Digital Electronics

Experiment 3

Name: Ayush Jain **SAP ID: 60004200132**

Div: B1 **Branch: Computer Engineering**

Aim:

To analyse the truth table of binary to gray and gray to binary converter using combination of NAND gates and to understand the working of binary to gray and gray to binary converter with the help of LEDs display.

Theory:

Binary Numbers is default way to store numbers. Gray code has property that two successive numbers differ in only one bit.

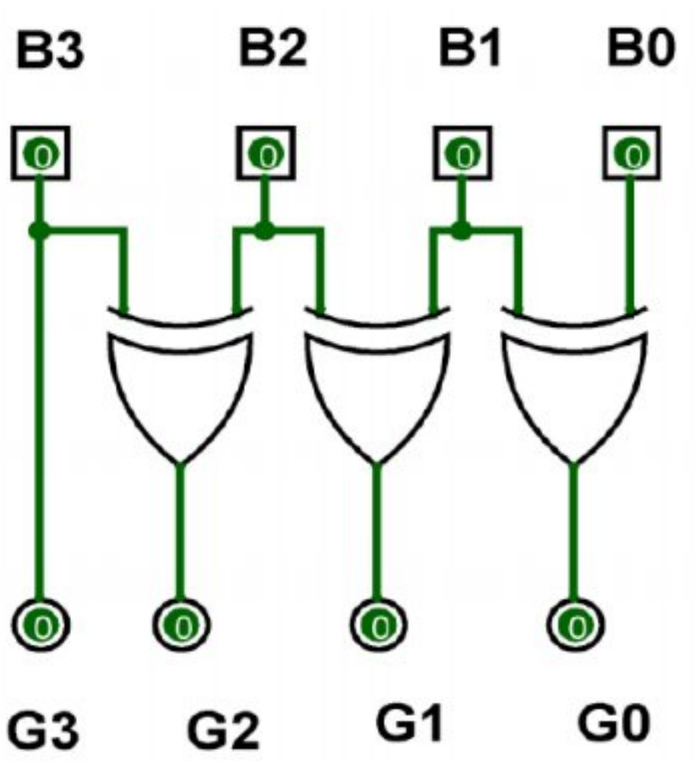
1) Binary to Gray conversion:

1. The Most Significant Bit (MSB) of the gray code is always equal to the MSB of the given binary code.

2. Other bits of the output gray code can be obtained by Ex-ORing binary code bit at that index and previous index.

There are four inputs and four outputs. The input variable are defined as B3, B2, B1, B0 and the output variables are defined as G3, G2, G1, G0. From the truth table, combinational circuit is designed.The logical expressions are defined as :

