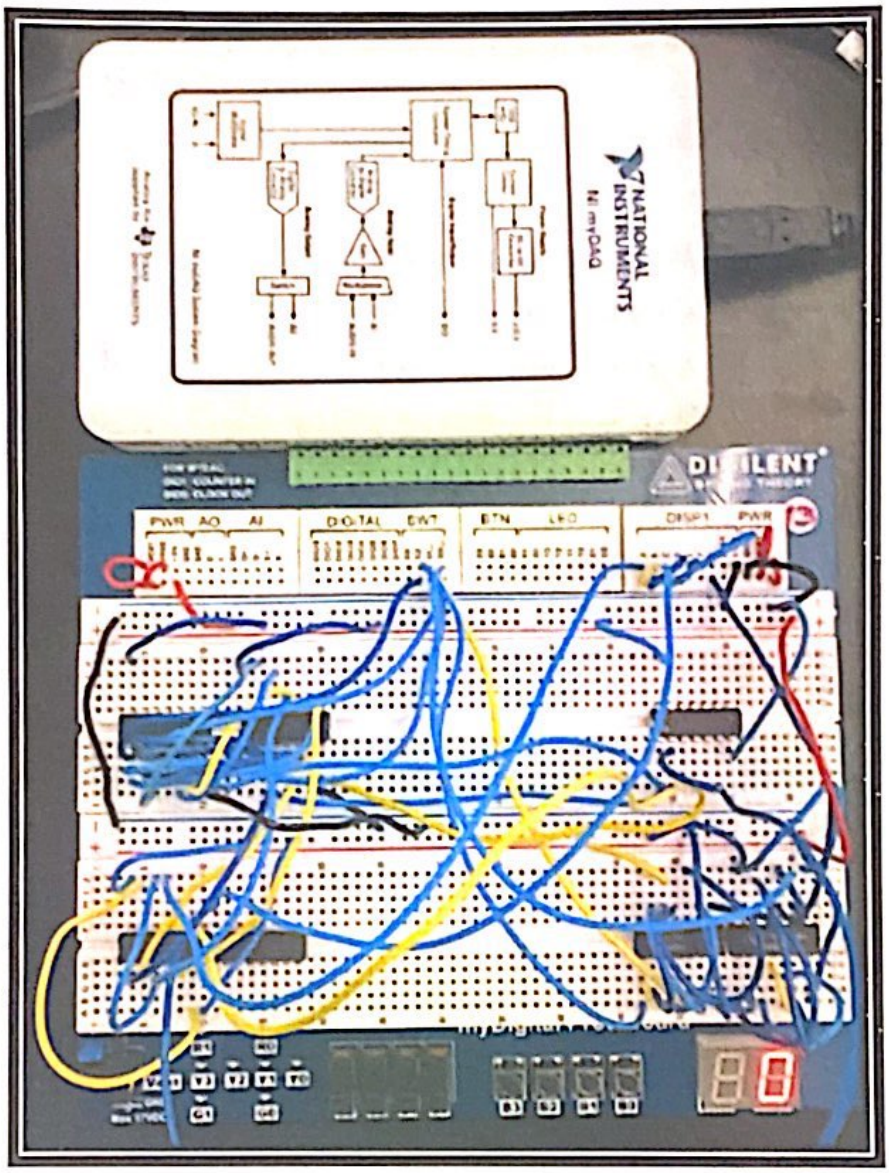
BIRTHDAY PROJECT



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Digital Electronics

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Introduction

In this project, students were to design, build and test a circuit that displayed students date of birth on a single seven-segment display. This project does not have any real practical application but it is a fun exercise that will enhance students understanding in Digital Electronics. Some of the skills students learned were working with AOI, NAND and NOR gates. Another skill students used was working with the seven segment display where the inputs were a to g. The number of segments depended on the complexity of student's birthdays.

