EE 214: Digital Circuits Laboratory

LAB - 6

Roll No.: 200010003

- **<u>Aim</u>:** Realization, Design and Implementation of a given logic circuit using a *3:8 decoder* and suitable 2-input logic gates, and using minimum number of *2-input NAND gates.*

- **<u>Summary of the experiment</u>:**
    1. Creation and formulation of boolean expression and truth table for the given problem statement, in terms of outputs of a 3:8 decoder, and 2-input NAND gates.
    2. Design and Implementation of the logic circuit with the use of a 3:8 decoder, and suitable logic gates (NAND, OR)
    3. Design and Implementation of the logic circuit using only 2-input NAND gates.

- **<u>Problem Statement:</u>**
  An automobile alarm circuit is used to detect certain undesirable conditions. Three switches are used to indicate the status of the door (D), the ignition (IS), and the headlights (HS), respectively. The task is to design a logic circuit with these switches as inputs so that the alarm (A) will be activated only whenever either of the following conditions exists:
    (a) The headlights are ON while the ignition is OFF.
    (b) The door is open while the ignition is ON.

  Then, implement the above using:
    1. 3:8 decoder and suitable 2-input logic gates (active low)
    2. Minimum number of 2-input NAND gates

- **Components used:** DM74LS138 (3:8 decoder), IC7400 (NAND) , IC7432 (OR) , 1 kilo-ohm resistor array, DIP switches, LED displays, breadboard, conducting wires, power supply.

- **Design Procedure, Circuit Diagrams and Snapshots:**
  (attached below)

- **Results and Discussions:**
  1. We formed a boolean expression for the given logic problem. Then, we constructed a truth table for it and implemented it using a 3:8 decoder (and suitable logic gates, i.e. NAND and OR), and then using only NAND gates.
  2. The outputs from the decoder were active-low. So, two NAND gates and one OR gate were used to get the required logic expression from the decoder outputs, which are Y_1 , Y_5 , Y_6 and Y_7 .
  3. Since the given logic expression is of the form AB + CD, and only one of the variables is negated, we would need 4 NAND gates to construct the required logic circuit.

- **Conclusion:** We formulated and designed the given logic circuit, then proceeded to implement it using a 3:8 decoder (with suitable 2-input logic gates), and then using only 2-input NAND gates. The outputs obtained could then be verified using the constructed truth table.

Page No.
Date 04/02/2022

Lab-6

→ Design Procedure, Truth Table, and logic diagram

- Given variables: HS(headlights), D(door), IS(ignition), A(Alarm)
  [CLOSED/OFF = 0, OPEN/ON = 1]

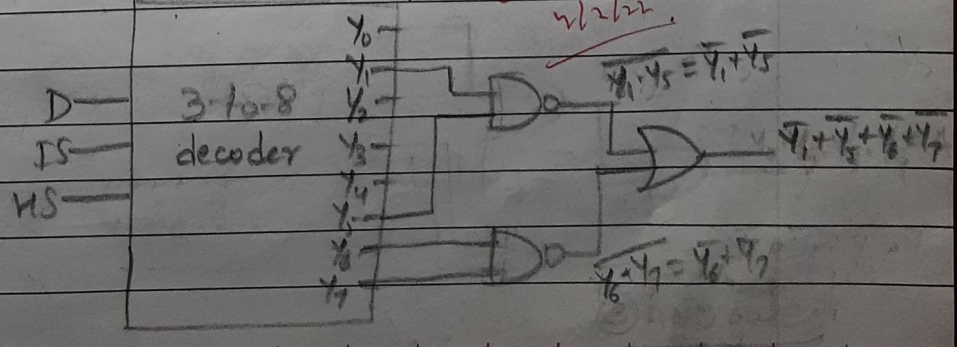
- Based on conditions given for alarm ON:-
  condition1: $HS \cdot \overline{IS}$ } $\Rightarrow A = HS \cdot \overline{IS} + D \cdot IS$
  condition2: $D \cdot IS$ }

- Truth table: (Enable = 1) For the negative logic 3-to-8 decoder.

D	IS	HS	A
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$Y_0 = D + IS + HS$
$Y_1 = D + IS + \overline{HS}$
$Y_2 = D + \overline{IS} + HS$
$Y_3 = D + \overline{IS} + \overline{HS}$
$Y_4 = \overline{D} + IS + HS$
$Y_5 = \overline{D} + IS + \overline{HS}$
$Y_6 = \overline{D} + \overline{IS} + HS$
$Y_7 = \overline{D} + \overline{IS} + \overline{HS}$

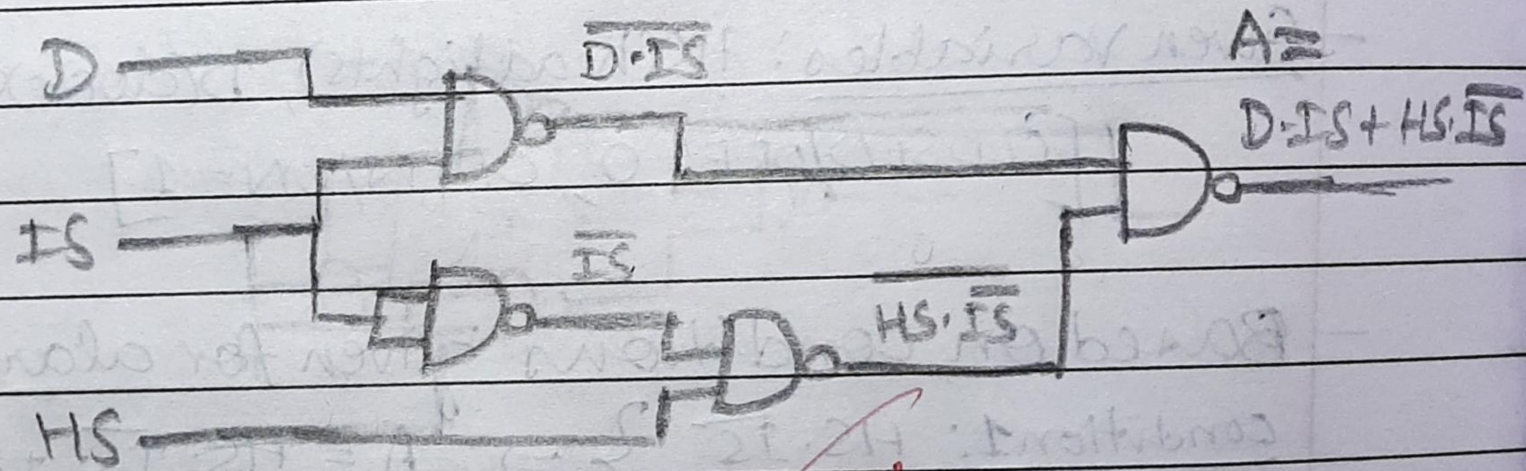
- Using a 3:8 decoder,
  $A = \overline{Y_1} + \overline{Y_5} + \overline{Y_6} + \overline{Y_7}$



Synopsis 4/2/22.

