LAB REPORT : 7

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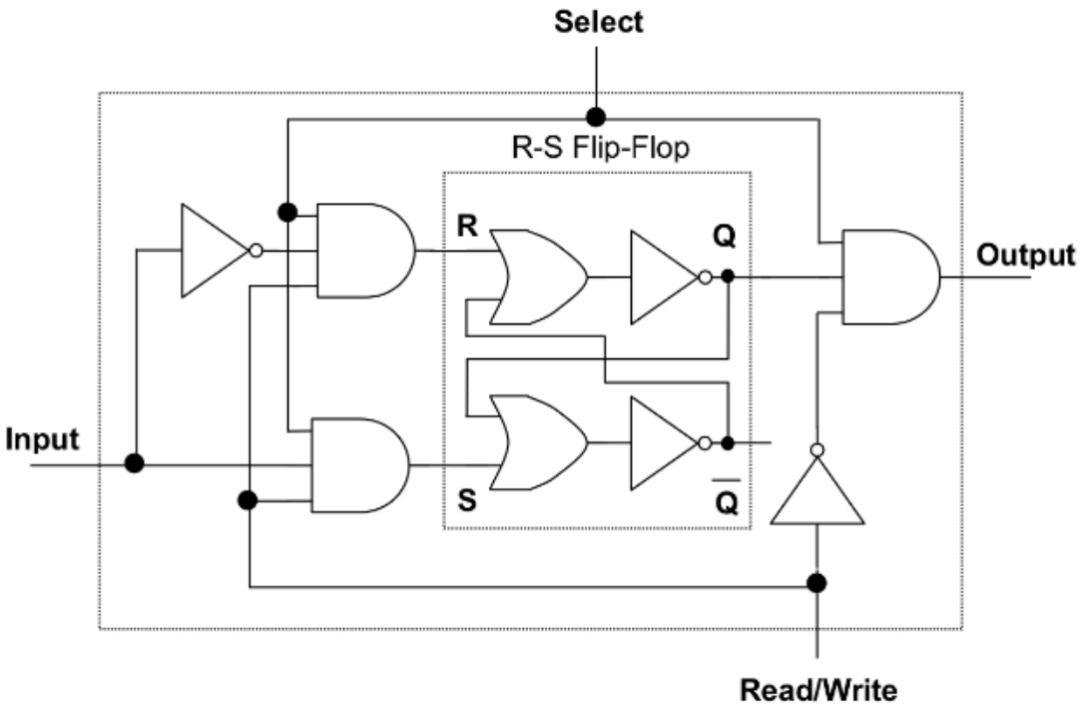
GROUP: 1

AIM OF THE EXPERIMENT:

To design and simulate a circuit that describes the functioning of the binary cell of RAM using an SR Latch. In this experiment, we verify the operation of the memory cell and show the same as output.

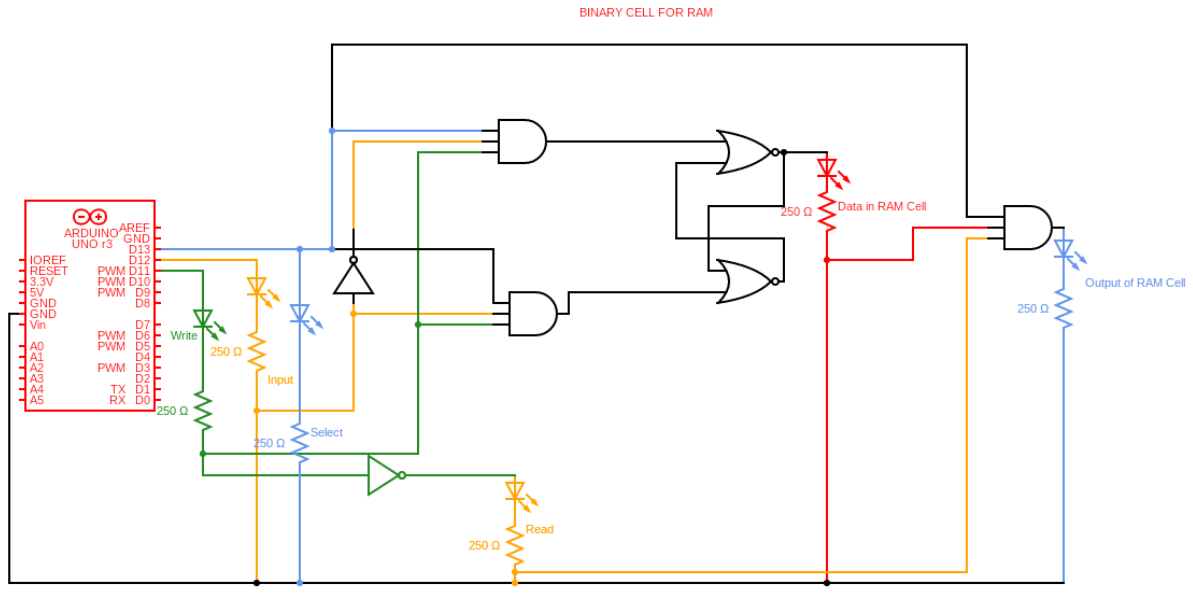


Logic Diagram of Binary Cell for RAM

ELECTRONIC COMPONENTS USED:

1. Arduino Uno R3
2. One Hex Inverter (IC 74HC04)
3. One Triple 3-Input AND Gate (IC 74HC11)
4. Breadboard
5. One Quad NOR Gate (IC 74HC02)
6. Six Resistors of 250 Ω each
7. Six LEDs (Red,Blue,Orange,White,Green,Yellow)
8. A bunch of connecting wires

REFERENCE CIRCUIT: CIRCUIT DIAGRAM REPRESENTING BINARY CELL FOR RAM



CIRCUIT DIAGRAM TO ILLUSTRATE A DECADE COUNTER

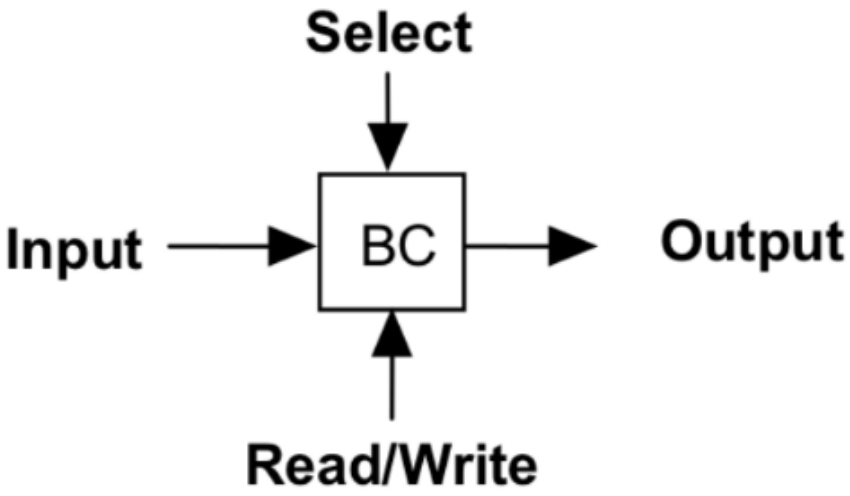
PROCEDURE:

1. Provide all the live wire and ground connections from the Arduino to all the breadboards first.
2. Take a wire from the Pin 13,Pin 12 and Pin 11 of the Arduino and connect it to the anode of the Select LED,Input LED and Write LED respectively.
3. Take one end of the resistor and connect it to the cathode of the Select LED ,Input LED, Write LED and ground the other ends.
4. Take a wire from the Pin 11 of the Arduino and connect it as input into the Hex Inverter then connect the output to the anode of Read LED.
5. Take one end of the resistor and connect it to the cathode of the Read LED and ground the other end.
6. Take a wire from the Pin 11 of the Arduino and connect it as input 3A into the 3-Input AND Gate.
7. Take a wire from the Pin 12 of the Arduino and connect it as Input 6 into the Hex Inverter then connect the Output 6 as Input 3B into the 3-Input AND Gate.
8. Take a wire from the Pin 13 of the Arduino and connect it as Input 3C into the 3-Input AND Gate.
9. Take a wire from the Output 3 of the 3-Input AND Gate and connect it as Input 4B of the Quad NOR Gate.
10. Take one end of the resistor and connect it to the cathode of the Input LED and ground the other end.
11. Take a wire from the Pin 13 of the Arduino and connect it as Input 1A into the 3-Input AND Gate.
12. Take a wire from Output 1 the Hex Inverter and then connect it as Input 1B into the 3-Input AND Gate.

13. Take a wire from Output 4 the Quad NOR Gate and then connect it as Input 1C into the 3-Input AND Gate.
14. Take a wire from the Output 1 of the 3-Input AND Gate and connect it to the anode of the Output of Cell LED.
15. Take one end of the resistor and connect it to the cathode of the Output of Cell LED and ground the other end.
16. Take a wire from Output 4 the Quad NOR Gate and then connect it to the anode of the Data in Flipflop LED.
17. Take one end of the resistor and connect it to the cathode of the Data in Flipflop LED and ground the other end.
18. Take a wire from the Pin 12 of the Arduino and connect it as Input 2A into the 3-Input AND Gate.
19. Take a wire from the Pin 13 of the Arduino and connect it as Input 2B into the 3-Input AND Gate.
20. Take a wire from the Pin 11 of the Arduino and connect it as Input 2C into the 3-Input AND Gate.
21. Take a wire from Output 2 the 3-Input AND Gate and then connect it as Input 1A into the Quad NOR Gate.
22. Connect the Output 4 of the Quad NOR Gate to the Input 1B of the Quad NOR Gate.
23. Connect the Output 1 of the Quad NOR Gate to the Input 4A pin of the Quad NOR Gate.
24. Feed an approriate code into the Arduino to make the above circuit work and make sure all the connections are tight by crosscheck the wirings from the given circuit and make the necessary changes.

