LAB 2

Laboratory Report for CS 2420

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*Abstract* – This lab assignment served as an introduction to the different types of logic chips found on the NI Elvis board. I wired circuits with three different chips, measured their input using a truth tables and determined their logical function based on the results of the truth tables. Using these results I isolated the chip capable of the nand function and used it to create a slightly more complex logical function involving three inputs.

# Introduction

Understanding the logical functions produced by each chip and how to manipulate these functions is a vital skill to electrical engineering and digital logic. In order to build more complex functions, one must understand the logical stepping stones of and, or, & nand. Because every logical equation involving “and” and “or” can also be equivalently expressed using only “nand” gates, this is the logical chip I used to create the slightly more complex logical function towards the end of the lab assignment.

# Experimental Method

To begin the project, I located the 7432 chip on my Elvis board. I wired power (5v) to the chip and made sure to connect the ground wire. I then connected DIO 0 to input gate 1 and DIO 2 into input gate 2. I then connected the output gate to DIO 8 to record the results from the input. I then input the various possible combinations (hi/lo) for each input and recorded the results in a truth table. I then used that truth table to determine the logical function of the chip.

I repeated this process for two more chips, recording their results.

Finally, I created a relatively simple logic gate representing the expression “xy’ + z” using only nand gates. I recorded the results in a truth table and used that to determine the validity of my logical function.

# Results

First, in order to test the functionality of the DIO connections, I filled out the following truth table:

|  |  |  |  |
| --- | --- | --- | --- |
| Input | | Output (hi/lo) | |
| DIO 1 | DIO 0 | DIO 9 | DIO 8 |
| Lo | lo | off | Off |
| Lo | Hi | Off | On |
| Hi | Lo | On | Off |
| Hi | Hi | On | on |

Because the DIO produced the correct results, I moved on to testing the 7432 chip located on my board. I connected power and ground to the chip and used DIO 0 and DIO1 as inputs and recorded the following results on DIO 8:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DIO 1 | DIO 0 | DIO 8 | X | Y | Out(i/o) |
| lo | lo | lo | 0 | 0 | 0 |
| lo | hi | hi | 0 | 1 | 1 |
| hi | lo | hi | 1 | 0 | 1 |
| hi | hi | hi | 1 | 1 | 1 |

According to these results, this is a quad 2-input OR gate chip.

I then repeated the procedure using the 7408 logic chip located on my Elvis board. This produced the following results:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DIO 1 | DIO 0 | DIO 8 | X | Y | Out(i/o) |
| lo | lo | lo | 0 | 0 | 0 |
| lo | hi | Lo | 0 | 1 | 0 |
| hi | lo | Lo | 1 | 0 | 0 |
| hi | hi | hi | 1 | 1 | 1 |

According to these results, this is a quad 2-input AND gate.

Finally, I repeated this procedure using the 7400 chip and produced the following results.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DIO 1 | DIO 0 | DIO 8 | X | Y | Out(i/o) |
| lo | lo | Hi | 0 | 0 | 1 |
| lo | hi | Hi | 0 | 1 | 1 |
| hi | lo | Hi | 1 | 0 | 1 |
| hi | hi | lo | 1 | 1 | 0 |

According to these results, this is a Quad 2-input NAND gate chip.

The simple expression we were asked to create using only nand gates is xy’ + z.

By negation the expression becomes- (xy’ +z)’’

By distribution – ((xy’)’ \* z’)’

This equivalent expression ((xy’)’ \* z’)’ can be implemented using only NAND gates. I have drawn a diagram of the logic gate that was implemented below.

X

Y

Z

I recorded the output of this logic gate below and was ensured that it was correct by my instructor.

|  |  |  |  |
| --- | --- | --- | --- |
| x | y | z | Output |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

# Conclusion

This lab served as an intro to the logic behind the common chips found on our Elvis boards. In order to build ever-increasingly complex circuits and functions, it is imperative that we understand the basic operations of the different logic chips. These are the foundations for the more complex functions. By testing the output of each chip with various input, I was able to ascertain the common language terms for each chip (and, or, nand).

# References

*No references were used (other than handouts) in the creation of this laboratory report.*