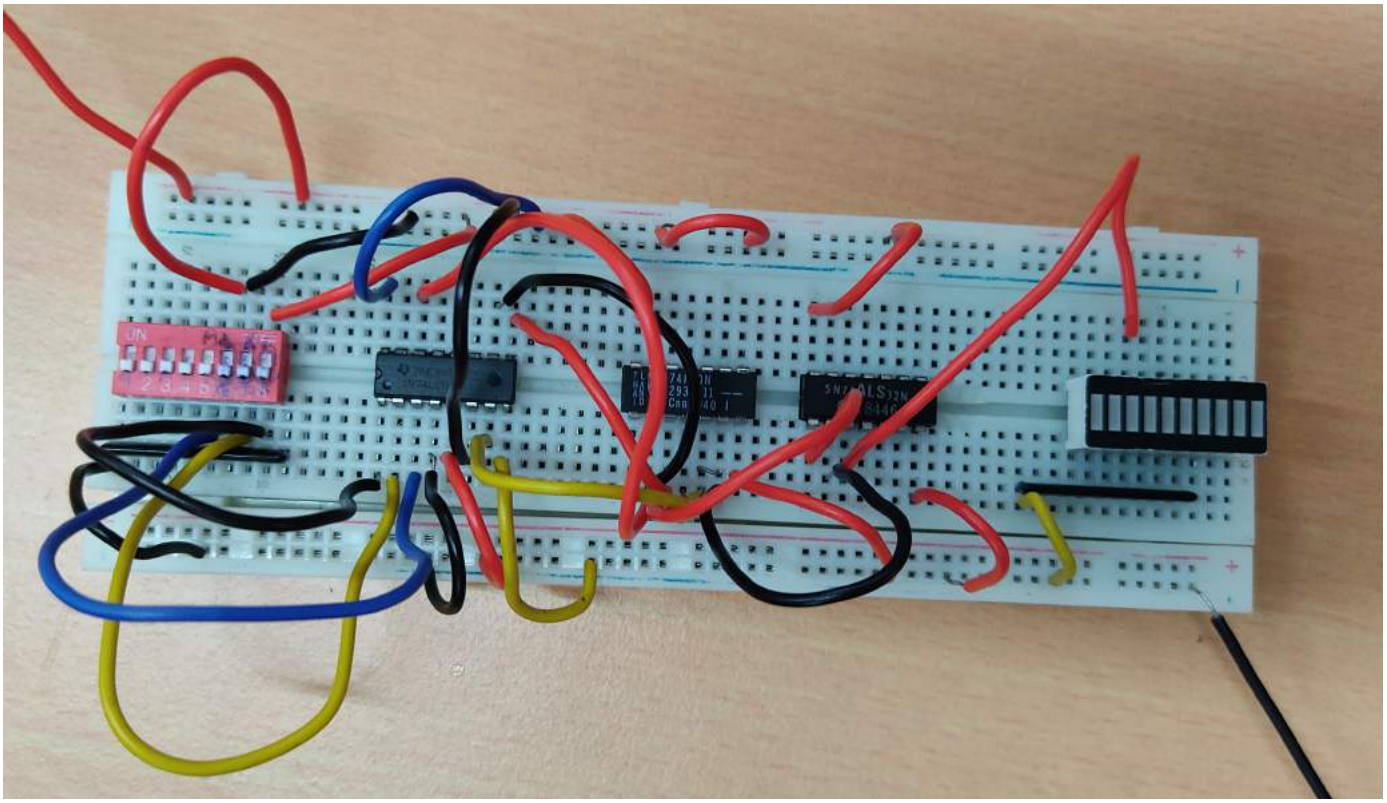
Page No.
Date

– using only 2-input NAND gates:

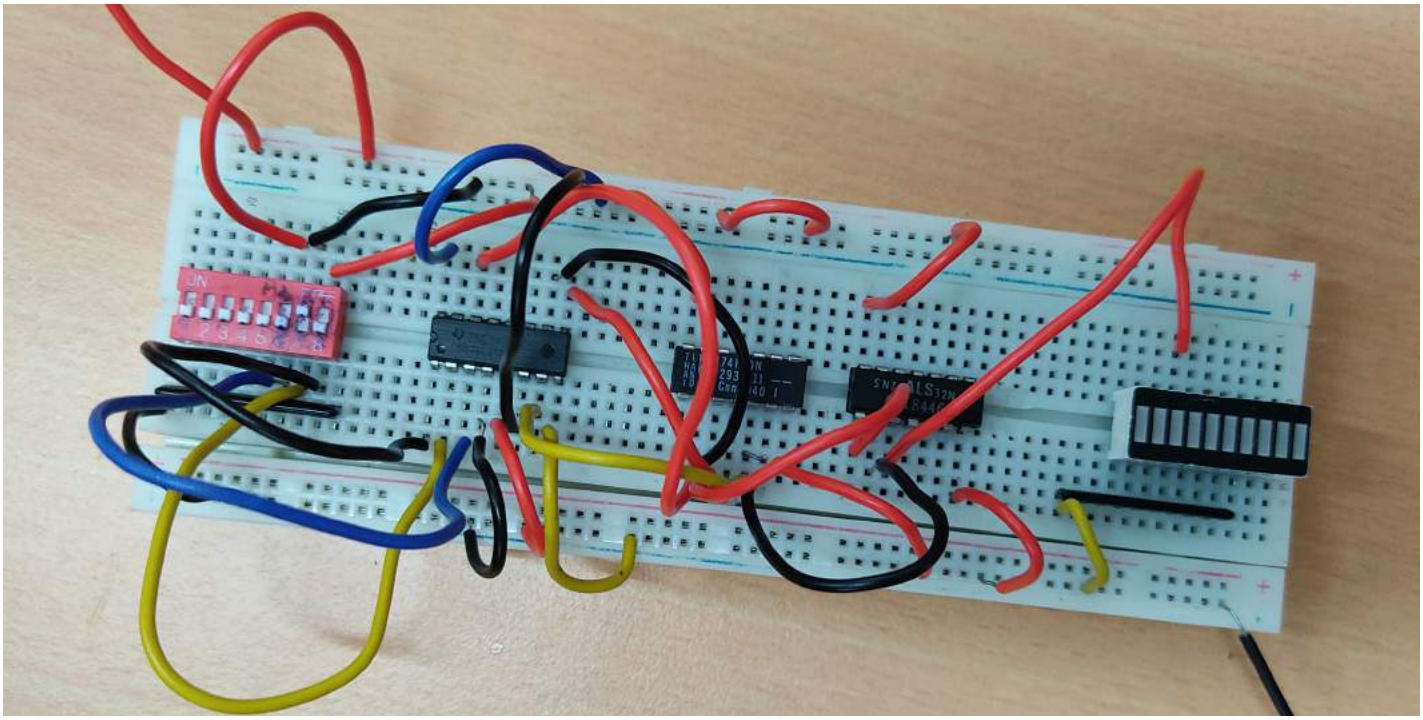


Sgangaly
4/2/22

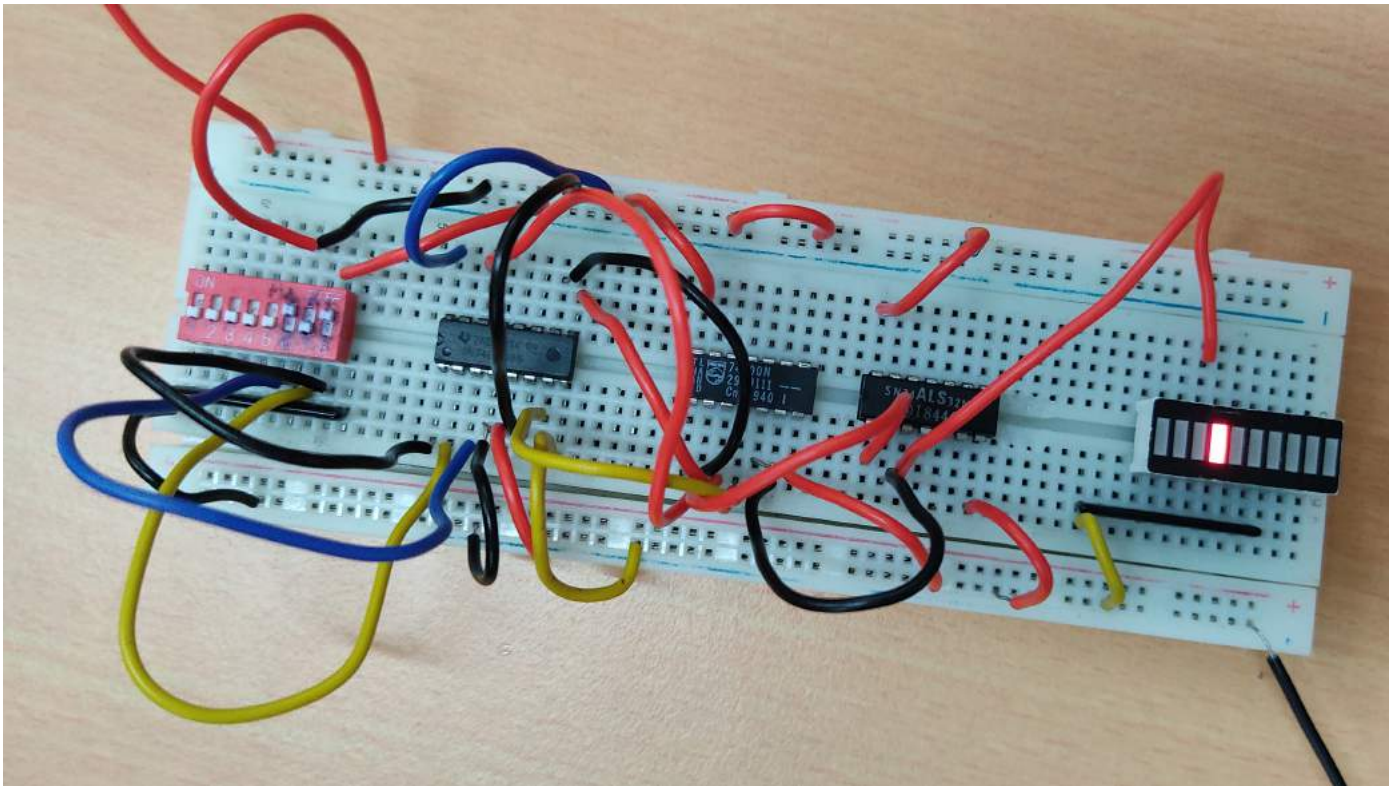
1) Circuit using 3:8 decoder and suitable 2-input logic gates.



