Final Lab Record

submitted by

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CSE-B

for the completion
of

CSLR 61
Embedded Systems Laboratory

Contents

Lab 1 (31-01-2022)

1. Blink LEDs in alternate order – 1 and 3 together and 2 and 4 together.
2. Blink LEDs – count from 1 to 15; if the board is counting odd value, wait for 1 sec, else wait for 2 sec.
3. Blink LEDs – for all composite number below 15.
4. Blink LEDs – to count even numbers

1. Blink LEDs in alternate order – 1 and 3 together and 2 and 4 together.

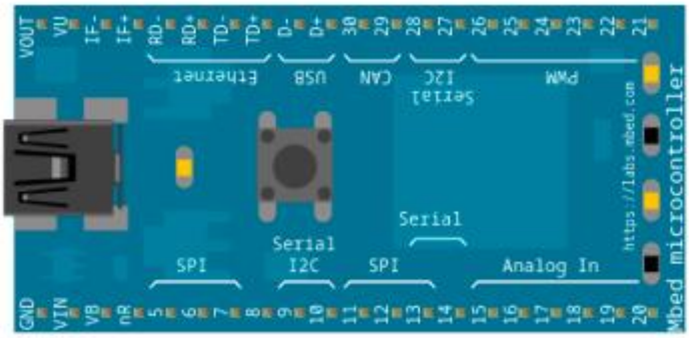
Aim:

To blink LEDs in alternate order – 1 and 3 should blink together and 2 and 4 should blink together.

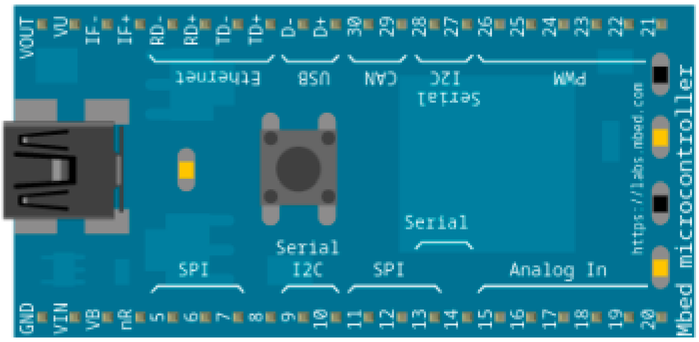
Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);

int main()
{
    while (1)
    {
        // 1010
        // 0101
        int arr[] = {10, 5};
        for (int i = 0; i < sizeof(arr) / sizeof(int); i++)
        {
            myleds = arr[i];
            wait(1);
        }
    }
}
```

Outputs:



VOUT VU IF- IF+ RD- RD+ TD- TD+ D- D+ 30 29 28 27 26 25 24 23 22 21
Ethernet
USB
CAN
I2C
Serial
PWM
Serial
Serial
I2C
SPI
SPI
Analog In
https://labs.mbed.com
Mbed microcontroller
GND VIN VB nR 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20



VOUT VU IF- IF+ RD- RD+ TD- TD+ D- D+ 30 29 28 27 26 25 24 23 22 21
Ethernet
USB
CAN
I2C
Serial
PWM
Serial
Serial
I2C
SPI
SPI
Analog In
https://labs.mbed.com
Mbed microcontroller
GND VIN VB nR 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

2. Blink LEDs – count from 1 to 15; if the board is counting odd value, wait for 1 sec, else wait for 2 sec.

Aim

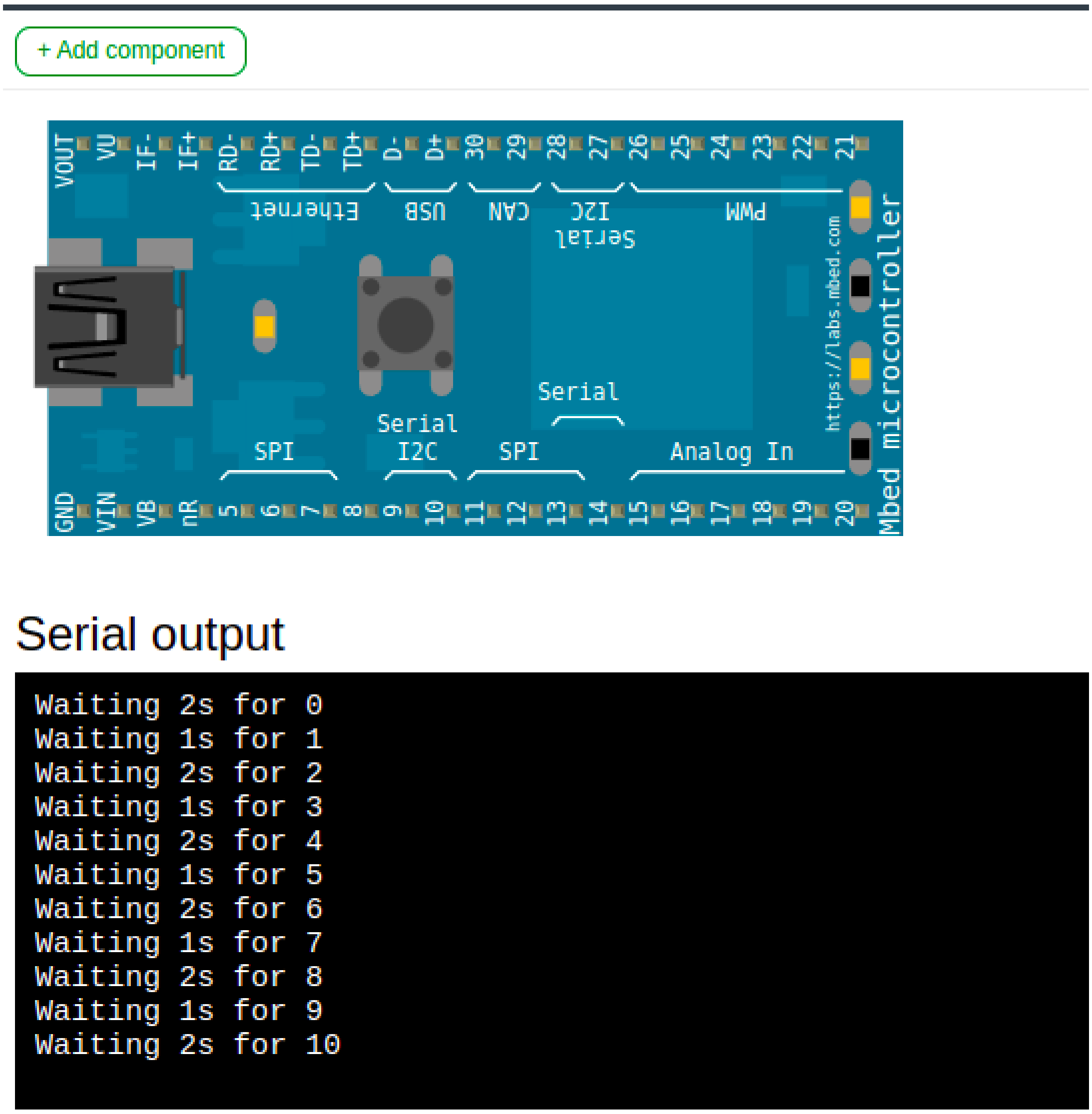
To blink LEDs and count from 1 to 15. If the board is counting odd value, it should wait for 1 sec, else it should wait for 2 sec.

Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);

int main()
{
   while (1)
   {
      for (int i = 0; i < 16; i++)
      {
         myleds = i;
         if (i % 2 == 1)
         {
            printf("Waiting 1s for %d\n", i);
            wait(1);
         }
```

```
            else
            {
               printf("Waiting 2s for %d\n", i);
               wait(2);
            }
         }
      }
   }
```

Outputs:



Serial output

```
Waiting 2s for 0
Waiting 1s for 1
Waiting 2s for 2
Waiting 1s for 3
Waiting 2s for 4
Waiting 1s for 5
Waiting 2s for 6
Waiting 1s for 7
Waiting 2s for 8
Waiting 1s for 9
Waiting 2s for 10
```

3. Blink LEDs – for all composite number below 15.

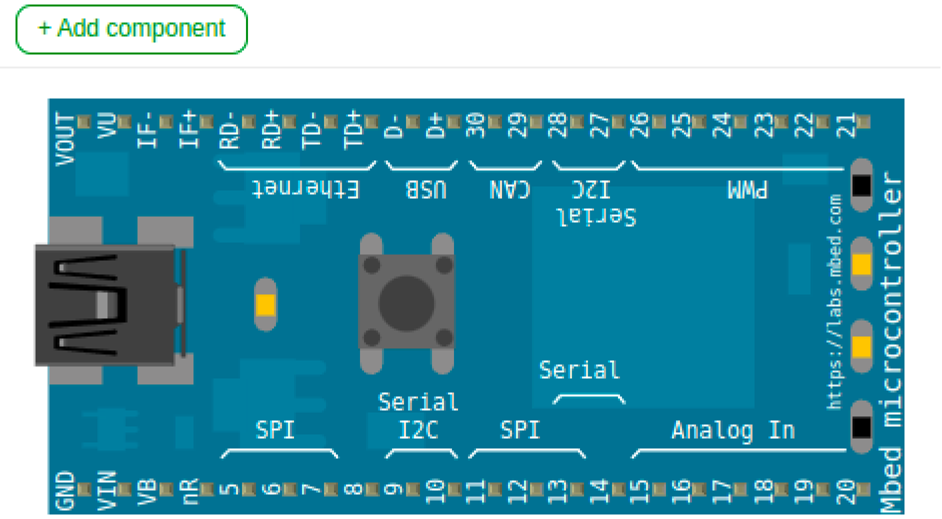
Aim:

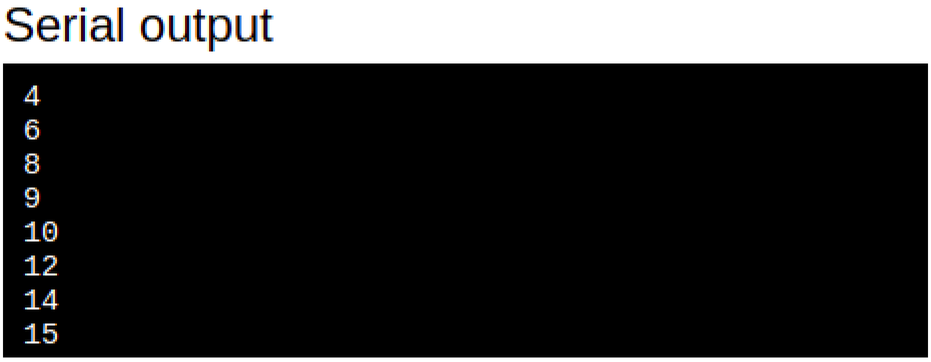
To blink LEDs for all composite numbers below 15.

Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);

bool isComposite(int n)
{
    if (n == 1)
        return false;
    for (int i = 2; i * i <= n; ++i)
    {
        if (n % i == 0)
            return true;
    }
    return false;
}
int main()
{
    while (1)
    {
        for (int i = 1; i < 16; i++)
        {
            if (isComposite(i))
            {
                printf("%d\n", i);
                myleds = i;
                wait(1);
            }
        }
    }
}
```

Output:





Serial output

```
4
6
8
9
10
12
14
15
```

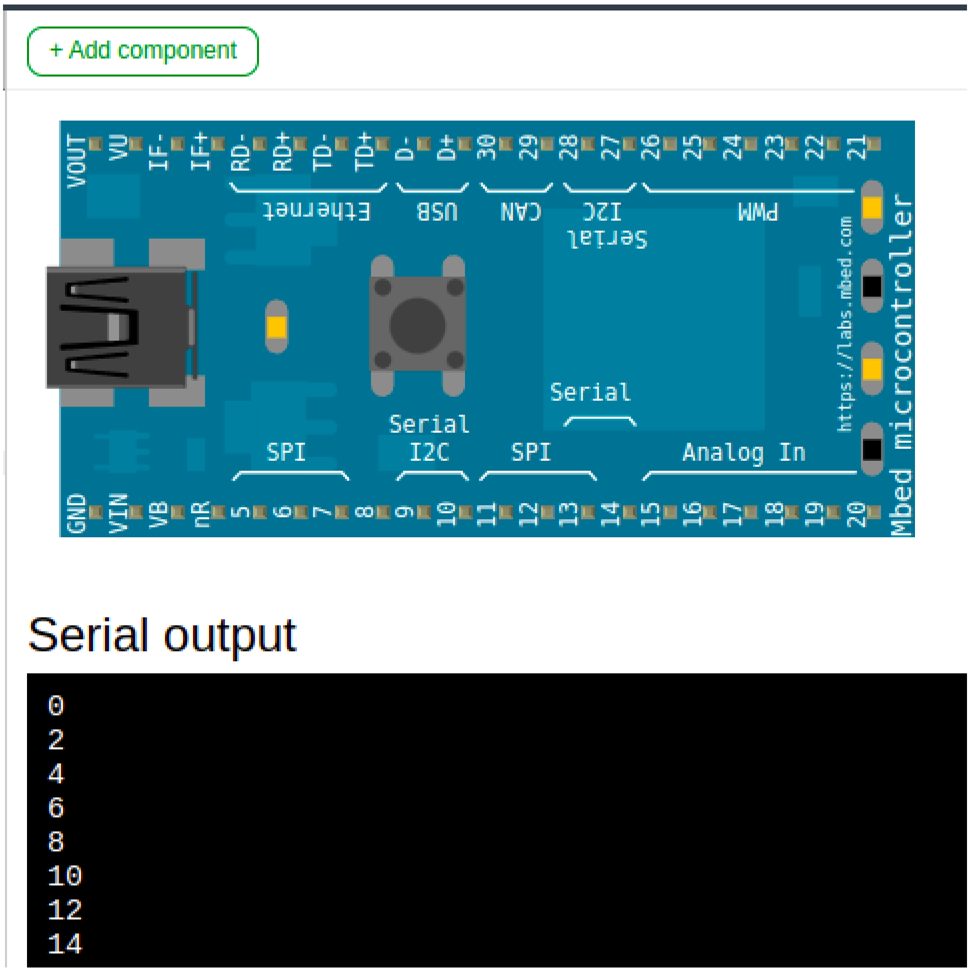
4. Blink LEDs – to count even numbers.

Aim:
To blink LEDs to count even numbers

Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);

int main()
{
    while (1)
    {
        for (int i = 0; i < 16; i += 2)
        {
            printf("%d\n", i);
            myleds = i;
            wait(0.5);
        }
    }
}
```

Output:



Serial output

```
0
2
4
6
8
10
12
14
```

Lab2 (07-02-2022)

1. Switch between hex counter and decade counter using switches. Display the current value of the counter with the help of 4 LEDs and the screen. Libraries Used: InterruptIn, BusOut
2. Display the octal counter using the onboard LEDs using Ticker Object; After 10 second, reset all the values of the onboard LED using Timeout Object. Libraries Used: TimeOut, Ticker
3. Display the odd counter using the onboard LEDs and screen; After 10 seconds, reset all the values of the onboard LED and display even counter using Timeout Object. Give switch option to manually toggle between two counters. Libraries Used: InterruptIn, Ticker, TimeOut, BusOut

1. Switch between hex counter and decade counter using switches. Display the current value of the counter with the help of 4 LEDs and the screen. Libraries Used: InterruptIn, BusOut

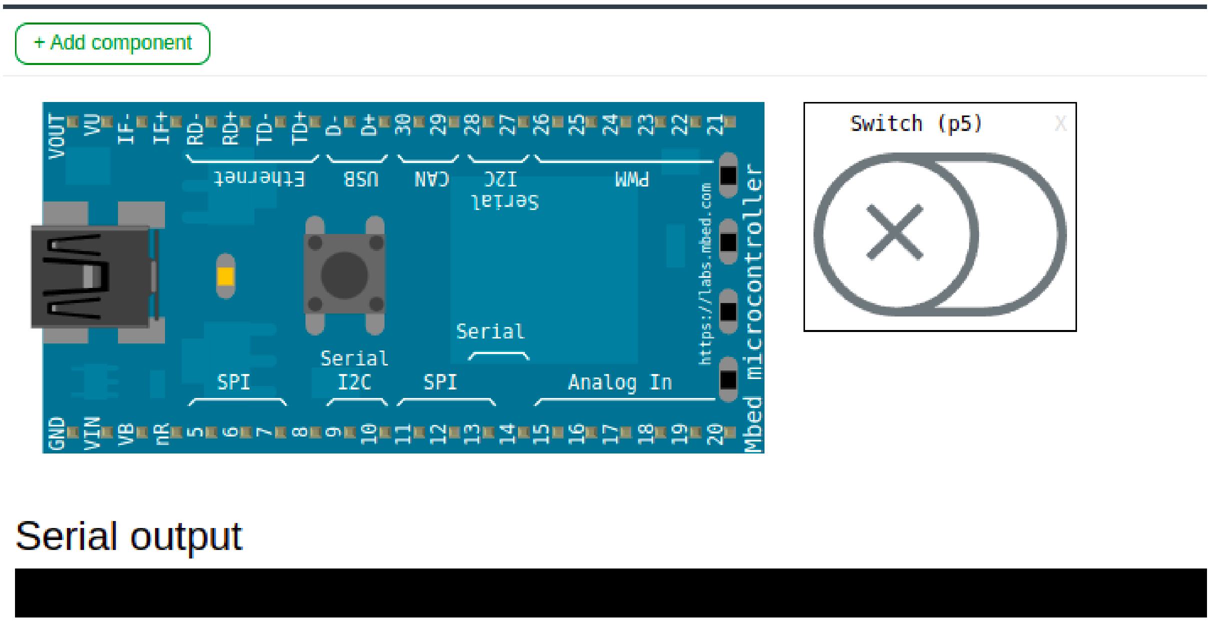
Aim:

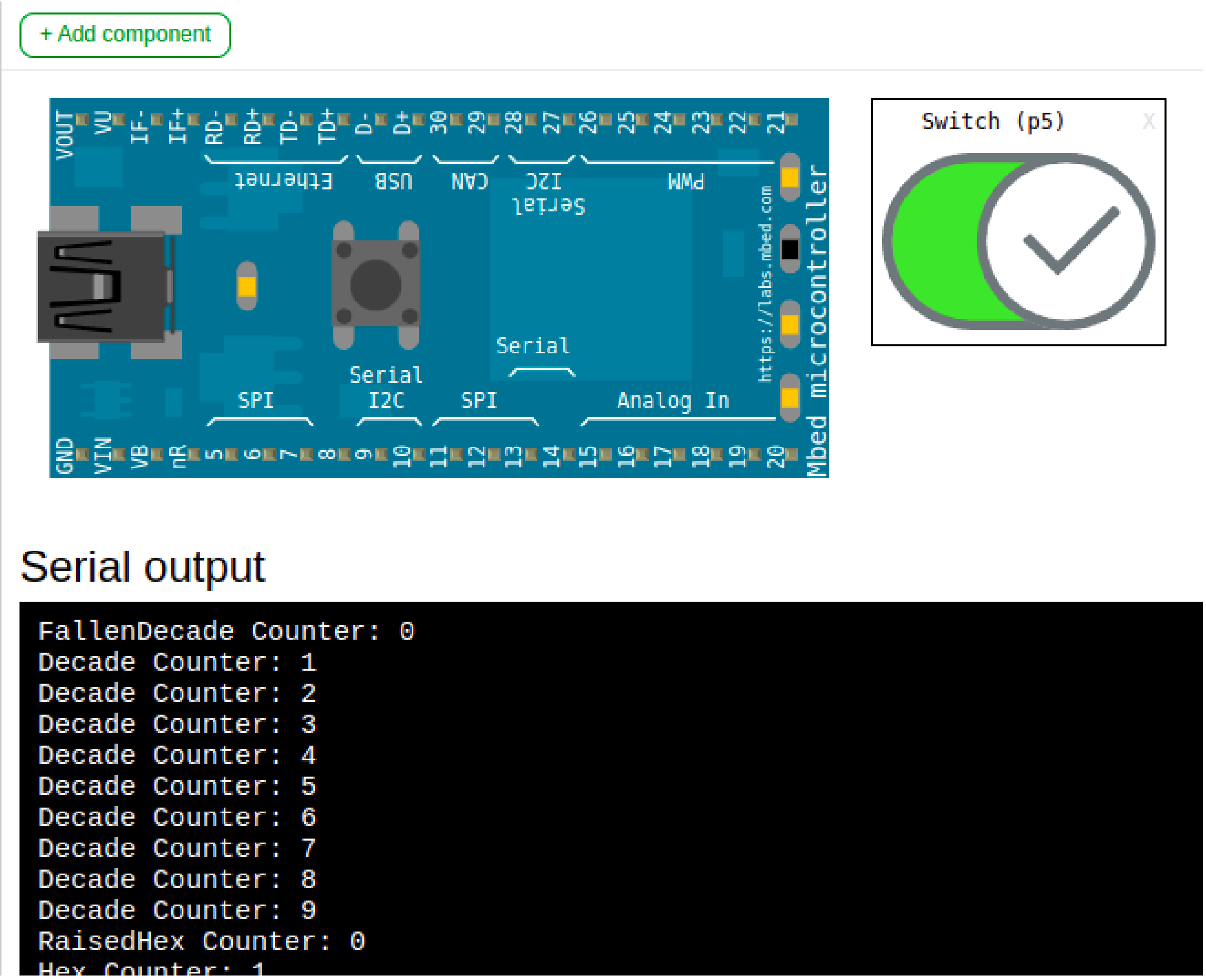
To switch between hex counter and decade counter using switches. It must display the current value of the counter with the help of 4 LEDs and the screen

Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);
InterruptIn button(p5);

void hex_counter()
{
   printf("Raised");
   while (1)
   {
      for (int i = 0; i < 16; i++)
      {
         myleds = i;
         printf("Hex Counter: %d\n", i);
         wait(0.5);
      }
   }
}
void dec_counter()
{
   printf("Fallen");
   while (1)
   {
      for (int i = 0; i < 10; i++)
      {
            myleds = i;
            printf("Decade Counter: %d\n", i);
            wait(0.5);
        }
    }
}
int main()
{
    button.rise(&hex_counter);
    button.fall(&dec_counter);
}
```

Output:





Serial output

```
FallenDecade Counter: 0
Decade Counter: 1
Decade Counter: 2
Decade Counter: 3
Decade Counter: 4
Decade Counter: 5
Decade Counter: 6
Decade Counter: 7
Decade Counter: 8
Decade Counter: 9
RaisedHex Counter: 0
Hex Counter: 1
```

2. Display the octal counter using the onboard LEDs using Ticker Object; After 10 second, reset all the values of the onboard LED using Timeout Object. Libraries Used: TimeOut, Ticker

Aim

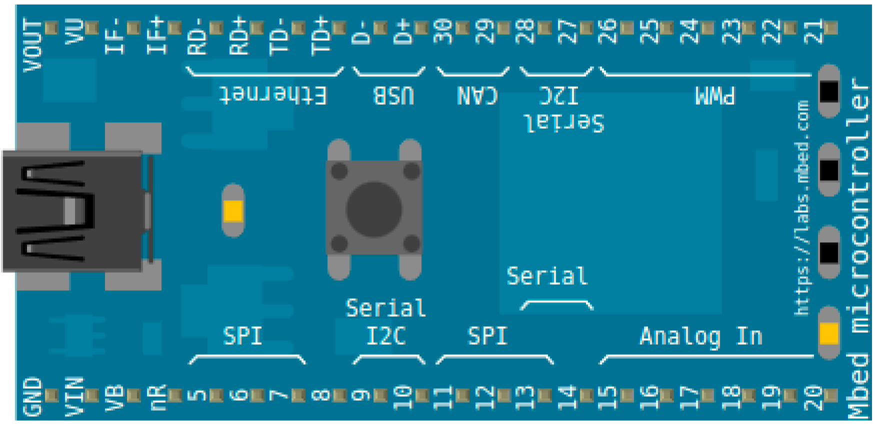
To display the octal counter using the onboard LEDs using Ticker object. After 10 second, it must reset all the values of the onboard LED using timeout Object.

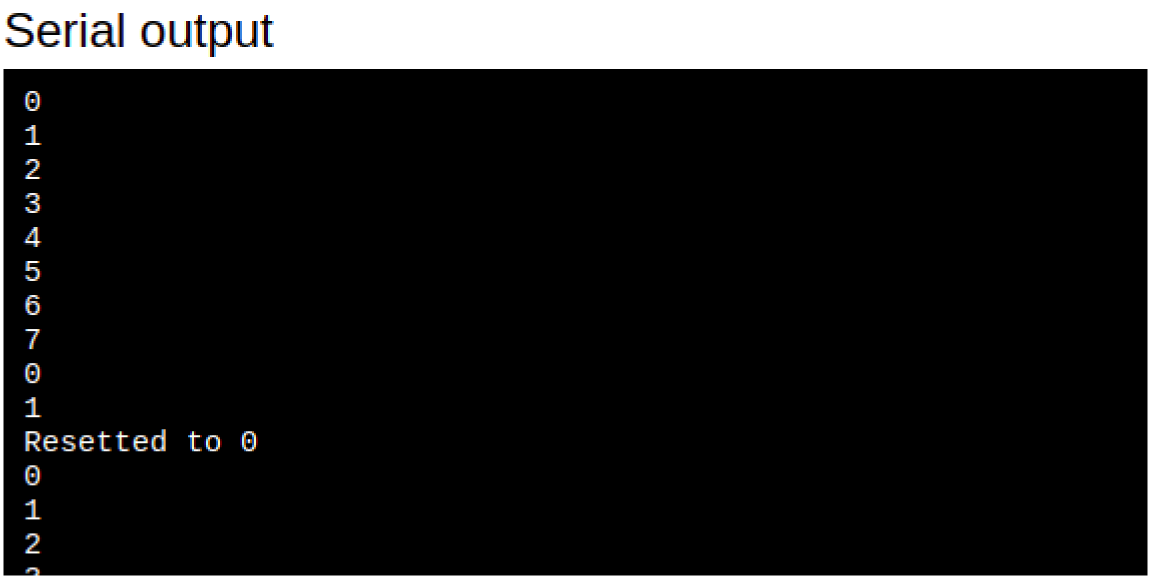
Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);
Ticker tk;
Timeout to;

int curr = 0;
void oct_counter()
{
   myleds = curr;
   printf("%d \n", curr);
```

```
    curr += 1;
    curr %= 8;
}
void reset()
{
    curr = 0;
    printf("Resetted to 0\n");
}
int main()
{
    tk.attach(&oct_counter, 1.0);
    to.attach(&reset, 10.0);
}
```

Output:





Serial output

```
0
1
2
3
4
5
6
7
0
1
Resetted to 0
0
1
2
```

3. Display the odd counter using the onboard LEDs and screen; After 10 seconds, reset all the values of the onboard LED and display even counter using Timeout Object. Give switch option to manually toggle between two counters. Libraries Used: InterruptIn, Ticker, TimeOut, BusOut

Aim

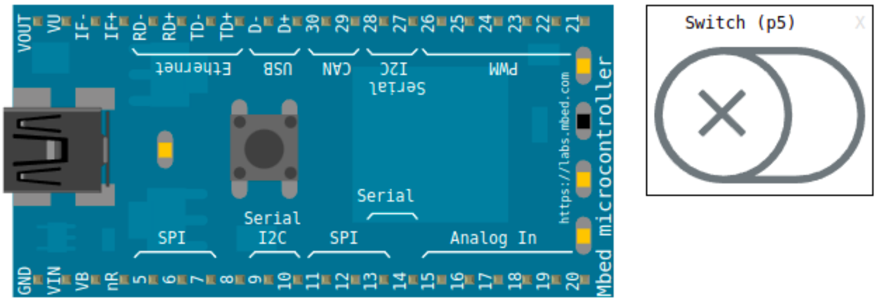
To display the odd counter using the onboard LEDs and screen. After 10 seconds, it reset all the values of the onboard LED and display even counter using Timeout Object. Switch should be there to manually toggle between two counters as well.

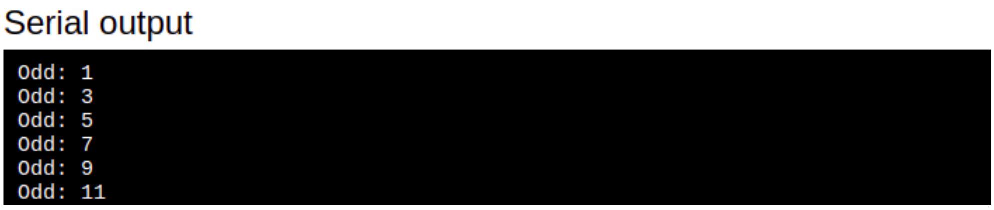
Code:

```
#include "mbed.h"

BusOut myleds(LED1, LED2, LED3, LED4);
InterruptIn btn(p5);
Ticker tk;
Timeout to;

int odd = 1;
const char *cntr_type = "Odd";
int val = 1;
void counter()
{
   myleds = val;
   printf("%s: %d \n", cntr_type, val);
   val += 2;
   val %= 16;
}
void change_type()
{
   printf("changed type using button \n");
   if (odd)
   {
      odd = 0;
      val = 0;
      cntr_type = "Even";
   }
   else
   {
      odd = 1;
      val = 1;
      cntr_type = "Odd";
   }
}
void reset()
{
   printf("reseting the values after timeout \n");
   odd = 0;
```

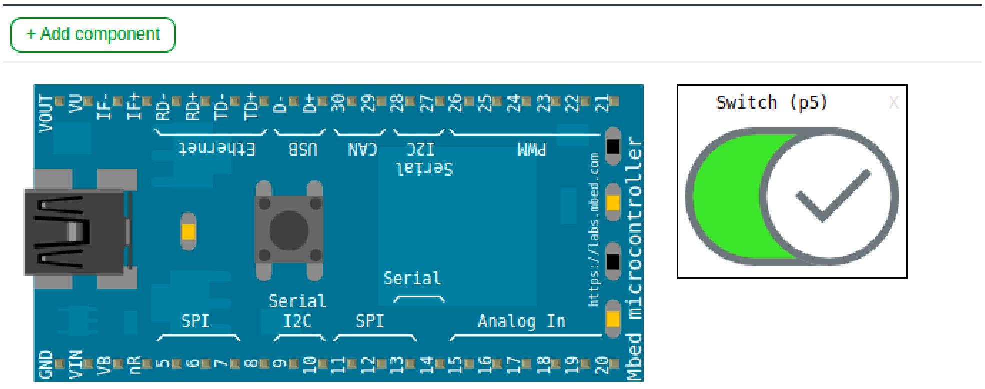
```
    val = 0;
    cntr_type = "Even";
}
int main()
{
    tk.attach(&counter, 1.0);
    btn.rise(&change_type);
    btn.fall(&change_type);
    to.attach(&reset, 10.0);
}
```

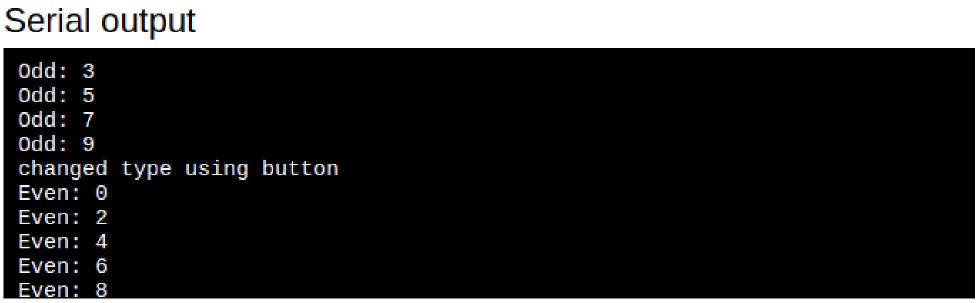
Output:




Serial output

```
Odd: 1
Odd: 3
Odd: 5
Odd: 7
Odd: 9
Odd: 11
```




Serial output

```
Odd: 3
Odd: 5
Odd: 7
Odd: 9
changed type using button
Even: 0
Even: 2
Even: 4
Even: 6
Even: 8
```

Lab 3 (14-02-2022)

1. Increase the intensity of one LED while descreasing the other LED's intensity at the same unit. Display the intensity value of the LEDs. Libraries Used: pwmout
2. Interface potentiometer with mbed board and based on the value of potentiometer, adjust the intensity of an external LED. Libraries To Be Used: pwmout, analogin
3. Interface switch, 2 LEDs, potentiometer with the mbed board. If the switch is on, control the intensity of the LEDs using potentiometer (one LED should be increasing and other should be decreasing at the rate given via potentiometer). If the switch is off, blink LEDs one at increasing rate and other at decreasing rate (same rate) and loop back.

