MULTIPLEXER AND DEMULTIPLEXER

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ROLL NO.: 2025102061

TABLE NO.: 13

GROUP: G9

EXPERIMENT 4 – PART A: 4:1 Multiplexer

Aim:

To design, assemble, and test a 4-to-1 Multiplexer using basic logic gates, and verify its function by selecting one of four inputs based on the two select lines.

Components Required:

1. Digital Test Kit or Arduino
2. Breadboard
3. Connecting wires
4. IC 74HC04 (Inverter)
5. IC 74HC11 (AND gate)
6. IC 74HC32 (OR gate)
7. LEDs for output visualization

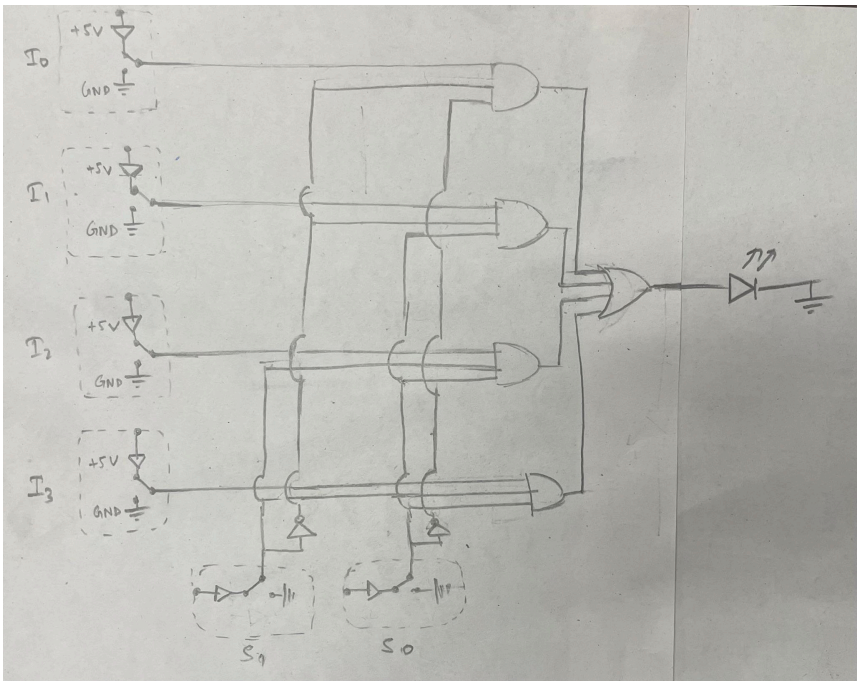
Circuit Implementation:

A 4-to-1 Multiplexer selects one of the four inputs (I0 to I3) and forwards it to the output Y depending on the two select lines S0 and S1. The logic expression for the output is:

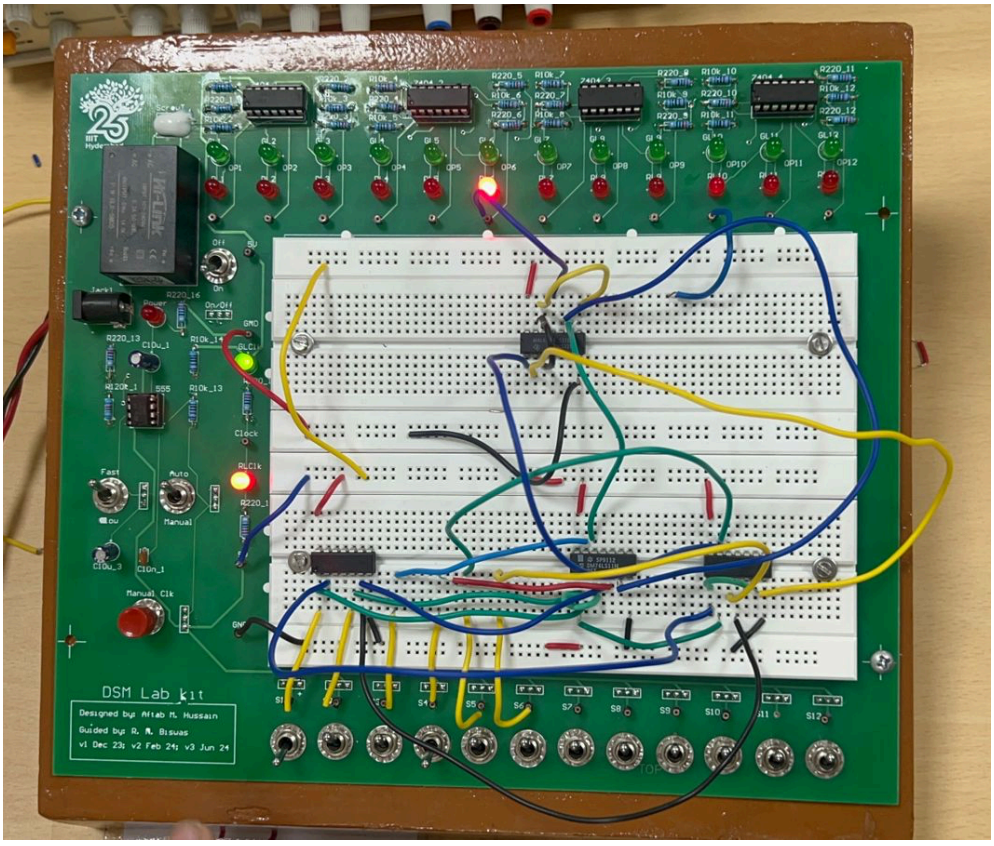
S1	S0	Output Y
0	0	I0
0	1	I1
1	0	I2
1	1	I3