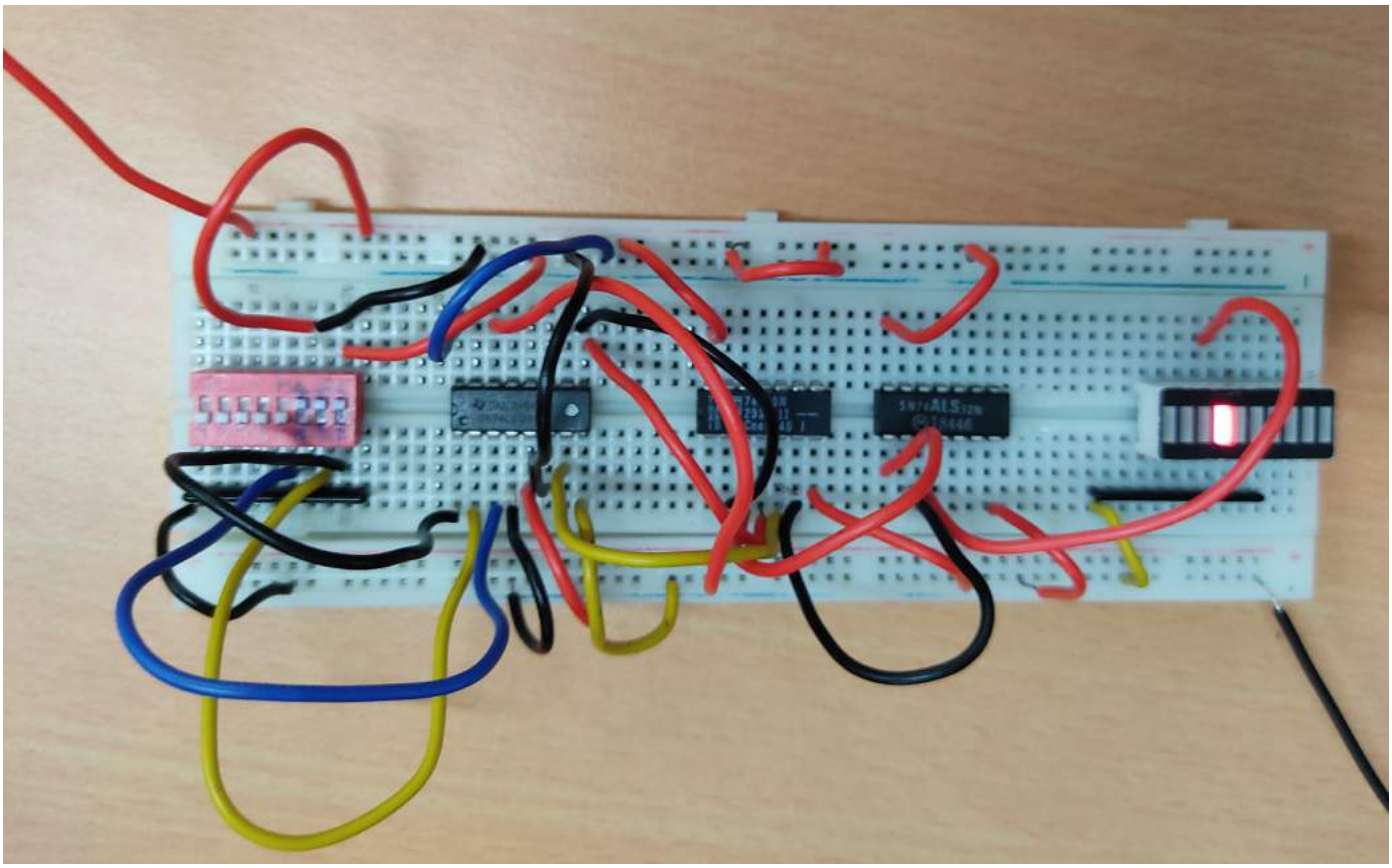
0_0_0 -> 0



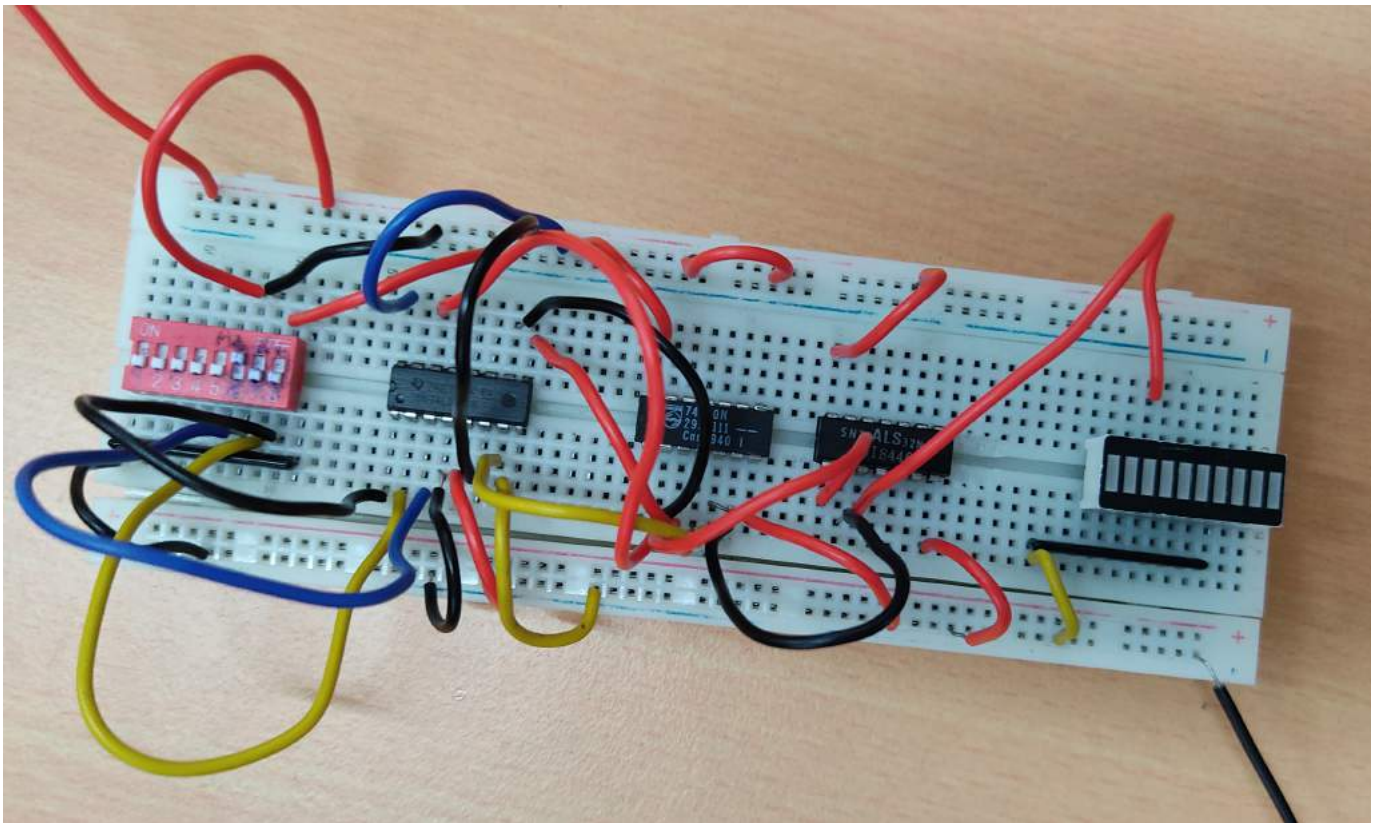
0_1_0 -> 0



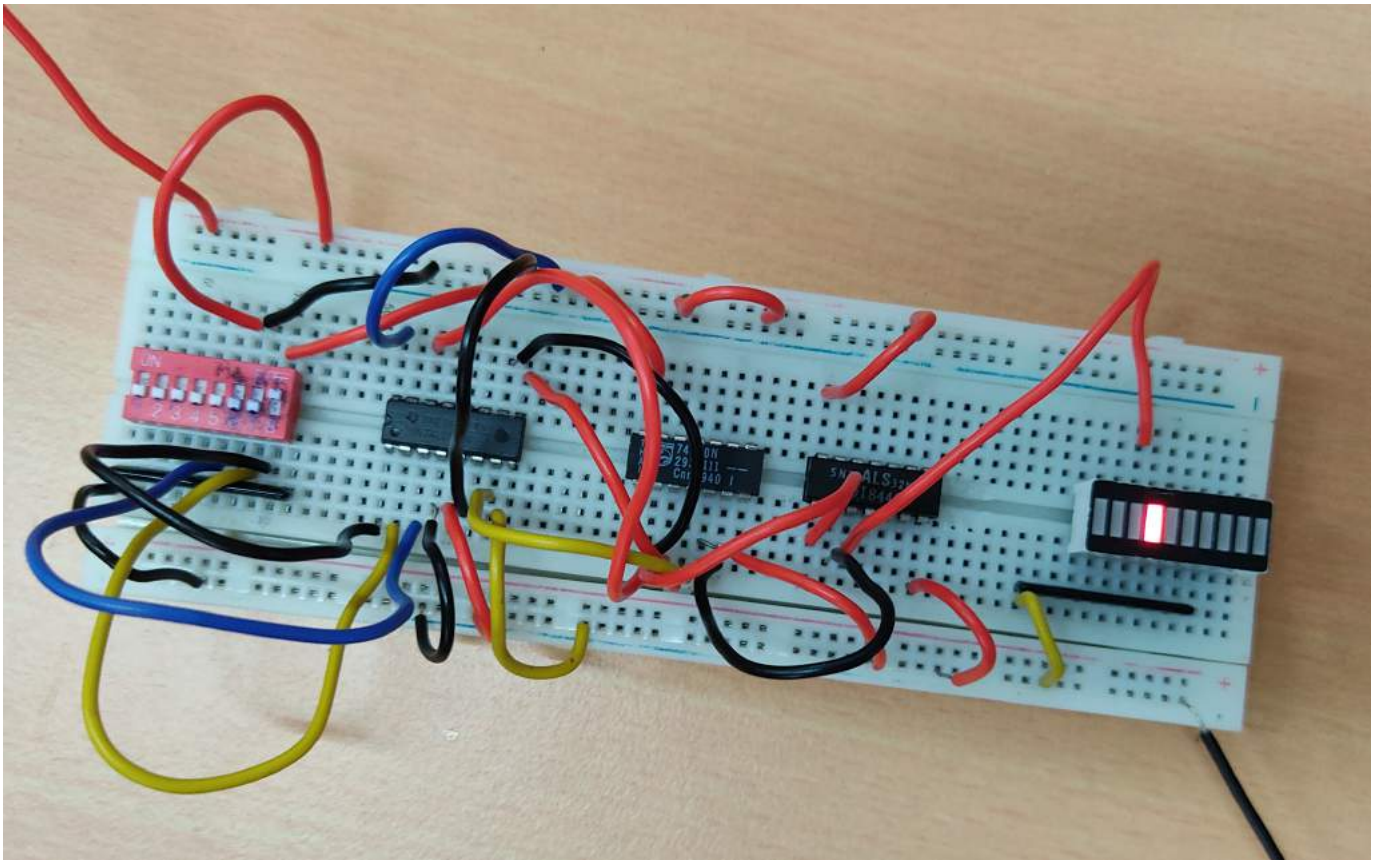