Materials

Description	Quantity	Part #
AND	2	IC 74LS08
OR	1	IC 74LS32
INVERTER	1	IC 74LS04
NAND	2	IC 74LS00
Multisim	1	14.1
Wires	-	N/A
Breadboard	1	800949B-01

Design Brief

Designer: - Keyur Rana

Design Statement – To design, test and build a combinational circuit that displays your birthday in a 7 segment display in sequential order with dashes (-) between the month, day and year.

Constraints:

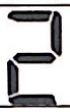
- Seven-Segment display must be common cathode.
- The Karnaugh mapping must be used to obtain the simplified logic expression for each of the seven segments.
- At least one segment must be implement with NAND only logic.

Segments for the seven segment display were a to g. They are the inputs.

Deliverables

- Report
- K - map
- Prototype breadboard

Evidence of Analysis – Truth Tables

X	Y	Z	DISPLAY	a	b	c	d	e	f	g
0	0	0		1	1	1	1	1	1	0
0	0	1		1	1	0	1	1	0	1
0	1	0		0	0	0	0	0	0	1
0	1	1		1	1	0	1	1	0	1
1	0	0		1	1	0	1	1	0	1
1	0	1		0	0	0	0	0	0	1
1	1	0		1	1	1	1	1	1	0
1	1	1		1	1	0	1	1	0	1

XYZ are the input 0/1 = off/on

a, b, c, d, e, f, g = 0/1 = off/on

XYZ counts from 0-7 in binary

The seven-segment display displays numbers

There are seven segments in a seven-segment display (a-g)

Evidence of Analysis – K-Maps

	X'Y'	X'Y	XY	XY'
Z'	1	0	1	1
Z'	1	1	1	0

X'Y'+YZ+XY+XZ'

(a=b=d=e)

	X'Y'	X'Y	XY	XY'
Z'	1	0	1	0
Z'	0	0	0	0

X'Y'Z'+XYZ'

(c=f)

