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LAB 4
DIGITAL SYSTEM AND MICROCONTROLLERS

AIM:

To design an Arithmetic and Logic Unit (ALU) capable of performing 8 arithmetic and logic functions using 1 bit operands .

F0	F1	F2	ALU function	Y1	Y0
0	0	0	Zero	-	0
0	0	1	A OR B	-	A+B
0	1	0	A AND B	-	A.B
0	1	1	A XOR B	-	A (+) B
1	0	0	A PLUS B	Carry	Sum
1	0	1	A MINUS B	Carry	Difference
1	1	0	A PLUS B PLUS C	Carry	Sum
1	1	1	A MINUS B MINUS C	Carry	Difference

Note : First 4 are Logic Functions generating output Y0 and next 4 are Arithmetic functions generating output Y1Y0 in two bits.

ELECTRONIC COMPONENTS :

1) Arduino
2) LED
3) Resistor
4) BreadBoard
5) Logic Gates

LINK TO THE REFERENCE CIRCUIT :

https://crcit.net/c/8d54bd3a06ed4af6b18412a69416554e

PROCEDURE:

1) There are two output bits - Y0 and Y1 which are generated using Multiplexers MUX0 and MUX1 respectively .
2) Here, MUX 0 is enabled always and MUX 1 is enabled only when F2 = 1 i.e for Arithmetic functions only because Carry and Borrow are only there for Arithmetic functions.
3) Verify theoretically that MUX 0 and MUX1 generate outputs Y0 and Y1 respectively.

4) Give F0,F1,F2,A,B,C as inputs to circuit from the arduino .
5) Apply all the combinations of the Function select inputs F2F1F0 one by one and tabulate the observed outputs Y0 and Y1 for as many combinations of the data inputs A, B, C as possible.
6) Code :

```
int F2,F1,F0,A,B,C;
void setup()
{
 pinMode(2, OUTPUT);
 pinMode(3, OUTPUT);
 pinMode(4, OUTPUT);
 pinMode(5, OUTPUT);
 pinMode(6, OUTPUT);
 pinMode(7, OUTPUT);
 Serial.begin(96000);
}

void loop()
{
 Serial.print("F2=");
 while(Serial.available()==0){};
 F2 = Serial.read();
 F2=F2-'0';
 Serial.println(F2);
 digitalWrite(2,F2);

 Serial.print("F1=");
 while(Serial.available()==0){};
 F1 = Serial.read();
 F1=F1-'0';
 Serial.println(F1);
 digitalWrite(3,F1);

 Serial.print("F0=");
 while(Serial.available()==0){};
 F0 = Serial.read();
 F0=F0-'0';
 Serial.println(F0);
 digitalWrite(4,F0);

 Serial.print("A=");
 while(Serial.available()==0){};
 A = Serial.read();
 A=A-'0';
```

```
  Serial.println(A);
  digitalWrite(5,A);

  Serial.print("B=");
  while(Serial.available()==0){};
  B = Serial.read();
  B=B-'0';
  Serial.println(B);
  digitalWrite(6,B);

  Serial.print("C=");
  while(Serial.available()==0){};
  C = Serial.read();
  C=C-'0';
  Serial.println(C);
  digitalWrite(7,C);

  Serial.println("Enter the values again");


}
```

CONCLUSION:

F2F1F0	AB : 00	01	10	11
000	Y0=0	Y0=0	Y0=0	Y0=0
001	Y0=0	Y0=1	Y0=1	Y0=1
010	Y0=0	Y0=0	Y0=0	Y0=1
011	Y0=0	Y0=1	Y0=1	Y0=0
100	Y0=0	Y0=1	Y0=1	Y0=0
	Y1=0	Y1=0	Y1=0	Y1=1
101	Y0=0	Y0=1	Y0=1	Y0=0
	Y1=0	Y1=1	Y1=0	Y1=0
110 C=0	Y0=0	Y0=1	Y0=1	Y0=0
	Y1=0	Y1=0	Y1=0	Y1=1

