LAB REPORT-3

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PART-A : MULTIPLEXER

AIM/OBJECTIVE OF THE EXPERIEMENT:

To design, assemble and test a (1:4) Multiplexer using basic logic gates (whose select lines and inputs are through Arduino).

ELECTRONIC COMPONENTS USED:

1)Ardunio Uno R3

2)Hex Inverter(74HCO4 IC)

3)2 Triple 3-input AND gates(74HC11IC)

4)Quad OR gate(74HC32 IC)

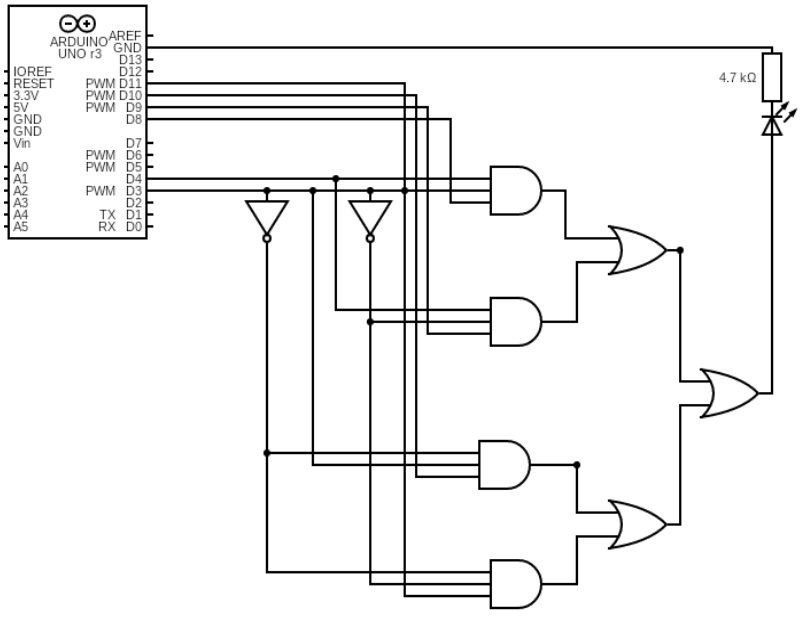
5)5 Leds

6)5 Resistors-1kΩ

7)Wires

8)Breaboard

REFERENCE CIRCUIT:



PROCEDURE:

1)Take the breadboard and ardunio,give GND and power conections to the breadboard through ardunio.

2)Place 74HC04IC ,(2)74HC11 IC and 74HC32IC on the breadboard and give Vcc and GND connections to it.

3)Connect the any of the two pins(let's say pin2 and pin3) to breadboard i.e., S1 and S2 and give led and resistor connections to it

4)Connect 4 digitalpins(lets say pin 4,5,6,7) to the breadboard from ardunio and give connections to it with led and resistor,name it as i0,i1,i2,i3.

5)And also connect the S1 to Hex inverter to give its complement output as S1' and similarly connect s2 to Hex inverter 2nd input to give its complement ouput from 2nd output as s2'.

6)By the boolean expression connect all the logic gate,select lineS and i0,i1,i2,i3 shown in the reference circuit.

$$Y = I_0 (S1)' (S0)' + I_1 (S1)' S0 + I_2 S1 (S0)' + I_3 S1 S0$$

7)Using this expression we can test the multiplexer.

8)Now for the IC 74HC04 (Inverter) the data inputs are denoted by 1A, 2A and the data outputs1Y, 2Y.

9) Now for the IC 74HC11 (AND) the data inputs are denoted by 2A, 2B, 2C and so on and the data outputs by 2Y, 3Y.

10)Now for the IC 74HC32(OR) the data inputs are denoted by 1A,2A,1B,2B,3A,3B and data outputs by 1Y,2Y,3Y respectively.

11)Now write an Arduino code to give different combinations of inputs at input and select lines and view them using LED at the output line.