CONCLUSION:

We have successfully designed and simulated a binary cell for RAM with the help of an SR Latch. The cell has three inputs and a single output. The inputs are labeled “Select”, “Read/write”, and “Input”. The output line is labelled “Output”.



A Binary Cell

ROLE OF SELECT PIN:

The “select” input is used to access the cell, either for reading or writing.When the select line is high, “1”, then a memory operation can be performed on this cell. When the select line of the binary cell is low, “0”, then the cell is not being read from or written to i.e., if “select” is low, the inputs to the R-S flip-flop will stay low (its stored value will not change) and the output produced by the cell will be low regardless of whether the actual bit held in the flip-flop is “0” or “1”. For a memory operation to be performed on the cell, the “select” should be high.

READING FUNCTION OF CELL:

If the clock value on the “Read/write” line is low (which makes the “negated Read/write” high) indicating the cell contents are to be read. When the cell is being read its contents cannot be modified. The reason for this is that the same low value on the “Read/write” line that allows the cell to be read, is fed into the and gates guarding the inputs to the flip-flop.

WRITING FUNCTION OF CELL:

When the cell is selected and the “Read/write” line is set to high, signifying a “write” operation, the value placed into the cell will depend solely on the state of the “Input” line. Thus, if “Input” is high, S (set) will receive a high and the flip-flop will store a “1”. If, on the other hand, “Input” is low, then R (reset) which receives a negated version of “Input” will go high and the flip-flop will reset to “0”.

The observation table for the binary cell of RAM is :

S.NO.	READ = 0 WRITE = 1	SELECT	INPUT	OUTPUT	OBSERVATIONS
1	1	0	1	0	Select =0 => No writing
2	1	1	0	0	Writing 0
3	0	1	1	0	Reading 0
4	1	1	1	0	Writing 1
5	0	1	0	1	Reading 1
6	0	0	1	0	Select=0 => output =0
7	1	1	1	0	Writing 1
8	0	1	0	1	Reading 1
9	0	0	0	0	Select =0 => output =0

The code used for this simulation is embedded below :

```
//S -> Select Cell

//U -> Unselect Cell

//R -> Set to READ mode

//W -> Set to WRITE mode

//I -> Input 1

//J -> Input 0

//For any other character,print "Enter a valid character"

int Select = 13;
int Input = 12;
int R_W = 11;

char S = '1', U = '0', R = '0', W = '1', I = '1', J = '0';

char X;

void setup()
{
    Serial.begin(9600);
    pinMode(Input, OUTPUT);
    pinMode(R_W, OUTPUT);
    pinMode(Select, OUTPUT);

    digitalWrite(Input, I);
    digitalWrite(Select, S);
    digitalWrite(R_W, W);
}

void loop()
{

    if (Serial.available() > 0)
    {
        X = Serial.read();
        Serial.println(X);

        if (X == 'S')
        {
            digitalWrite(Select, HIGH);
            Serial.print(X);
            Serial.println(": Select Pin is HIGH ");
        }
        else if (X == 'U')
        {
            digitalWrite(Select, LOW);
            Serial.print(X);
```

```
53              Serial.println(": Select Pin is LOW");
54          }
55
56          else if (X == 'W')
57          {
58              digitalWrite(R_W, HIGH);
59              Serial.print(X);
60              Serial.println(": Setting to WRITE mode:");
61
62              X = Serial.read();
63          }
64          // The Input is relayed to the user
65          else if (X == 'I')
66          {
67              digitalWrite(Input, HIGH);
68              Serial.print(X);
69              Serial.println(": Input = 1");
70          }
71          else if (X == 'J')
72          {
73              digitalWrite(Input, LOW);
74              Serial.print(X);
75              Serial.println(": Input = 0");
76          }
77
78          else if (X == 'R')
```

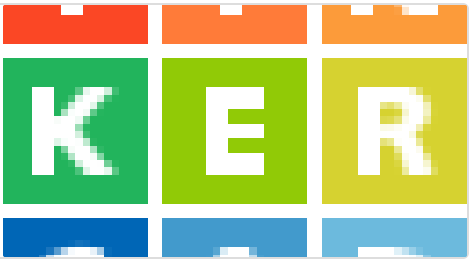
```
79              {
80                  digitalWrite(R_W, LOW);
81                  Serial.print(X);
82                  Serial.println(": Setting to READ mode");
83              }
84              else
85              {
86                  Serial.print(X);
87                  Serial.println(": Enter a valid character. ");
88              }
89          }
90          delay(1000);
91      }
92
```

LINKS FOR TINKERCAD SIMULATION:

Tinkercad | From mind to design in minutes

Tinkercad is a free, easy-to-use app for 3D design, electronics, and coding.

https://www.tinkercad.com/things/0XmVvIv0QLK-lab-7-ram-cell/editel?sharecode=IYgrm5ue0xeQLhheRCtEWqwV2jUF0zv1GcYqlaP-gJE



THANK YOU!