1 . Increase the intensity of one LED while descreasing the other LED's intensity at the same unit. Display the intensity value of the LEDs. Libraries Used: pwmout

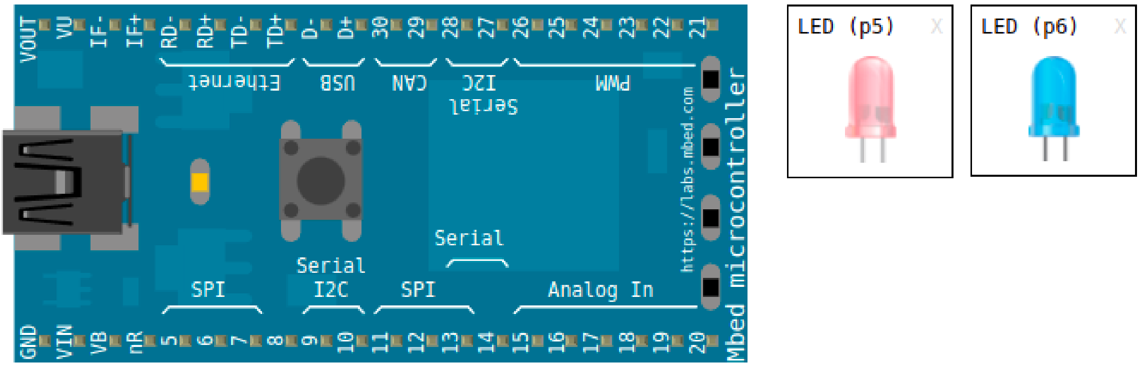
Aim

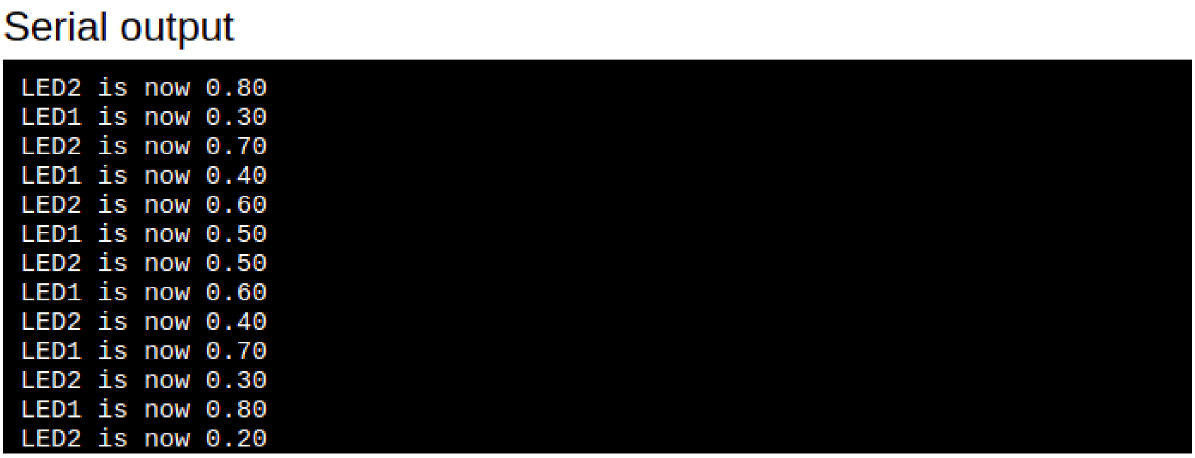
To increase the intensity of one LED while descreasing the other LED's intensity at the same unit. We must also display the intensity value of the LEDs.

Code

```
#include "mbed.h"

PwmOut led1(p5);
PwmOut led2(p6);

int main()
{
   led2 = 1;
   led1 = 0;
   while (1)
   {
      led1 = led1 + 0.10;
      led2 = led2 - 0.10;
      printf("LED1 is now %.2f\n", led1.read());
      printf("LED2 is now %.2f\n", led2.read());
      wait(1);
      if (led1 == 1.0)
      {
         led1 = 0;
      }
      if (led2 == 0)
      {
         led2 = 1;
      }
   }
}
```

Output:




Serial output

```
LED2 is now 0.80
LED1 is now 0.30
LED2 is now 0.70
LED1 is now 0.40
LED2 is now 0.60
LED1 is now 0.50
LED2 is now 0.50
LED1 is now 0.60
LED2 is now 0.40
LED1 is now 0.70
LED2 is now 0.30
LED1 is now 0.80
LED2 is now 0.20
```

2. Interface potentiometer with mbed board and based on the value of potentiometer, adjust the intensity of an external LED. Libraries To Be Used: pwmout, analogin

Aim

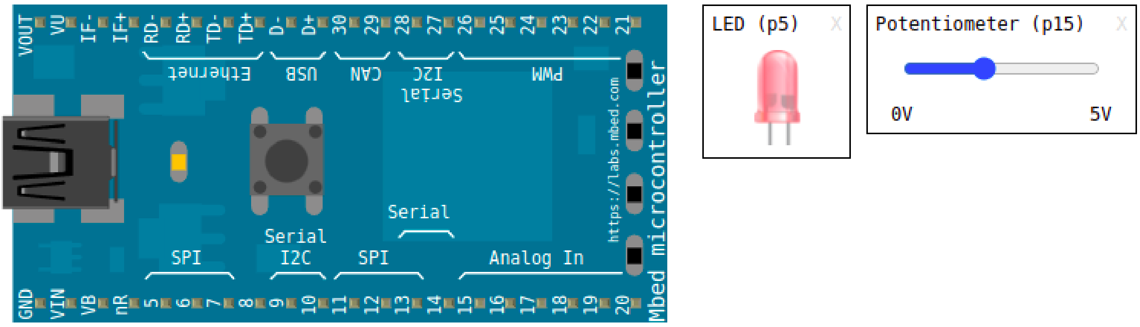
To interface potentiometer with mbed board and based on the value of potentiometer and adjust the intensity of an external LED.

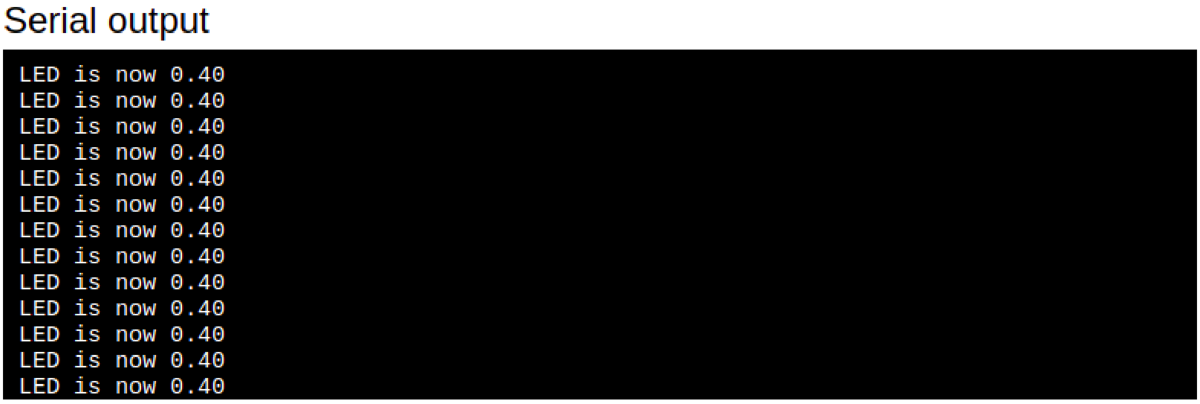
Code

```
#include "mbed.h"

PwmOut led(p5);
AnalogIn p(p15);

int main()
{
   while (1)
   {
      led = p.read();
```

```
        printf("LED is now %.2f\n", led.read());
        wait(0.5);
    }
}
```

Output:




Serial output

```
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
LED is now 0.40
```

3. Interface switch, 2 LEDs, potentiometer with the mbed board. If the switch is on, control the intensity of the LEDs using potentiometer (one LED should be increasing and other should be decreasing at the rate given via potentiometer). If the switch is off, blink LEDs one at increasing rate and other at decreasing rate (same rate) and loop back.

Aim

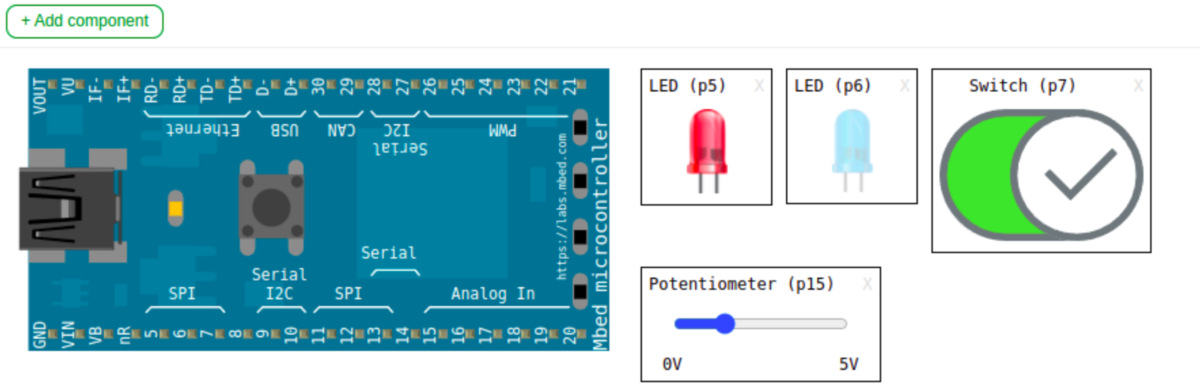
To interface switch, 2 LEDs, potentiometer with the mbed board. If the switch is on, we must control the intensity of the LEDs using potentiometer ,one LED should be increasing and other should be decreasing at the rate given via potentiometer. If the switch is off, we must blink LEDs one at increasing rate and other at decreasing rate (same rate) and loop back.

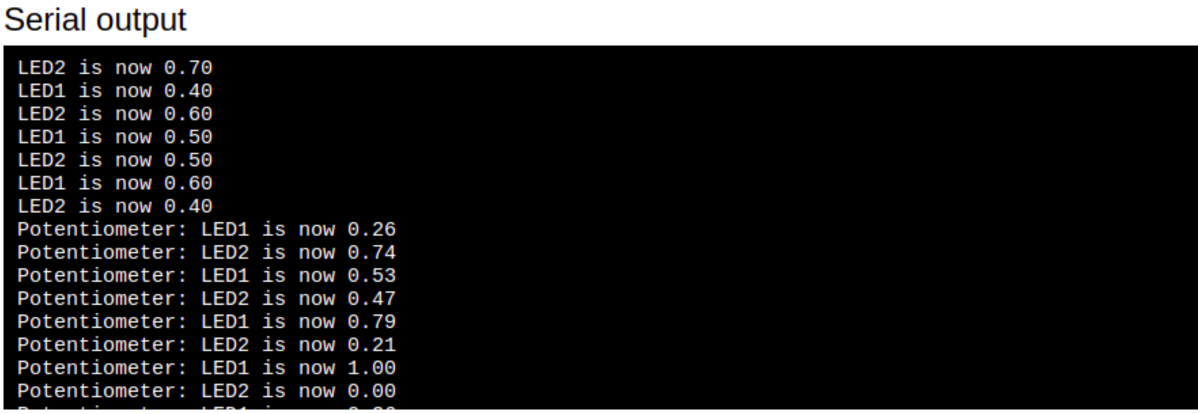
Code:

```
#include "mbed.h"

PwmOut led1(p5);
PwmOut led2(p6);
InterruptIn btn(p7);
AnalogIn p(p15);
```

```
#define MAX(x, y) x > y ? x : y
#define MIN(x, y) x > y ? y : x

void inc_dec_by_potentio()
{
    led1 = 0;
    led2 = 1;
    while (1)
    {
        float rate = p.read();
        led1 = MIN(led1 + rate, 1);
        led2 = MAX(led2 - rate, 0);
        printf("Potentiometer: LED1 is now %.2f\n", led1.read());
        printf("Potentiometer: LED2 is now %.2f\n", led2.read());
        wait(1);
        if (led1 == 1)
        {
            led1 = 0;
        }
        if (led2 == 0)
        {
            led2 = 1;
        }
    }
}
void inc_dec()
{
    led1 = 0;
    led2 = 1;
    while (1)
    {
        led1 = led1 + 0.10;
        led2 = led2 - 0.10;
        printf("LED1 is now %.2f\n", led1.read());
        printf("LED2 is now %.2f\n", led2.read());
        wait(1);
        if (led1 == 1.0)
        {
            led1 = 0;
        }
        if (led2 == 0)
        {
            led2 = 1;
        }
    }
}
int main()
{
    btn.rise(inc_dec_by_potentio);
    btn.fall(inc_dec);
}
```

Output:




Serial output

```
LED2 is now 0.70
LED1 is now 0.40
LED2 is now 0.60
LED1 is now 0.50
LED2 is now 0.50
LED1 is now 0.60
LED2 is now 0.40
Potentiometer: LED1 is now 0.26
Potentiometer: LED2 is now 0.74
Potentiometer: LED1 is now 0.53
Potentiometer: LED2 is now 0.47
Potentiometer: LED1 is now 0.79
Potentiometer: LED2 is now 0.21
Potentiometer: LED1 is now 1.00
Potentiometer: LED2 is now 0.00
```

Lab 4 (28-02-2022)

1. Write a program to increase the intensity of external LED. At the same rate, increase the sound intensity of speaker.Libraries Used: pwmout
2. Design an alarm system, which makes double beep sound for every 5s using a speaker. Libraries To Be Used: pwmout, analogin
3. Have a switch, 2 LEDs and a speaker interfaced with mbed board. Upon switching on, the intensity of the sound should be increasing and the upon switching off, should make the intensity of the sound decreasing. Proportionally increase or decrease the intensity of two LEDs.
4. Design a program to make ambulance sound

1 Write a program to increase the intensity of external LED. At the same rate, increase the sound intensity of speaker.Libraries Used: pwmout

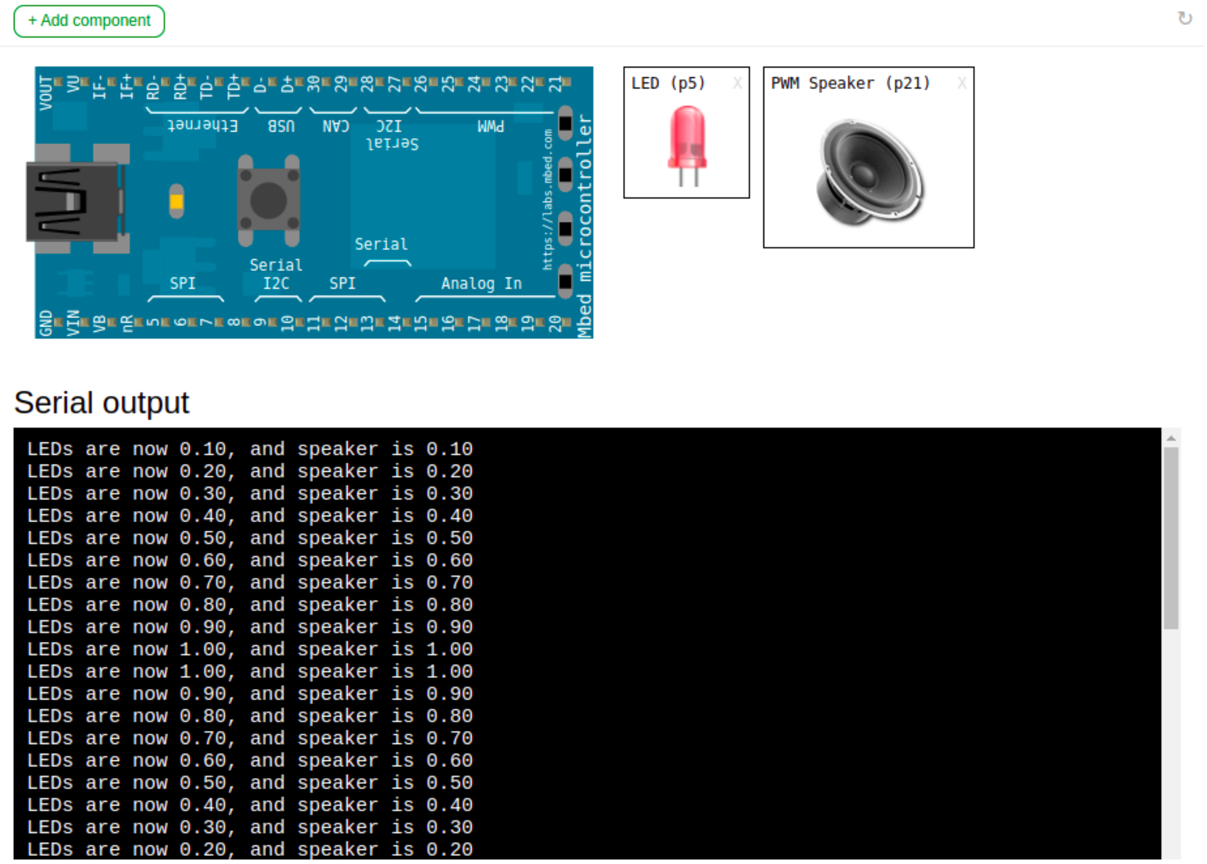
Aim

To write a program to increase the intensity of external LED. At the same rate, we must increase the sound intensity of speaker.