12)**CODE:**

```
int i0,i1,i2,i3, s1, s2;
void setup()
{
   pinMode(7, OUTPUT);
   pinMode(6, OUTPUT);
   pinMode(5, OUTPUT);
   pinMode(4, OUTPUT);
   pinMode(3, OUTPUT);
   pinMode(2, OUTPUT);
   Serial.begin(9600);
}
void loop()
{
        if(Serial.available() > 0)
    {
       i0 = Serial.read() - '0';
       i1 = Serial.read() - '0';
       i2 = Serial.read() - '0';
       i3 = Serial.read() - '0';
```

```
  Serial.read();
  s1 = Serial.read() - '0';
  s2 = Serial.read() - '0';
Serial.print("\n i0: ");
  Serial.print(i0);
  Serial.print("; i1: ");
  Serial.print(i1);
  Serial.print("; i2: ");
  Serial.print(i2);
  Serial.print("; i3: ");
  Serial.println(i3);
  digitalWrite(7, i0);
  digitalWrite(6, i1);
  digitalWrite(5, i2);
  digitalWrite(4, i3);
  digitalWrite(3, s1);
  digitalWrite(2, s2);

  if(s1 == 0 && s2 == 0)
    Serial.println("Select Bits: 00. Selecting i0");
  if(s1 == 0 && s2 == 1)
```

```
        Serial.println("Select Bits: 01. Selecting i1");
      if(s1 == 1 && s2 == 0)
        Serial.println("Select Bits: 10. Selecting i2");
      if(s1 == 1 && s2 == 1)
        Serial.println("Select Bits: 11. Selecting i3");
   }
    delay(100);
}
```

13) Verify the multiplexer function by tabulating the values of the output(s) for all input combinations.

CONCLUSION:

By the above code we find the output for all the inputs,Below truth table shows about the function of multiplexer.

MULTIPLEXER TRUTH TABLE		
INPUT		OUTPUT
S0	S1	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

From the above truth table, we can write the output expressions as

If S1=0 and S0=0 then Y = I 0

Therefore, Y = I_0(S1)' (S0)'

If S1= 0 and S0=1, the Y = I 1

Therefore, Y = I_1(S1)' (S0)'

If S1=1 and S0=0, then Y = I 2

Therefore, Y = I_2(S1)' (S0)'

If S1=1 and S0=1 the Y = I 3

Therefore, Y = $I_0$3S1)' (S0)'

To get the total data output from the multiplexer, all these product terms are to be summed and

then the final Boolean expression of this multiplexer is given as

$$Y = I_0(S1)' (S0)' + I_1(S1)' (S0)' + I_2(S1)' (S0)' + I_3(S1)' (S0)'$$

1)We understood multiplexer takes 4 inputs and give output in 4:1 MUX.And boolean expression is also verified

2)From this experiement,we designed ,assembled and tested a(4:1) Multiplexer using basic logic gtaes(whose select lines and inputs are through ardunio).

LINK FOR THE TINKERCAD SIMULATION:

https://www.tinkercad.com/things/lcBwOuuzMFe-lab3-part1/editel?sharecode=DBX7lLcoViR-WTC0l1oV5A4tJu2E0kEFHPqLDZH1-fI&sharecode=DBX7lLcoViR-WTC0l1oV5A4tJu2E0kEFHPqLDZH1-fI

PART-B: DEMULTIPLEXER

AIM/OBJECTIVE OF THE EXPERIEMENT:

To design, assemble and test a (4:1) Demultiplexer using basic logic gates (whose select lines and inputs are through Arduino).

