

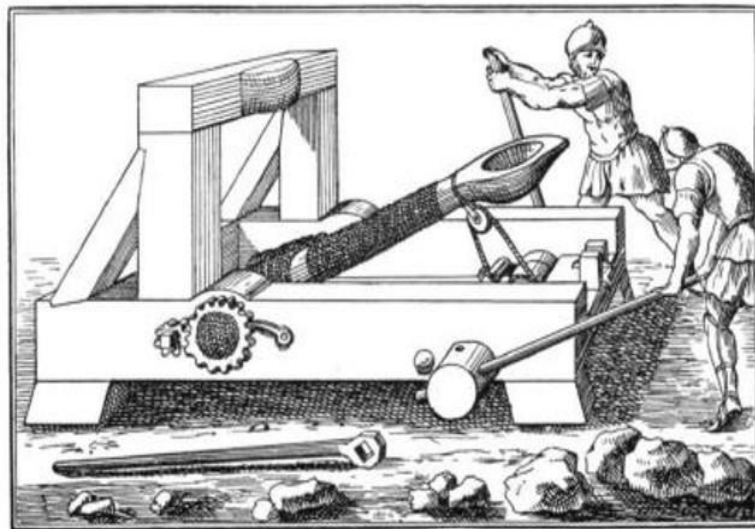


**DEPARTMENT  
OF  
ELECTRONICS AND COMMUNICATION ENGINEERING**



**THAPAR INSTITUTE**  
OF ENGINEERING & TECHNOLOGY  
(Deemed to be University)

**Handout/Assignment-  
for  
Engineering Design Project-I (UTA013)**



**INSTRUCTOR INCHARGE**



## ASSIGNMENT – 2 (A)

### STUDY OF IR SENSORS

#### Exercise 1

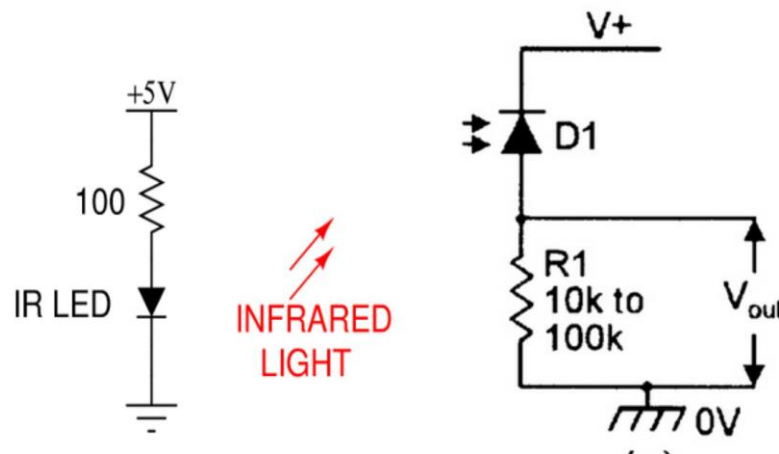
- A. Demonstrate the working of IR sensors and receiver and display output using LED.
- B. Use the two pair IR sensors of Mangonel to combine the two sensors output into one signal.

#### Hardware

- Bread Board, Power supply
- Resistances and LED
- IR transmitter and Receiver (Photodiode), Single core connecting wires

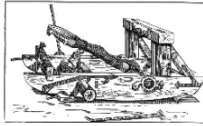
#### Theory

The figure below shows an IR pair in which IR LED emits infrared light which is received by photo diode D1 and the output voltage across resistor R1 is high. When we block the flow of light then the output voltage becomes low.



#### Reflections (Conclusions):

We have verified the working of an IR pair (IR LED and IR photodetector). This pair works as a sensor and can be used in the mangonel to sense movement.



## ASSIGNMENT – 2(B)

**Exercise 1** – To verify the functional table of CD4543

### Hardware Required

- Decoder (CD4543)
- Seven Segment Display
- Single core connecting wires

### Theory

The decoder (CD4543) is a combinational digital circuit that decodes an 4-bit binary input in the range 0000-1001 (BCD) in to its corresponding decimal level. Example for the binary value 0101 we need to display 5. Hence the decoder will output a HIGH on segments (a, c, d, f and g) with output a LOW on segments (b and e). The latch signal is normally connected to 5V via 10Kohm resistor as per the circuit diagram. This allows the decoder to decode the present binary input (the latch is said to be in a transparent state). When the latch is connected to 0V via the jumper provided its logic state changes to a LOW and the decoder will decode the binary input prior to the latch going low (i.e. the display is frozen when the latch is LOW).

