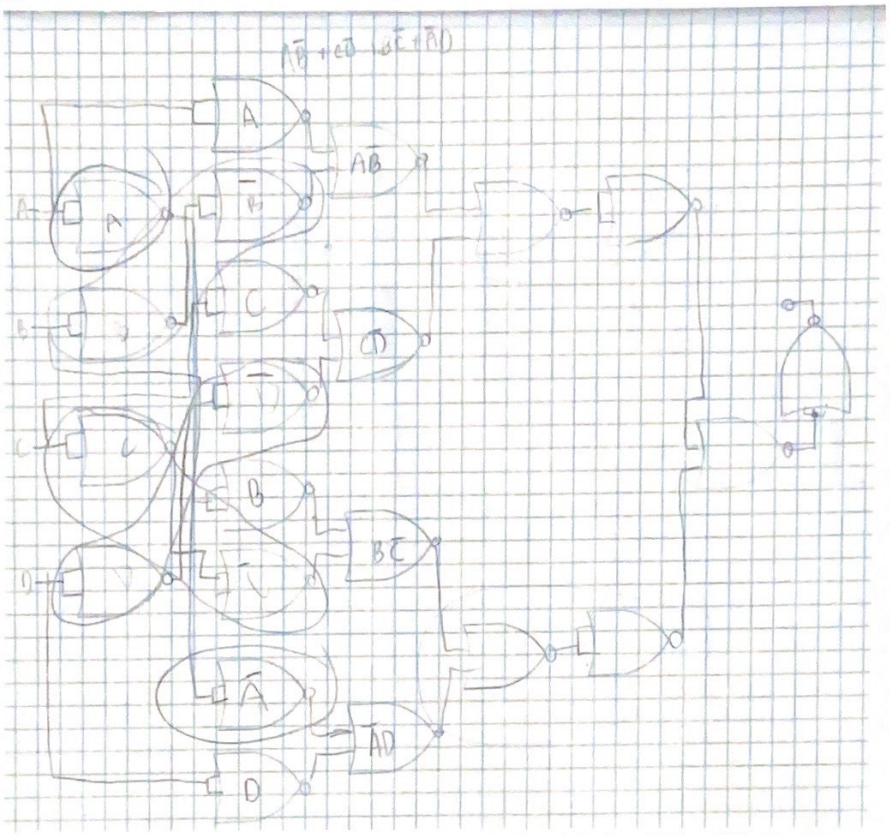
Simplified

Fire place control circuit NAND (Unsimplifed and Simplified)



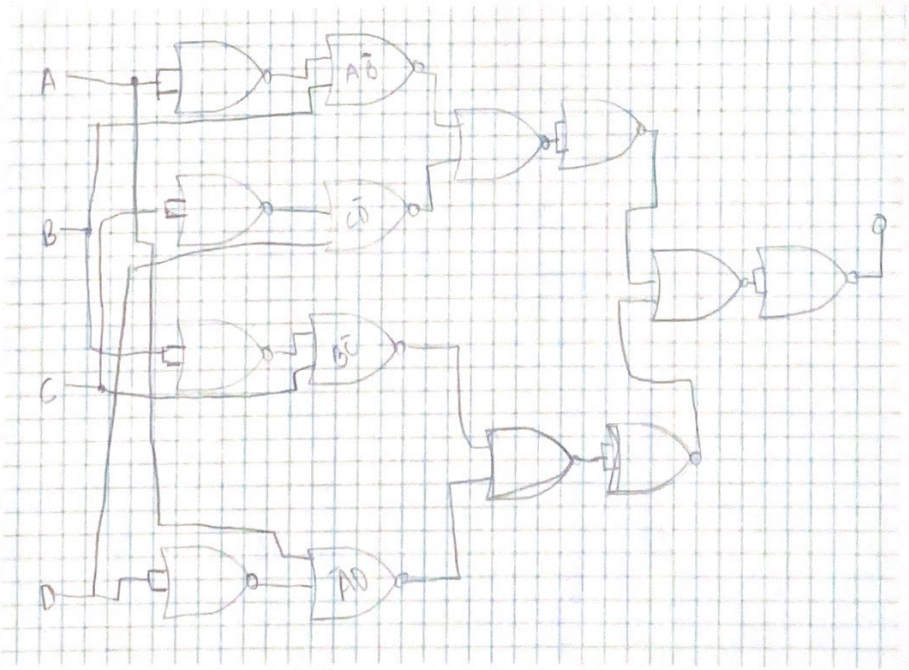
Evidence of Working Design – NOR (Original and Simplified)