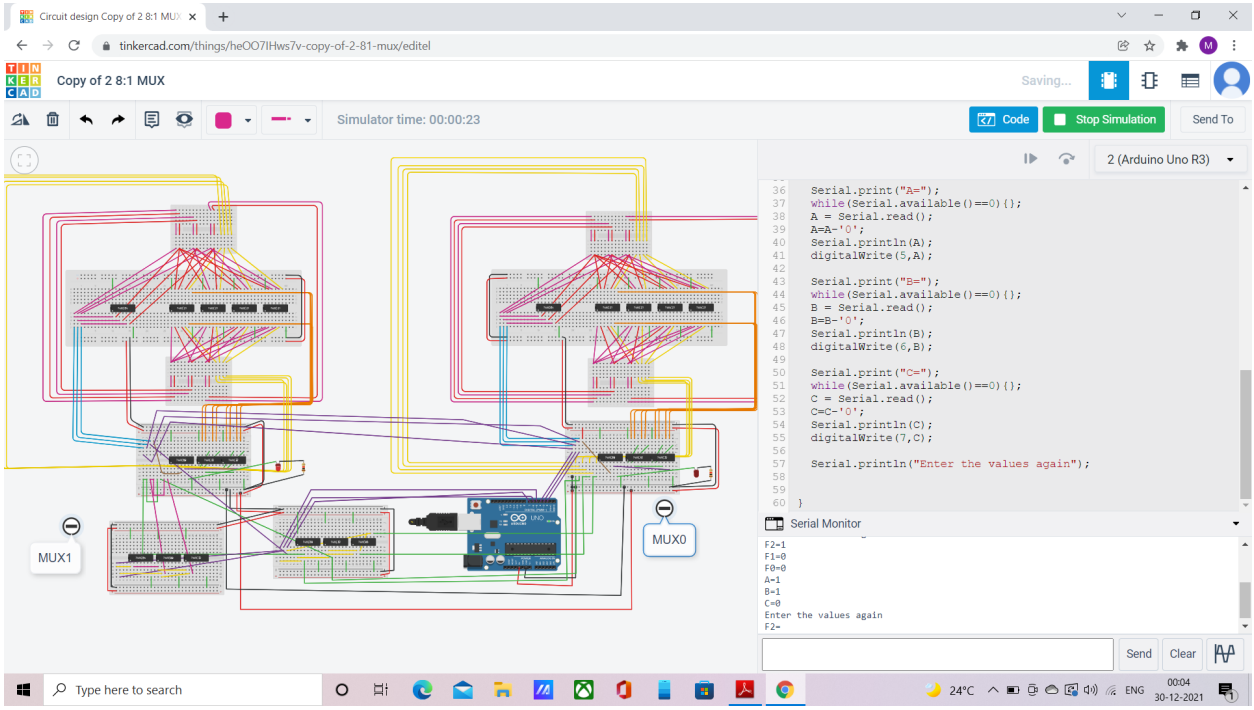
	C=1	Y0=1	Y0=0	Y0=0	Y0=1
		Y1=0	Y1=1	Y1=1	Y1=1
111	C=0	Y0=0	Y0=1	Y0=1	Y0=0
		Y1=0	Y1=1	Y1=0	Y1=0
	C=1	Y0=1	Y0=0	Y0=0	Y0=1
		Y1=1	Y1=1	Y1=0	Y1=1

LINK TO THE TINKERCAD SIMULATION :

