Title: Introduction to Characteristics of NAND and NOR Gates

Objectives

The objectives of this experiment are:

- To verify the input and output relationships/characteristics of 2-input NAND and NOR gates.

- To gain practical experience with integrated circuits (ICs) 7400 (NAND) and 7402 (NOR) and their pin configurations.

- To implement and test NAND and NOR gate circuits using a breadboard and laboratory equipment.

Introduction

NAND and NOR gates are universal logic gates, capable of implementing any logical function, making them essential in digital electronics. The NAND gate outputs a logic 0 only when all inputs are 1, otherwise outputting 1. The NOR gate outputs a logic 1 only when all inputs are 0, otherwise outputting 0. This experiment aims to verify the truth tables of these gates using the 7400 (NAND) and 7402 (NOR) ICs on the AT-700 Portable Analog/Digital Laboratory. By connecting data switches to inputs and observing outputs via LED lights, the experiment confirms the theoretical behavior of NAND and NOR gates and provides hands-on experience with digital circuit implementation.


Procedures

The experiment was conducted following these steps from the lab manual:

1. **Identify Pin Configurations**: Determined the correct input and output pin numbers for the 7400 (NAND) and 7402 (NOR) ICs using their data sheets.

2. **Setup Circuit on Breadboard**: Installed the components as shown in the circuit diagram (Fig. 2-1) on the AT-700 breadboard. Connected pin 14 of each IC to +5V and pin 7 to GND on the AT-700 power supply.

1

3. **Connect Inputs and Outputs**: Connected data switches "0" and "1" to points A and B of the circuit, respectively. Connected the LED light's pins "0" and "1" to the output points Y1 (NAND) and Y2 (NOR) of the circuit.

4. **Test Input Combinations**: Changed the data switches "0" and "1" between logic 0 and 1 positions to apply all possible input combinations (00, 01, 10, 11) for the NAND and NOR gates. Observed the LED light, where a lit LED indicated logic 1 and a dark LED indicated logic 0.

5. **Record Results**: Recorded the observed outputs in a truth table as specified in Truth Table 2-2.

Experiment Pictures
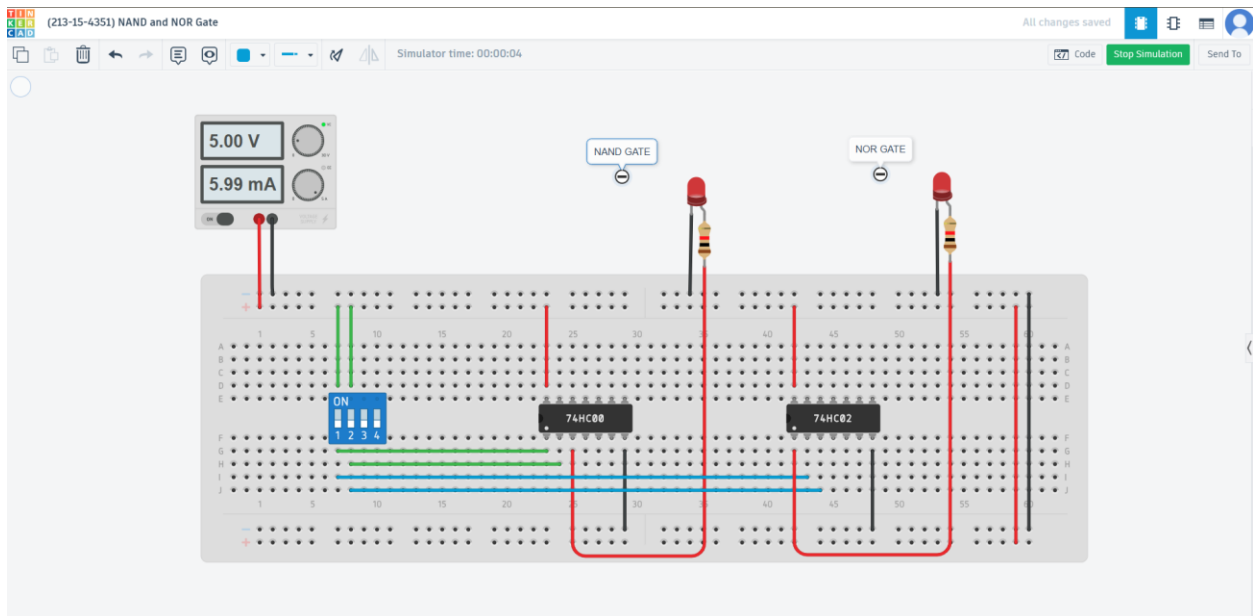
Tinkercad Link

NOR & NAND GATE:

https://www.tinkercad.com/things/0MnqIwbwsXs-213-15-4351-nand-and-nor-gate?sharecode=EmcPIKpMkhjqmlvoqn-MHsEj7o2Kf_6OO6o0TJplHg0

Experimental Results

The experiment tested all possible input combinations for the NAND and NOR gates, with outputs observed on the LED light. The results are summarized in the following truth table:

NAND and NOR Gates (7400 and 7402)

A	B	Y1 (NAND)	Y2 (NOR)
0	0	1	1
0	1	1	0
1	0	1	0
1	1	0	0

The LED light showed a lit LED for logic 1 and a dark LED for logic 0, matching the expected outputs for each gate based on their theoretical behavior. For the NAND gate, the output was 0 only when both inputs were 1. For the NOR gate, the output was 1 only when both inputs were 0.

Conclusion

This experiment successfully verified the input-output relationships of the 2-input NAND and NOR gates using the 7400 and 7402 ICs, respectively. The observed results in the truth table matched the expected behavior: the NAND gate outputs 1 unless both inputs are 1, and the NOR gate outputs 1 only when both inputs are 0. The practical setup on the AT-700 breadboard provided valuable experience in working with IC pin configurations, breadboard wiring, and digital circuit testing. This experiment reinforced the understanding of universal logic gates and their significance in digital electronics, laying the groundwork for more complex circuit designs.