Unsimplified

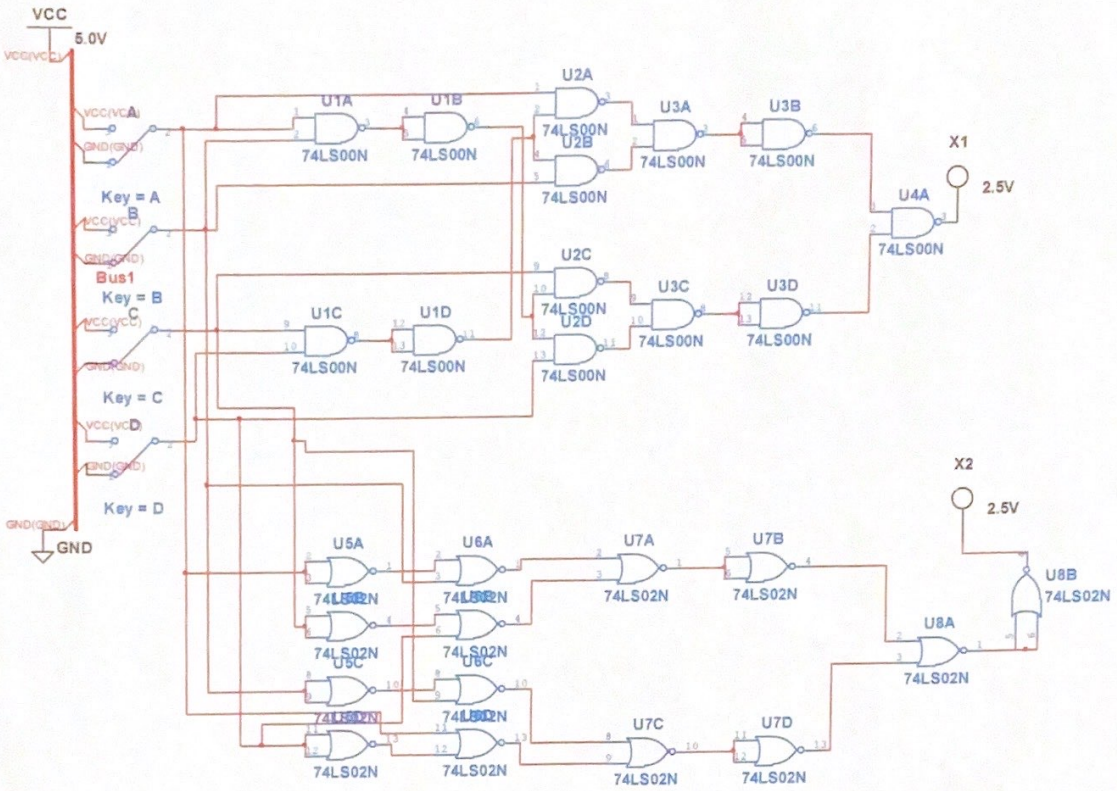


Simplified

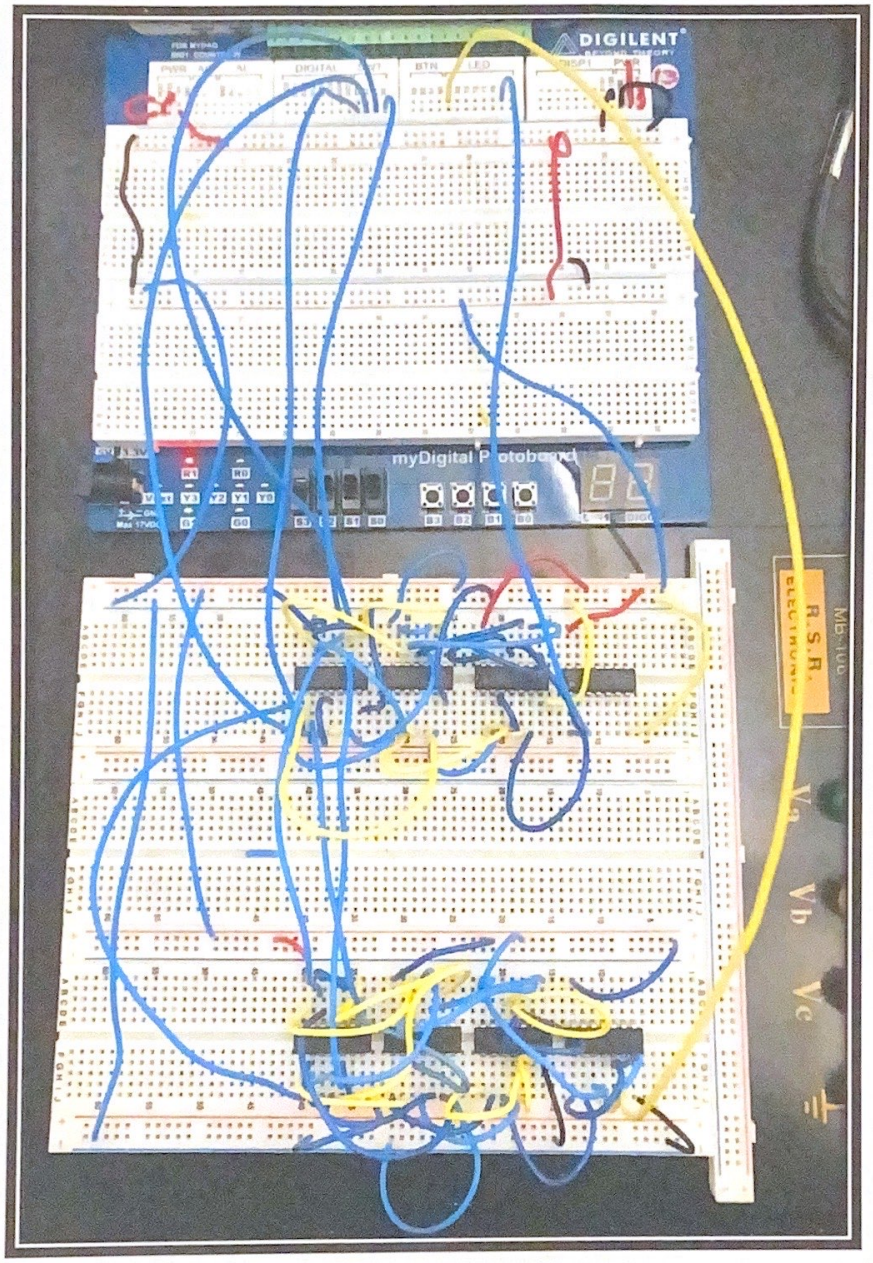
Fireplace control circuit NOR (Unsimplified and Simplified)



Evidence of Working Design – Breadboard circuit



Evidence of Working Design – Breadboard circuit



Fire place control circuit wired on a breadboard (Emergency and Faulty Simp.)

Conclusion

The fireplace control circuit project was overall a great project that enhanced and strengthened students understanding in Digital electronics. The students went through immerse and painfully long process of recreating circuits for individual part. Firstly, they created a design brief. Next they drew truth tables for both Emergency and Faulty indicator. After that, they made K-maps for both and then went on sketching AOI simplified of Emergency and Faulty indicator. They also sketched simplified and simplified version of Faulty NOR and Emergency NAND. Many students had difficulty simplifying circuits because they weren't used to the new concept of simplifying NOR and NAND gates. After immerse work, they moved on to creating the circuits on a software called Multisim, where they simulated their circuits. On Multisim, they combined the Faulty NOR simplified and Emergency NAND simplified into one. Students then moved on to building the circuit on a breadboard. Many students encountered a problem with the breadboard. Whenever they were wiring, their ICs would tend to pop-out of the breadboard socket which got students really frustrated. To fix this problem, they rewired the circuit on a different external breadboard. Some of the errors students made during wiring were wiring the wire into the wrong socket and striping the wire to short causing a loose connection to the socket. I personally really liked this problem because even though I was struggling with my broken board, it gave me hopes not to give up and continue wiring even when more than half of the class was ahead and finished with the project. I would like to do these kinds of fun project in the near future.