### Schematic Diagram

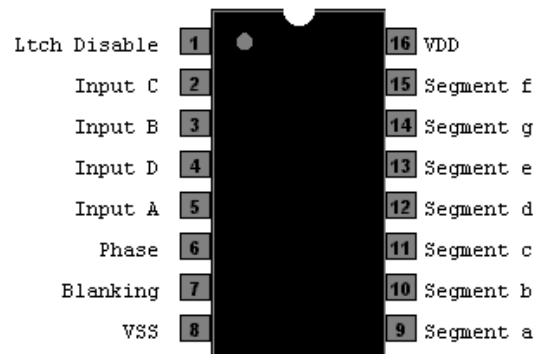
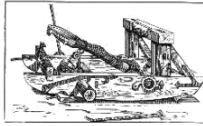


Figure 1: Pin diagram of CD4543

Truth table of CD4543B for Common Cathode Seven Segment Display.														
LD	BL	PH	D	C	B	A	a	b	c	d	e	f	g	DISPLAY
1	0	0	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0	1	1	0	0	0	0	1
1	0	0	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	0	0	1	1	1	1	1	1	0	0	1	3
1	0	0	0	1	0	0	0	1	1	0	0	1	1	4
1	0	0	0	1	0	1	1	0	1	1	0	1	1	5
1	0	0	0	1	1	0	1	0	1	1	1	1	1	6
1	0	0	0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	0	0	1	1	1	1	1	0	1	1	9

Figure 2: Functional table of CD4543



## Exercise 2 – BCD (binary coded decimal) to 7 Segment Display

### Hardware Required

- Decoder (CD4543)
- Seven Segment Display
- Single core connecting wires
- Arduino Uno

### Theory

The decoder (CD4543) is a combinational digital circuit that decodes an 4-bit binary input in the range 0000-1001 (BCD) in to its corresponding decimal level. Example for the binary value 0101 we need to display 5. Hence the decoder will output a HIGH on segments (a, c, d, f and g) with output a LOW on segments (b and e). The latch signal is normally connected to 5V via 10Kohm resistor as per the circuit diagram.

This allows the decoder to decode the present binary input (the latch is said to be in a transparent state). When the latch is connected to 0V via the jumper provided its logic state changes to a LOW and the decoder will decode the binary input prior to the latch going low (i.e. the display is frozen when the latch is LOW).

### Schematic Diagram

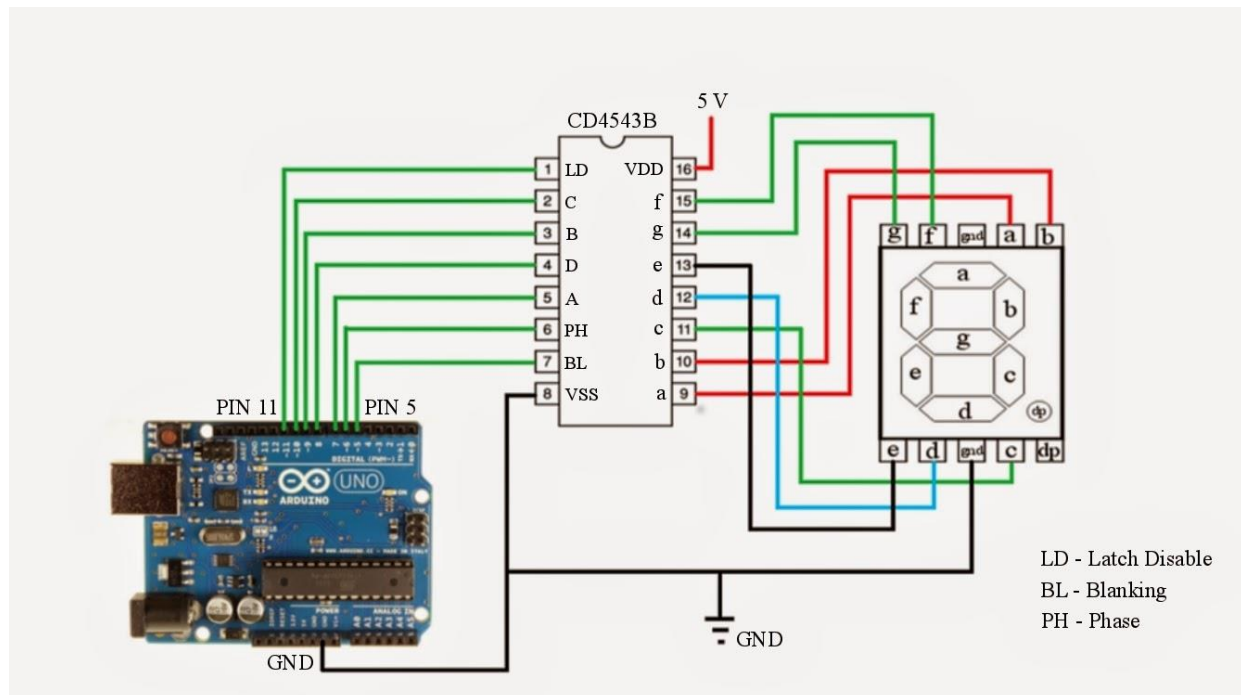
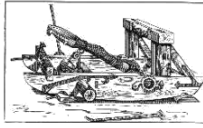