Y = (I0)(S1)'(S0)' + (I1)(S1)'(S0) + (I2)(S1)(S0)' + (I3)(S1)(S0)

Reference Circuit:



Visual Circuit:



Procedure:

1. Write the Boolean expression from the truth table.
2. Assemble the circuit using the required ICs.
3. Provide power (VCC and GND) to the IC.
4. Connect inputs I0 to I3 and select lines S0, S1.
5. Use LEDs to observe output Y.
6. Test various combinations of inputs and select lines.
7. Record the observations.

Observation:

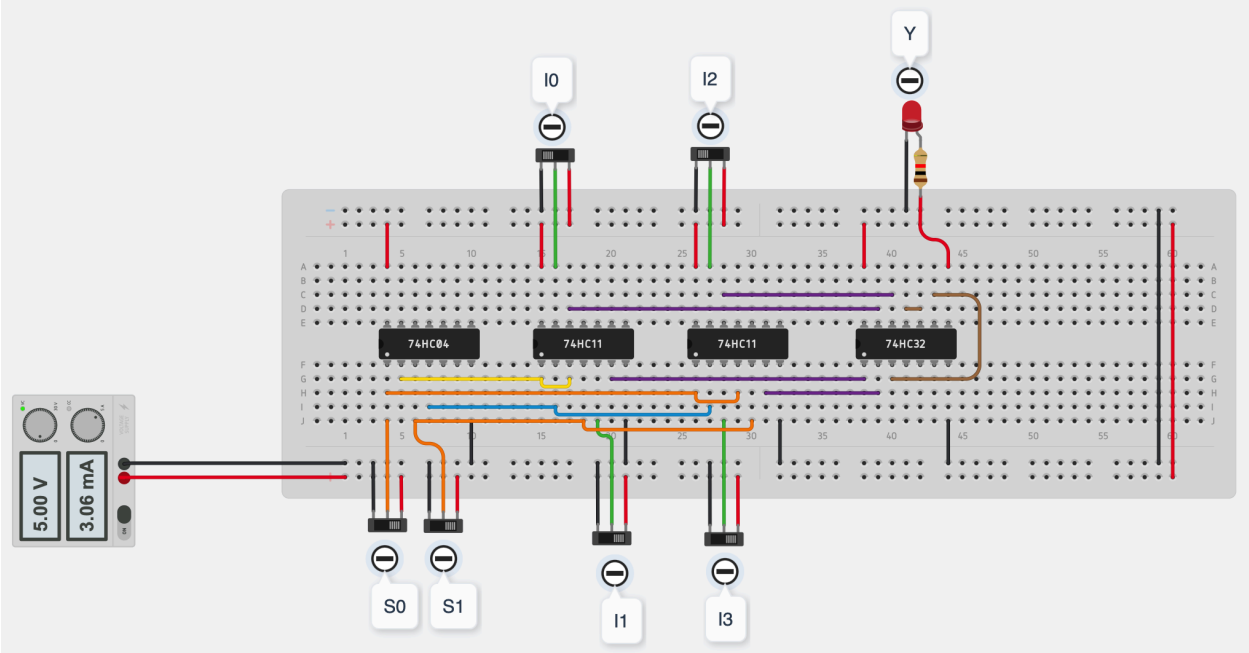
The experimental observations:
The output Y corresponds to the selected input based on the select lines. Only one input is routed to the output at a time.