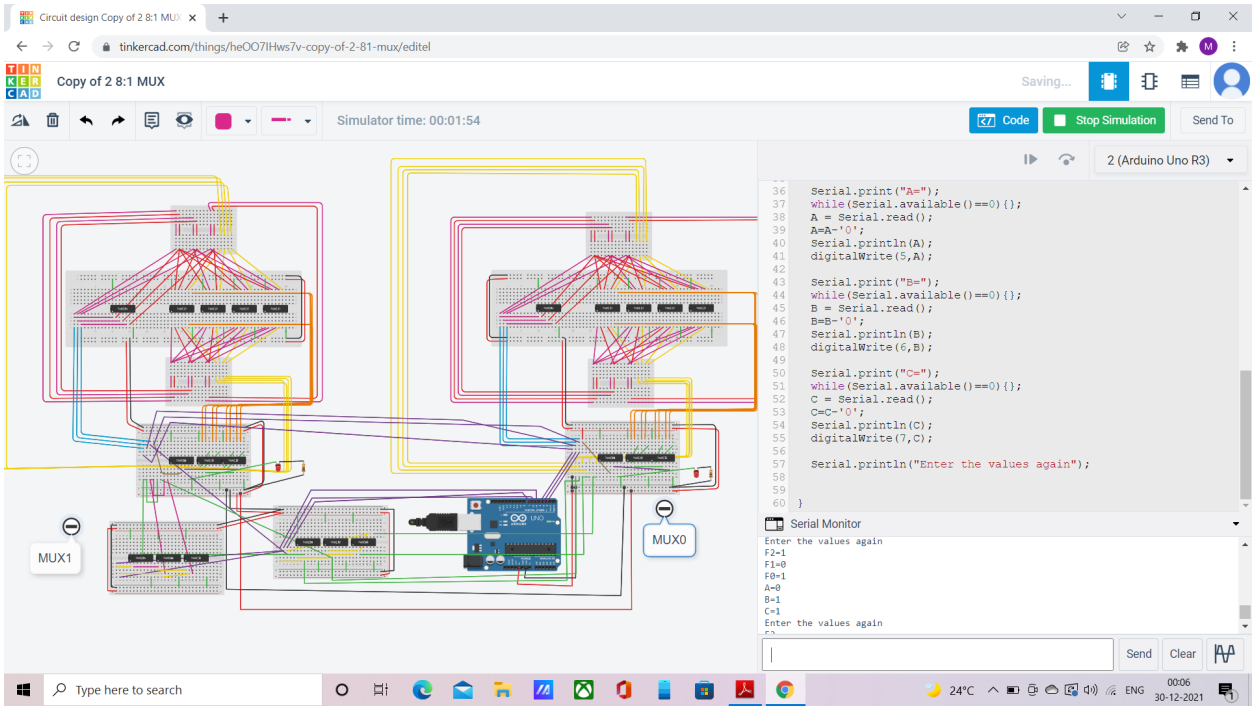
https://www.tinkercad.com/things/heOO7IHws7v-copy-of-2-81-mux/editel?sharecode=6kH5di6OBxZyapjKgIRBEeLNwK0Tx3l6MNuiy1f5Hgc

SCREENSHOTS OF OUTPUTS:

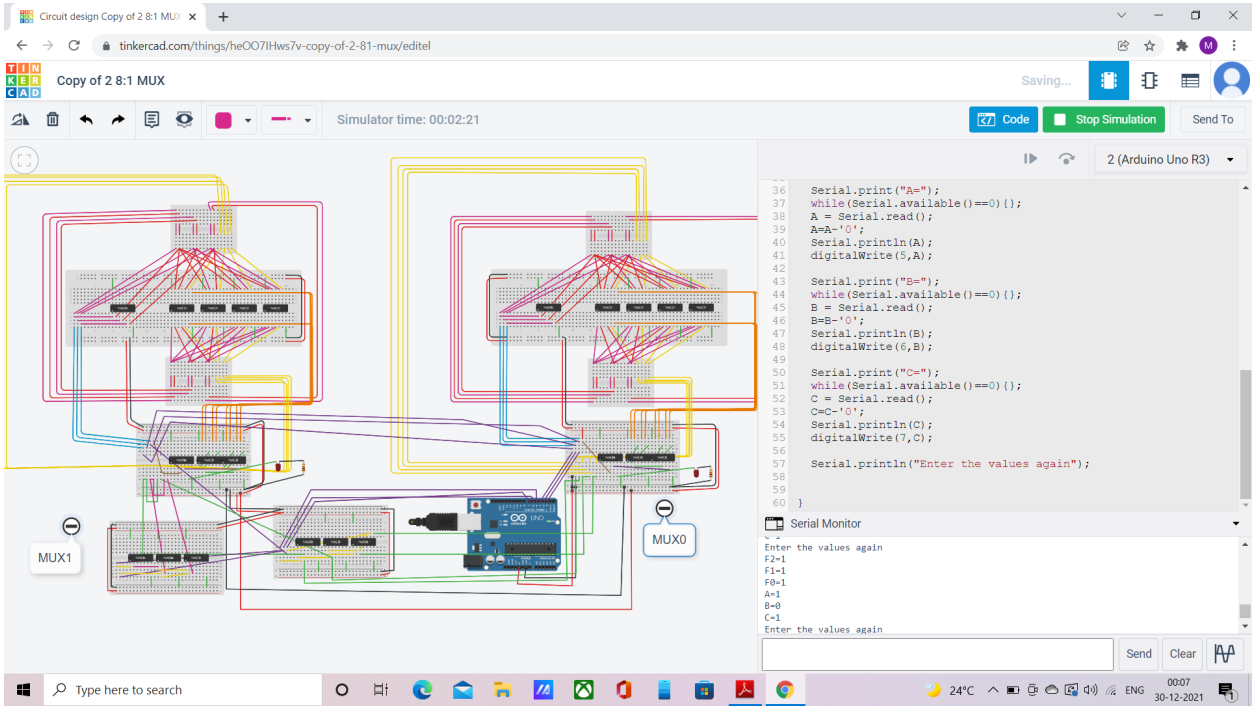
1)



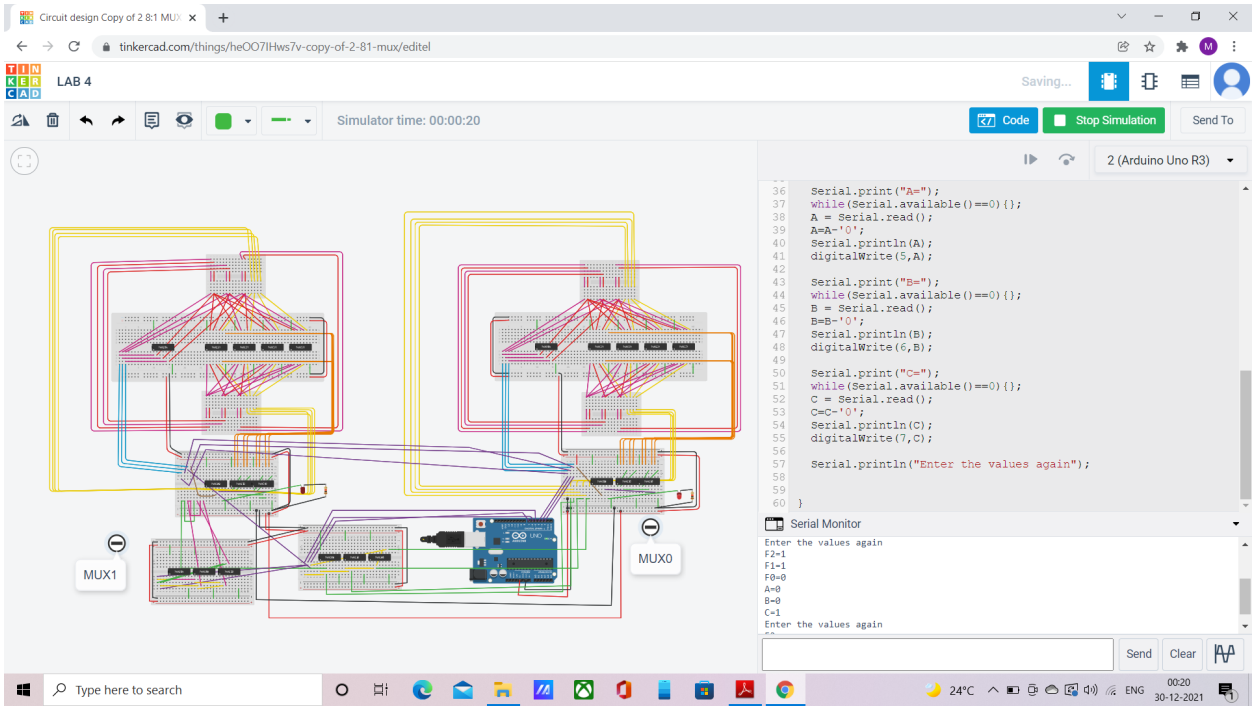
2)