Code:

```
#include "mbed.h"

PwmOut led(p5);
PwmOut speaker(p21);

int main()
{
   int inc = 1;
   while (1)
   {
      led = led + inc * 0.10;
      speaker = speaker + inc * 0.10;
      printf("LEDs are now %.2f, and speaker is %.2f\n", led.read(),
           speaker.read());
      wait(0.5);
      if (led == 1.0)
      {
         inc = -1;
      }
      if (led == 0)
      {
         inc = 1;
      }
   }
}
```

Output:



Serial output

```
LEDs are now 0.10, and speaker is 0.10
LEDs are now 0.20, and speaker is 0.20
LEDs are now 0.30, and speaker is 0.30
LEDs are now 0.40, and speaker is 0.40
LEDs are now 0.50, and speaker is 0.50
LEDs are now 0.60, and speaker is 0.60
LEDs are now 0.70, and speaker is 0.70
LEDs are now 0.80, and speaker is 0.80
LEDs are now 0.90, and speaker is 0.90
LEDs are now 1.00, and speaker is 1.00
LEDs are now 1.00, and speaker is 1.00
LEDs are now 0.90, and speaker is 0.90
LEDs are now 0.80, and speaker is 0.80
LEDs are now 0.70, and speaker is 0.70
LEDs are now 0.60, and speaker is 0.60
LEDs are now 0.50, and speaker is 0.50
LEDs are now 0.40, and speaker is 0.40
LEDs are now 0.30, and speaker is 0.30
LEDs are now 0.20, and speaker is 0.20
```

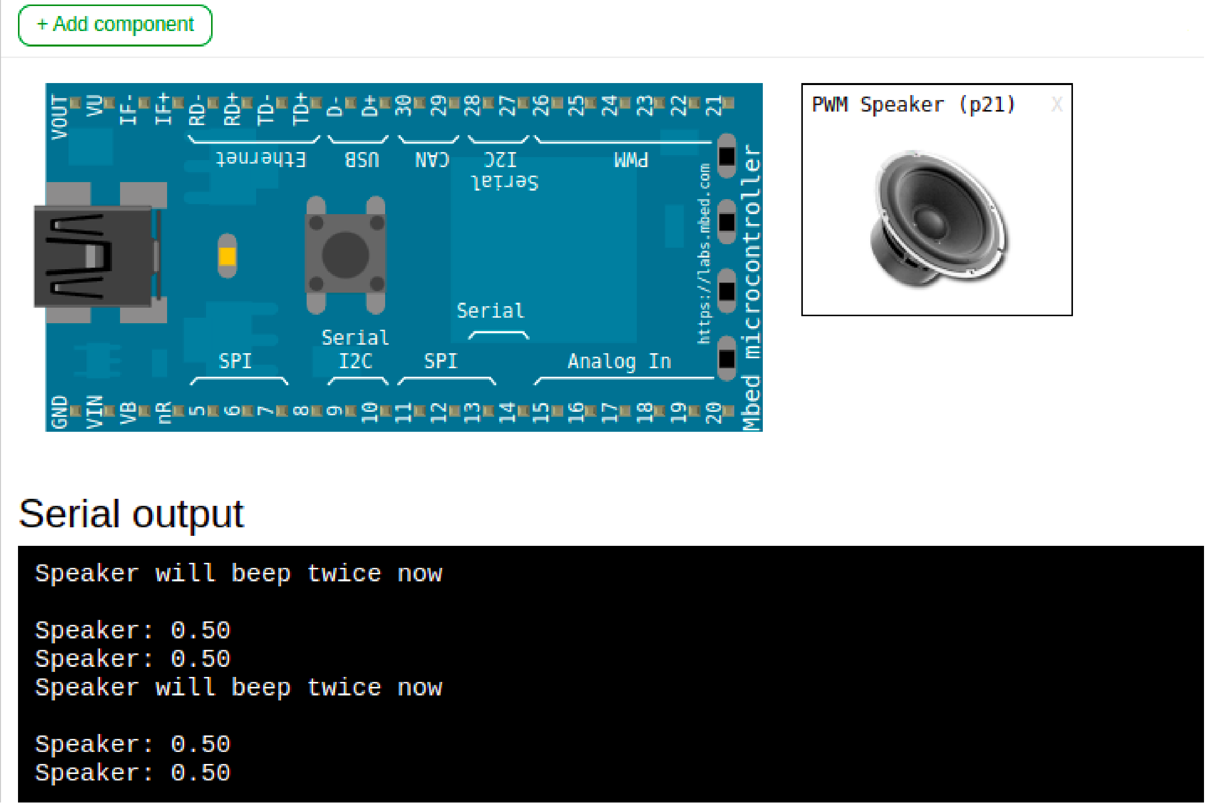
2 Design an alarm system, which makes double beep sound for every 5s using a speaker. Libraries To Be Used: pwmout, analogin

Aim:
To design an alarm system, which makes double beep sound for every 5s using a speaker.

Code:

```
#include "mbed.h"

PwmOut speaker(p21);

int main()
{
    while (1)
    {
        // Can use ticker as well
        wait_ms(5000);
        printf("Speaker will beep twice now \n\n");
        speaker = 0.5;
        wait_ms(50);
        printf("Speaker: %.2f\n", speaker.read());
        speaker = 0;
        wait_ms(50);
        speaker = 0.5;
        wait_ms(50);
        printf("Speaker: %.2f\n", speaker.read());
        speaker = 0;
    }
}
```

Output:


+ Add component
VOUT VU IF- IF+ RD- RD+ TD- TD+ D- D+ 30 29 28 27 26 25 24 23 22 21
Ethernet USB CAN I2C Serial PWM
https://labs.mbed.com
Mbed microcontroller
Serial
Serial I2C
SPI SPI Analog In
GND VIN VB nR 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
PWM Speaker (p21)
X

Serial output

```
Speaker will beep twice now

Speaker: 0.50
Speaker: 0.50
Speaker will beep twice now

Speaker: 0.50
Speaker: 0.50
```

3 Have a switch, 2 LEDs and a speaker interfaced with mbed board. Upon switching on, the intensity of the sound should be increasing and the upon switching off, should make the intensity of the sound decreasing. Proportionally increase or decrease the intensity of two LEDs.

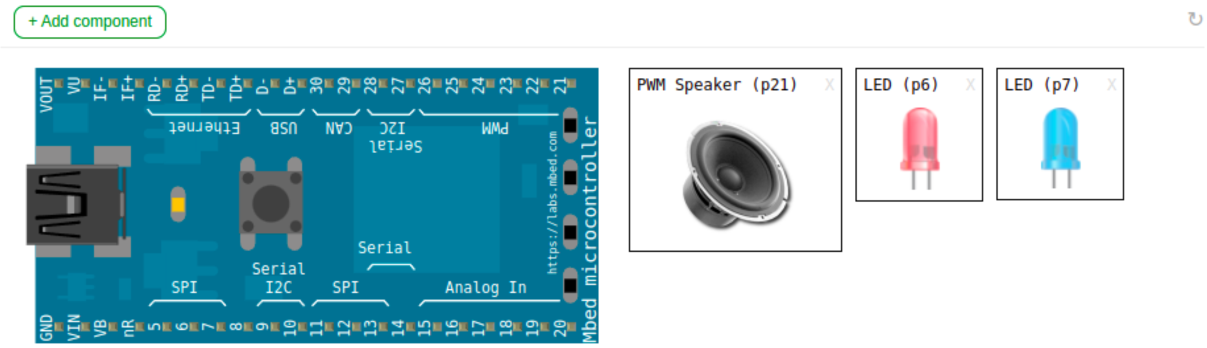
Aim

To interface a switch, 2 LEDs and a speaker with mbed board. Upon switching on, the intensity of the sound is to be increased and upon switching off, the intensity of the sound is to be decreasded. The intensity of two LEDs is to be proportionally increased or decreased.

Code:

```
#include "mbed.h"

PwmOut speaker(p21);
PwmOut led1(p6);
PwmOut led2(p7);

float delta = -0.1f;
InterruptIn btn(p5);
void pos() { delta = 0.1f; }
void neg() { delta = -0.1f; }
int main()
{
    btn.rise(&pos);
    btn.fall(&neg);
    speaker = 0;
    while (1)
    {
        if (delta > 0 && speaker >= 1)
            speaker = 0;
        if (delta < 0 && speaker <= 0)
            speaker = 1;
        speaker = speaker + delta;
        led1 = speaker;
        led2 = speaker;
        wait(0.5);
    }
}
```

Output:



4 Design a program to make ambulance sound.

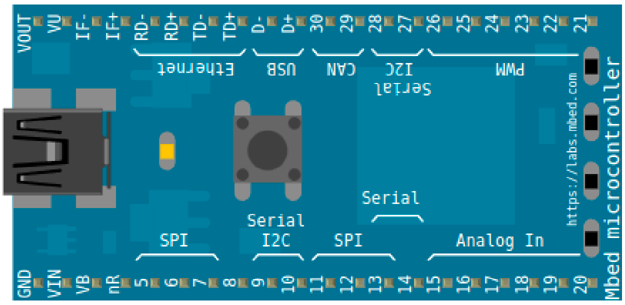
Aim
To design a program which will output ambulance sound

Code:

```
#include "mbed.h"

PwmOut speaker(p21);
```

```
int main()
{
   int i;
   while (1)
   {
      for (i = 0; i < 26; i++)
      {
         speaker.period(1.0 / 259.0);
         speaker = float(i) / 500.0;
         wait(0.5);
         speaker.period(1.0 / 340.0);
         wait(0.5);
      }
      for (i = 26; i >= 0; i--)
      {
         speaker.period(1.0 / 259.0);
         speaker = float(i) / 500.0;
         wait(0.5);
         speaker.period(1.0 / 440.0);
         wait(0.5);
      }
   }
}
```

Output:



Lab 5 (07-03-2022)

1. Blink LEDs in alternate order – 1 and 3 together and 2 and 4 together.
2. Blink LEDs – count from 1 to 15; if the board is counting odd value, wait for 1 sec, else wait for 2 sec.
3. Blink LEDs – for all composite number below 15.
4. Blink LEDs – to count even numbers

1 Blink LEDs in alternate order – 1 and 3 together and 2 and 4 together.

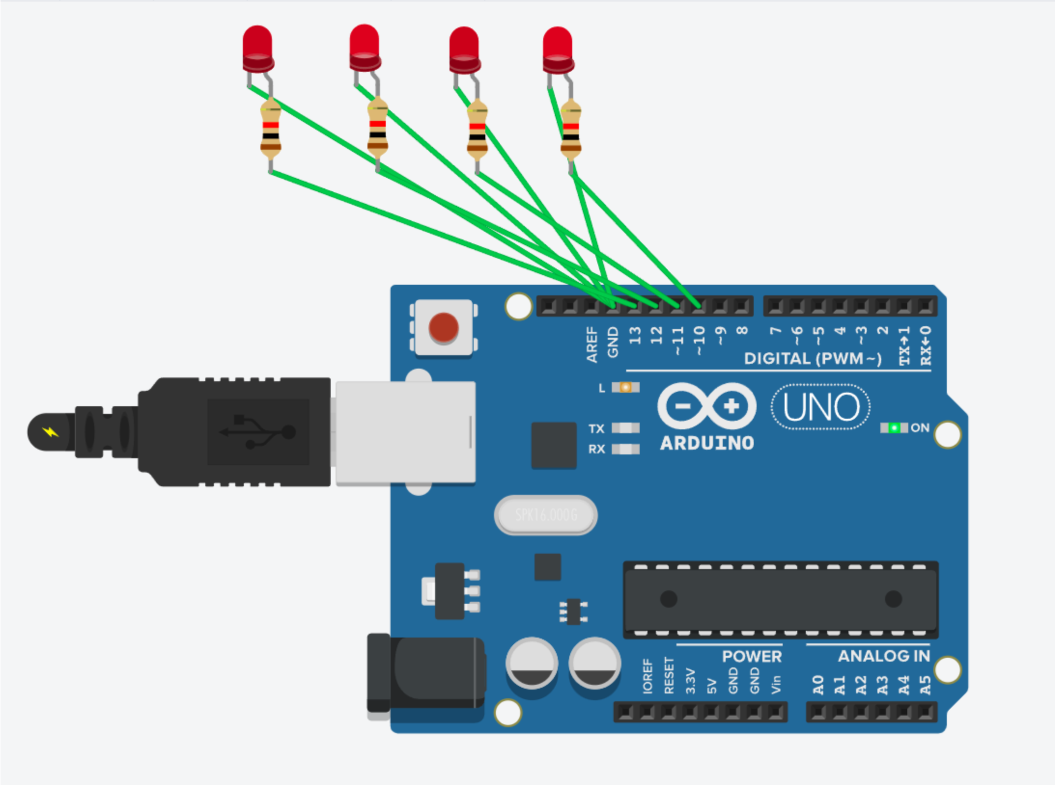
Aim

To blink LEDs in alternate order – 1 and 3 should blink together and 2 and 4 should blink together.

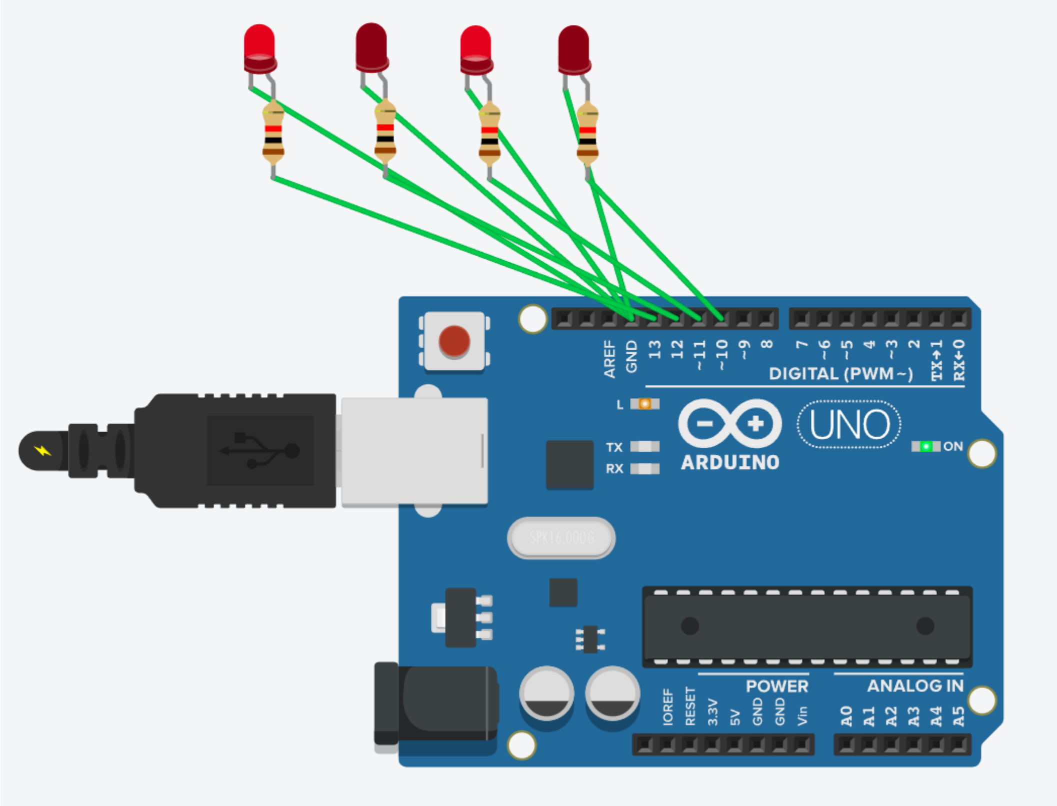
Code(C++):

```
#define F(x) x ? HIGH : LOW
int pins[] = {13, 12, 11, 10};
void setup()
{
   for (int i = 0; i < 4; i++)
      pinMode(pins[i], OUTPUT);
}
void show(int x)
{
   int vals[] = {F(x & 8), F(x & 4), F(x & 2), F(x & 1)};
   for (int i = 0; i < 4; i++)
   {
      digitalWrite(pins[i], vals[i]);
   }
}
void loop()
{
   show(0b1010);
   delay(1000);
   show(0b0101);
   delay(1000);
}
```