1_0_1 -> 1



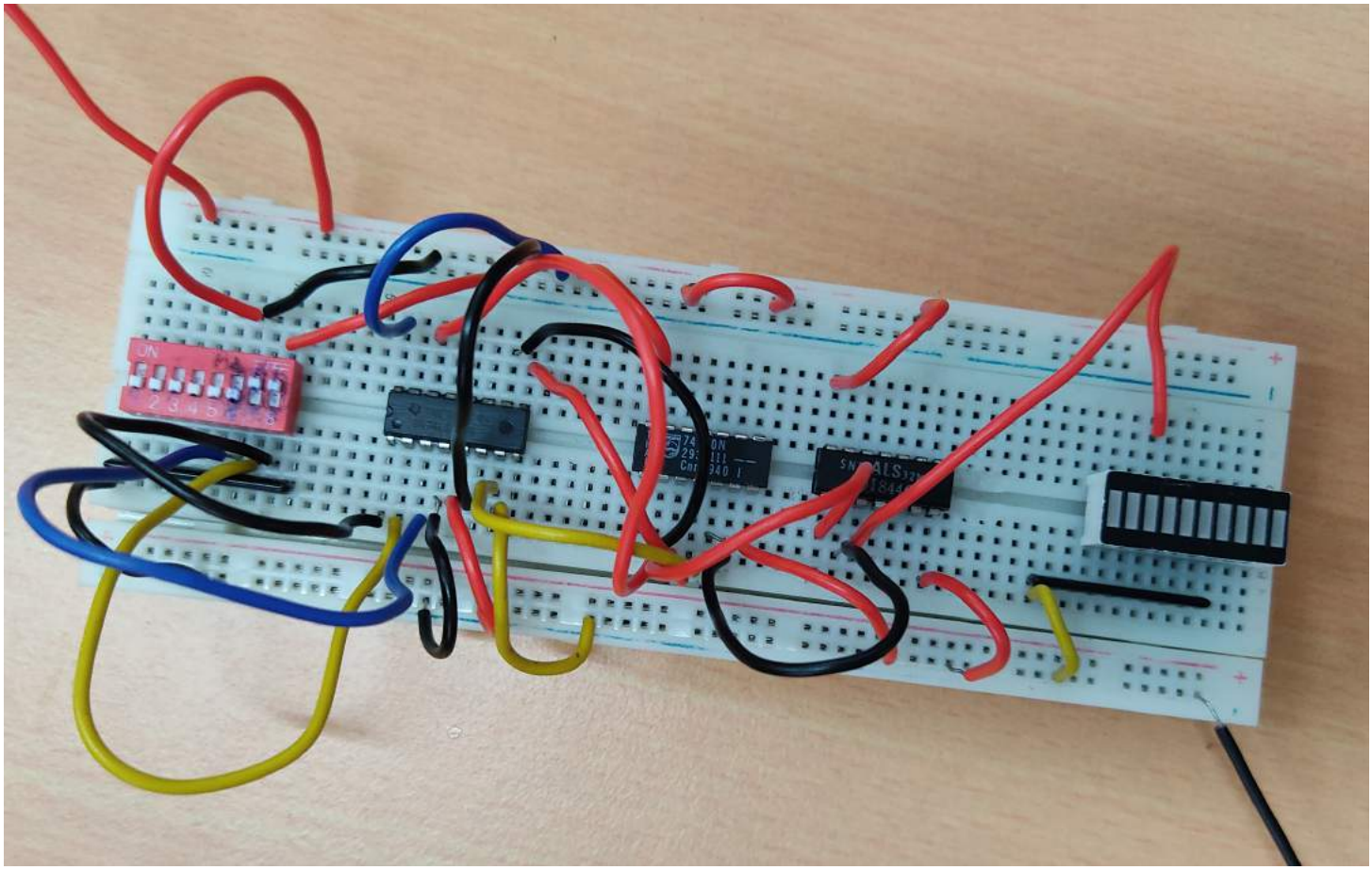
1_1_1 -> 1



1_0_0 -> 0

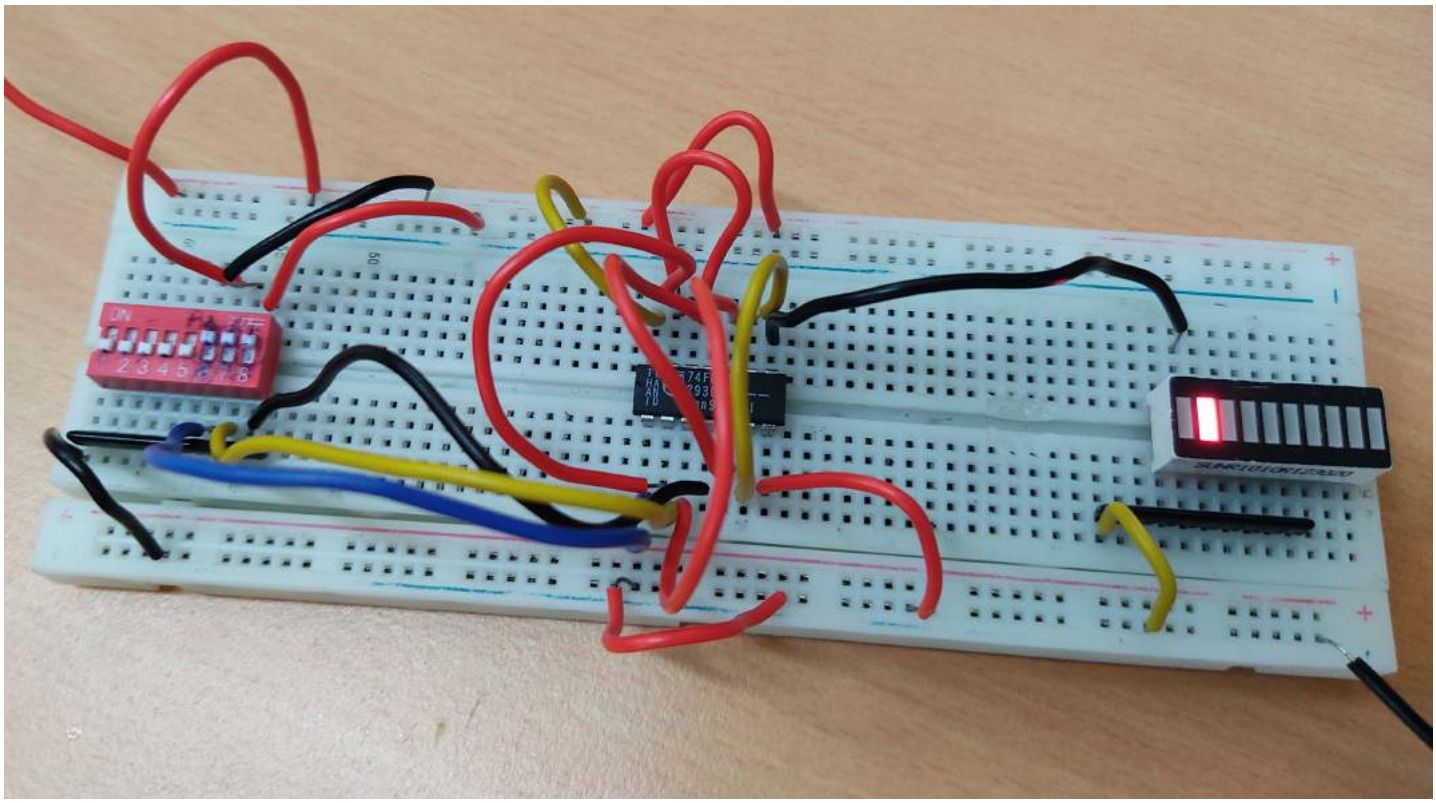


0_0_1 -> 1