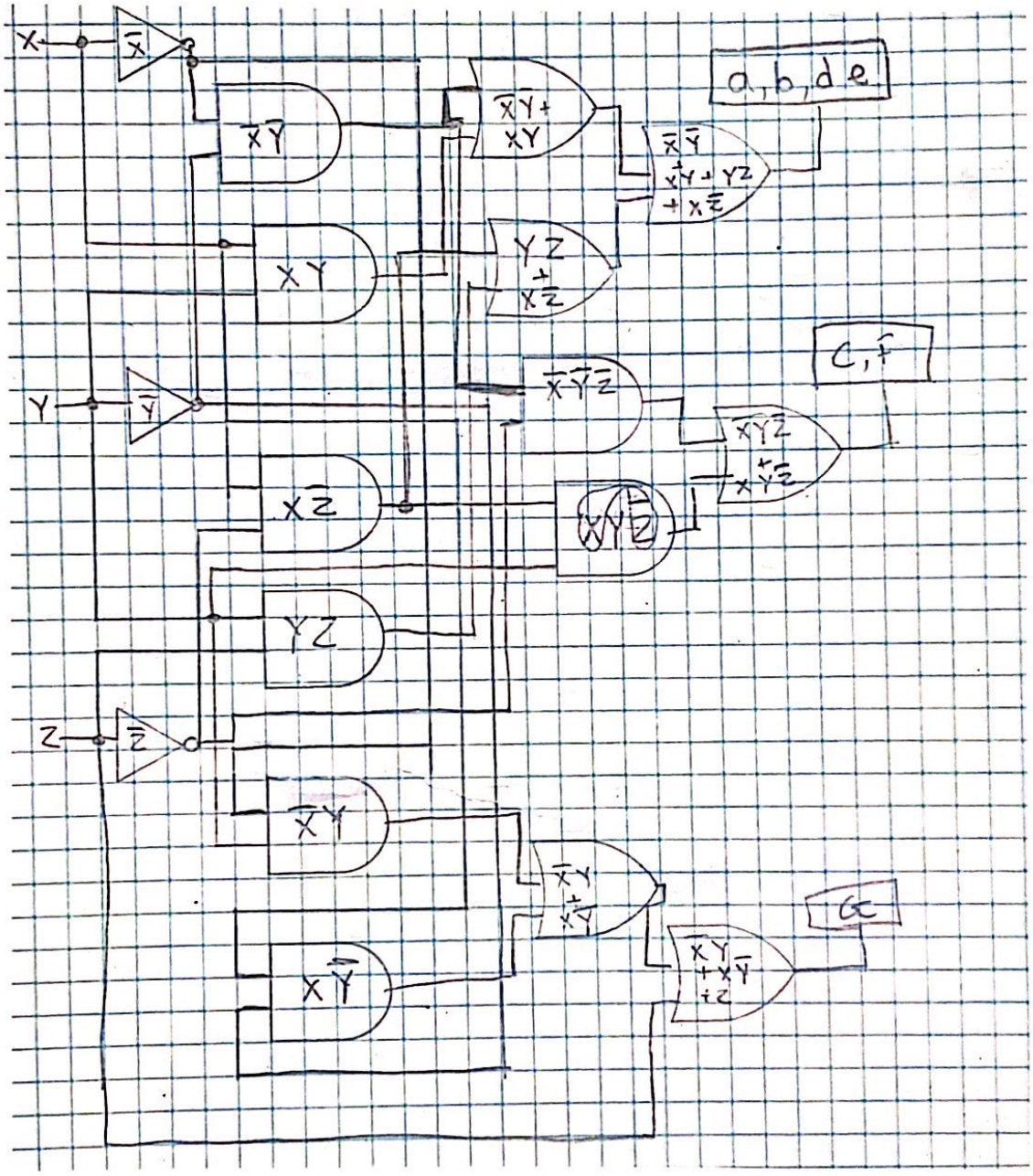
	X'Y'	X'Y	XY	XY'
Z'	0	1	0	1