Output:



AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN



AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN

2 Blink LEDs – count from 1 to 15; if the board is counting odd value, wait for 1 sec, else wait for 2 sec.

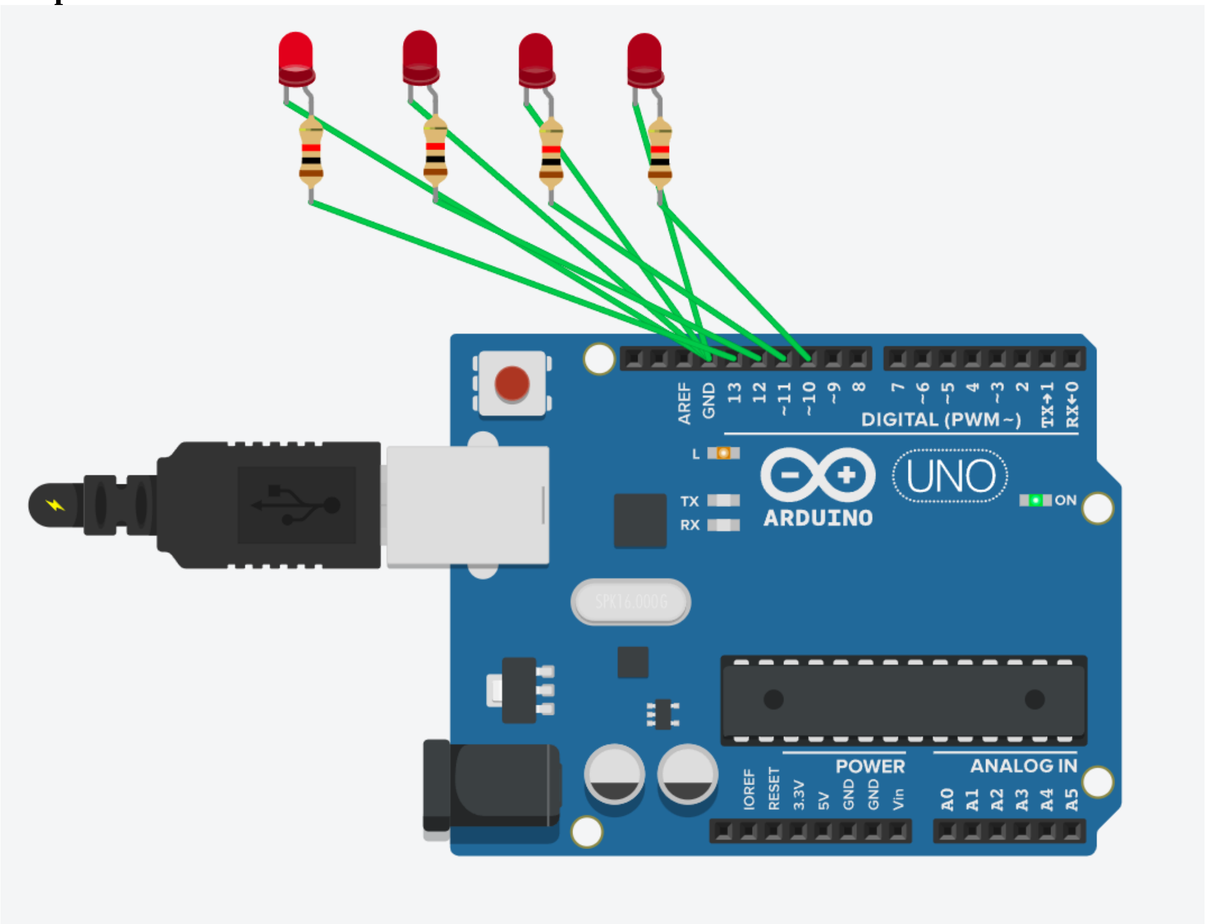
Aim

To blink LEDs and count from 1 to 15. If the board is counting odd value, it should wait for 1 sec, else it should wait for 2 sec.

Code(C++):

```
#define F(x) x ? HIGH : LOW
int pins[] = {13, 12, 11, 10};
void setup()
{
   for (int i = 0; i < 4; i++)
      pinMode(pins[i], OUTPUT);
}
void show(int x)
{
   int vals[] = {F(x & 8), F(x & 4), F(x & 2), F(x & 1)};
   for (int i = 0; i < 4; i++)
   {
      digitalWrite(pins[i], vals[i]);
   }
}
void loop()
{
   for (int i = 1; i < 16; i++)
   {
      show(i);
      if (i % 2 == 1)
         delay(1000);
      else
         delay(2000);
   }
}
```

Output:



3 Blink LEDs – for all composite number below 15.

Aim

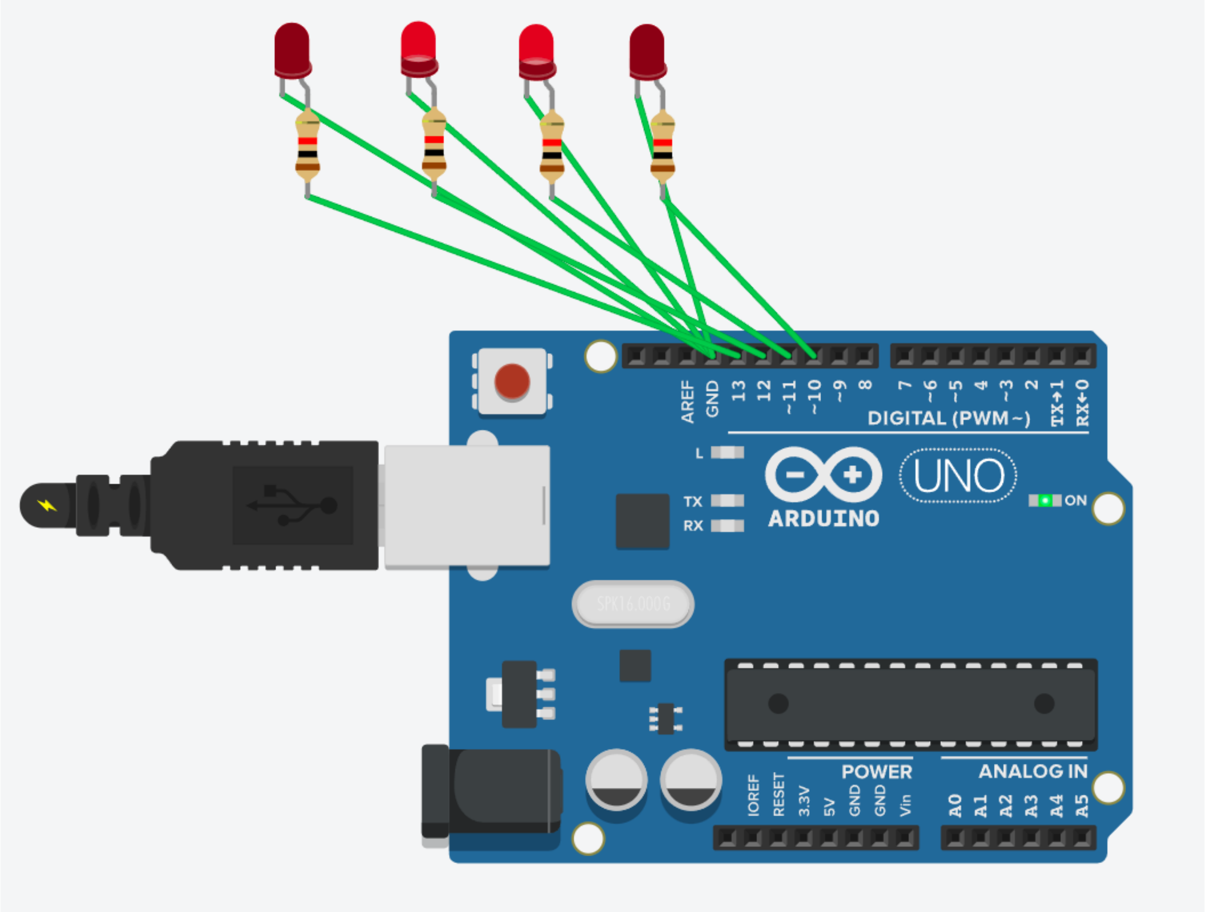
To blink LEDs for all composite numbers below 15.

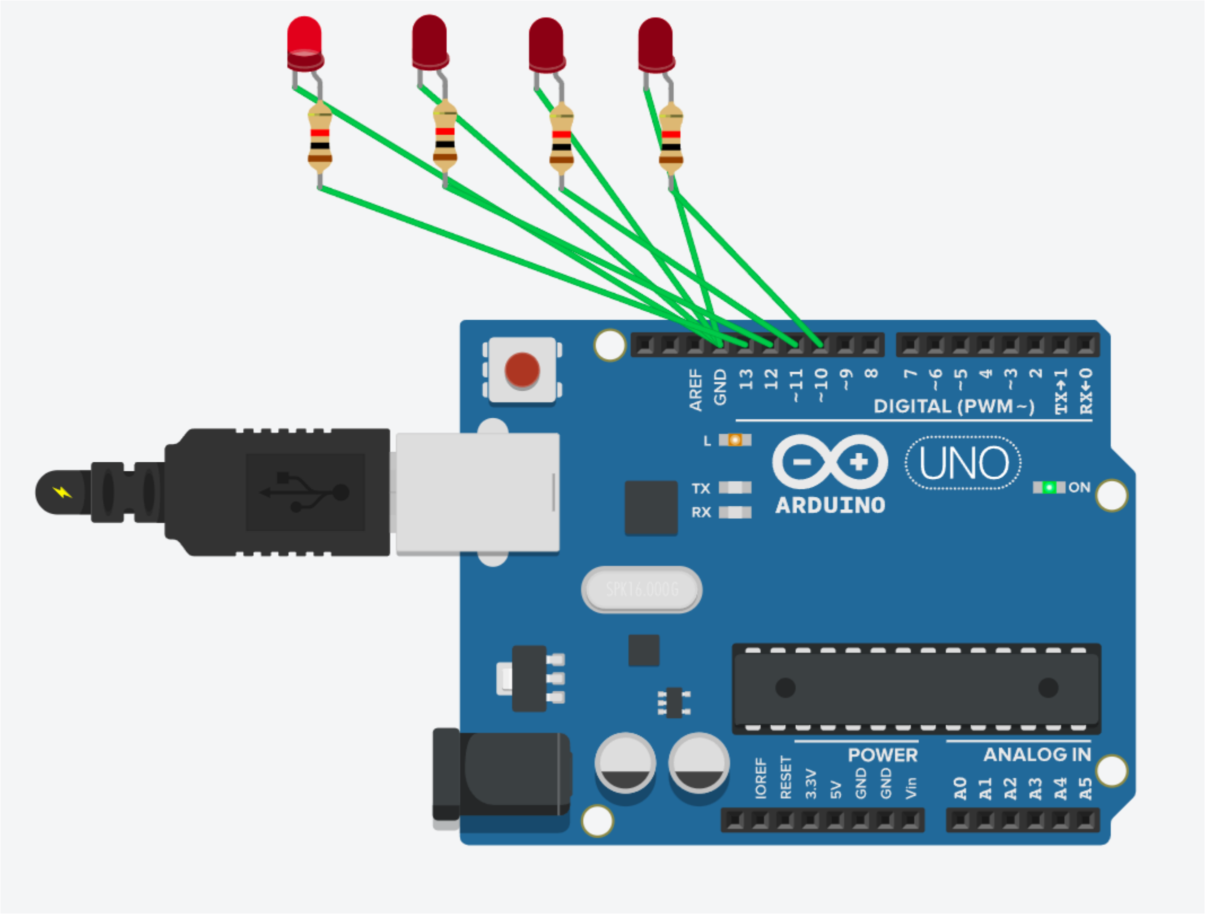
Code(C++):

```
#define F(x) x ? HIGH : LOW
int pins[] = {13, 12, 11, 10};
void setup()
{
   for (int i = 0; i < 4; i++)
      pinMode(pins[i], OUTPUT);
}
void show(int x)
{
   int vals[] = {F(x & 8), F(x & 4), F(x & 2), F(x & 1)};
   for (int i = 0; i < 4; i++)
   {
      digitalWrite(pins[i], vals[i]);
   }
}
bool is_prime(int x)
```

```
{
    for (int i = 2; i < x; i++)
    {
        if (x % i == 0)
            return false;
    }
    return true;
}
void loop()
{
    for (int i = 2; i < 16; i += 1)
    {
        if (!is_prime(i))
        {
            show(i);
            delay(1000);
        }
    }
}
```

Output:





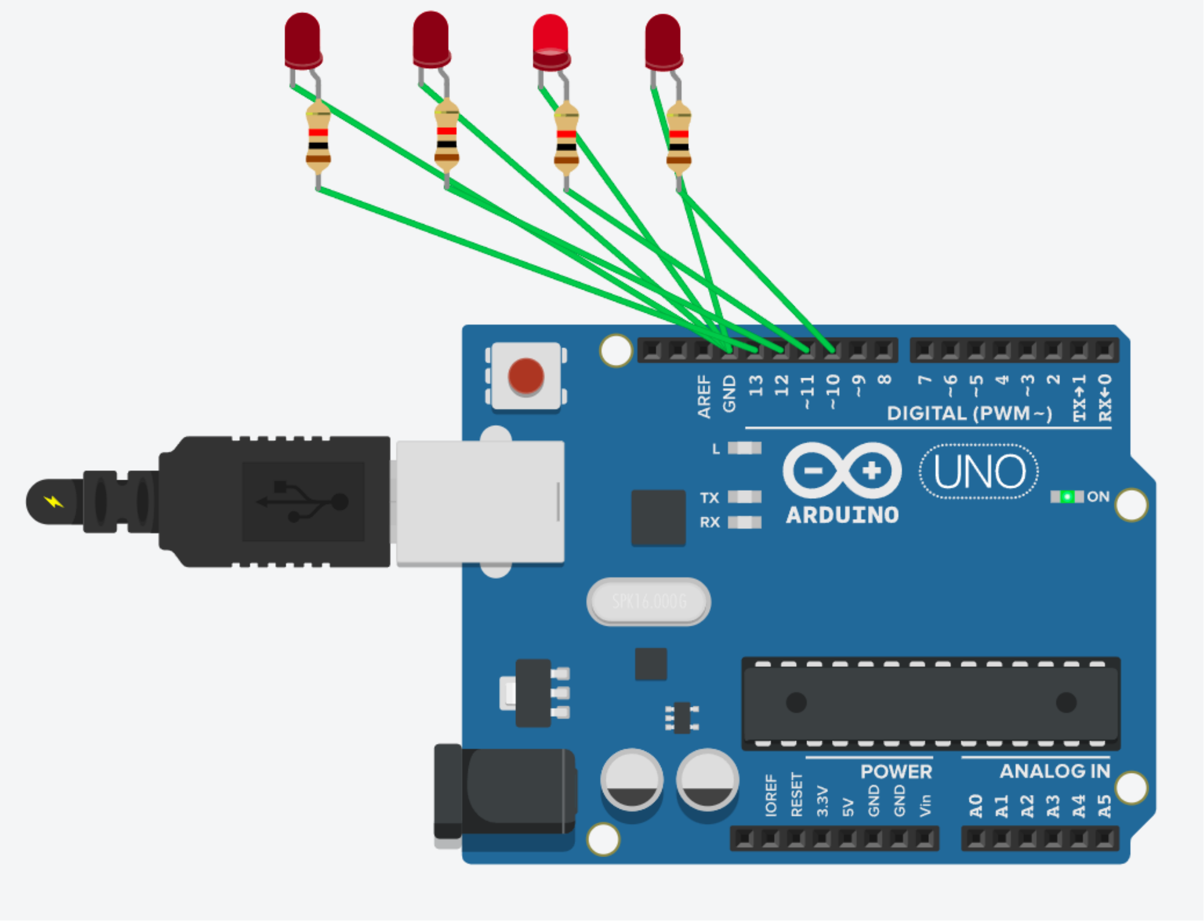
4 Blink LEDs – to count even numbers

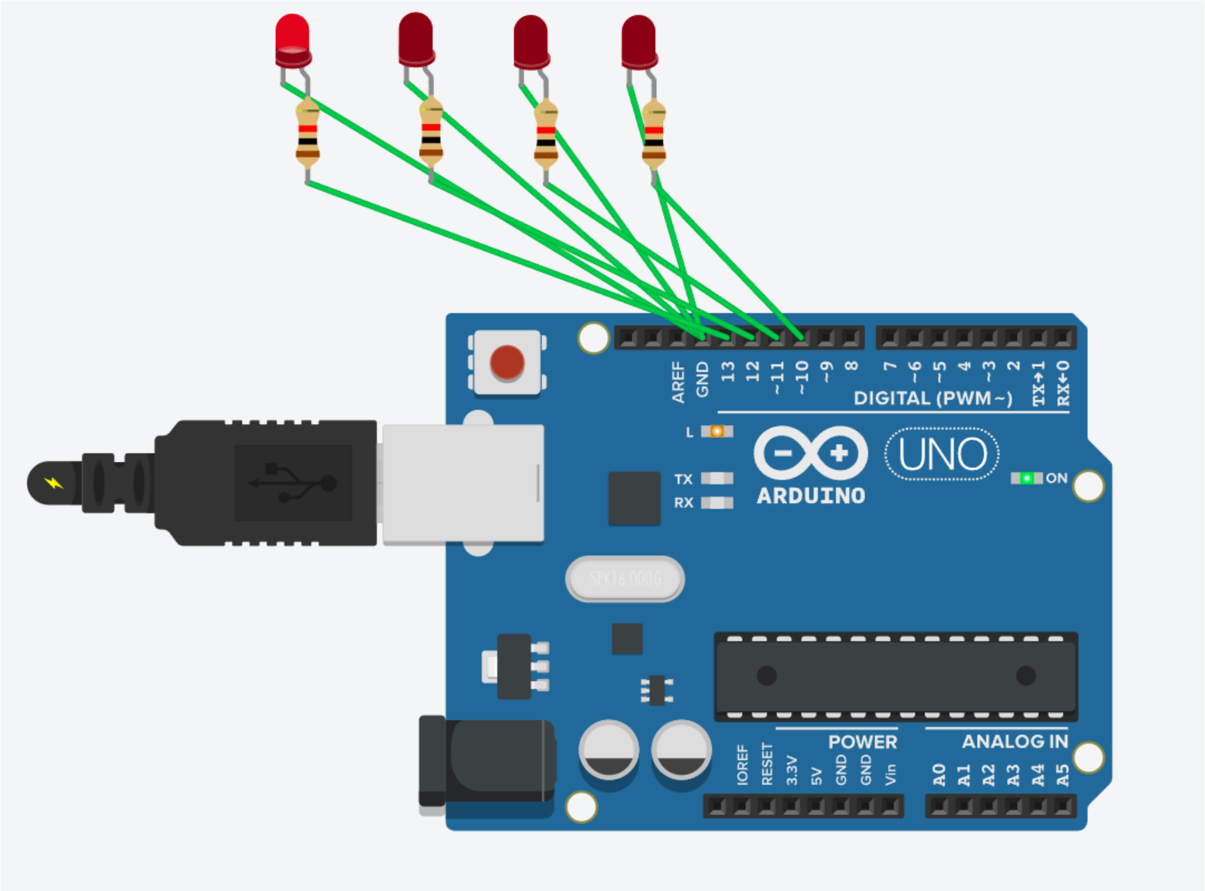
Aim
To blink LEDs to count even numbers

Code(C++):

```
#define F(x) x ? HIGH : LOW
int pins[] = {13, 12, 11, 10};
void setup()
{
    for (int i = 0; i < 4; i++)
        pinMode(pins[i], OUTPUT);
}
void show(int x)
{
    int vals[] = {F(x & 8), F(x & 4), F(x & 2), F(x & 1)};
    for (int i = 0; i < 4; i++)
    {
        digitalWrite(pins[i], vals[i]);
    }
}
void loop()
{
    for (int i = 0; i < 16; i += 2)
    {
        show(i);
        delay(1000);
    }
}
```

Output:




AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
ANALOG IN
A0
A1
A2
A3
A4
A5

Lab 6 (28-03-2022)

1. Interface an ultrasonic sensor and display the distance measured in a screen and glow red, blue and green led if the distance is close, moderate and far respectively. Play different tones for different cases.
2. Interface a PIR sensor with Arduino and blink a led if any movement is captured by the sensor and count the number of movements. Make a buzzer when movement detected

1 Interface an ultrasonic sensor and display the distance measured in a screen and glow red, blue and green led if the distance is close, moderate and far respectively. Play different tones for different cases.

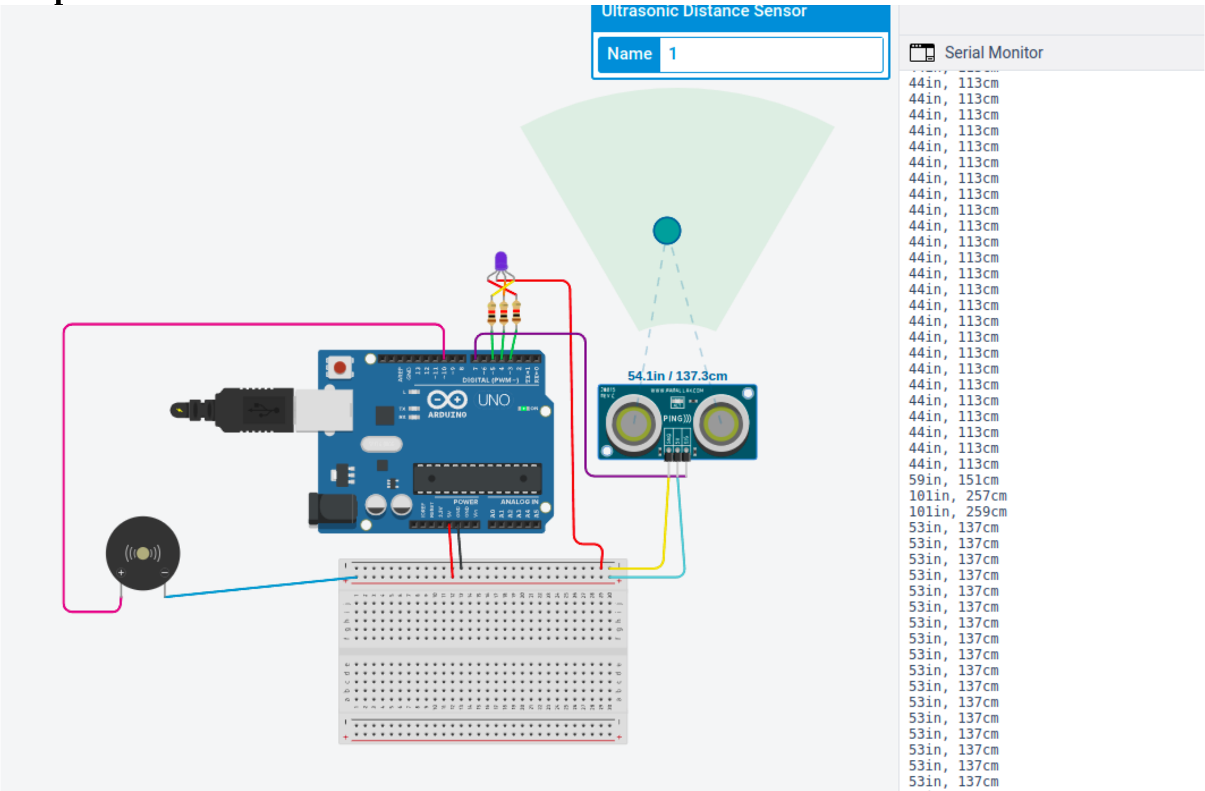
Aim:
To interface an ultrasonic sensor and display the distance measured in a screen and glow red, blue and green led if the distance is close, moderate and far respectively. We must play different tones for different cases.

Code(C++):

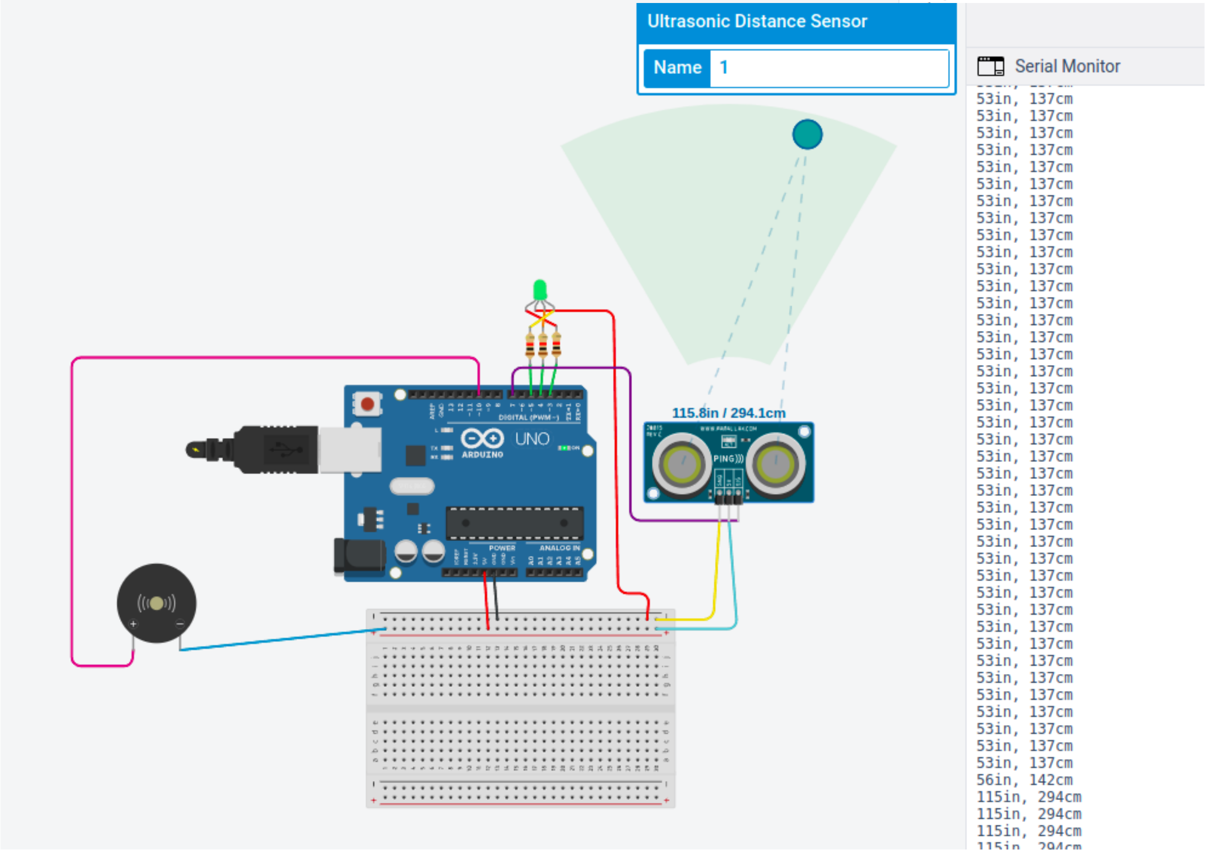
```
#define F(x) x ? HIGH : LOW
const int red = 3;
const int blue = 4;
const int green = 5;
const int speaker = 10;
const int ping = 7;
void setup()
{
   Serial.begin(9600);
   pinMode(red, OUTPUT);
   pinMode(blue, OUTPUT);
   pinMode(green, OUTPUT);
   pinMode(speaker, OUTPUT);
}
void displayLight(int code)
{
   digitalWrite(red, F(code == 0));
   digitalWrite(blue, F(code == 1));
   digitalWrite(green, F(code == 2));
}
void playTone(long duration, int freq)
{
   duration *= 1000;
   int period = (1.0 / freq) * 100000;
   long elapsed_time = 0;
   while (elapsed_time < duration)
   {
      digitalWrite(speaker, HIGH);
      delayMicroseconds(period / 2);
      digitalWrite(speaker, LOW);
```

```
        delayMicroseconds(period / 2);
        elapsed_time += (period);
    }
}
void loop()
{
    long duration, inches, cm;
    pinMode(ping, OUTPUT);
    digitalWrite(ping, LOW);
    delayMicroseconds(2);
    digitalWrite(ping, HIGH);
    delayMicroseconds(5);
    digitalWrite(ping, LOW);
    pinMode(ping, INPUT);
    duration = pulseIn(ping, HIGH);
    inches = microsecondsToInches(duration);
    cm = microsecondsToCentimeters(duration);
    Serial.print(inches);
    Serial.print("in, ");
    Serial.print(cm);
    Serial.print("cm");
    Serial.println();
    if (cm < 50)
    {
        displayLight(0);
        playTone(300, 100);
    }
    else if (cm < 150)
    {
        displayLight(1);
        playTone(300, 200);
    }
    else
    {
        displayLight(2);
        playTone(300, 300);
    }
    delay(100);
}
long microsecondsToInches(long microseconds)
{
    return microseconds / 74 / 2;
}
long microsecondsToCentimeters(long microseconds)
{
    return microseconds / 29 / 2;
}
```

Output:



```
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
44in, 113cm
59in, 151cm
101in, 257cm
101in, 259cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
```



```
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
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53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
53in, 137cm
56in, 142cm
115in, 294cm
115in, 294cm
115in, 294cm
```

2 Interface a PIR sensor with Arduino and blink a led if any movement is captured by the sensor and count the number of movements. Make a buzzer when movement detected

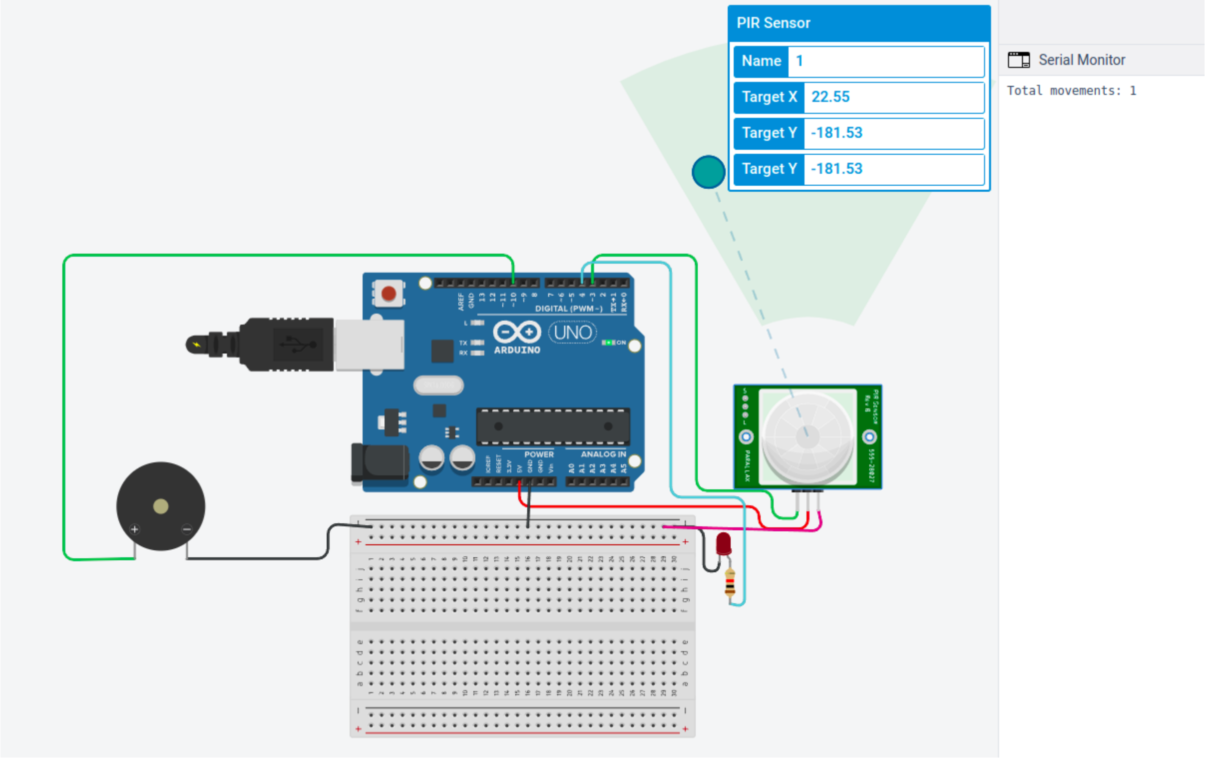
Aim:
To interface a PIR sensor with Arduino and blink a led if any movement is captured by the sensor and count the number of movements. We must make a buzzer when movement detected.