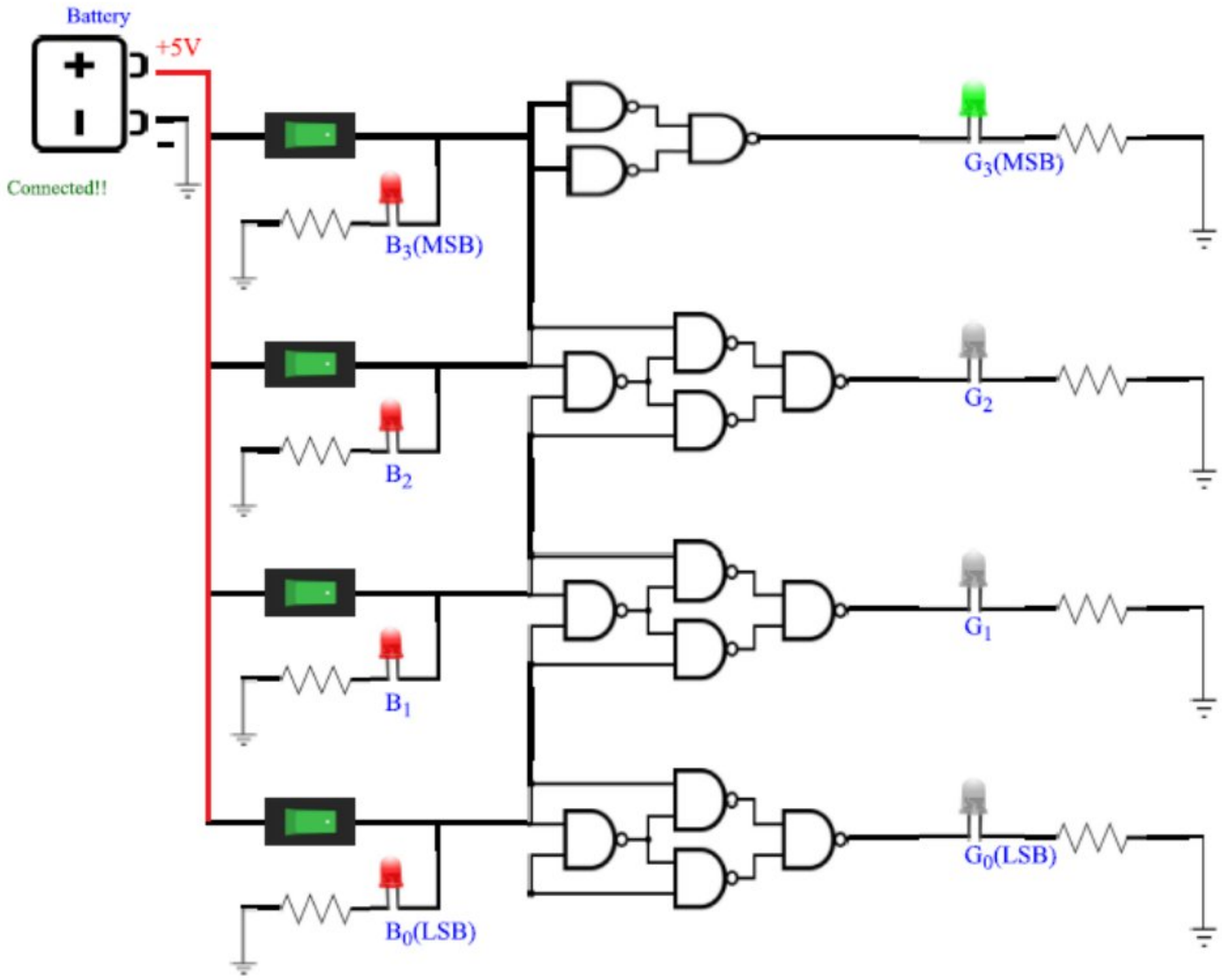
B3 = G3
B2 ⊕ B3 = G2
B1 ⊕ B2 = G1
B0 ⊕ B1 = G0



Natural-binary code				Gray code			
B3	B2	B1	B0	G3	G2	G1	G0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