Figure 1: Connection setup for converting BCD input to seven segment output.



### Reflections (Conclusions):

Now we are able to convert BCD to 7 segment display.

**Exercise 3** – Write an Arduino sketch to display the last digit of your Roll Number on the 7-segment display using Tinkercad

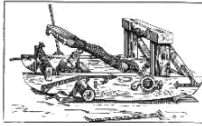
### Hardware Required

- Decoder (CD4543)
- Seven Segment Display
- Single core connecting wires
- Arduino Uno
- Tinkercad Software tool (<https://www.tinkercad.com/>)

**Theory** (Write the theory as per your understanding during self-effort and lab hours)

The decoder is CD 4543 is combinational digital circuit that decodes a 4-bit binary input in the range 0000 - 1001 (BCD) into its corresponding decimal level. The 7-segmented display is a form of electronic display for displaying decimal numerals that is an alternative to the more complex dot matrix. My Roll no. is 102003241, 1 is the last digit and therefore I display 1 on the 7-segment display. The latch signal is connected to the 5V via 1K $\Omega$  resistor as shown in the circuit diagram. This allows the decoder to decode the present binary input (the latch is said to be in transparent state). When the latch is connected to 0V, its logic state changes to low. Hence, with the help of decoding decoder & 7 segment display, we can display any digit n in the display.



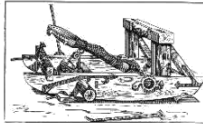


Code:

```
void setup()
{
    pinMode ( 2, OUTPUT);
    pinMode ( 3, OUTPUT);
    pinMode ( 4, OUTPUT);
    pinMode ( 5, OUTPUT);
}

void loop()
{
    int i = 1;
    int a = ( i / 2 );
    int b = ( ( i / 2 ) % 2 );
    int c = ( ( i / 4 ) % 2 );
    int d = ( ( i / 8 ) % 2 );
    digitalWrite ( 2, a );
    digitalWrite ( 3, b );
    digitalWrite ( 4, c );
    digitalWrite ( 5, d );
    delay ( 1000 );
}
```





Arduino sketch to display the last digit of your Roll Number - 1

Simulator time: 00:00:10

Code Stop Simulation Export Share

1 (Arduino Uno R3)

```

1 // C++ code
2 //
3 void setup()
4 {
5   pinMode(2, OUTPUT);
6   pinMode(3, OUTPUT);
7   pinMode(4, OUTPUT);
8   pinMode(5, OUTPUT);
9 }
10
11 void loop()
12 {
13   int i=1;
14   int a = (i%2);
15   int b = ((i/2)%2);
16   int c = ((i/4)%2);
17   int d = ((i/8)%2);
18   digitalWrite(2, a);
19   digitalWrite(3, b);
20   digitalWrite(4, c);
21   digitalWrite(5, d);
22   delay(1000);
23 }

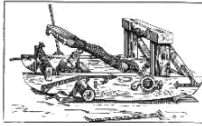
```

Serial Monitor

## Reflections:

With the help of CD 4543, Arduino, angle core, connecting wires, we were able to use 7-segment display to show us the last digit our roll-no. My Roll-No is 102003241, so on 7-segment display, 1 was shown.





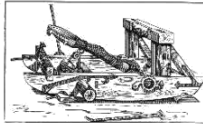
### Assignment Tasks:

- Using Tinkercad, write an Arduino sketch to make an up counter which counts from 0 to 9 & repeat it infinitely.

