Title: Design and Implementation of Multiplexers

Objectives

- Design and implement a 2-to-1 multiplexer circuit using logic gates.
- Design and implement a 4-to-1 multiplexer circuit using 2-to-1 multiplexers.
- Verify the input-output relationships of both circuits by observing the output with an LED light.
- Record and validate the results using truth tables.

Introduction

Multiplexers are key components in digital electronics, used to select one of multiple input signals and route it to a single output based on selector inputs. A 2-to-1 multiplexer (MUX) selects between two inputs using one selector line, while a 4-to-1 multiplexer selects among four inputs using two selector lines. This experiment, conducted as part of CSE 213 at Daffodil International University, aimed to design and implement a 2-to-1 multiplexer using basic logic gates (AND, OR, NOT) and extend this to a 4-to-1 multiplexer using 2-to-1 multiplexers on an AT-700 portable laboratory breadboard. The input-output relationships were verified by observing the output on an LED light and constructing truth tables.

Procedures

2-to-1 Multiplexer

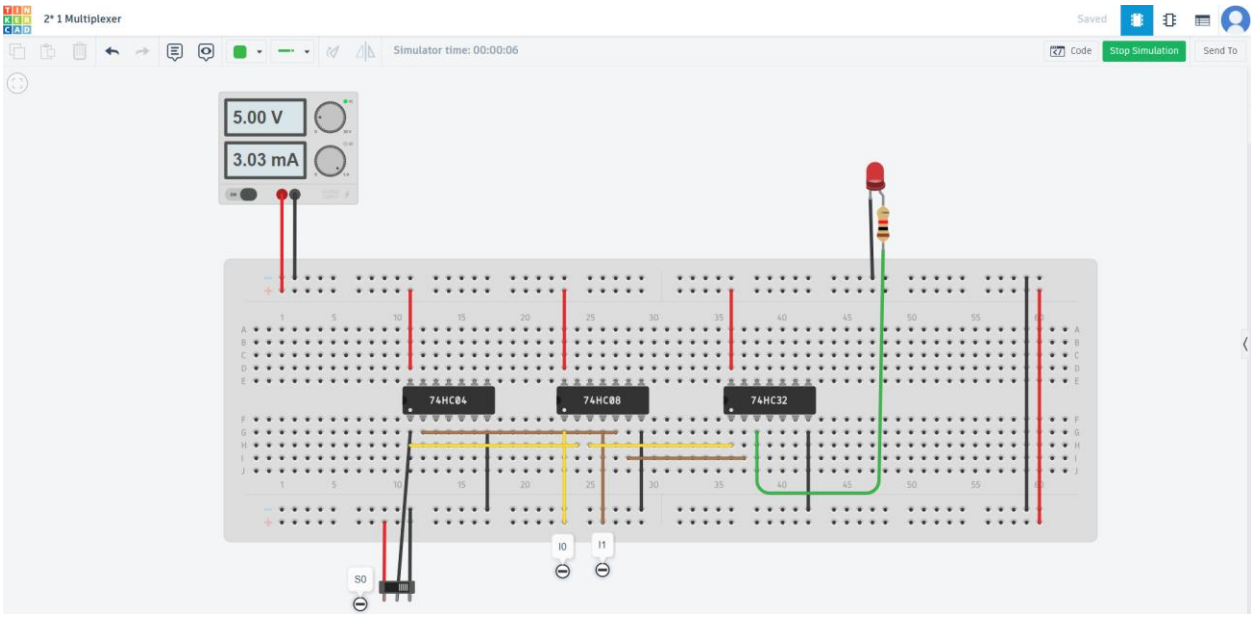
1. Identified pin configurations for ICs 7404 (NOT), 7408 (AND), and 7432 (OR) using their datasheets.
2. Installed components for the 2-to-1 multiplexer circuit (as per Fig. 10-1 from the lab manual) on the AT-700 breadboard. Connected pin 14 of each IC to +5V and pin 7 to GND.
3. Connected data switches "0", "1", and "2" to inputs S (selector), W0, and W1 of the multiplexer circuit, respectively.
4. Connected the output (f) to the LED light pin "0" through a 220-ohm resistor.
5. Changed data switches "0", "1", and "2" between "0" and "1" positions to test all input combinations and observed the LED light. An illuminated LED indicated Logic 1, and a dark LED indicated Logic 0.
6. Recorded the results in the truth table for the 2-to-1 multiplexer.