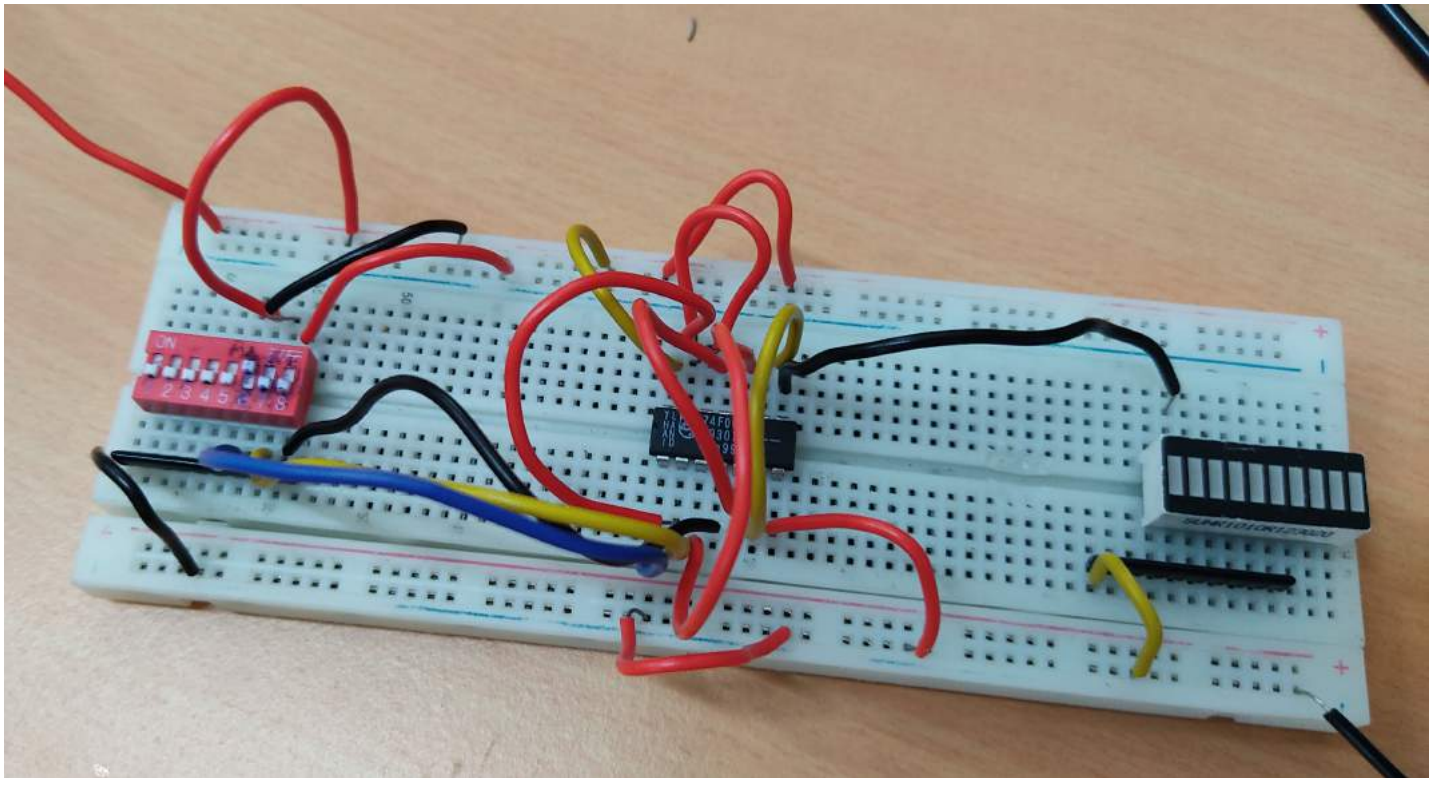


0_1_1 -> 0

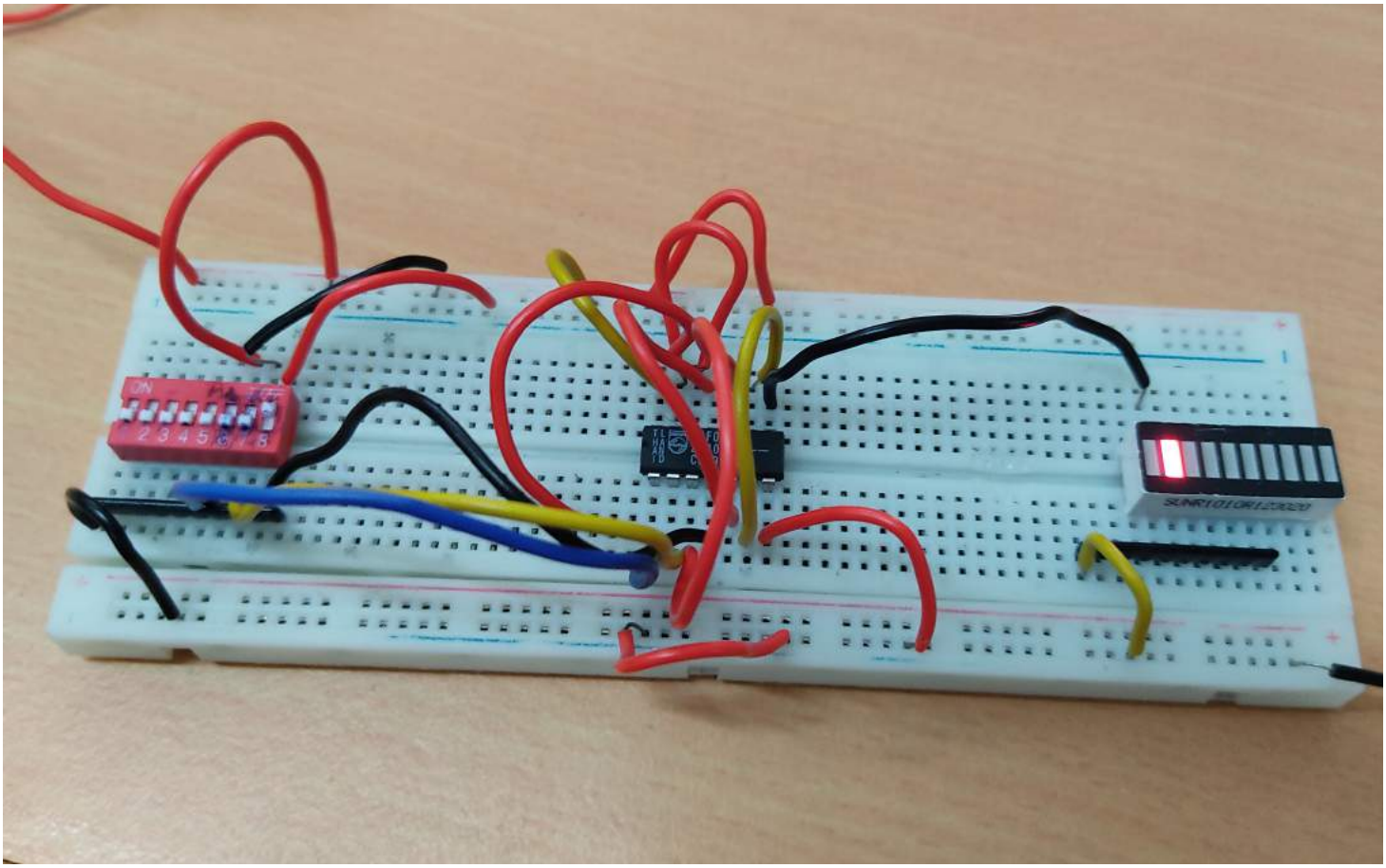
2) Circuit using 2-inputs NAND gates.