Circuit design Copy of 2 8:1 MUX
tinkercad.com/things/heOO7IHws7v-copy-of-2-81-mux/editel
Copy of 2 8:1 MUX
Saving...
Simulator time: 00:01:54
Code
Stop Simulation
Send To
2 (Arduino Uno R3)
Serial.print("A=");
while(Serial.available()==0){};
A = Serial.read();
A=A-'0';
Serial.println(A);
digitalWrite(5,A);
Serial.print("B=");
while(Serial.available()==0){};
B = Serial.read();
B=B-'0';
Serial.println(B);
digitalWrite(6,B);
Serial.print("C=");
while(Serial.available()==0){};
C = Serial.read();
C=C-'0';
Serial.println(C);
digitalWrite(7,C);
Serial.println("Enter the values again");
}
Serial Monitor
Enter the values again
F2=1
F1=0
F0=1
A=0
B=1
C=1
Enter the values again
Send
Clear
MUX1
MUX0
Type here to search
24°C
ENG
00:06
30-12-2021

3)


Circuit design Copy of 2 8:1 MUX
tinkercad.com/things/heOO7IHws7v-copy-of-2-81-mux/editel
Copy of 2 8:1 MUX
Saving...
Simulator time: 00:02:21
Code
Stop Simulation
Send To
2 (Arduino Uno R3)
Serial.print("A=");
while(Serial.available()==0){};
A = Serial.read();
A=A-'0';
Serial.println(A);
digitalWrite(5,A);
Serial.print("B=");
while(Serial.available()==0){};
B = Serial.read();
B=B-'0';
Serial.println(B);
digitalWrite(6,B);
Serial.print("C=");
while(Serial.available()==0){};
C = Serial.read();
C=C-'0';
Serial.println(C);
digitalWrite(7,C);
Serial.println("Enter the values again");
}
Serial Monitor
Enter the values again
F2=1
F1=1
F0=1
A=1
B=0
C=1
Enter the values again
Send
Clear
MUX1
MUX0
Type here to search
24°C
ENG
00:07
30-12-2021

4)


Circuit design Copy of 2 8:1 MUX
tinkercad.com/things/heOO7IHws7v-copy-of-2-81-mux/editel
LAB 4
Saving...
Simulator time: 00:00:20
Code
Stop Simulation
Send To
2 (Arduino Uno R3)
Serial.print("A=");
while(Serial.available()==0){};
A = Serial.read();
A=A-'0';
Serial.println(A);
digitalWrite(5,A);
Serial.print("B=");
while(Serial.available()==0){};
B = Serial.read();
B=B-'0';
Serial.println(B);
digitalWrite(6,B);
Serial.print("C=");
while(Serial.available()==0){};
C = Serial.read();
C=C-'0';
Serial.println(C);
digitalWrite(7,C);
Serial.println("Enter the values again");
}
Serial Monitor
Enter the values again
F2=1
F1=1
F0=0
A=0
B=0
C=1
Enter the values again
Send
Clear
MUX1
MUX0
Type here to search
24°C
ENG
00:20
30-12-2021