ELECTRONIC COMPONENTS USED:

1)Ardunio Uno R3

2)Hex Inverter(74HCO4 IC)

3)2 Triple 3-input AND gates(74HC11 IC)

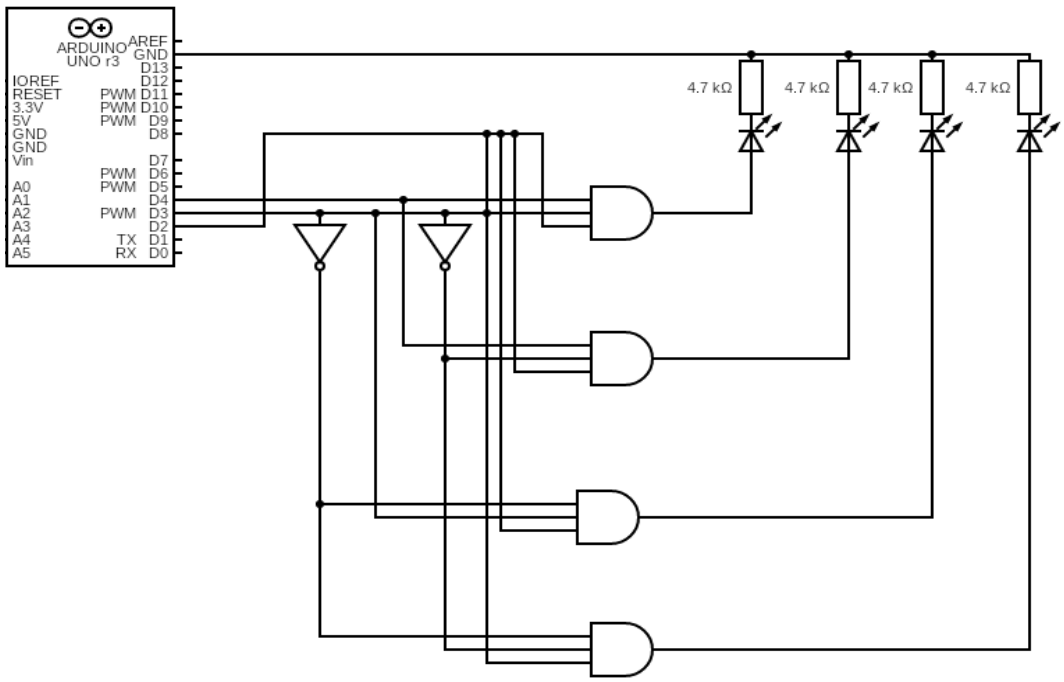
4)7-Leds

5)7-Resistors-1kΩ

6)Wires

7)Breadboard

REFERENCE CIRCUIT:



PROCEDURE:

1)Take the breadboard and ardunio,give GND and power conections to the breadboard through ardunio.

2)Place 74HC04IC and (2)74HC11 IC on the breadboard and give Vcc and GND connections to it.

3)Connect the any of the two pins(let's say pin2 and pin3) to breadboard i.e., S1 and S2 and give led connections to it to check s1 and s2.

4)Connect the circuit as shown in the circuit diagram.

5)Connect the input pin from ardunio to breadboard(let's say pin 4).

6)Now for the IC 74HC04 (Inverter) the data inputs are denoted by 1A, 2A and the data outputs1Y, 2Y.

7) Now for the both IC s 74HC11 (AND) the data inputs are denoted by 2A, 2B, 2C and so on and the data outputs by 2Y, 3Y.

8)Now connect the all data output pins to the led bulbs respectivly and name it as A,B,C,D.

9)Now write an Arduino code to give different combinations of inputs at input and select lines and view them using LED at the output line.

11)**CODE**:

```
int i0, s1, s0;
void setup()
{ pinMode(4, OUTPUT);
   pinMode(3, OUTPUT);
   pinMode(2, OUTPUT);
```

```
    Serial.begin(9600);
}
void loop()
{
 if(Serial.available() > 0)
     {
        i0 = Serial.read() - '0';
        Serial.read();
        s0= Serial.read() - '0';
        s1= Serial.read() - '0';
       Serial.print("\n i0: ");
        Serial.print(i0);
   Serial.print("\n s0: ");
        Serial.print(s0);
   Serial.print("\n s1: ");
        Serial.print(s1);
        digitalWrite(4, i0);
        digitalWrite(3, s0);
        digitalWrite(2, s1);
         if(s0== 0 && s1== 0)
          Serial.println("Select Bits: 00. Selecting A");
        if(s0== 0 && s1== 1)
```

```
        Serial.println("Select Bits: 01. Selecting B");
      if(s0= 1 && s1== 0)
        Serial.println("Select Bits: 10. Selecting C");
      if(s0== 1 && s1== 1)
        Serial.println("Select Bits: 11. Selecting D");
   }
    delay(100);
}
```

By using the above code we test the 1:4 Demultiplexer

10)Verify the multiplexer function by tabulating the values of the output(s) for all input combinations.

