INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY

HYDERABAD

Lab Report-6

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Course: Digital Systems and Microcontrollers Lab

Contents

1 RS Latch

1.1 Objective:

To Assemble a latch using NOR gates

1.2 Equipment Required

1. Digital Test Kit
2. NOR Gate(CD4001)
3. Connecting Wires
4. Vcc and GND

1.3 Procedure

1.3.1 Setup

1. Place the IC on the breadboard
2. Connect the Vcc and the GND
3. Connect the Inputs to S and R
4. Connect the Other Input of the NOR gate to the Output of the Other gate
5. Show the output Q through an LED

1.3.2 Testing

S	R	Q
0	1	0
0	0	0
1	0	1
0	0	1
0	1	0
1	0	1
0	1	0
0	0	0
1	1	Forbidden Input
0	0	0
1	0	1
1	1	Forbidden Input
0	0	0
0	1	0
1	1	Forbidden Input
0	0	0

Table 1: Testing Sequence

1.4 Schematic

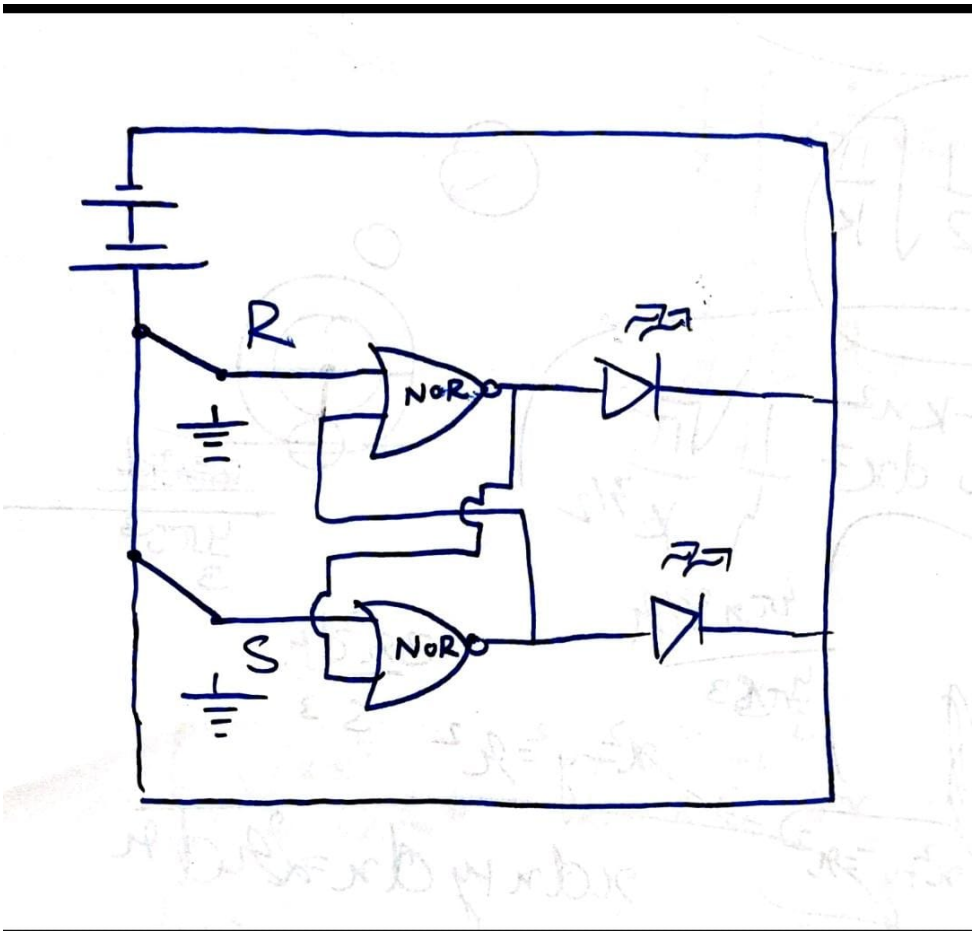


Figure 1: Schematic

1.5 LAB Photo

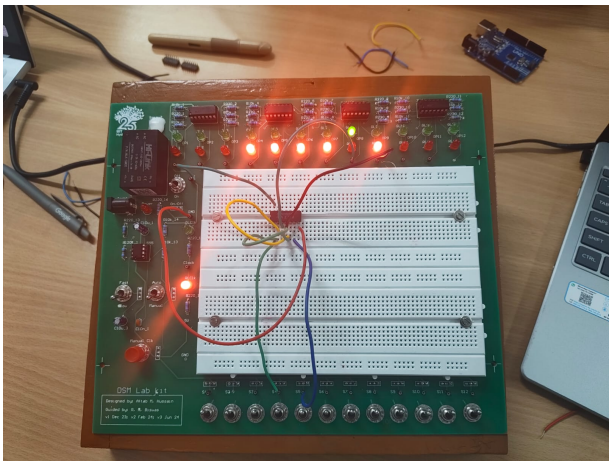
h 

Figure 2: Lab Photo

1.6 TinkerCAD

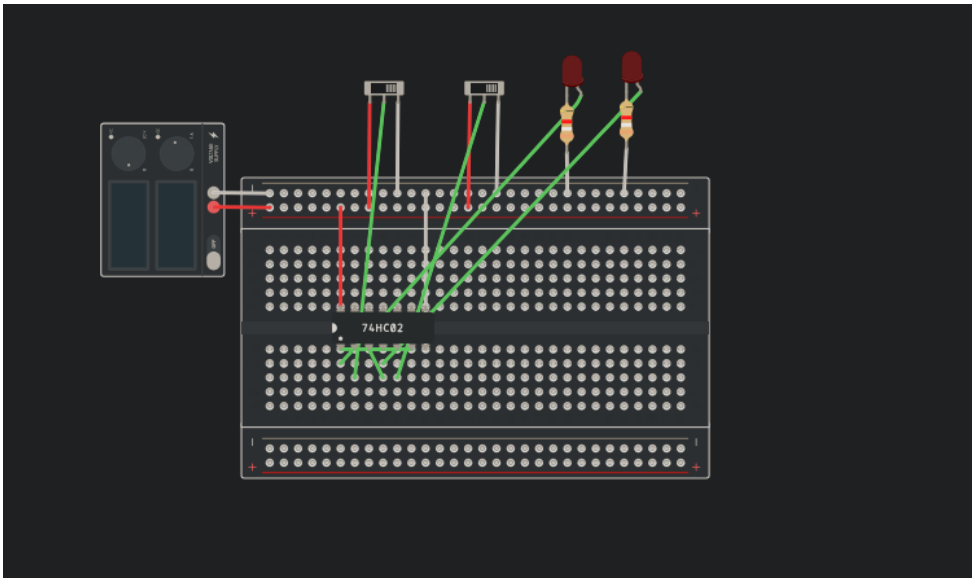


Figure 3: TinkerCAD

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1.7 Conclusion