Z'	1	1	1	1

X'Y+XY'+Z

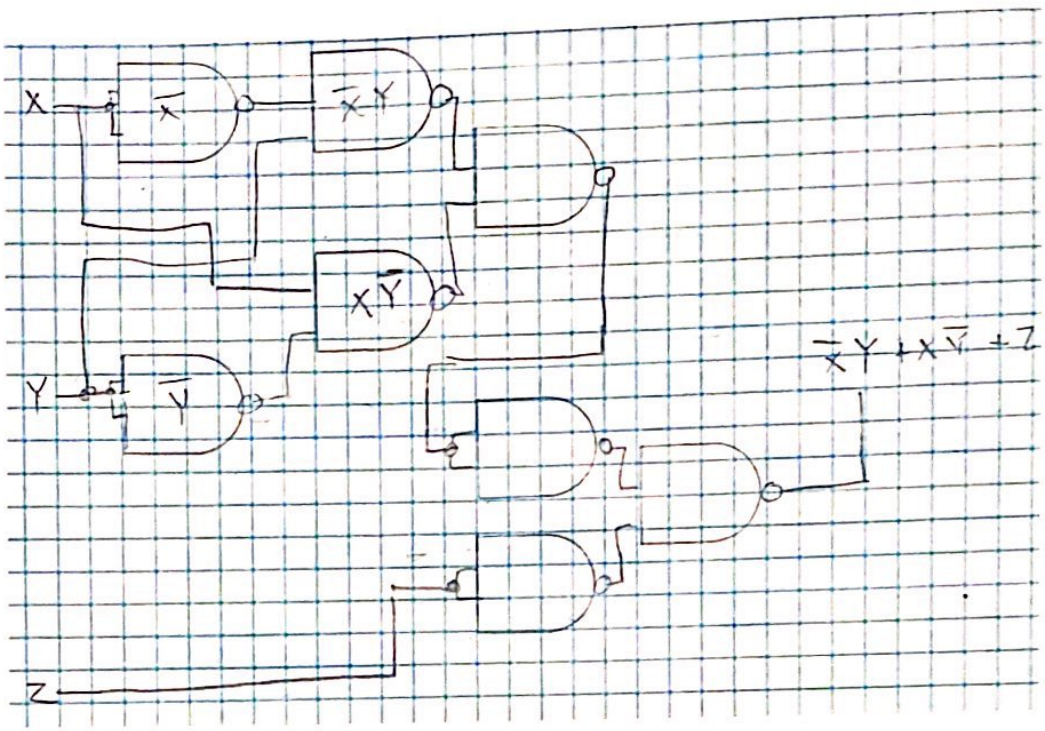
(g)