Code(C++):

```
#define F(x) x ? HIGH : LOW
const int led = 4;
const int pir = 3;
const int speaker = 10;
int totalMovements = 0;
bool isMoving = false;
void setup()
{
   Serial.begin(9600);
   pinMode(led, OUTPUT);
   pinMode(pir, INPUT);
   pinMode(speaker, OUTPUT);
}
void playTone(long duration, int freq)
{
   duration *= 1000;
   int period = (1.0 / freq) * 100000;
   long elapsed_time = 0;
   while (elapsed_time < duration)
   {
      digitalWrite(speaker, HIGH);
      delayMicroseconds(period / 2);
      digitalWrite(speaker, LOW);
      delayMicroseconds(period / 2);
      elapsed_time += (period);
   }
}
void loop()
{
   int pirStat = digitalRead(pir);
   if (pirStat == HIGH)
   {
      if (!isMoving)
      {
         playTone(300, 300);
         totalMovements += 1;
         Serial.print("Total movements: ");
         Serial.print(totalMovements);
         Serial.print("\n");
```

```
            isMoving = true;
        }
        digitalWrite(led, HIGH);
    }
    else
    {
        isMoving = false;
        digitalWrite(led, LOW);
    }
}
```

Output:



PIR Sensor

Name: 1

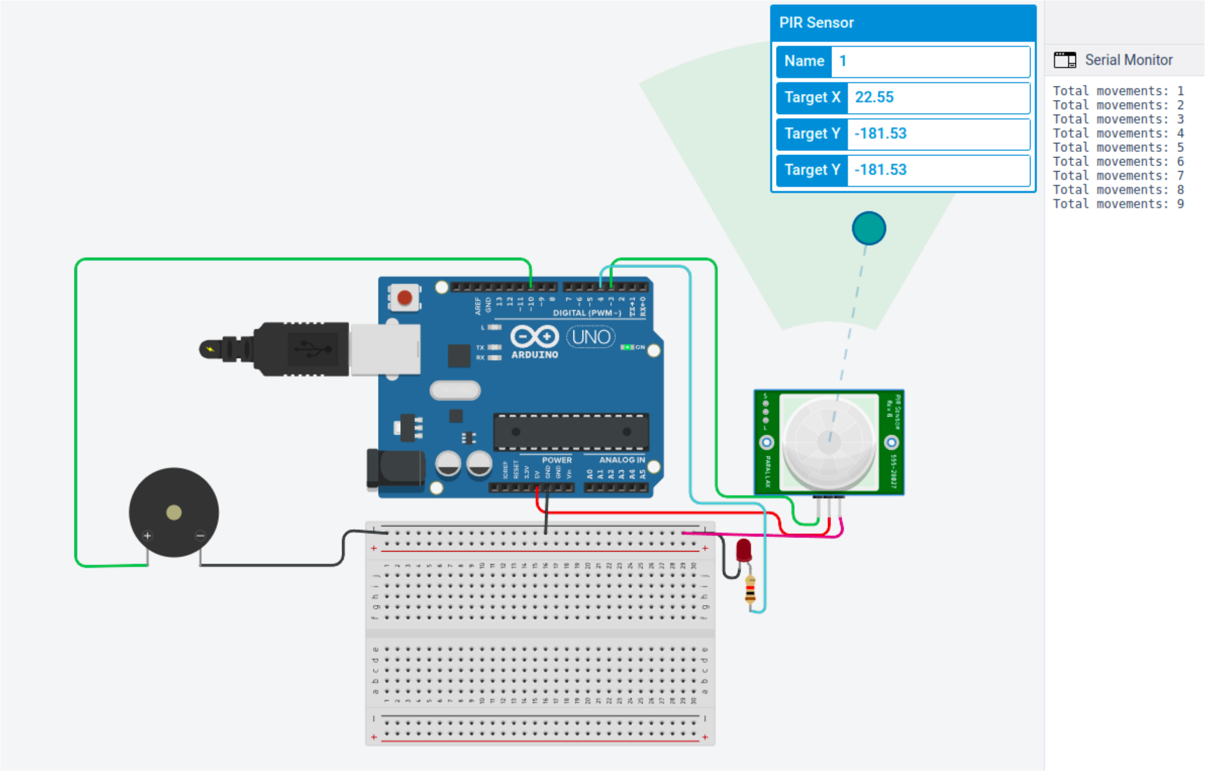
Target X: 22.55

Target Y: -181.53

Target Y: -181.53

Serial Monitor

```
Total movements: 1
```



PIR Sensor

Name 1

Target X 22.55

Target Y -181.53

Target Y -181.53

```
Total movements: 1
Total movements: 2
Total movements: 3
Total movements: 4
Total movements: 5
Total movements: 6
Total movements: 7
Total movements: 8
Total movements: 9
```

Lab 7 (11-04-2022)

1. Interface two 7-segment display with Arduino Uno board. Implement the a)odd counter and b)even counter and display the values in the seven-segment display.
2. Interface the ambient light sensor with an Arduino Uno board. Check the light value from the sensor, and switch on/off the bulb (based on the threshold value).
3. Interface the temperature and gas sensor with Arduino Uno board. Check the temperature and the gas value, if the limit is beyond the threshold, switch on the bulb and make alarm using buzzer.

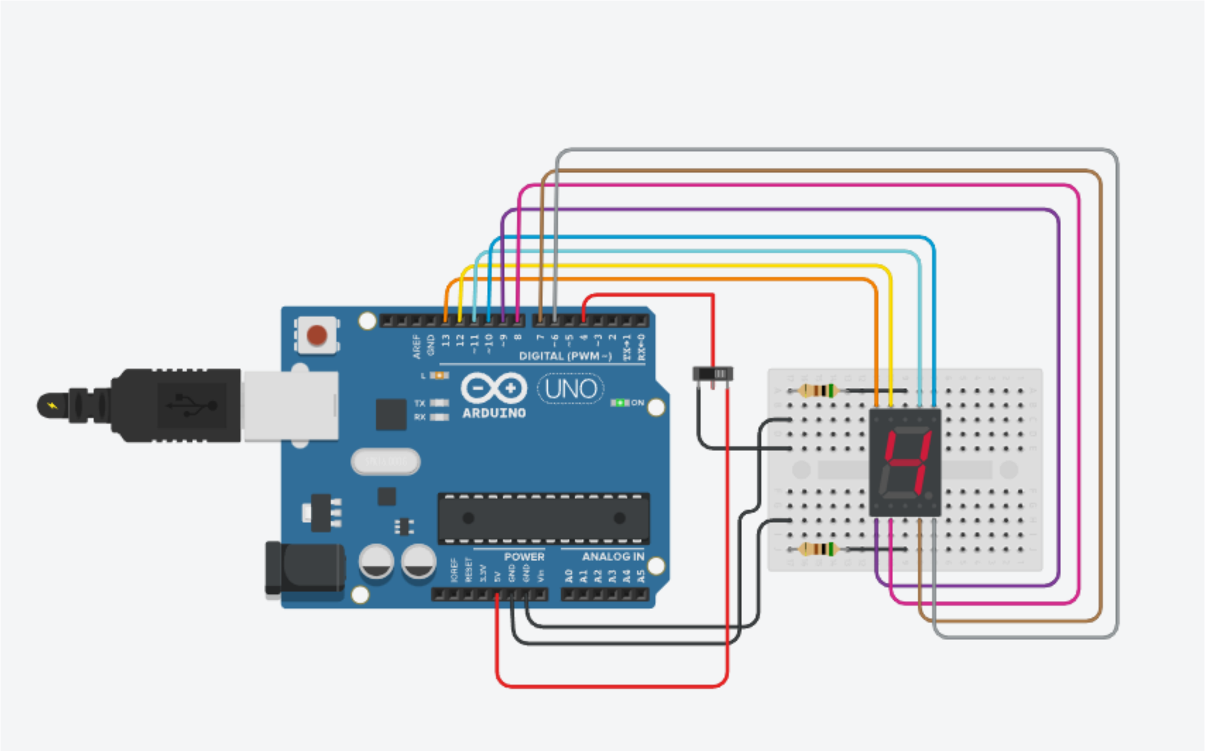
1 Interface two 7-segment display with Arduino Uno board. Implement the a) odd counter and b) even counter and display the values in the seven-segment display

Code:

```
unsigned const int A = 13;
unsigned const int B = 12;
unsigned const int C = 11;
unsigned const int D = 10;
unsigned const int E = 9;
unsigned const int F = 8;
unsigned const int G = 7;
unsigned const int H = 6;
unsigned const int btn = 4;

void setup(void)
{
  pinMode(A, OUTPUT);
  pinMode(B, OUTPUT);
  pinMode(C, OUTPUT);
  pinMode(D, OUTPUT);
  pinMode(E, OUTPUT);
  pinMode(F, OUTPUT);
  pinMode(G, OUTPUT);
  pinMode(H, OUTPUT);
  pinMode(btn, INPUT);
}
int pins[] = {A,B,C,D,E,F,G,H};

void zero(void) {
  digitalWrite(A, LOW);
  digitalWrite(B, HIGH);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, HIGH);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
```

```
}

void one(void) {
  digitalWrite(A, LOW);
  digitalWrite(B, LOW);
  digitalWrite(C, LOW);
  digitalWrite(D, HIGH);
  digitalWrite(E, LOW);
  digitalWrite(F, LOW);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void two(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, LOW);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, HIGH);
  digitalWrite(F, HIGH);
  digitalWrite(G, LOW);
  digitalWrite(H, LOW);
}

void three(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, LOW);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, LOW);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void four(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, HIGH);
  digitalWrite(C, LOW);
  digitalWrite(D, HIGH);
  digitalWrite(E, LOW);
  digitalWrite(F, LOW);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void five(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, HIGH);
  digitalWrite(C, HIGH);
  digitalWrite(D, LOW);
  digitalWrite(E, LOW);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void six(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, HIGH);
  digitalWrite(C, HIGH);
  digitalWrite(D, LOW);
  digitalWrite(E, HIGH);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void seven(void) {
  digitalWrite(A, LOW);
  digitalWrite(B, LOW);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, LOW);
  digitalWrite(F, LOW);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void eight(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, HIGH);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, HIGH);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void nine(void) {
  digitalWrite(A, HIGH);
  digitalWrite(B, HIGH);
  digitalWrite(C, HIGH);
  digitalWrite(D, HIGH);
  digitalWrite(E, LOW);
  digitalWrite(F, HIGH);
  digitalWrite(G, HIGH);
  digitalWrite(H, LOW);
}

void (*nums[])() ={zero,one,two,three, four, five,six,seven,eight,nine};

// Start
void loop(void)
{
  if(digitalRead(btn)==HIGH){
    for(int i=0;i<10;i+=2){
      nums[i]();
      delay(1000);
    }
  }else{
    for(int i=1;i<10;i+=2){
              nums[i]();
      delay(1000);
    }
  }


}
```

Output:

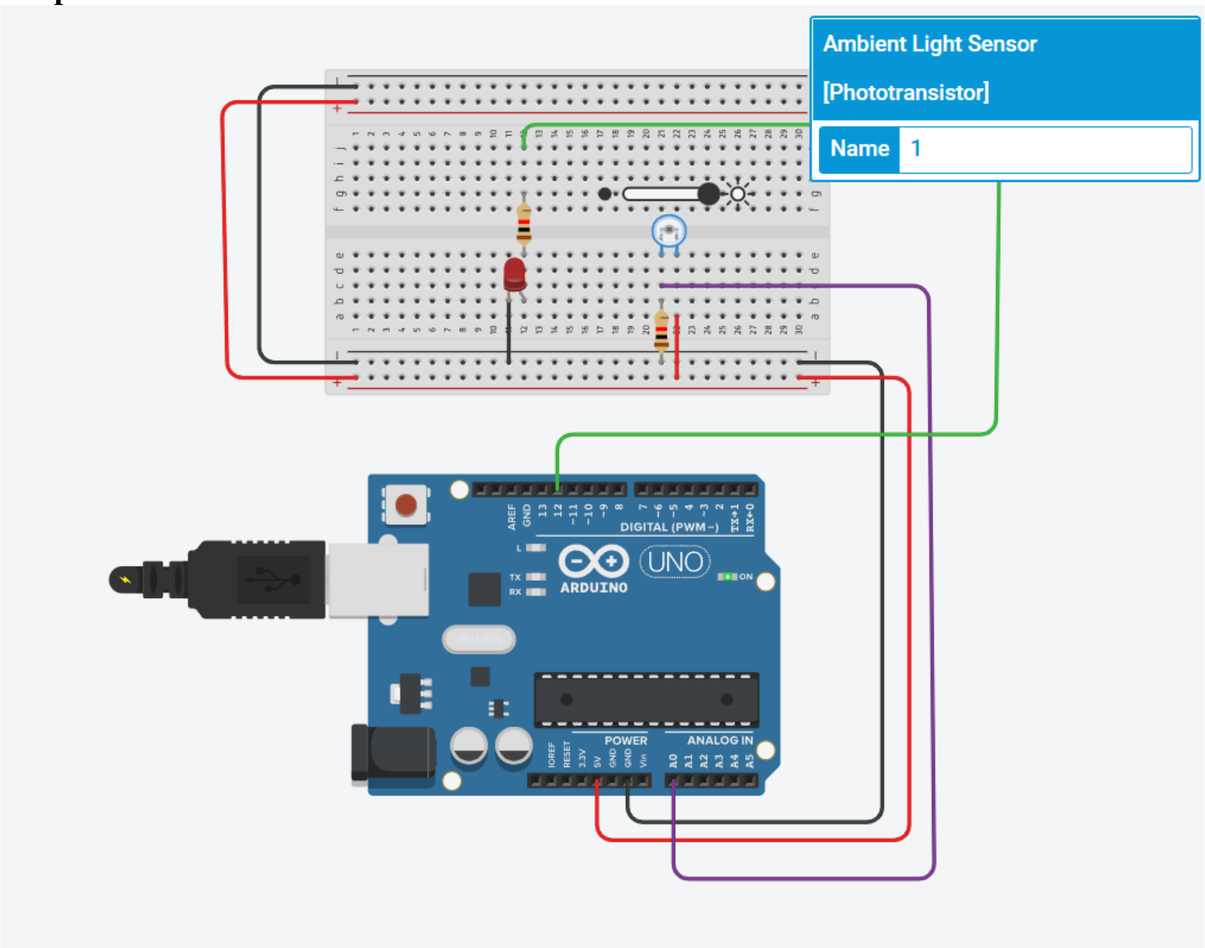


2 Interface the ambient light sensor with an Arduino Uno board. Check the light value from the sensor, and switch on/off the bulb (based on the threshold value).

Code:

```
int LED = 12;
int MQ2pin = A0;

void setup() {
  Serial.begin(9600);
}

void loop() {
  float sensorValue;
  sensorValue = analogRead(MQ2pin); // read analog input pin 0

  if(sensorValue >= 10){
    digitalWrite(LED,HIGH);

    Serial.println("\nSensor Value: ");
    Serial.print(sensorValue);
    Serial.println("\nDANGER\n");
  }
  else{
    digitalWrite(LED,LOW);
    Serial.println("\nSensor Value: ");
    Serial.print(sensorValue);

  }
  delay(1000);
}

float getsensorValue(int pin){
  return (analogRead(pin));
}
```

Output:



Ambient Light Sensor [Phototransistor]

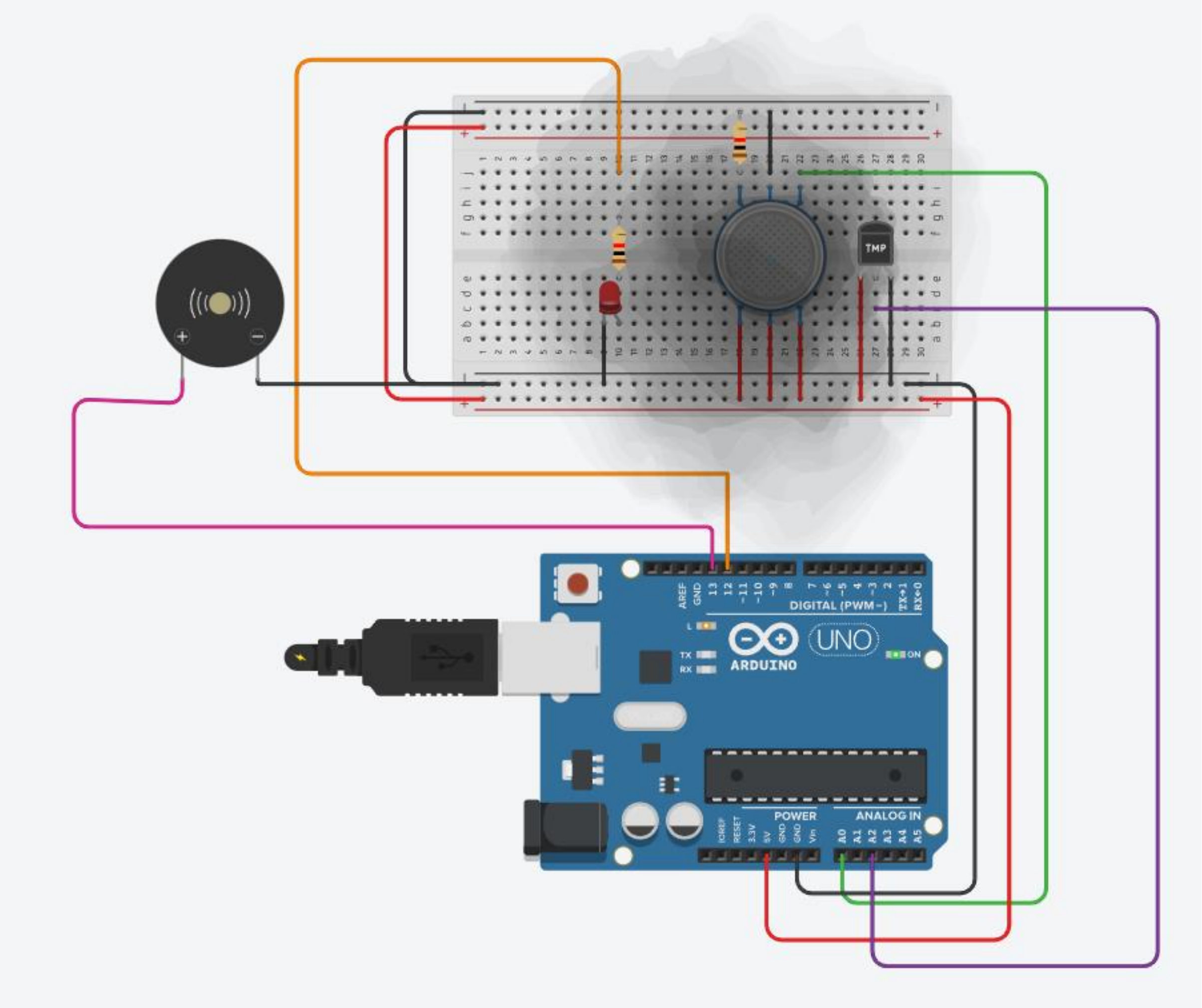
Name 1

3 Interface the temperature and gas sensor with Arduino Uno board. Check the temperature and the gas value, if the limit is beyond the threshold, switch on the bulb and make alarm using buzzer.