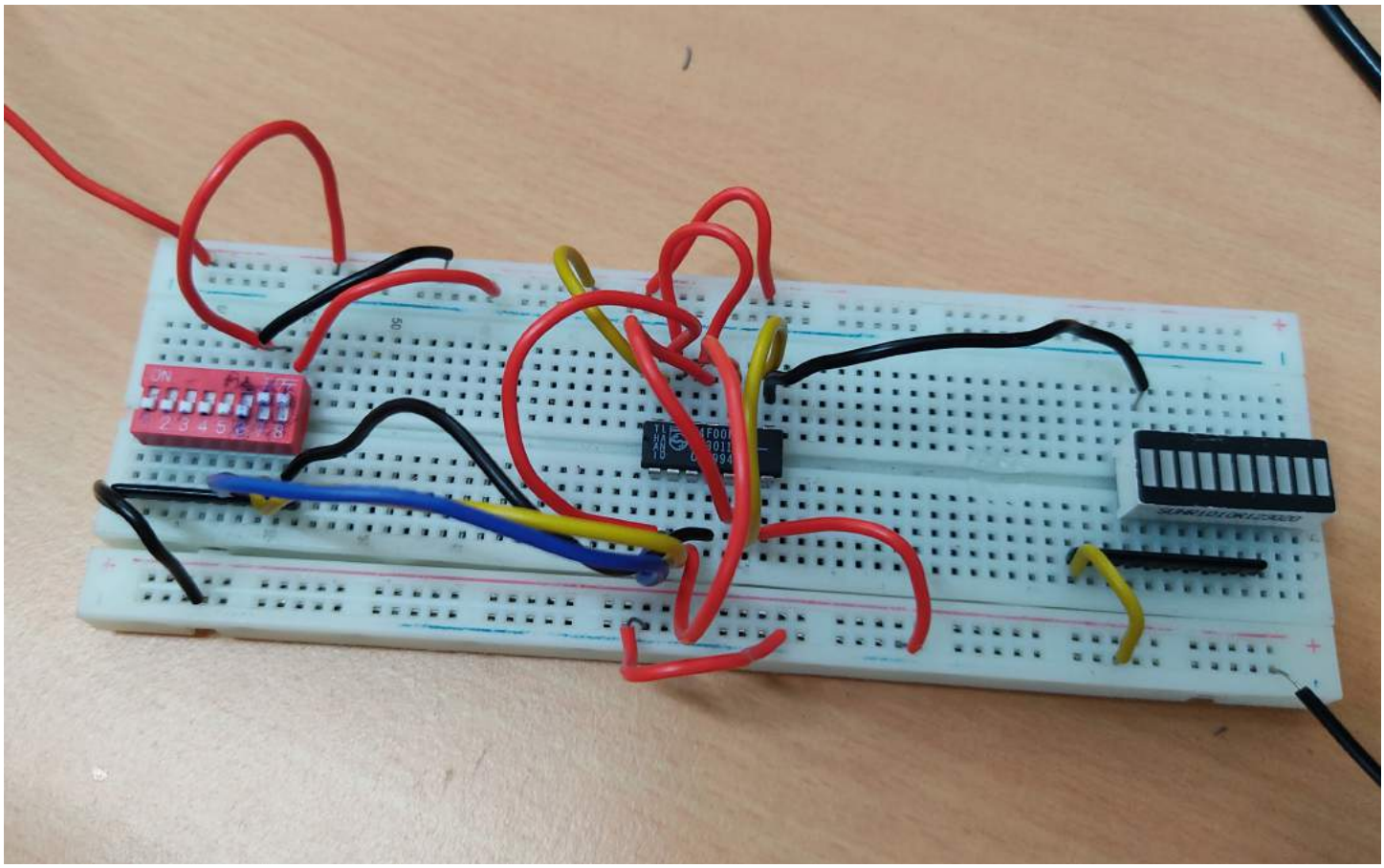
1_1_1 -> 1



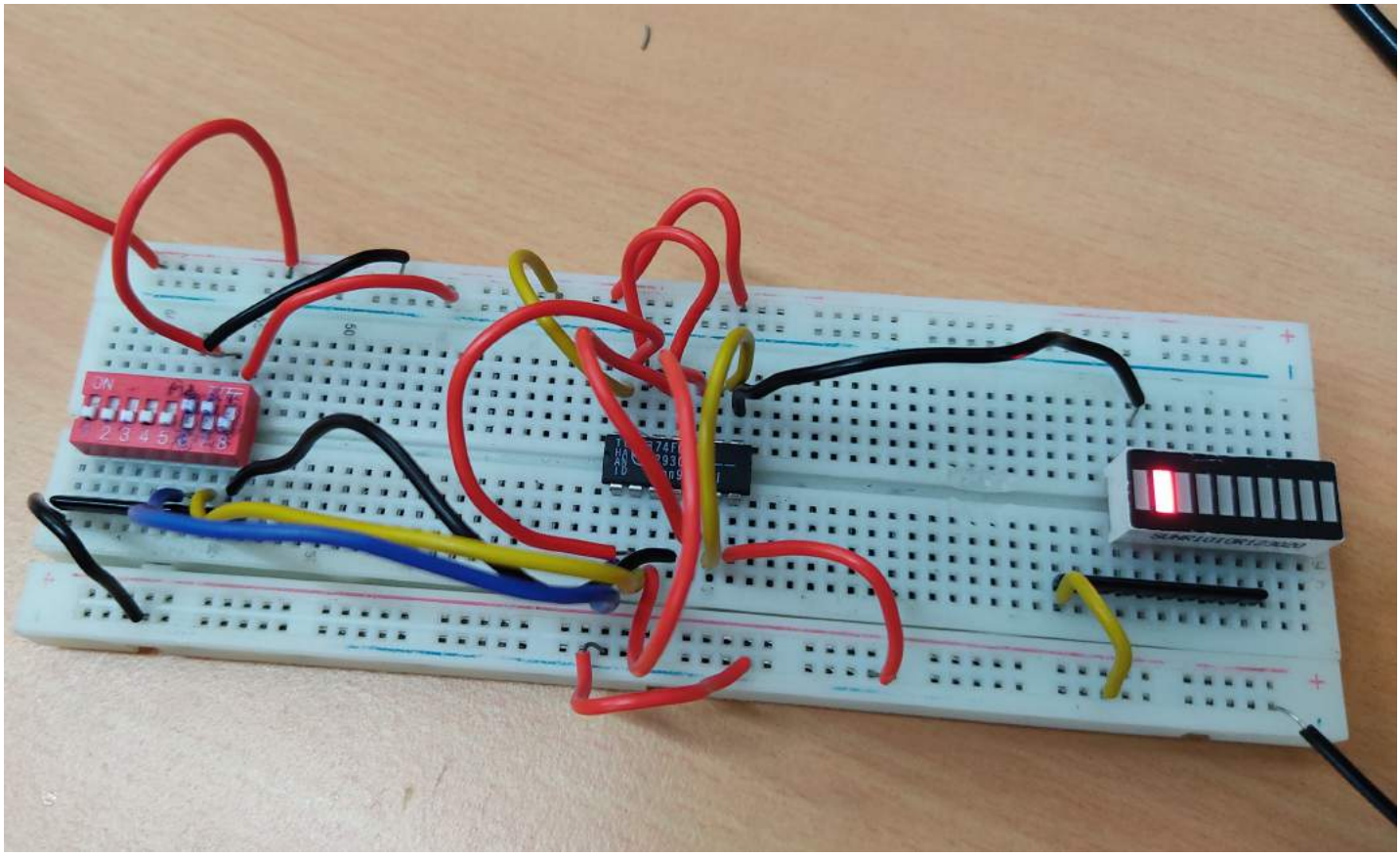
1_0_0 -> 0