The K-Maps for all truth tables

Evidence of Working Design – Hand drawn completed Circuit

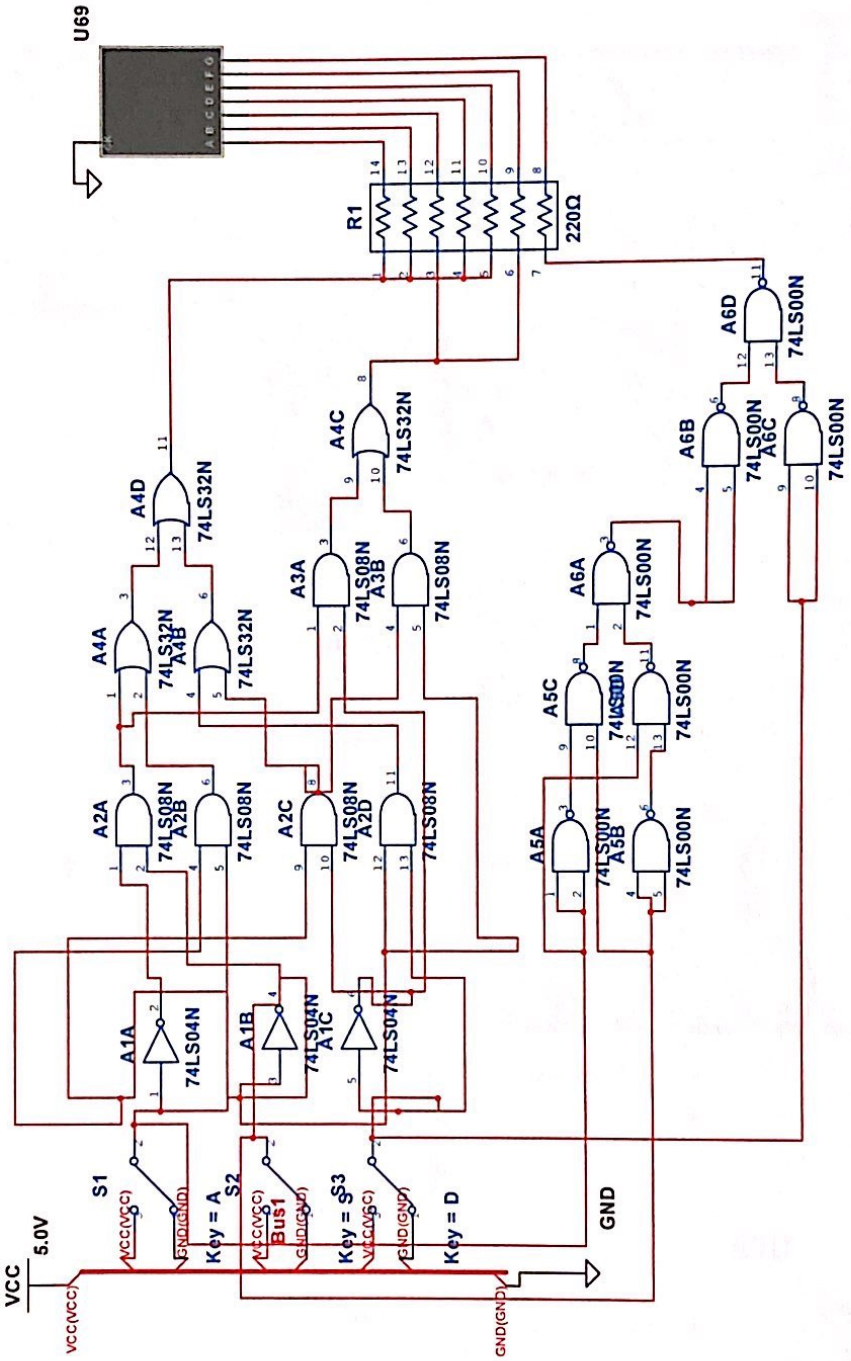


The AOI circuit hand drawn in the Engineering Notebook.



The NAND simplified of the last segment (g)

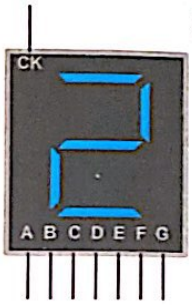
Evidence of Working Design – Computer Simulated Circuit



The computer simulated circuit build on Multisim 14.1 (AOI+NAND)

Evidence of Working Design – Computer Simulated Data Sequencing