### Code:

```
void setup()
{
    pinMode ( 2 , OUTPUT);
    pinMode ( 3 , OUTPUT);
    pinMode ( 4 , OUTPUT);
    pinMode ( 5 , OUTPUT);
}

void loop()
{
    int n;
    for ( n = 0; n <= 9; n++)
    {
        int i = n;
        int a = ( i / 2);
        int b = ( ( i / 2) / 2);
        int c = ( ( i / 4) / 2);
        int d = ( ( i / 8) / 2);
        digitalWrite ( 2 , a);
        digitalWrite ( 3 , b);
        digitalWrite ( 4 , c);
        digitalWrite ( 5 , d);
        delay ( 1000);
    }
}
```



## Tinkercad Snapshots:

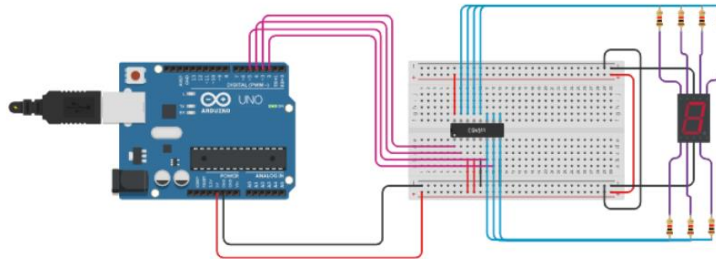
Infinitely repeating counter which counts from 0 to 9



design by:  
**Meharamt Singh**

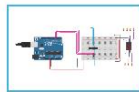
Edited 9/13/21, Created 9/7/21

Tinker this



Simulate

Add Image



This is an original of Infinitely repeating counter which counts from 0 to 9 by Meharamt Singh.

Infinitely repeating counter which counts from 0 to 9

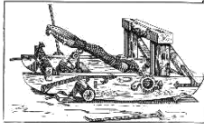
Simulator time: 00:00:03

Code Stop Simulation Export Share

1 (Arduino Uno R3)

```
1 // C++ code
2 //
3 void setup()
4 {
5   pinMode(2, OUTPUT);
6   pinMode(3, OUTPUT);
7   pinMode(4, OUTPUT);
8   pinMode(5, OUTPUT);
9 }
10
11 void loop()
12 {
13   int x;
14   for (x=0; x<=9; x++)
15   {
16     int i=x;
17     int a = (i*2);
18     int b = ((i/2)*2);
19     int c = ((i/4)*2);
20     int d = ((i/8)*2);
21     digitalWrite(2, a);
22     digitalWrite(3, b);
23     digitalWrite(4, c);
24     digitalWrite(5, d);
25     delay(1000);
26   }
27 }
```

Serial Monitor



### Reflections (Conclusions):

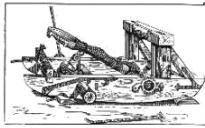
With the help of for loop in Arduino's coding language, we were able to display all the numbers from 0-9 at a delay of 1000 ms.

- Using Tinkercad, write an Arduino sketch to make an up counter which counts from 9 to 0 & repeat it infinitely.

### Code:

```
void setup()
{
    pinMode (2, OUTPUT);
    pinMode (3, OUTPUT);
    pinMode (4, OUTPUT);
    pinMode (5, OUTPUT);
}

void loop()
{
    int n;
    for ( n = 9; n >= 0; n--)
    {
        int i = n;
        int a = (i/2);
        int b = ((i/2)/2);
        int c = (((i/4)/2));
        int d = (((i/8)/2));
        digitalWrite (2, a);
        digitalWrite (3, b);
        digitalWrite (4, c);
        digitalWrite (5, d);
        delay (1000);
    }
}
```



## Tinkercad Snapshots:

Infinitely repeating counter which counts from 9 to 0

design by: **Meharamt Singh**

Edited 9/13/21, Created 9/13/21

[Tinker this](#)

[Simulate](#) [Add Image](#)

This is an original of Infinitely repeating counter which counts from 9 to 0 by Meharamt Singh.

Infinitely repeating counter which counts from 9 to 0

All changes saved

Simulator time: 00:00:09

[Code](#) [Stop Simulation](#) [Export](#) [Share](#)

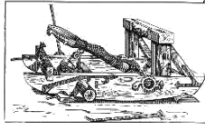
1 (Arduino Uno R3)

```
// C++ code
//
void setup()
{
  pinMode(2, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
}

void loop()
{
  int x;
  for (x=9;x>=0;x--)
  {
    int i=x;
    int a = (i%2);
    int b = ((i/2)%2);
    int c = ((i/4)%2);
    int d = ((i/8)%2);
    digitalWrite(2, a);
    digitalWrite(3, b);
    digitalWrite(4, c);
    digitalWrite(5, d);
    delay(1000);
  }
}
```

Serial Monitor





### Reflections (Conclusions):

with the help of for loop in Arduino's coding language, we were able to display all the numbers from 0-9 at a delay of 1000ms.