We have successfully Checked the Working of an RS latch.

2 Master Slave Flip-Flop

2.1 Objecctive

To Design a Master Slave Flip-Flop using NAND(CD4012) and NOR(CD4001) gates

2.2 Equipment Required

1. Digital Test Kit
2. NAND(CD4012)
3. NOR(CD4001)
4. Connecting Wires
5. Vcc and GND

2.3 Procedure

2.3.1 Master

1. Place the IC's on the Breadboard
2. Connect the Vcc and The GND
3. Connect the Input J and K
4. Connect the Clock to the first set of NAND gates
5. Connect the outputs of these NAND gates to the second set and label them as $S_{M'}$ and $R_{M'}$
6. Connect the Output of one NAND gate to the input of the other
7. label these outputs as Q_M , Q'_M
8. Label the final outputs as Q and Q'

2.3.2 Slave

1. Connect Q_M and Q'_M to the inputs of the NOR gate with the clock as the other input
2. label these inputs as R_S and S_S
3. as in the master connect the outputs to the inputs of the NOR gates

2.3.3 Testing

J	K	Action	$Q_(n+1)$
0	0	HOLD	Q
0	1	CLEAR	0
1	0	SET	1
1	1	TOGGLE	Q’

Table 2: Testing Table

$$R_M = K \cdot Q \cdot Clk \quad S_M = J \cdot Q' \cdot Clk' \quad R_S = Q'_M \cdot Clk'$$