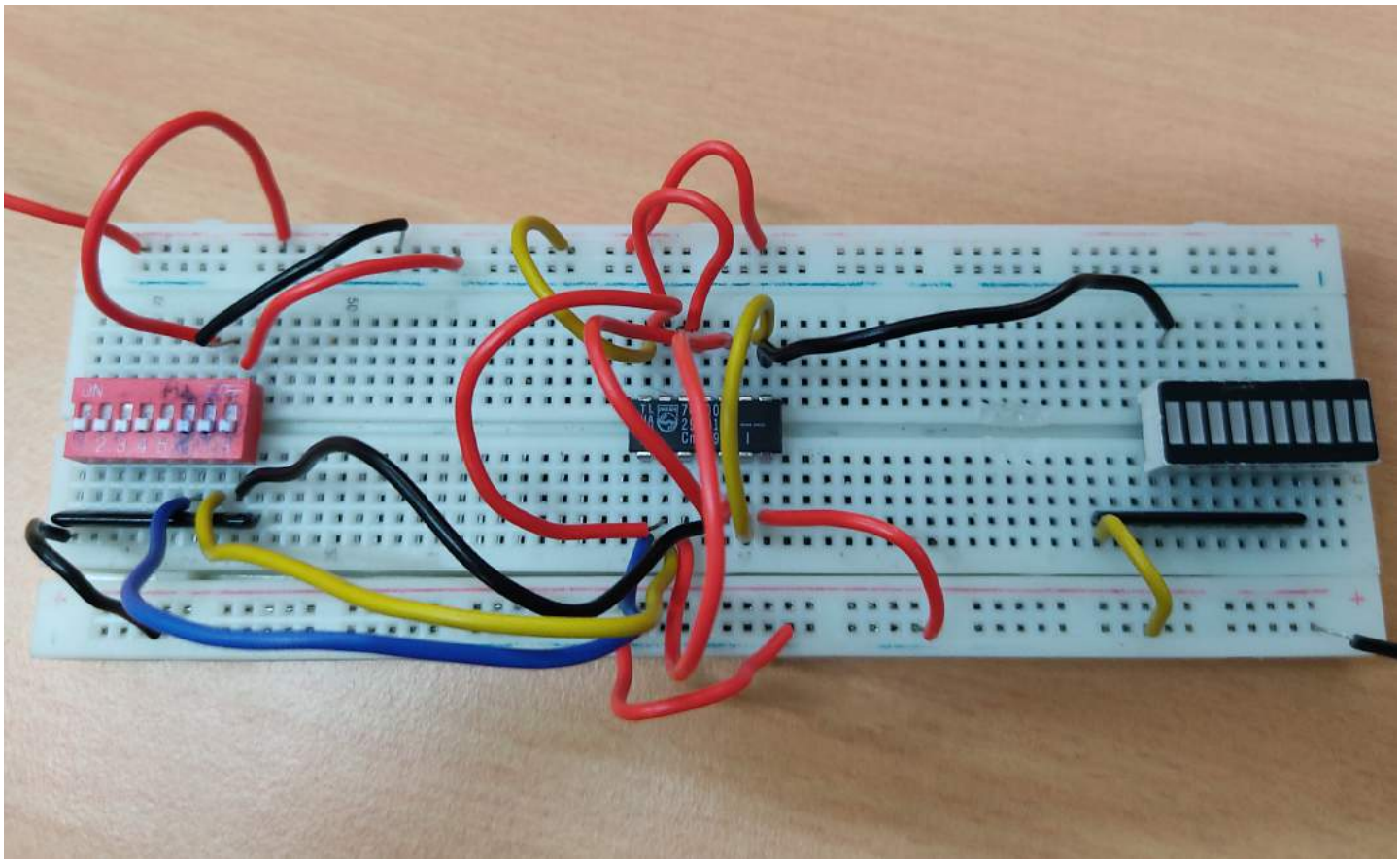
0_0_1 -> 1



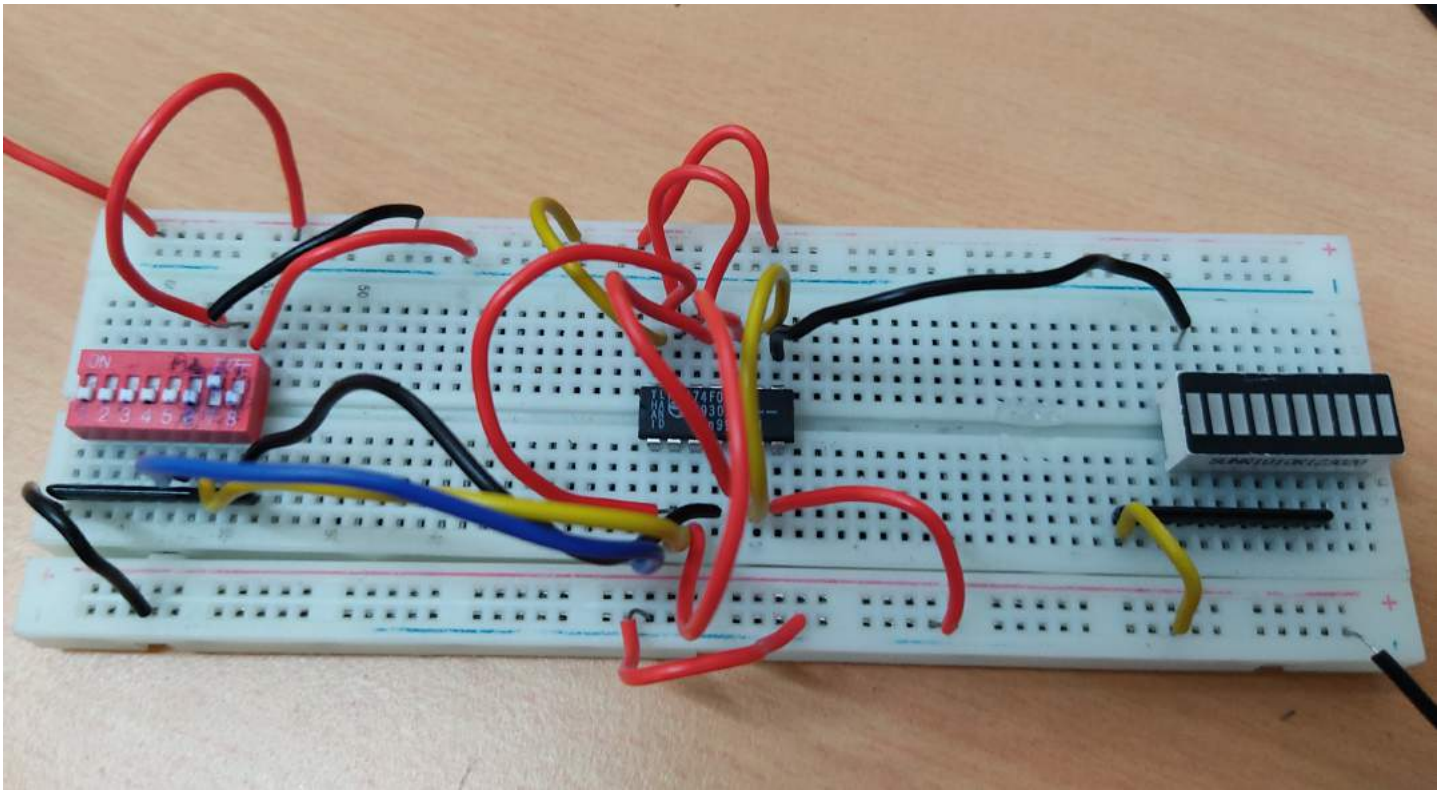