Construction of Binary to Gray Converter using NAND gates only

Print

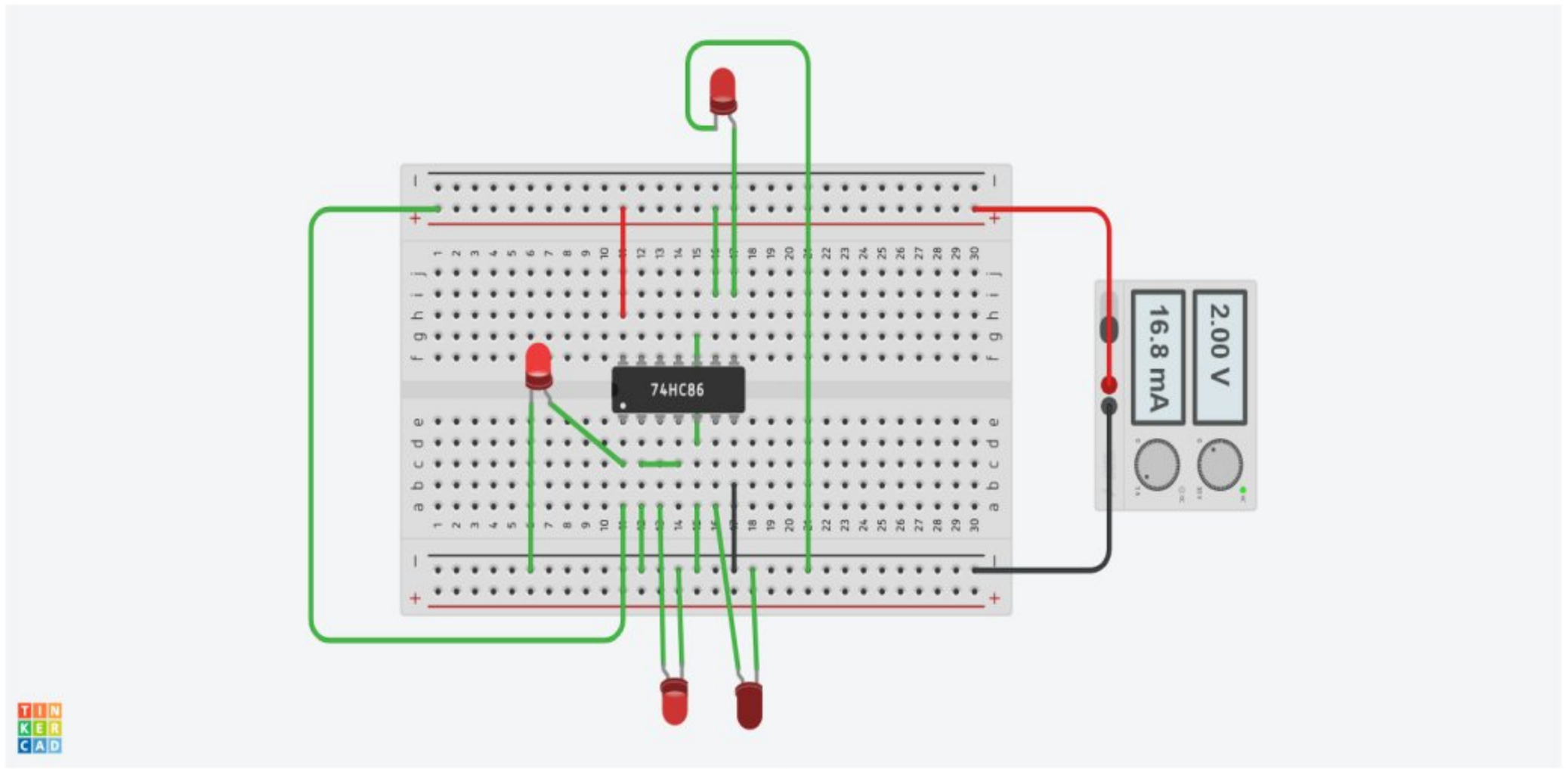


TRUTH TABLE

Add

Serial No.	Binary				Gray			
	B_3 (MSB)	B_2	B_1	B_0 (LSB)	G_3 (MSB)	G_2	G_1	G_0 (LSB)
1	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	1
3	0	0	1	0	0	0	1	1
4	0	0	1	1	0	0	1	0
5	0	1	0	0	0	1	1	0
6	0	1	0	1	0	1	1	1
7	0	1	1	0	0	1	0	1
8	0	1	1	1	0	1	0	0
9	1	0	0	0	1	1	0	0
10	1	0	0	1	1	1	0	1
11	1	0	1	0	1	1	1	1
12	1	0	1	1	1	1	1	0
13	1	1	0	0	1	0	1	0
14	1	1	0	1	1	0	1	1
15	1	1	1	0	1	0	0	1
16	1	1	1	1	1	0	0	0

Tinkercad:



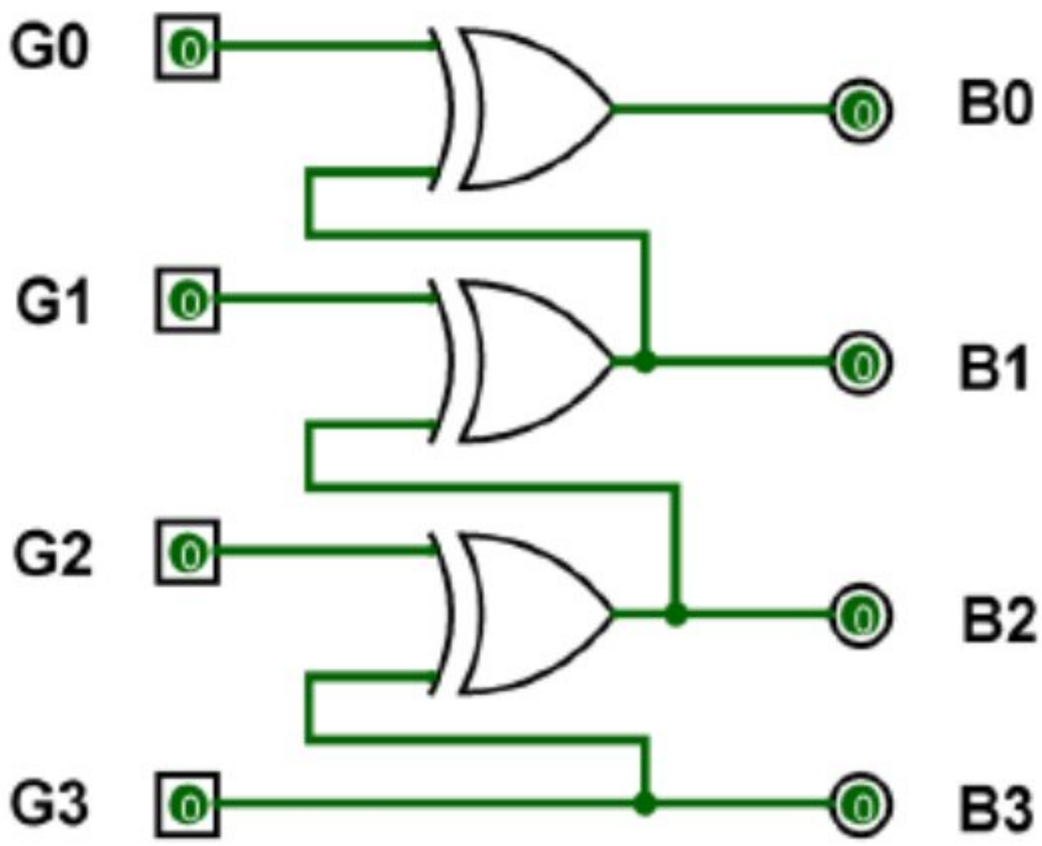
Binary 1001 (input) → Gray 1101 (output)

2) Gray to Binary conversion:

1.The Most Significant Bit (MSB) of the binary code is always equal to the MSB of the given binary number.
2.Other bits of the output binary code can be obtained by checking gray code bit at that index. If current gray code bit is 0, then copy previous binary code bit, else copy invert of previous binary code bit.

There are four inputs and four outputs. The input variable are defined as G3, G2, G1, G0 and the output variables are defined as B3, B2, B1, B0. From the truth table, combinational circuit is designed.The logical expressions are defined as :

