Title: Design and Implementation of Encoder and Decoder Circuits Using Logic Gates

Objectives

- Design and implement a 2-to-4 decoder circuit using logic gates.
- Design and implement a 4-to-2 encoder circuit using logic gates.
- Verify the input-output relationships of both circuits by constructing truth tables.
- Observe and record circuit outputs using an LED light.

Introduction

Decoders and encoders are fundamental components in digital electronics used for signal routing and data conversion. A 2-to-4 decoder converts a 2-bit binary input into one of four active outputs, while a 4-to-2 encoder converts one of four active inputs into a 2-bit binary output. This experiment, conducted as part of CSE 213 at Daffodil International University, aimed to design and implement these circuits using basic logic gates (AND, OR, NOT) on an AT-700 portable laboratory breadboard. The input-output relationships were verified by constructing truth tables and observing outputs on an LED light.

Procedures

2-to-4 Decoder

1. Identified pin configurations for ICs 7404 (NOT), 7408 (AND), and 7432 (OR) using their datasheets.
2. Installed components for the 2-to-4 decoder circuit (as per Fig. 8-2(a) 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" and "1" to inputs A and B of the decoder circuit.
4. Connected the four outputs (Y0, Y1, Y2, Y3) to the LED light pins "0" to "3" through 220-ohm resistors.
5. Applied all possible input combinations (00, 01, 10, 11) using the data switches and observed the LED light. An illuminated LED indicated Logic 1, and a dark LED indicated Logic 0.

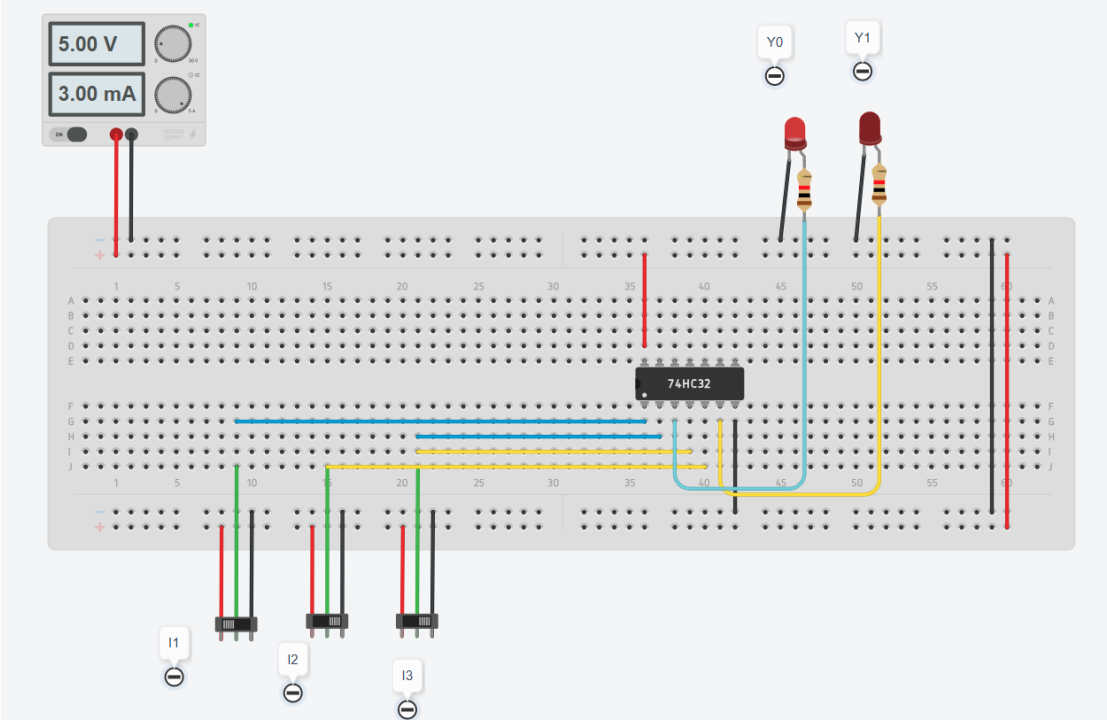
6. Recorded the results in the truth table for the 2-to-4 decoder.