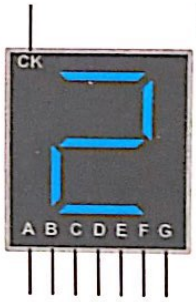
(000)



(001)

(010)

(011)



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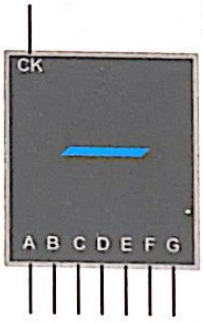

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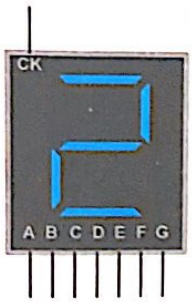
(110)

The circuit built on Multisim displaying numbers



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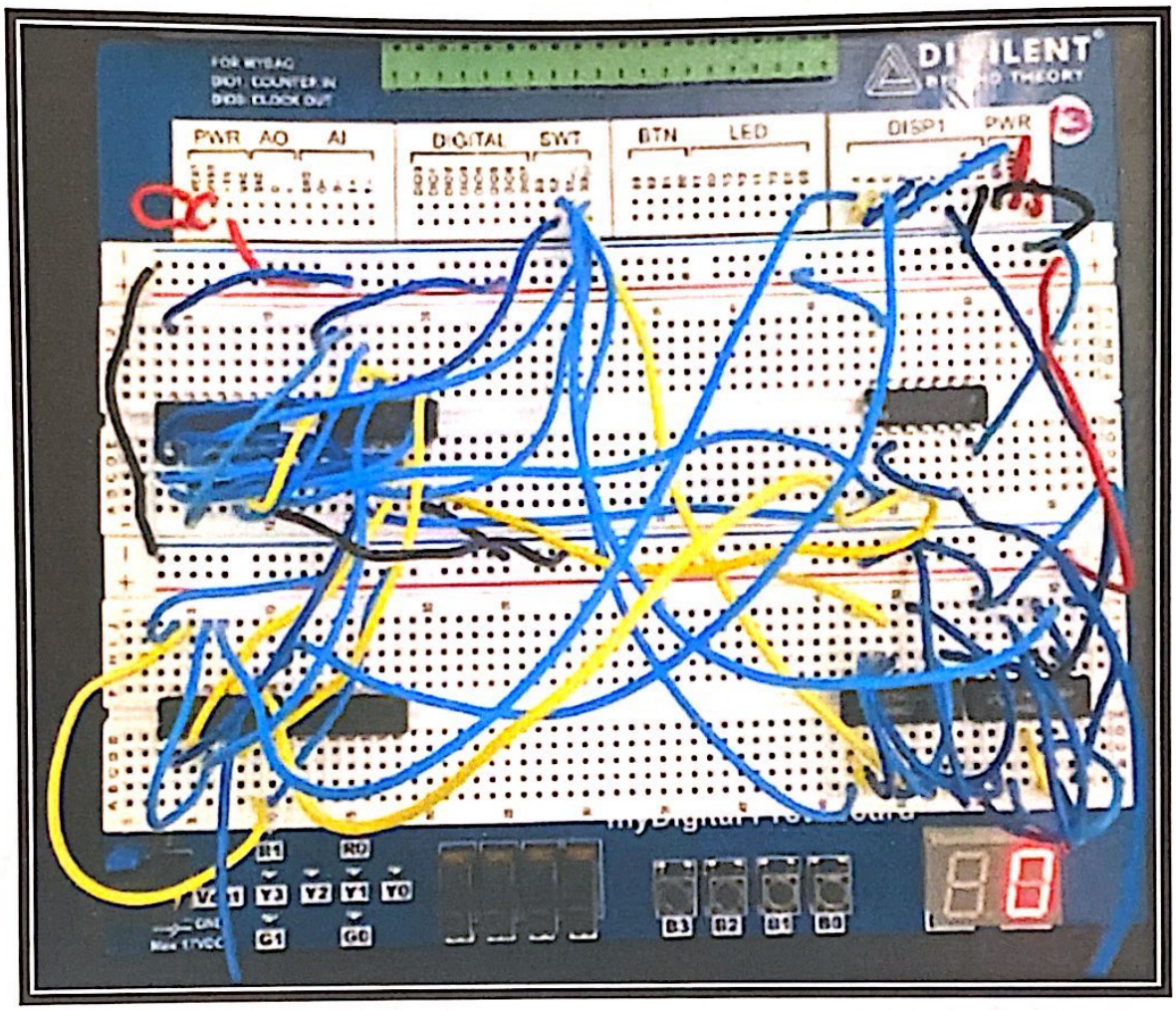
Evidence of Working Design – Breadboard Circuit