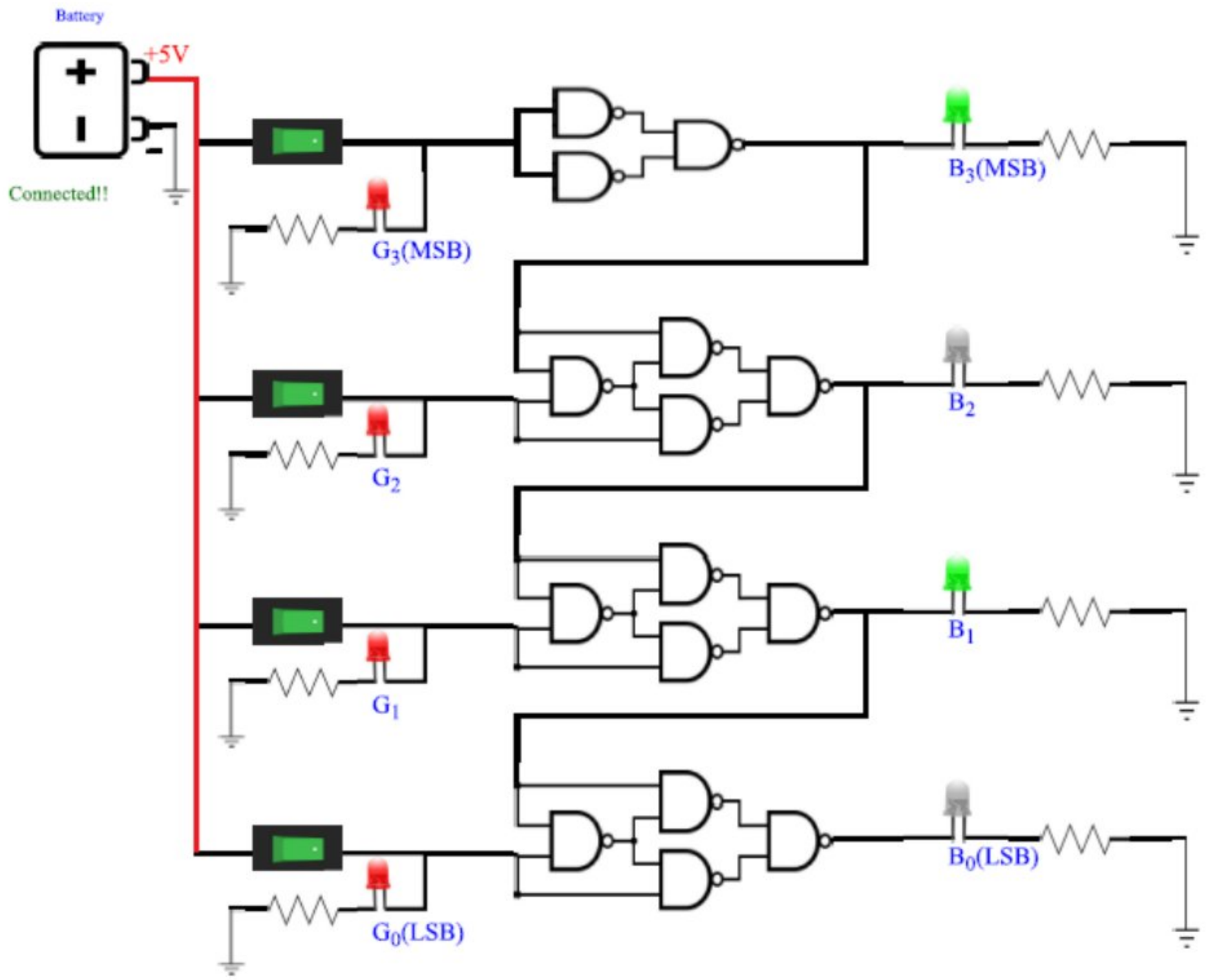
$G0 \oplus G1 \oplus G2 \oplus G3 = B0$
$G1 \oplus G2 \oplus G3 = B1$
$G2 \oplus G3 = B2$
$G3 = B3$



Gray code				Natural-binary code			
G3	G2	G1	G0	B3	B2	B1	B0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	1
1	0	0	0	1	1	1	1
1	0	0	1	1	1	1	0
1	0	1	0	1	1	0	0
1	0	1	1	1	1	0	1
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	1
1	1	1	0	1	0	1	1
1	1	1	1	1	0	1	0