Result and Analysis:

Hence, it is proven that:
i = I0 for S1 = 0 and S0 = 0
i = I1 for S1 = 0 and S0 = 1
i = I2 for S1 = 1 and S0 = 0
i = I3 for S1 = 1 and S0 = 1
The output i depends on the combination of select lines. For each case, only one input is routed to the output as expected. The experimental results matched the theoretical Boolean expression, confirming the correct operation of the 4:1 Multiplexer.

Circuit Simulation:

https://www.tinkercad.com/things/dEl0V3F7pm8-mux?sharecode=sjO8RNGUWapPC7Sp_0hjQVSCLDDliamckTZYihhqkng



EXPERIMENT 4 – PART B: 1:4 Demultiplexer

Aim:

To design, assemble, and test a 1-to-4 Demultiplexer using basic logic gates, and verify its function by routing a single input to one of four outputs based on the two select lines.

Components Required:

1. Digital Test Kit or Arduino
2. Breadboard
3. Connecting wires
4. IC 74HC04 (Inverter)
5. IC 74HC11 (AND gate)
6. LEDs for output visualization

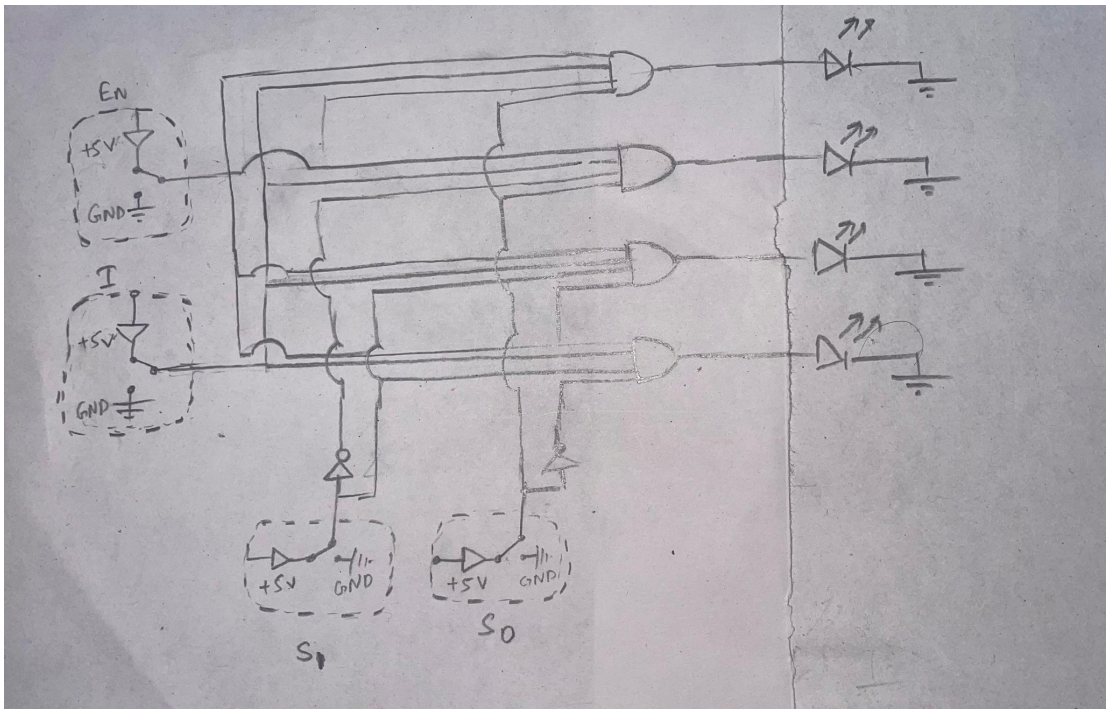
Circuit Implementation:

A 1-to-4 Demultiplexer routes one input signal (i) to one of four outputs (y0 to y3) depending on the select lines S0 and S1. The logic expressions are:

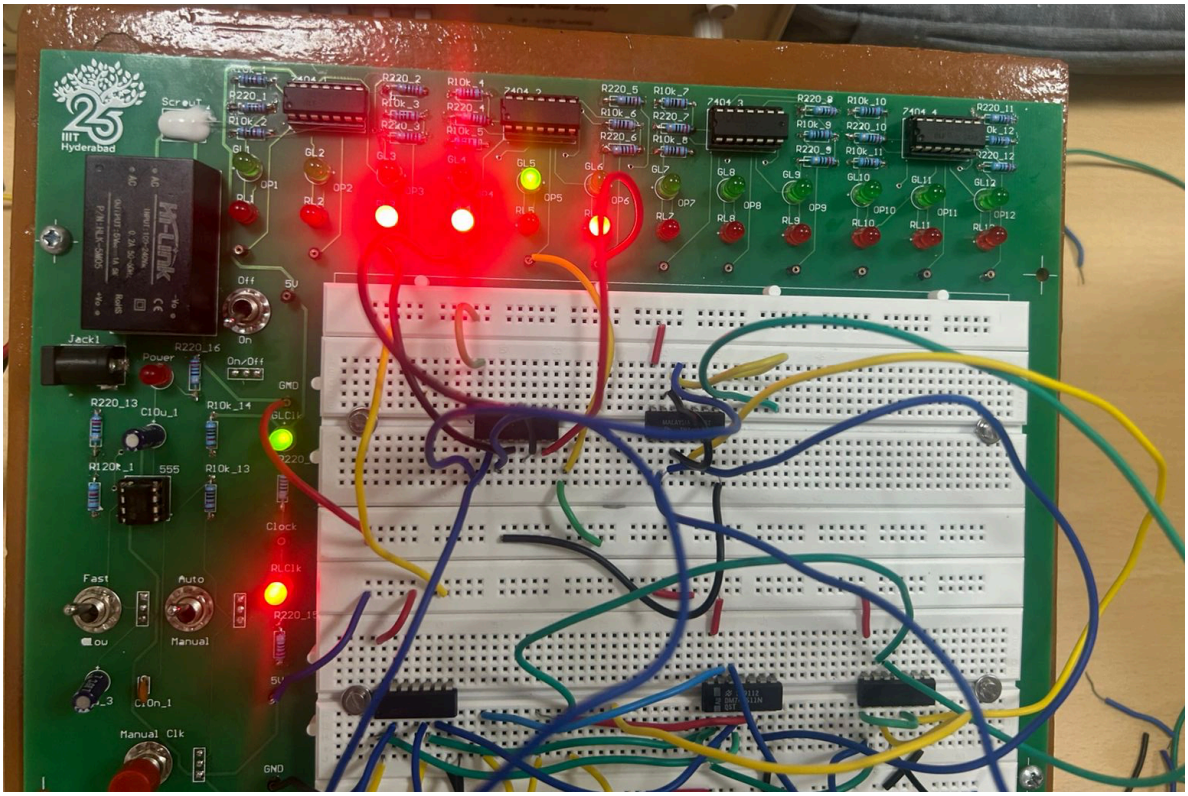
S1	S0	y3	y2	y1	y0
0	0	0	0	0	i
0	1	0	0	i	0
1	0	0	i	0	0
1	1	i	0	0	0

y0 = i(S1)’(S0)’
y1 = i(S1)’S0
y2 = iS1(S0)’
y3 = iS1S0

Reference Circuit:



Visual Circuit:



Procedure:

1. Derive the Boolean expressions.
2. Assemble the circuit using ICs.
3. Provide VCC and GND.
4. Connect input i and select lines S0, S1.
5. Use LEDs to observe outputs y0 to y3.
6. Apply different combinations of select lines and record the output.

Observation:

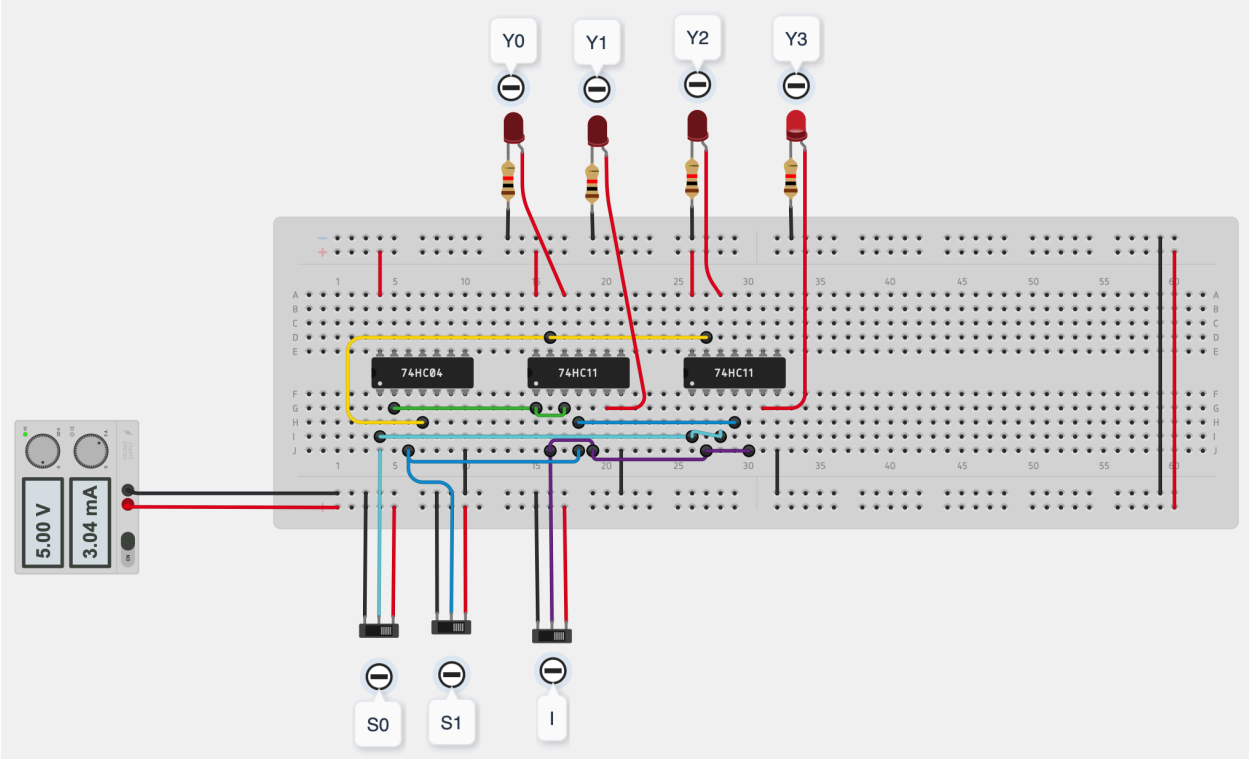
The experimental observations:
The input is routed to only one output at a time according to the select lines.
The correct LED glows as expected.

Result and Analysis:

Hence, it is proven that:
y0 = i for S1 = 0 and S0 = 0
y1 = i for S1 = 0 and S0 = 1
y2 = i for S1 = 1 and S0 = 0
y3 = i for S1 = 1 and S0 = 1
For each select line combination, the input i is routed to the correct output line while all other outputs remain inactive. The observed results are consistent with the theoretical expressions, validating the proper functioning of the 1:4 Demultiplexer.

Circuit Simulation:

https://www.tinkercad.com/things/7NmxDDGt51A-demux?sharecode=kyjIKYf2nAla4yWF5lOWOYKadR4J8PeN0r7CwvRbYwU



EXPERIMENT 4 – PART C: Integrated Testing (Multiplexer and Demultiplexer Combined)

Aim:

To integrate the 4:1 Multiplexer and 1:4 Demultiplexer circuits and test the signal routing by providing inputs through the multiplexer and observing the outputs at the demultiplexer.

Components Required:

1. Digital Test Kit or Arduino
2. Breadboard
3. Connecting wires
4. IC 74HC04 (Inverter)
5. IC 74HC11 (AND gate)
6. IC 74HC32 (OR gate)
7. LEDs for output visualization