2.4 Schematic

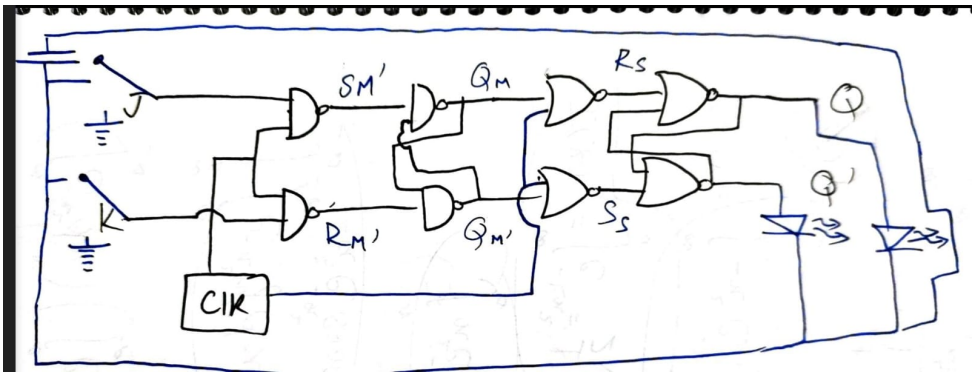

Figure 4: Schematic

2.5 LAB Photo

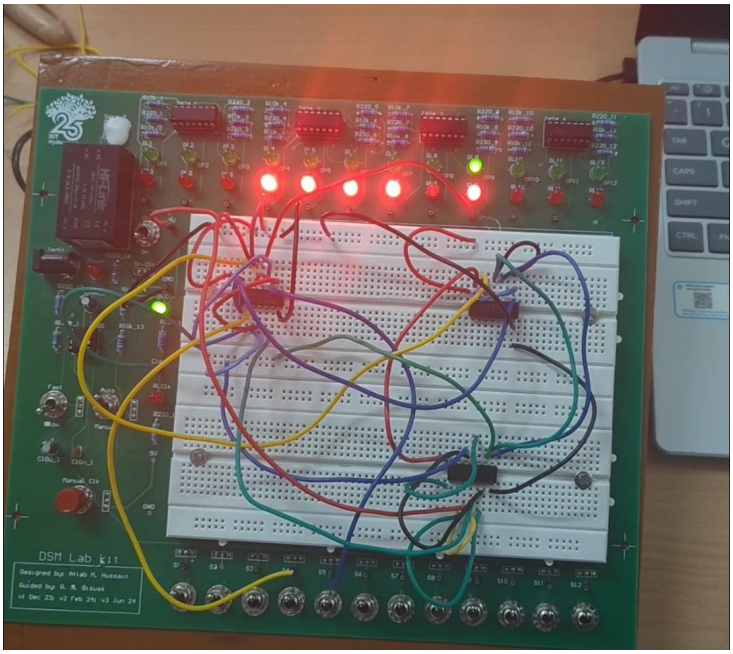

Figure 5: LAB Photo

2.6 TinkerCAD

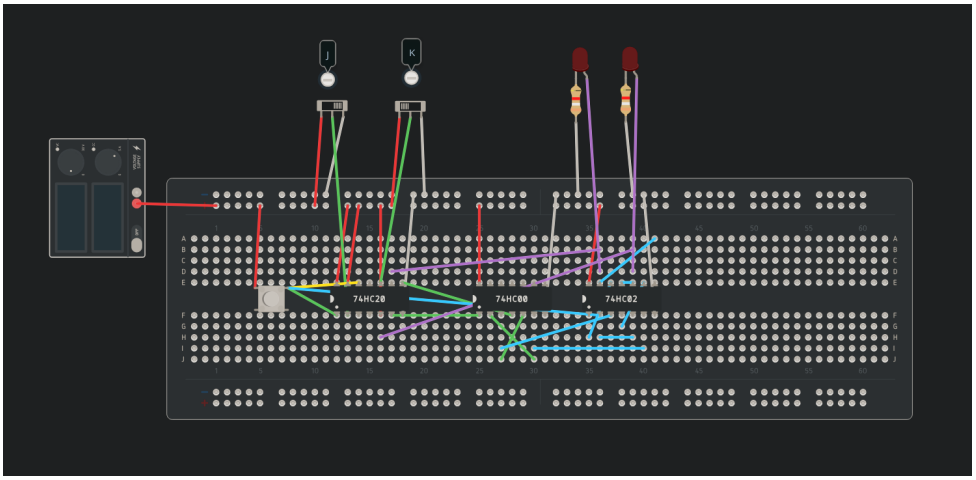

Figure 6: TinkerCAD Simulation

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2.7 Conclusion

We have successfully Designed and Demonstrated the working of a Master-Slave Flip-Flop