0_1_1 -> 0



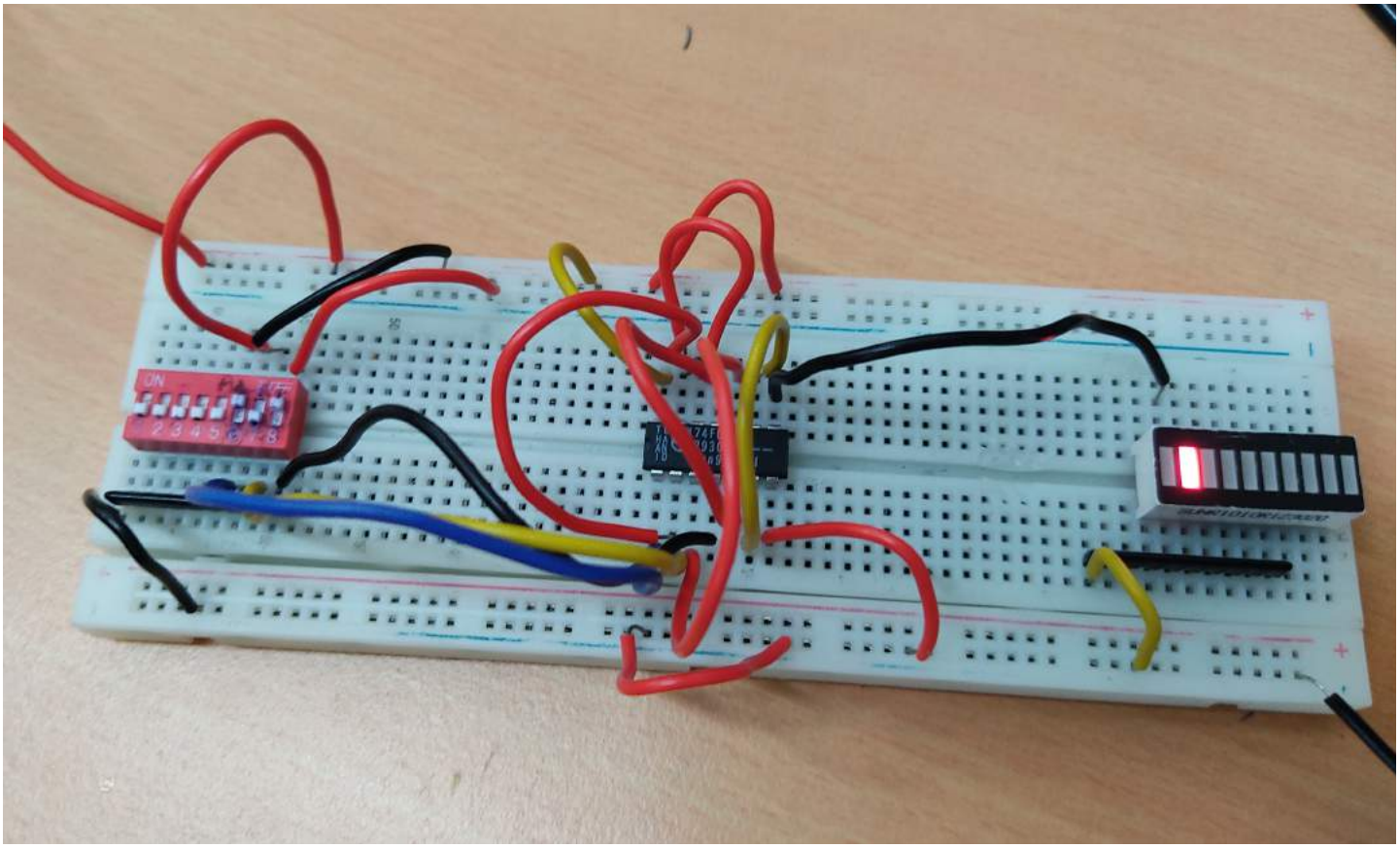
1_1_0 -> 1



0_0_0 -> 0



0_1_0 -> 0



1_0_1 -> 1