4-to-1 Multiplexer

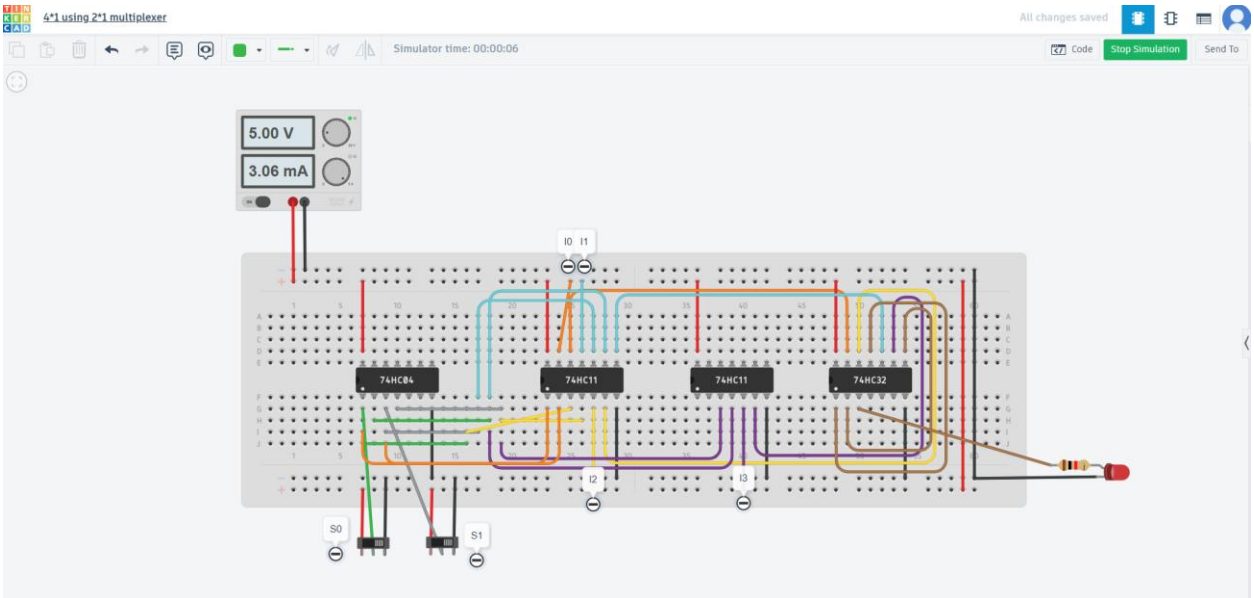
1. Installed components for the 4-to-1 multiplexer circuit (as per Fig. 10-2 from the lab manual) on the AT-700 breadboard, ensuring proper connections to +5V (pin 14) and GND (pin 7) for each IC.
2. Connected data switches to inputs S0, S1 (selector lines), and I0, I1, I2, I3 (data inputs) of the 4-to-1 multiplexer circuit.
3. Connected the output (f) to the LED light pin "0" through a 220-ohm resistor.
4. Changed data switches between "0" and "1" positions to test all input combinations and observed the LED light. An illuminated LED indicated Logic 1, and a dark LED indicated Logic 0.
5. Recorded the results in the truth table for the 4-to-1 multiplexer.

Experimental Pictures

- **2-to-1 Multiplexer Circuit**:



- **4-to-1 Multiplexer Circuit**:



Tinkercad Link

- **2-to-1 Multiplexer Circuit:** https://www.tinkercad.com/things/0CP5of1qcAL-2-1-multiplexer?sharecode=urY_RFLijVvg7KLyko5lp_TLxU36q_tJPBbS8Z7NQKo
- **4-to-1 Multiplexer using 2-to-1 multiplexers Circuit:** https://www.tinkercad.com/things/fYOsuMdEXrY-41-using-21-multiplexer?sharecode=Mw2Ke0F34YO_spr3UQBGWWebAItXNCaFUNmMuhbGC98

Experimental Results

The truth tables below summarize the observed input-output relationships for the 2-to-1 and 4-to-1 multiplexer circuits.

Truth Table for 2-to-1 Multiplexer

Selection Line(S)	Output(Y)
0	0
1	1

Truth Table for 4-to-1 Multiplexer

Selection Line(S1)	Selection Line(S0)	Output(Y)
0	0	I0
0	1	I1
1	0	I2
1	1	I3

Conclusion

The experiment successfully demonstrated the design and implementation of a 2-to-1 multiplexer and a 4-to-1 multiplexer using logic gates on the AT-700 portable laboratory. The 2-to-1 multiplexer correctly selected between two inputs based on a single selector line, and the 4-to-1 multiplexer extended this by selecting among four inputs using two selector lines. The observed output, recorded via the LED light and truth tables, matched theoretical expectations, confirming the circuits' functionality. This experiment enhanced understanding of multiplexer design and the practical application of combinational logic circuits.