3 4-Bit Up-Down Counter

3.1 Objective

Using Arduino To implement a 4 bit ripple counter

3.2 Equipment Required

1. Digital Test Kit
2. Arduino UNO
3. Arduino IDE
4. Connceting Wire

3.3 Procedure

3.3.1 Setup

1. Connect the Arduino to the Laptop
2. Connect the outlets of the Arduino to LEDs

3.3.2 Code

Listing 1: Arduino Code

```
1
2  const int ledPins[4] = {2, 3, 4, 5};
3  int count = 0;
4  bool up = true;
5  unsigned long lastToggle = 0;
6  const unsigned long period = 500;
7
8  void setup() {
9    for(int i = 0; i < 4; i++){
10     pinMode(ledPins[i], OUTPUT);
11     digitalWrite(ledPins[i], LOW);
12   }
13 }
14
15 void loop() {
16   unsigned long currentTime = millis();
17
18   if(currentTime - lastToggle >= period){
19     lastToggle = currentTime;
20
21     for(int i = 0; i < 4; i++){
22       digitalWrite(ledPins[i], (count >> i) & 0x01);
23     }
24
25     if(up){
26       count++;
27     } else {
28       count--;
29     }
30
```

```
31      if(count >= 16){
32        up = false;
33        count = 15;
34      }
35
36      if(count < 0){
37        up = true;
38        count = 0;
39      }
40    }
41  }
```