4-to-2 Encoder

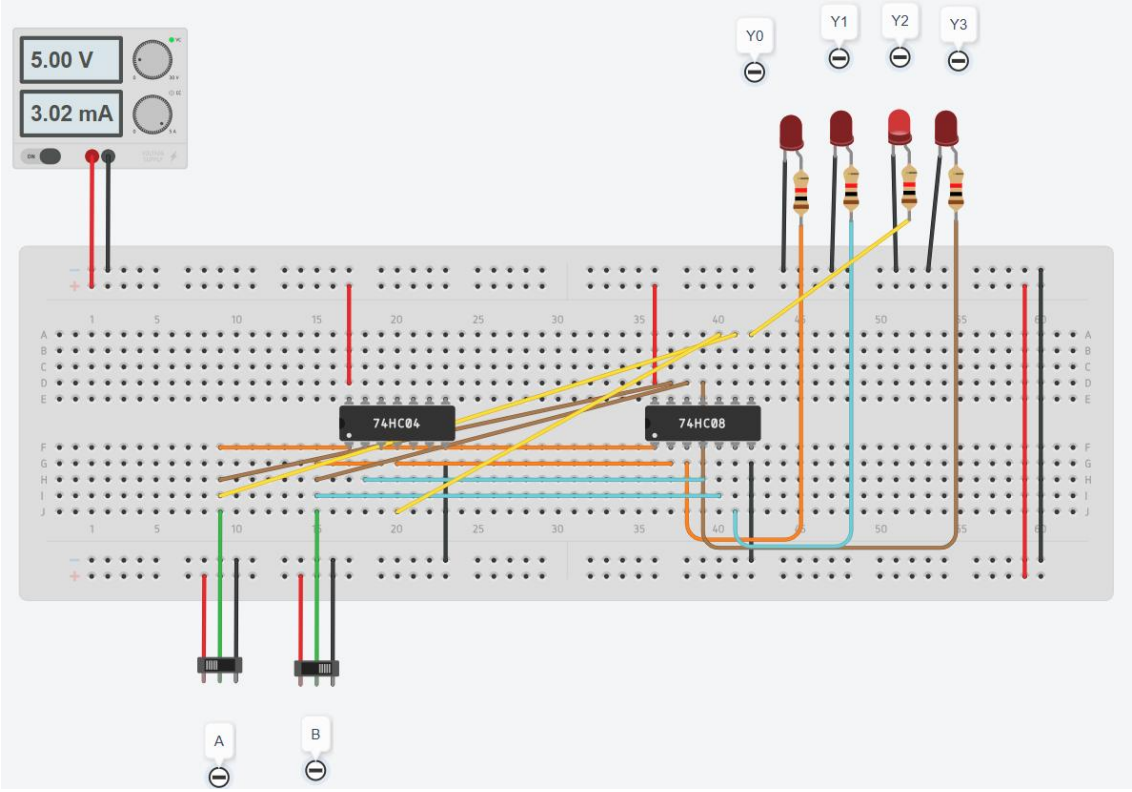
1. Installed components for the 4-to-2 encoder circuit (as per Fig. 8-2(b) from the lab manual) on the AT-700 breadboard, ensuring proper connections to +5V (pin 14) and GND (pin 7) for each IC.
2. Connected data switches "0", "1", "2", and "3" to inputs W0, W1, W2, and W3 of the encoder circuit.
3. Connected the two outputs (Y0, Y1) to the LED light pins "0" and "1" through 220-ohm resistors.
4. Activated one input at a time (setting one switch to "1" while others were "0") and observed the LED light outputs.
5. Recorded the results in the truth table for the 4-to-2 encoder.

Experimental Pictures

Encoder Circuit



Decoder Circuit



Tinkercad Link

Encoder Circuit: https://www.tinkercad.com/things/keyRCd1U5hV-213-15-4351encoder?sharecode=5axfQSwpgZn5Yd4x54N75okFJU1AckHzuuWOTPQm2wk

Decoder Circuit: https://www.tinkercad.com/things/6xUh0OJUbAp-213-15-4351decoder?sharecode=sJUvGItBmW-i3QmLeGWc8cY5CEpC1XiXsdzqXIpUw-g

Experimental Results

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

Truth Table for 2-to-4 Decoder

A	B	Y0	Y1	Y2	Y3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Truth Table for 4-to-2 Encoder

W0	W1	W2	W3	Y0	Y1
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Conclusion

The experiment successfully demonstrated the design and implementation of a 2-to-4 decoder and a 4-to-2 encoder using logic gates on the AT-700 portable laboratory. The truth tables confirmed the expected input-output relationships, with the decoder activating one of four outputs based on a 2-bit input and the encoder producing a 2-bit output from one of four active inputs. The experiment reinforced practical skills in constructing and testing combinational logic circuits, highlighting the importance of precise wiring and power connections.