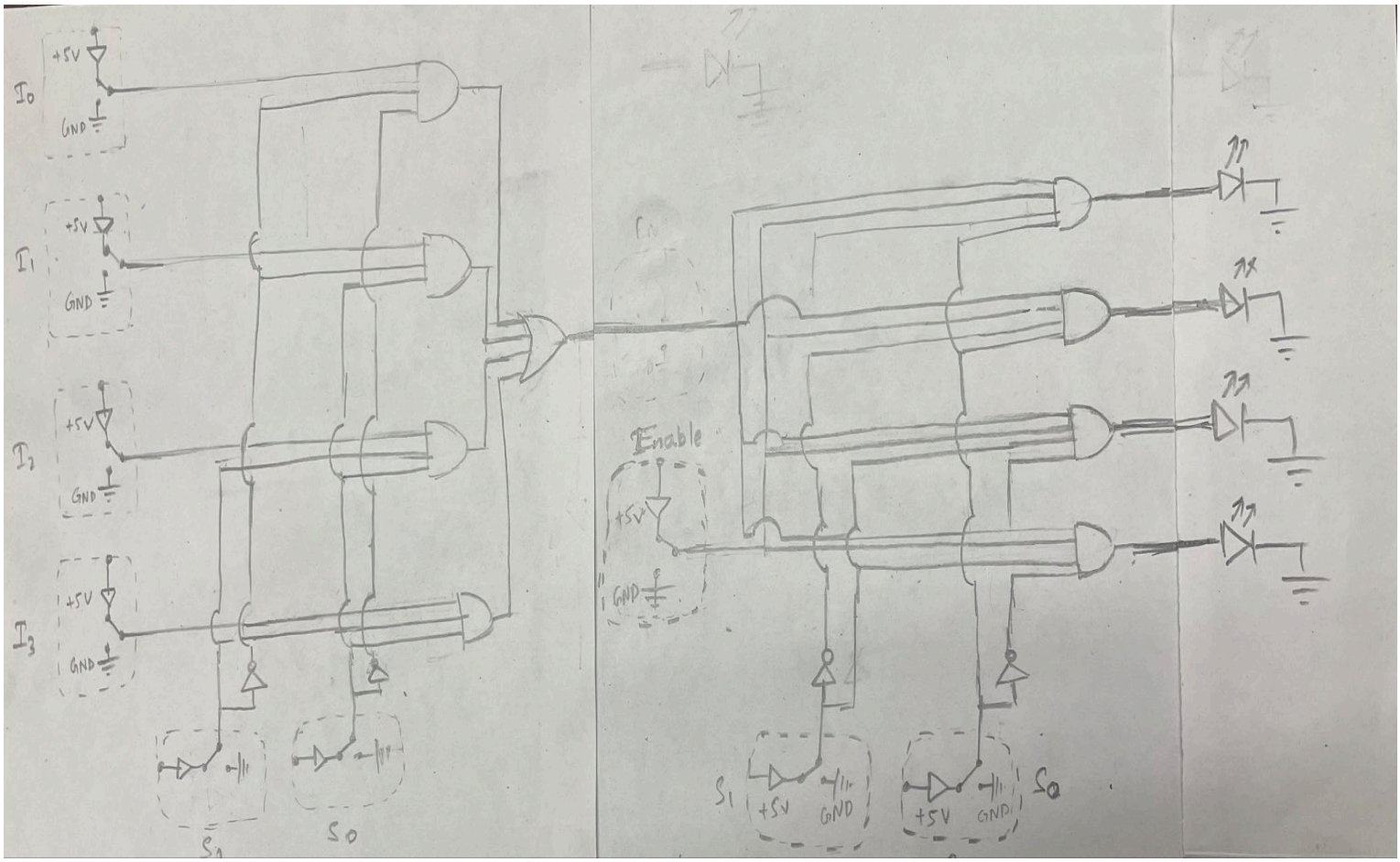
Circuit Implementation:

The output of the multiplexer is connected to the input of the demultiplexer. Both circuits share the same select lines. The input from the multiplexer is routed through the demultiplexer to the appropriate output.