3.4 Schematic

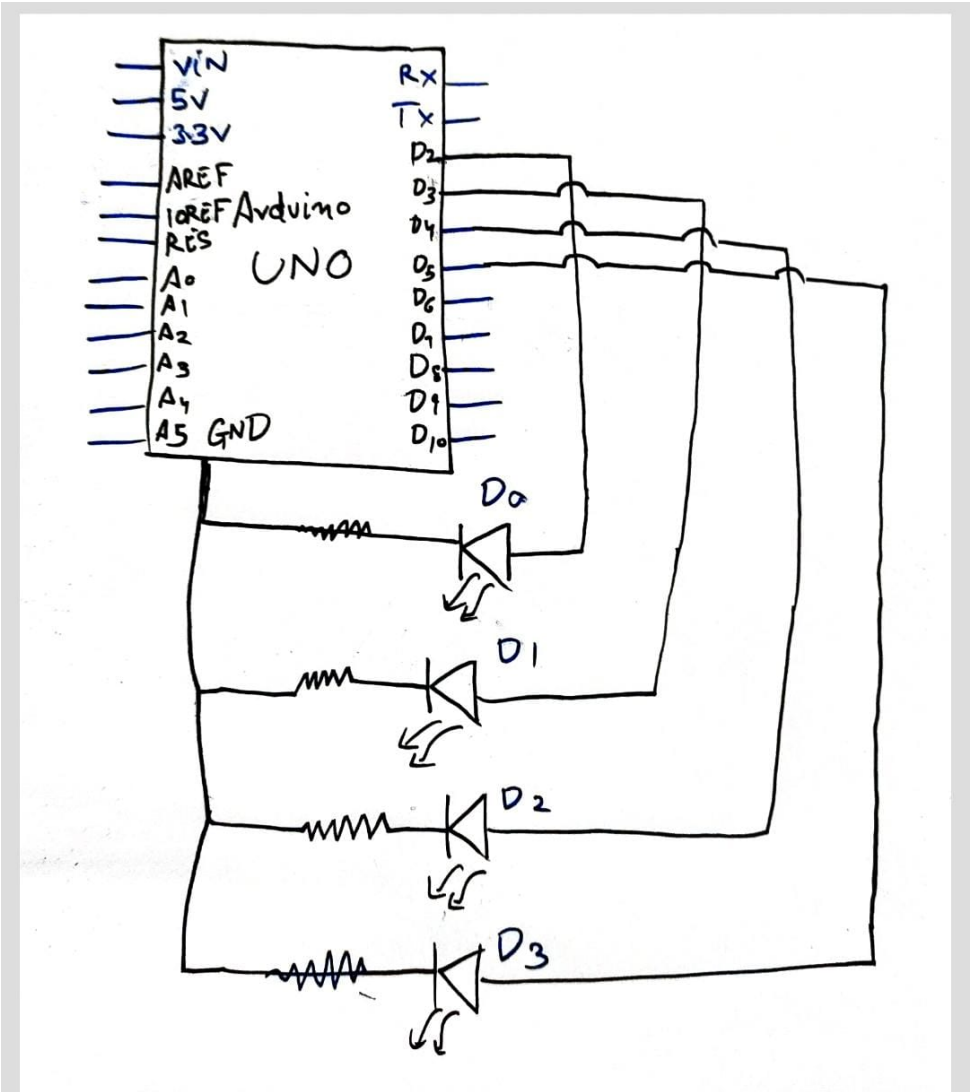

Figure 7: Schematic

3.5 Lab Photo

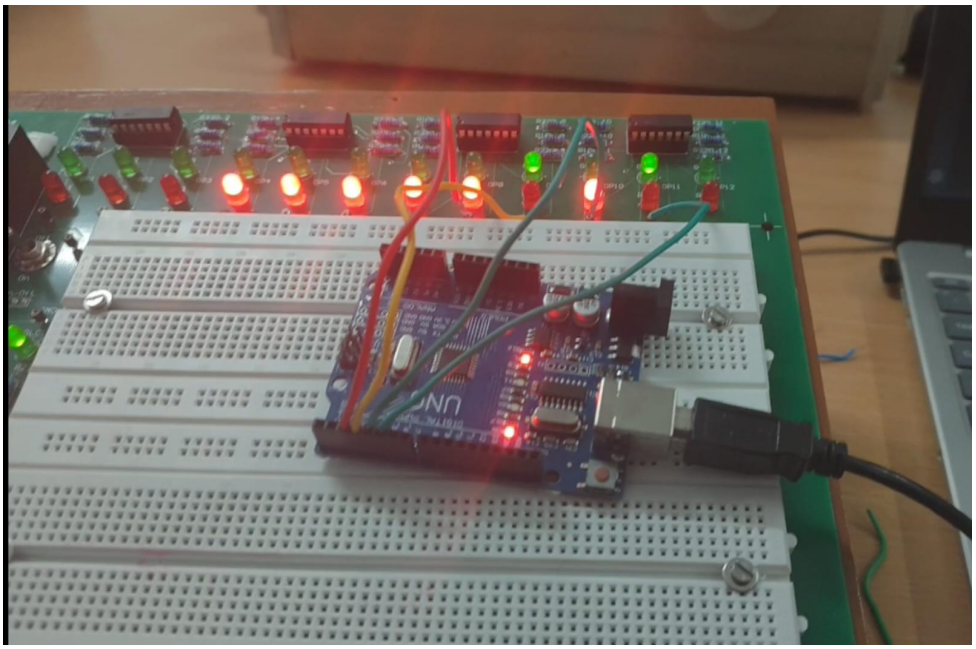

Figure 8: Lab Photo

3.6 TinkerCAD

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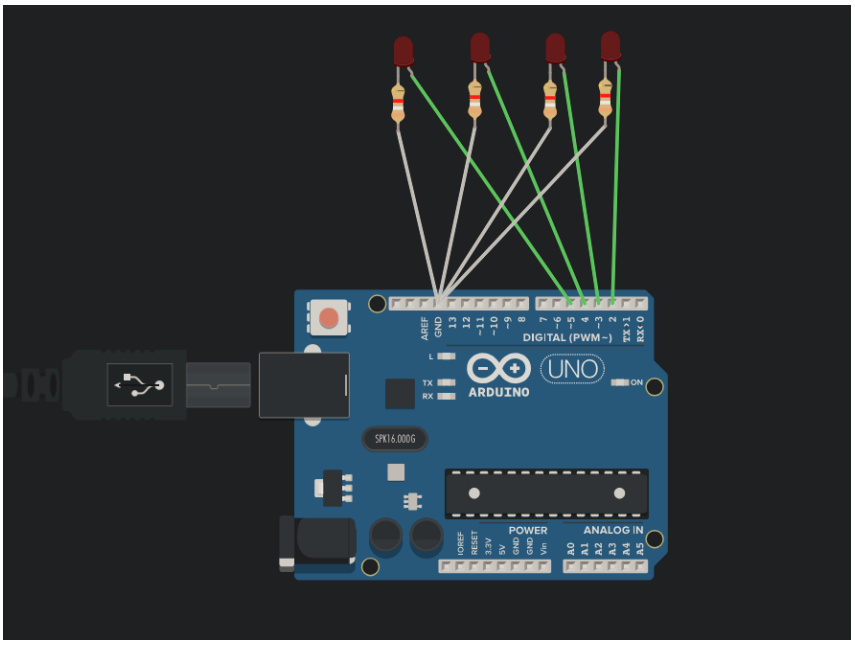
[h] 

Figure 9: Arduino TinkerCAD

3.7 Conclusion

We have succefully designed and tested a 4 Bit Ripple Counter