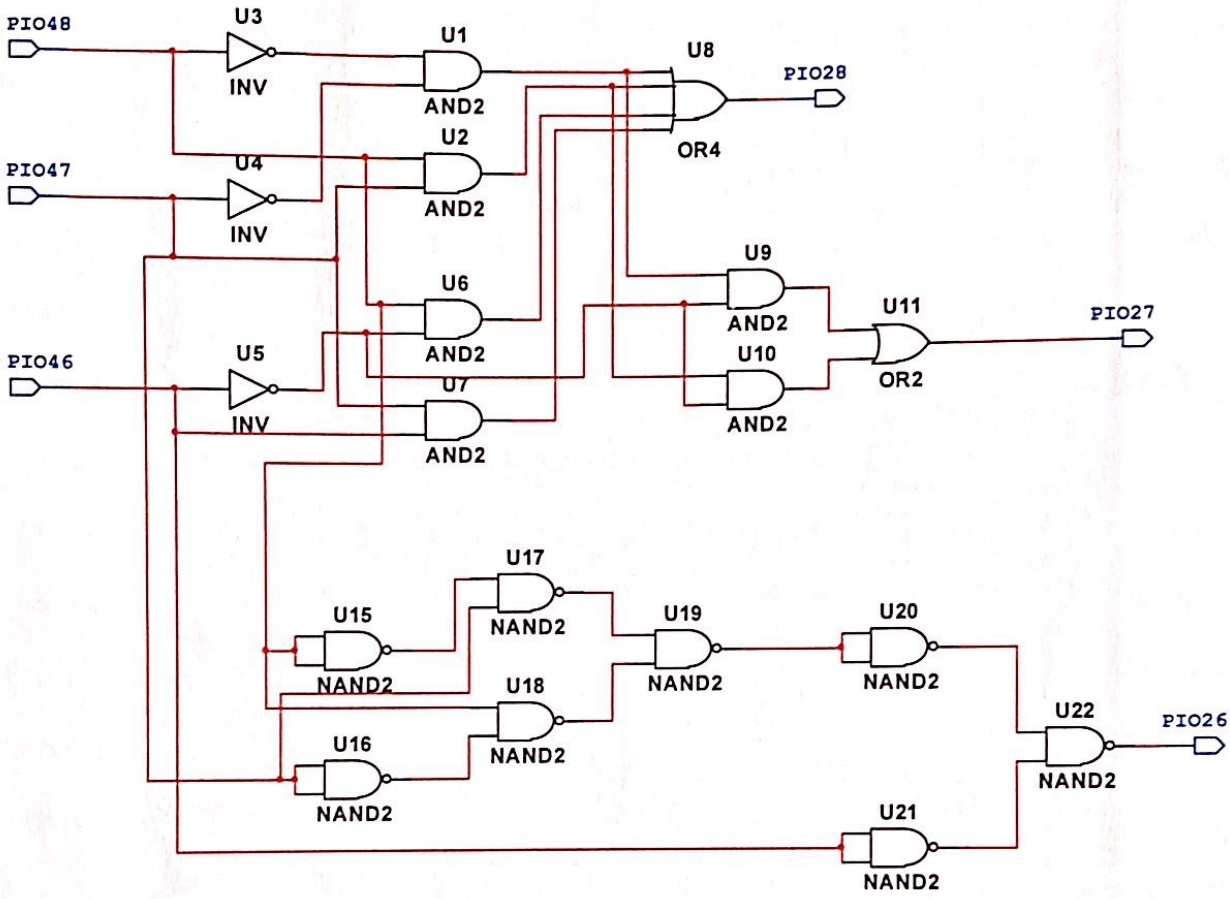


The AOI+NAND circuit built on breadboard

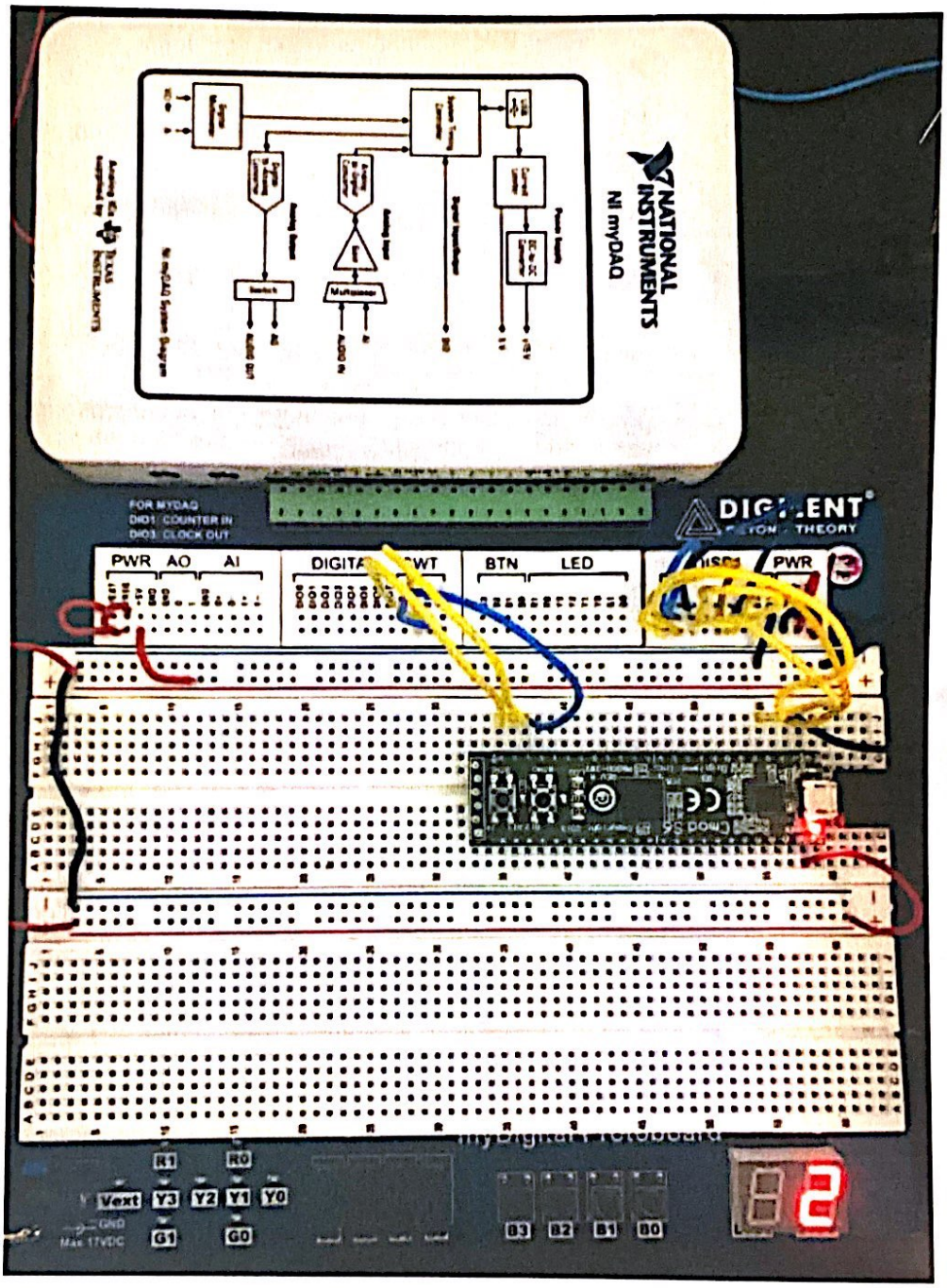
Conclusion

The Birthday project was overall a great project that enhanced and strengthened students understanding in Digital electronics. Students worked with AOI, NAND and NOR gates. The students were to design, test and build a combinational circuit that displays your birthday on a 7-segment display in sequential order with dashes (-) between the month, day and year. The first thing students did was writing the design brief in their Engineering Notebook. Next, they truth table for each segment of their birthdays. There were seven in total (a-g). They also created individual K-maps for each truth table. Luckily, I was granted with only three segments. This means that I only had to build three segments. The teacher soon realized that multiple students had very few segments. To solve this problem, the teacher forced students to create NAND and/or NOR circuit. The students made sure their circuit's Boolean expression was simplified to simplest form and then went on to hand drawing the circuit in the Engineering Notebook. After doing this, they went on Multisim and built their circuit. They simulated and fixed errors with their original sketch. After making sure that their circuit was working and displaying the number, they started building the circuit on a Breadboard. Just like always, the students had many errors with the breadboard. Students ICs were popping out like unusual and they were wiring wrong in general. Some did not connect the POWER and GND. When the circuits were working, the students were filled with joy because it was an individual project and everyone had a different birthdate. Overall, this project was very fun and it helped students get better at AOI, NAND and NOR gates. I personally found this project very easy because I had the least segments out of my class but it was a challenge for few in my class. I would love to do more of these fun little projects in the near future.

Appendix



The Date of Birth PLD design



The Date of birth circuit built on breadboard using CMOD S6

Summary

The strategy used to recreate the Date of birth design in PLD (Programmable Logic Device) design mode was to go on Multisim and switching to PLD mode and then selecting the inputs and output pins and wiring it like usual. Students were to simplify their circuit using more than two input gates. The shortcut some students took during the process of building this circuit was simplifying more than two input gates into one gate that has multiple input pins. After creating the circuit on PLD mode, students were to transfer the program to the CMOD S6 chip. Few advantages of implementing combination logic design with programmable logic are as follows, it takes less time when wiring, the circuit is way smaller comparing to when using ICs and over all, it can store more data than a AOI or NAND, NOR ICs. PLD also has disadvantages. For example, every time you reconnect the CMOD S6 with the power, it loses the program and it needs to be programmed again. However, PLD is preferably the best choice when wiring complicated long circuit .