Experiment No. 01

Experiment Name:

Controlling blinking LEDs

- Turning on each one of 8 LEDs in order and then extinguish them in order
- Lighting up 8 LEDs from top to bottom and then going backwards so only one LED is ON at any time
- Lighting up 8 LEDs in any other particular form

Objective:

In this lab we will learn about micro-controller and arduino. The objectives of this experiment include:

Understanding the basic use of micro-controller and arduino.
Designing a circuit using arduino board, breadboard and LED lights.
Writing a C program for micro-controller using arduino IDE.

By doing this experiment we will learn about how we can program a micro-controller of a arduino board and control the blinking of LEDs in the circuit.

Theory:

Micro-controller:
A micro-controller is a self-contained system with peripherals, memory and a processor that can be used as an embedded system. Most programmable micro-controllers that are used today are embedded in other consumer products or machinery including phones, peripherals, automobiles and household appliances for computer systems. Due to that, another name for a micro-controller is "embedded controller."

Some embedded systems are more sophisticated, while others have minimal requirements for memory and programming length and a low software complexity. Input and output devices include solenoids, LED lights, LCD displays, relays, switches and sensors for data like humidity, temperature or light level, amongst others.

Arduino:

Arduino is an open-source microcontroller platform, that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Since the boot loader has been programmed into the on board micro-controller, we can compile and upload sketches with only one software environment, that is, the Arduino Integrated Development Environment (IDE).

LED

An LED is a small light (it stands for "light emitting diode") that works with relatively little power.

Current Limiting Resistor:
We should connect a current-limiting resistor when an LED is used or else the LED can become burned due to excessive current. In this experiment, the operating voltage of the LED is between 1.5V and 2.0V and the operating current is between 10mA and 20mA. The arduino Uno board can supply 5V power, the LED we choose works at 1.7V, 15mA. The current-limiting resistance equals total voltage subtracted by LED voltage, then divided by current. In this case, that would be (5-1.7)/0.015. Thus, the current-limiting resistance equals 220Ω.

Connecting an LED:
LEDs have polarity, which means they will only light up if you orient the legs properly. The long leg is typically positive, and should connect to a digital pin on the Arduino board. The short leg goes to GND; the bulb of the LED will also typically have a flat edge on this side.

Code:

To blink the LED takes only a few lines of code. The first thing we do is define a variable that will hold the number of the pin that the LED is connected to. We don't have to do this (we could just use the pin number throughout the code) but it makes it easier to change to a different pin. We use an integer variable (called an int).

```
int ledPin = 13;
```

We can also define an array if there are multiple LEDs. For example:

```
int ledPins[] = {0,1,2,3,4,5,6,7,8,9}
```

The second thing we need to do is configure as an output the pin connected to the LED. We do this with a call to the pinMode() function, inside of the sketch's setup() function:

```
void setup()
{
  pinMode(ledPin, OUTPUT);
```

```
}
```

Finally, we have to turn the LED on and off with the sketch's loop() function. We do this with two calls to the digitalWrite() function, one with HIGH to turn the LED on and one with LOW to turn the LED off. If we simply alternated calls to these two functions, the LED would turn on and off too quickly for us to see, so we add two calls to delay() to slow things down. The delay function works with milliseconds, so we pass it 1000 to pause for a second.

```
void loop()
{
  digitalWrite(ledPin, HIGH);
  delay(1000);
  digitalWrite(ledPin, LOW);
  delay(1000);
}
```

Equipment:

1. A computer (Windows, Mac, or Linux).
2. An Arduino compatible micro-controller.
2. Arduino Software
3. A breadboard
4. A USB A-to-B cable
5. Male/Male Jumper Wires
6. LEDs
7. Resistors(220 Ω)

Experiment:

Circuit Diagram:

Program Source Code:

1.Turning on each one of 8 LEDs in order and then extinguish them in order

```
const int pin[] = {0,1,2,3,4,5,6,7,8,9};
void setup() {

  for(int i=0;i<10;i++)
      pinMode(pin[i], OUTPUT);

}

void loop() {

for(int i=1;i<=8;i++)
  {
      digitalWrite(pin[i], HIGH);
      delay(500);
  }


for(int i=8;i>=1;i--)
  {
      digitalWrite(pin[i], LOW);
      delay(500);
  }

}
```

2. Lighting up 8 LEDs from top to bottom and then going backwards so only one LED is ON at any time

```
const int pin[] = {0,1,2,3,4,5,6,7,8,9};
int i;
bool flag;
void setup() {

  for(int i=0;i<10;i++)
      pinMode(pin[i], OUTPUT);

  i = 1;
  flag = true;
}

void loop() {


      digitalWrite(pin[i], HIGH);
      delay(500);
      digitalWrite(pin[i], LOW);
    if(i==8)
      flag = false;
     if(i==1)
      flag = true;

      if(flag)  i++;
      else i--;


}
```

3. Lighting up 8 LEDs in any other particular form

```
const int pin[] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
int i,j;
void setup() {

  for (int i = 0; i < 10; i++)
    pinMode(pin[i], OUTPUT);
}

void loop() {

  for(i=1;i<=8;i++)
  {
    for(j=1;j<=i;j++)
    {
      digitalWrite(pin[j], HIGH);
      delay(200);
    }
    for(j=2;j<=i;j++)
    {
      digitalWrite(pin[j], LOW);
    }
    if(i==8)
      digitalWrite(pin[1],LOW);
    delay(200);
  }

  for(int i=8;i>=1;i--)
  {
    for(int j=8;j>=i;j--)
    {
      digitalWrite(pin[j], HIGH);
      delay(200);
    }
    for(int j=7;j>=i;j--)
    {

      digitalWrite(pin[j], LOW);
```

```
    }

    if(i==1)
      digitalWrite(pin[8],LOW);
    delay(200);
  }
}
```

Procedure:

Part1: Designing the circuit:

1. We designed the circuit by connecting the LEDs. We connected the positive terminal(long leg) of the LED with a digital pin on the Arduino board and the negative terminal (short leg) with the GND.

2. We also connected a current-limiting resistor with each LED to control current passing through each LED.

Part 2: Connecting Arduino to the computer

1. We launched the Arduino IDE from the computer then created a new sketch.

2. Then, we connected the Arduino UNO board with the computer through a USB A-to-B cable.

Part 3: Compiling and Uploading the sketch to the arduino

1. Now we need to write the source code for different experiments.

- For the first experiment, we need to had to turn on each LED in order and extinguish them in order. So, we iterated through each digital pin and put HIGH voltage and then we again iterated them in reverse order and put LOW voltage. We also applied the delay.

- For the second experiment, we need to light up 8 LEDs from top to bottom and then going backwards so only one LED is ON at any time. So, we iterated through each digital pin and put HIGH voltage, applied delay and then put LOW voltage. Again, we iterated through them in reverse order, put a HIGH voltage, applied delay and put LOW voltage using the digital write function.

- For the third experiment, we light up 8 LEDs in a particular form. For this purpose, we blink ON 1,2,…,8 LEDs at a time in the forward direction and also in the reverse direction.

2. Finally, we compiled and uploaded the sketch in the micro-controller of the arduino board and we can see the LEDs blinking in different manner based on the source code.

Conclusion:

From this experiment, we learned about micro-controller and how we can design circuit as well as use the arduino board. We also learned how to setup the IDE for Arduino and how to upload sketches.

We observed how the LEDs blink in different pattern based on the source code of the uploaded sketch. We noticed how we can control the blinking time by using the delay function.

Finally, we were able to blink the light according to the given pattern in first two experiment and light up LED's in a particular form in the third experiment and completed our experiment successfully. For third experiment, we had many ideas to light up LED's in a particular form but we had to select one of the patterns. We learned and enjoyed a lot doing this experiment.