CONCLUSION:

DEMULTIPLEXER TRUTH TABLE						
INPUT			OUTPUT			
S1	S0	I	A	B	C	D
0	0	0	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	0	0
0	1	1	0	1	0	0
1	0	0	0	0	0	0
1	0	1	0	0	1	0
1	1	0	0	0	0	0
1	1	1	0	0	0	1

From the above truth table, we can write the output expressions as

If S1=0 and S0=0 then A= I

Therefore, A= I(S1)’ (S0)’

If S1= 0 and S0=1, the B= I

Therefore,B= I(S1)’ S0

If S1=1 and S0=0, then C= I

Therefore, C= IS1 (S0)’

If S1=1 and S0=1 the D= I

Therefore, D= IS1 S0

1)From the above truth table we verify that it gives output as like above mentioned expresssions.
2)Finally.I designed,assembled and tested (1:4)Demultiplexer using basic logic gates.
3)LED s are glowing according to this equation.
4) Multiplexer function is verified.

LINK FOR THE TINKERCAD SIMULATION:

https://www.tinkercad.com/things/7GcYfvyikr2-demultiplexer/editel?sharecode=55iY9-2041thLvViMOcorLqUHrDZnKLN6GD-4FRG3ww

PART-C

Assemble and test circuits designed in Part A and B

AIM/OBJECTIVE OF THE EXPERIEMENT:

To design, assemble and test a (1:4)Multiplexer and (4:1) Demultiplexer using basic logic gates (whose select lines and inputs are through Arduino).

ELECTRONIC COMPONENTS USED:

1)Ardunio Uno R3

2)2 Hex Inverters(74HCO4 IC)

3)2 Triple 3-input AND gates(74HC11IC)