Code:

```
int LED = 12;
int gas = A0;
int tmppin= A2;
int piezo = 13;

void setup() {
  Serial.begin(9600);
  pinMode(LED, OUTPUT);
  pinMode(piezo, OUTPUT);
  pinMode(gas,INPUT);
  pinMode(tmppin,INPUT);

}

void loop() {
  float sensorValue, tempSensor;
  sensorValue = analogRead(gas); // read analog input pin 0

  tempSensor= analogRead(tmppin);

  bool smoke= sensorValue >= 300;
  bool temp= tempSensor >100;

  if(smoke&&temp){
    digitalWrite(LED,HIGH);
    digitalWrite(piezo, HIGH);

    Serial.println("\nSmoke Sensor Value: ");
    Serial.print(sensorValue);
    Serial.println("\nTemp Sensor Value: ");
    Serial.print(tempSensor);
    Serial.println(" \nDANGER\n");
  }
  else{
    digitalWrite(LED,LOW);
    digitalWrite(piezo, LOW);
    Serial.println("Smoke Sensor Value: ");
    Serial.print(sensorValue);
    Serial.println("\nTemp Sensor Value: ");
    Serial.print(tempSensor);
  }
  delay(1000);
}

float getsensorValue(int pin){
  return (analogRead(pin));
}
```

Output:



TMP
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
ANALOG IN
A0
A1
A2
A3
A4
A5

Lab 8 (18-04-2022)

1. Interface force sensor with Arduino board and display the amount of force given as input to sensor in LCD screen. Also, interface LED RGB and change color of the LED based on the some threshold values.
2. Interface the keypad and tilt sensor with Arduino board, if the sensor is being tilted, then take input from keypad and print it in the LCD.

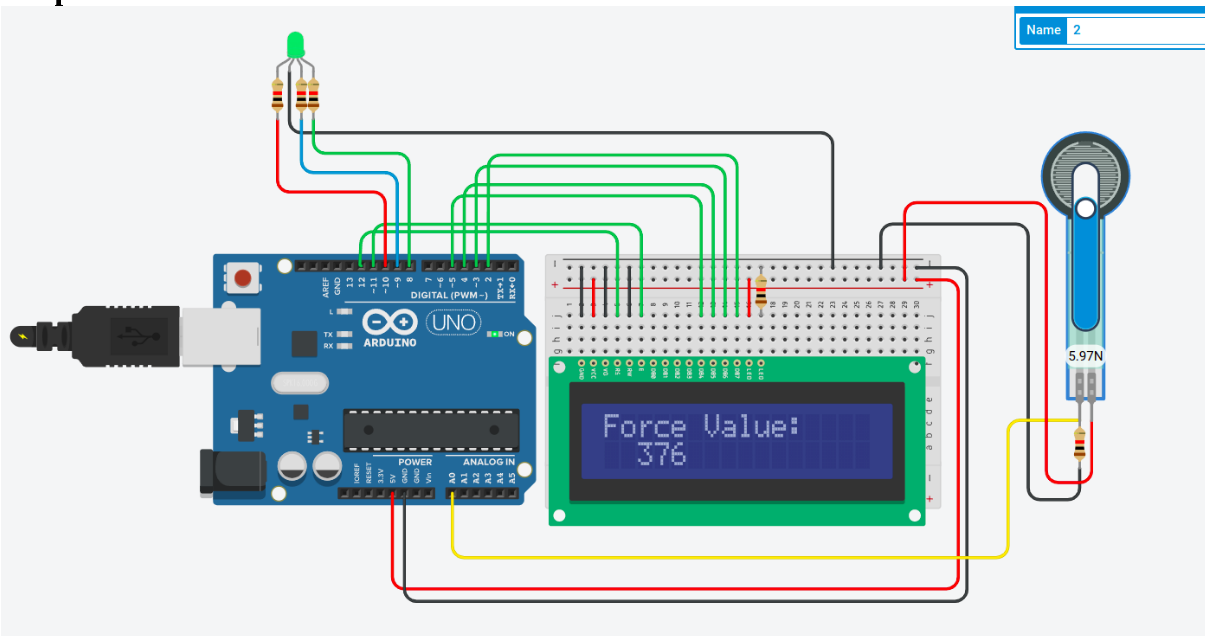
1 Interface force sensor with Arduino board and display the amount of force given as input to sensor in LCD screen. Also, interface LED RGB and change color of the LED based on the some threshold values.

Code:

```
#include<LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int Force_VAL = 0;
const int red = 10;
const int blue = 9;
const int green = 8;

void setup()
{
  pinMode(A0,INPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);

  pinMode(red, OUTPUT);
  pinMode(blue, OUTPUT);
  pinMode(green, OUTPUT);
}

void loop()
{
  Force_VAL = analogRead(A0);
  Serial.println(Force_VAL);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Force Value:");
  lcd.setCursor(2,1);
  lcd.print(Force_VAL);

  if(Force_VAL < 100){
        digitalWrite(red,HIGH);
    digitalWrite(blue,LOW);
    digitalWrite(green,LOW);
  }else if(Force_VAL >= 100 && Force_VAL < 200){
        digitalWrite(red,LOW);
```

```
   digitalWrite(blue,HIGH);
   digitalWrite(green,LOW);
  }else{
         digitalWrite(red,LOW);
   digitalWrite(blue,LOW);
   digitalWrite(green,HIGH);
  }
  delay(1000);
}
```

Output:



```
Force Value:
376
```

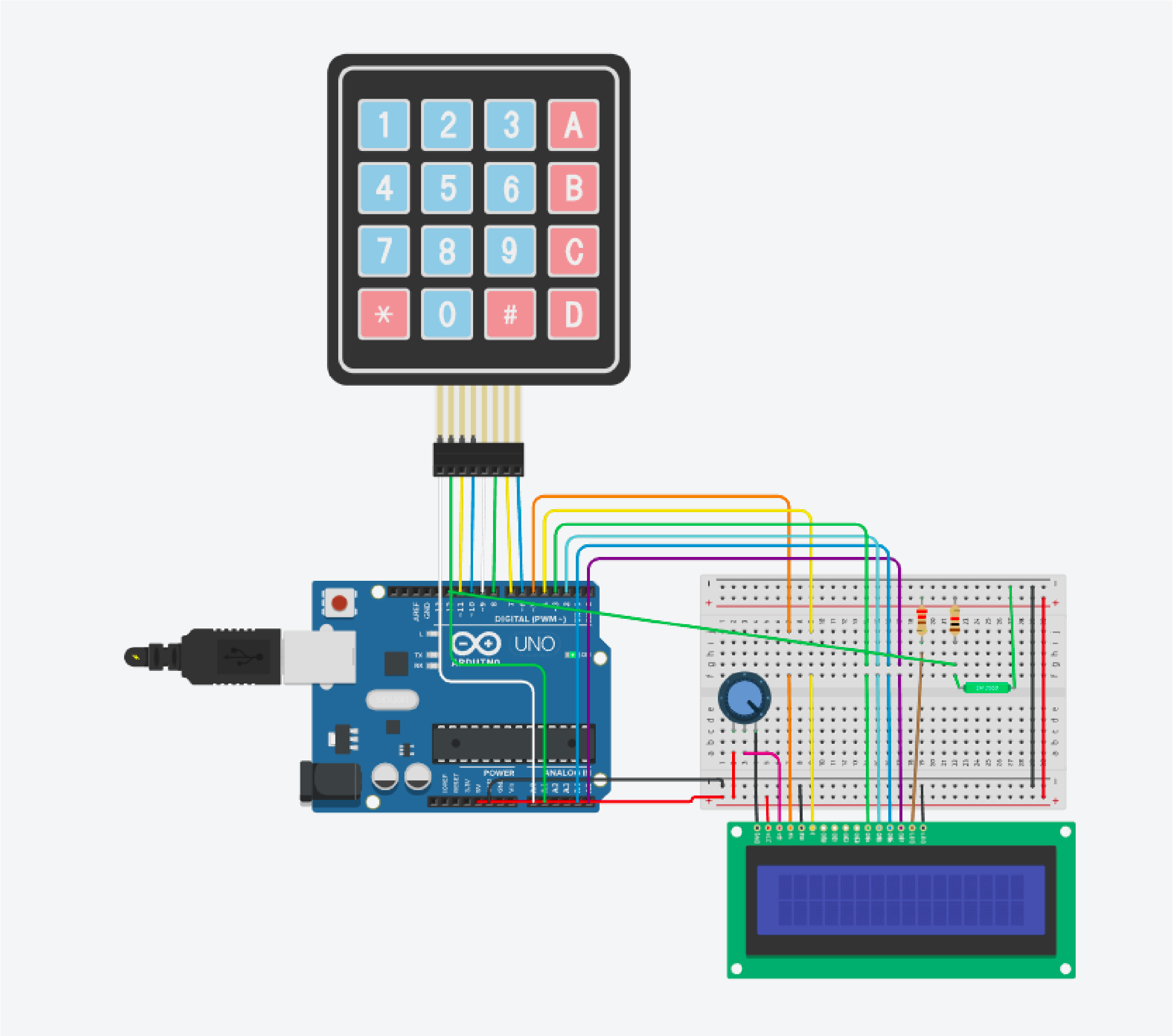
2 Interface the keypad and tilt sensor with Arduino board, if the sensor is being tilted, then take input from keypad and print it in the LCD.

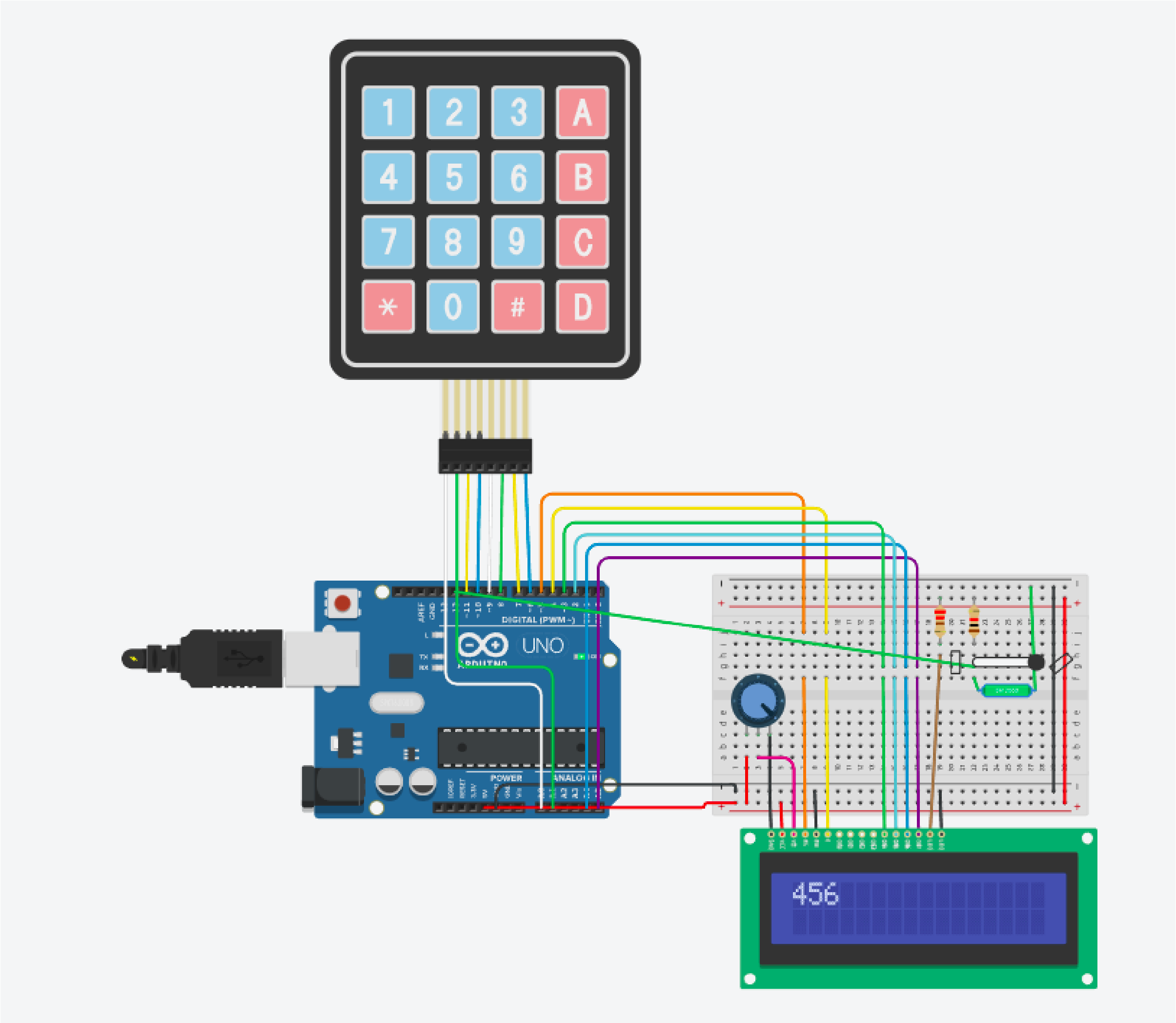
Code:

```
#include <Keypad.h>
#include <LiquidCrystal.h>

LiquidCrystal lcd(5, 4, 3, 2, A4, A5);

int tilt = 12;
const byte ROWS = 4; //four rows
const byte COLS = 4; //three columns
char keys[ROWS][COLS] = {
  {'1','2','3','A'},
  {'4','5','6','B'},
  {'7','8','9','C'},
  {'*','0','#','D'}
};
byte rowPins[ROWS] = {A0, A1, 11, 10}; //connect to the row pinouts of the keypad
byte colPins[COLS] = {9, 8, 7, 6}; //connect to the column pinouts of the keypad
```

```
int LCDRow = 0;


Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );


void setup(){
  pinMode(tilt, INPUT);
   Serial.begin(9600);
   lcd.begin(16, 2);
   lcd.setCursor(LCDRow, 0);
    }
void printons()
{char key = keypad.getKey();

  if (key){
    Serial.println(key);
    lcd.print(key);
    lcd.setCursor (++LCDRow, 0);
  }
}
void loop(){
  int reading;
  reading = digitalRead(tilt);
  if(!reading)
  {
    printons();
  }
}
```

Output:




1
2
3
A
4
5
6
B
7
8
9
C
*
0
#
D
DIGITAL (PWM ~)
UNO
ARDUINO
POWER
ANALOG IN
456