Construction of Gray to Binary Converter using NAND gates only

Print

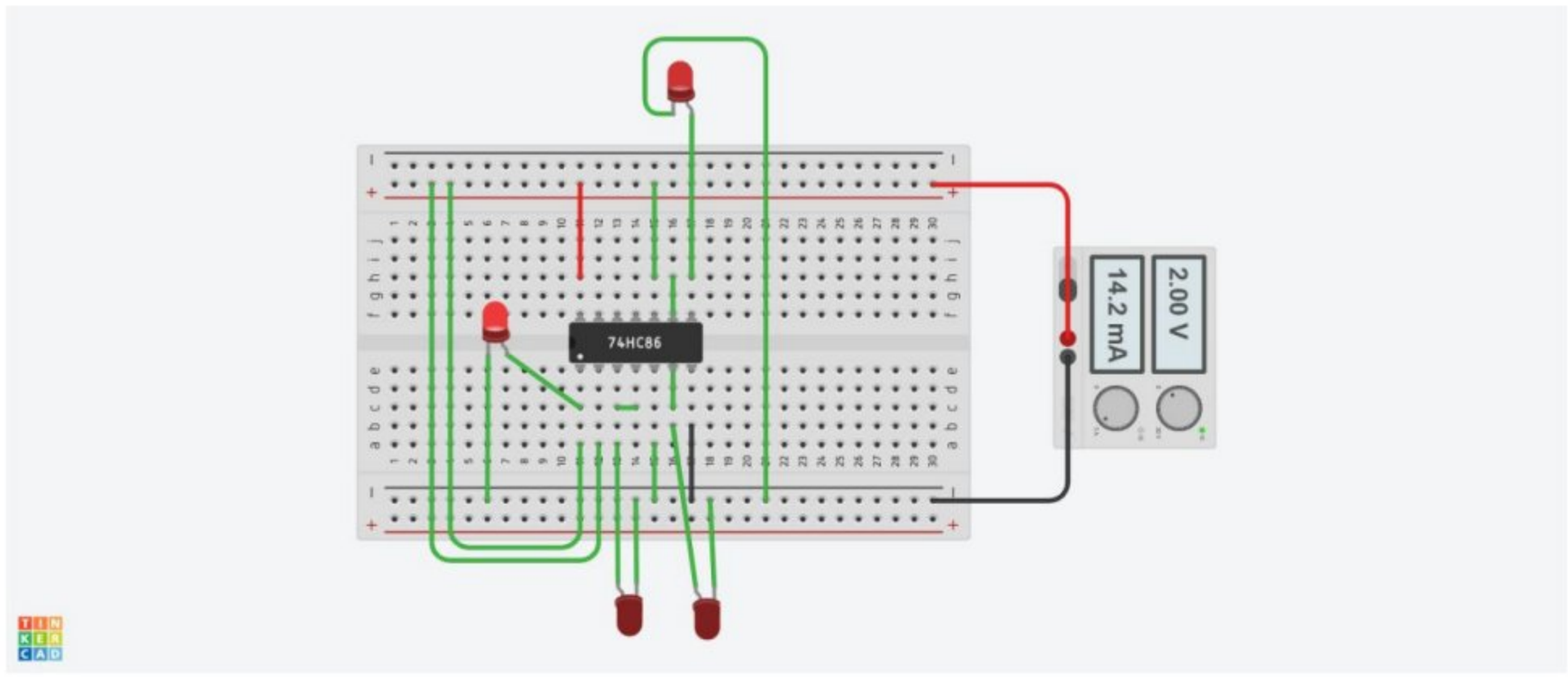


TRUTH TABLE

Add

Serial No.	Gray				Binary			
	G_3 (MSB)	G_2	G_1	G_0 (LSB)	B_3 (MSB)	B_2	B_1	B_0 (LSB)
1	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	1
3	0	0	1	0	0	0	1	1
4	0	0	1	1	0	0	1	0
5	0	1	0	0	0	1	1	1
6	0	1	0	1	0	1	1	0
7	0	1	1	0	0	1	0	0
8	0	1	1	1	0	1	0	1
9	1	0	0	0	1	1	1	1
10	1	0	0	1	1	1	1	0
11	1	0	1	0	1	1	0	0
12	1	0	1	1	1	1	0	1
13	1	1	0	0	1	0	0	0
14	1	1	0	1	1	0	0	1
15	1	1	1	1	1	0	1	0
16	1	1	1	0	1	0	1	1

Tinkercad:



Gray 1101 (input) → Binary 1001 (output)