4) 11-Leds

5) 11-Resistors-1kΩ

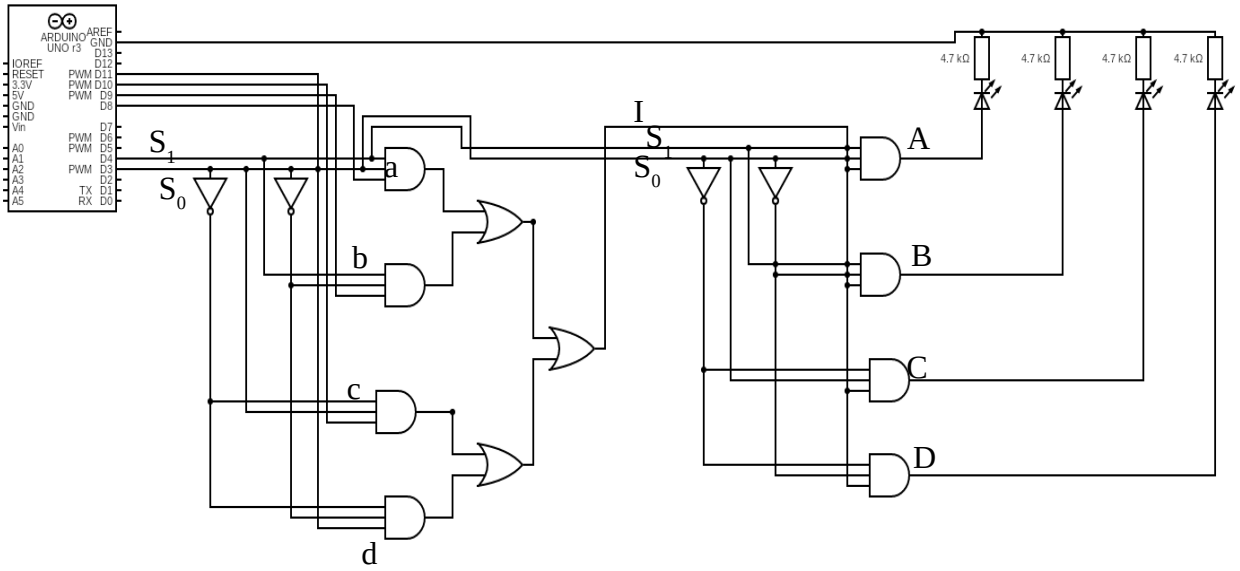
6) Wires

7)2 Breadboards

8)1 Breadboard small

9) Quad OR gate(74HC32 IC)

REFERENCE CIRCUIT:



PROCEDURE:

1)Take the 2 breadboards and 1 small breadboard and ardunio,give GND and power conections to the breadboard through ardunio.(Shown in reference circuit).

2)Place 74HC04IC ,(2)74HC11 IC and 74HC32IC on the one breadboard, SimilarlyPlace 74HC04IC ,(2)74HC11 IC on the another breadboard and give Vcc and GND connections to it.

3)Connect the any of the two pins(let's say pin2 and pin3) to small breadboard i.e., S1 and S2 and through the small ardunio give connections to the both ardunios.

4)Give all input and output connections from IC and to IC as shown in the circuit.(as like multiplexer and demultiplexer done in part A and part B)

5)Now for the IC 74HC04 (Inverter) the data inputs are denoted by 1A, 2A and the data outputs1Y, 2Y.

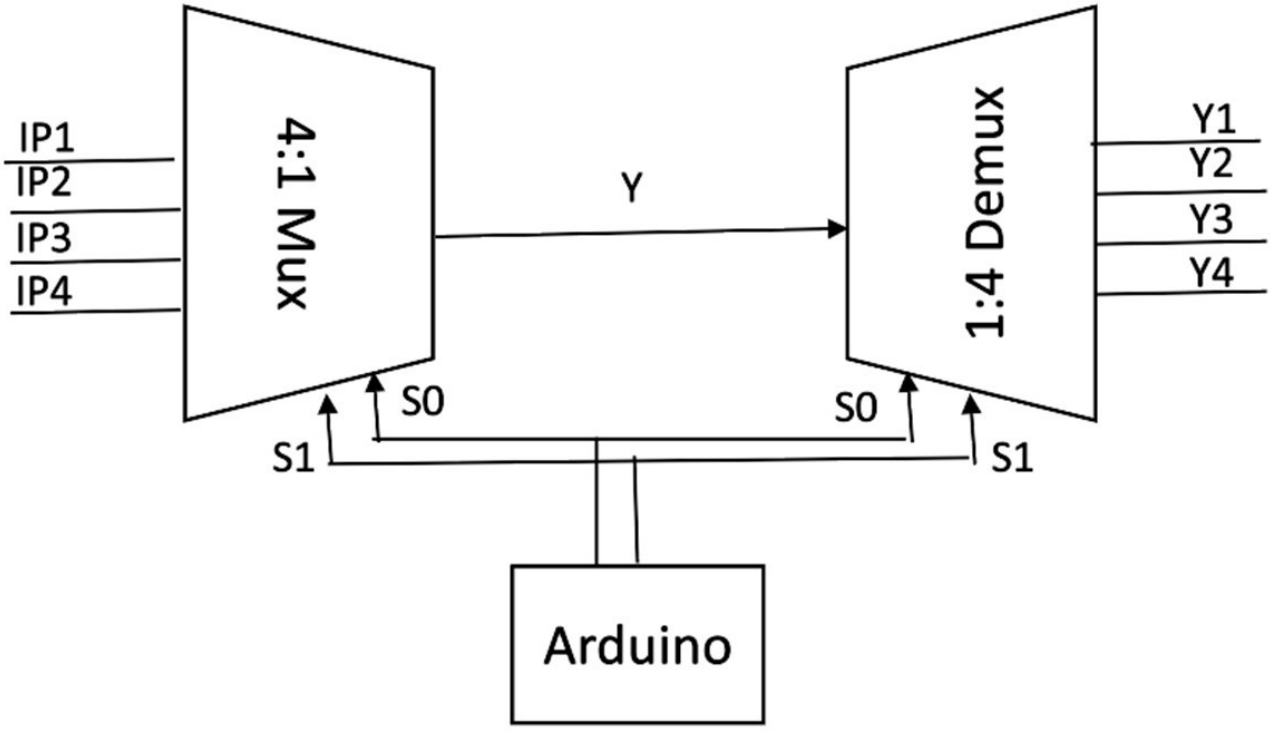
6) Now for the IC 74HC11 (AND) the data inputs are denoted by 2A, 2B, 2C and so on and the data outputs by 2Y, 3Y.