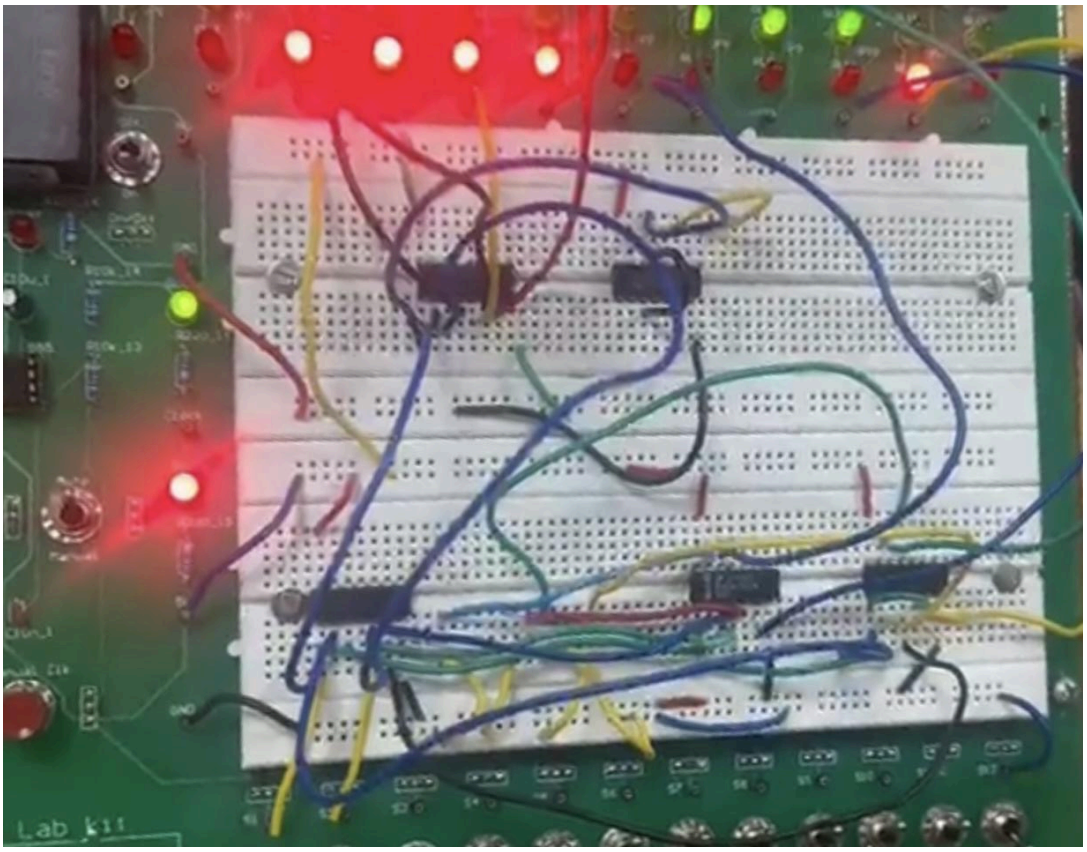
Select Line S1	Select Line S0	Multiplexer Selected Input	Demultiplexer Input	Active Output Line
0	0	I0	i	y0
0	1	I1	i	y1
1	0	I2	i	y2
1	1	I3	i	y3

i = (I0)(S1)'(S0)' + (I1)(S1)'(S0) + (I2)(S1)(S0)' + (I3)(S1)(S0)
y0 = i(S1)'(S0)'
y1 = i(S1)'S0
y2 = iS1(S0)'
y3 = iS1S0

Reference Circuit:



Visual Circuit:



Procedure:

1. Derive Boolean expressions for both circuits from the truth tables.
2. Assemble the multiplexer and demultiplexer circuits on a breadboard using the specified ICs.
3. Supply VCC and GND connections.
4. Provide inputs through switches or Arduino and connect output LEDs.
5. For the multiplexer, test how one of the four inputs is selected based on the select lines.
6. For the demultiplexer, test how the input `i` is routed to one of the outputs.
7. Record the output for various combinations of inputs and select lines.

Observation:

The experimental observations:

- In the **multiplexer**, the output `i` corresponds to one of the four inputs based on the select lines.
- In the **demultiplexer**, the input `i` is routed to only one output line depending on the select lines.
- The outputs matched the expected behavior according to the truth tables.

Result and Analysis:

Hence, it is proven that:
y0 = I0 for S1 = 0 and S0 = 0
y1 = I1 for S1 = 0 and S0 = 1
y2 = I2 for S1 = 1 and S0 = 0
y3 = I3 for S1 = 1 and S0 = 1

The output of the multiplexer is correctly routed through the demultiplexer to the appropriate output line depending on the select lines. For each combination of S1 and S0, the input from the selected multiplexer channel reaches the correct demultiplexer output. The observed results matched the theoretical expectation, confirming the successful integration of both circuits and their proper operation.

Circuit Simulation:

https://www.tinkercad.com/things/iCmHdncGhgl-mux-demux?sharecode=rLrvvydMfNMvk-1RN0upsdu0TKgSAAkmImcwYuVAkOI