7)Now for the IC 74HC32(OR) the data inputs are denoted by 1A,2A,1B,2B,3A,3B and data outputs by 1Y,2Y,3Y respectively.(Note that this IC only for the Multiplexer)

8)Now connect the Multiplexer outpin to the Demultiplexer board and give connections to the input pins respectively as shown in the circuit.

9)Connect the output pins to the to the leds A,B,C,D respectively and give connections to the leds with resistors.

10)Block diagram for this circuit ,combination of MUX and DEMUX



10)Now write an Arduino code to give different combinations of inputs at input and select lines and view them using LED at the output line.

11)**CODE:**

```
int aPin = 8;

int bPin = 9;

int cPin = 10;

int dPin = 11;

int s0Pin = 3;

int s1Pin = 4;

int a, b, c, d, s0, s1;

void setup(){
```

```
pinMode(aPin, OUTPUT);
    pinMode(bPin, OUTPUT);
    pinMode(cPin, OUTPUT);
    pinMode(dPin, OUTPUT);
    pinMode(s0Pin, OUTPUT);
    pinMode(s1Pin, OUTPUT);
    Serial.begin(9600);
}
void loop()
{
 if(Serial.available() > 0)
     {
        a = Serial.read() - '0';
         b = Serial.read() - '0';
         c = Serial.read() - '0';
         d = Serial.read() - '0';
         Serial.read();
         s0 = Serial.read() - '0';
         s1 = Serial.read() - '0';
        Serial.print("\n A: ");
         Serial.print(a);
         Serial.print("; B: ");
         Serial.print(b);
         Serial.print("; C: ");
```

```
      Serial.print(c);
      Serial.print("; D: ");
      Serial.println(d);
      Serial.print(" s0: ");
      Serial.println(s0);
      Serial.print(" s1: ");
      Serial.println(s1);
     digitalWrite(aPin, a);
      digitalWrite(bPin, b);
      digitalWrite(cPin, c);
      digitalWrite(dPin, d);
      digitalWrite(s0Pin, s0);
      digitalWrite(s1Pin, s1);
      if(s0 == 0 && s1 == 0)
        Serial.println("Select Bits: 00. Selecting A");
      if(s0 == 0 && s1 == 1)
        Serial.println("Select Bits: 01. Selecting B");
      if(s0 == 1 && s1 == 0)
        Serial.println("Select Bits: 10. Selecting C");
      if(s0 == 1 && s1 == 1)
        Serial.println("Select Bits: 11. Selecting D");
    }
  delay(100);
}
```

CONCLUSION:

1)We combined both MUX and DEMUX . And we test the input and outputs for the combination of MUX and DEMUX .

2)It works on both the MUX and DEMUX function.

LINK FOR THE TINKERCAD SIMULATION:

https://www.tinkercad.com/things/8KL8cw2N25A-copy-of-demultiplexer/editel?sharecode=NK3OfKO3t2XXfpKxw1bfRV_6a-nlN4IBuxMqWCdIr2c