Part A	
Class B Tech CSE 4th Year	**Sub: Internet of Things Lab**
Aim: Controlling LED and Buzzer using analog and digital read-write and Potentiometer	
Prerequisite: Basics of programming, microcontrollers and basic electronics	
Outcome: Connections of LEDs and buzzers and controlling active and passive buzzers using variable voltage by potentiometer	

Theory:

1. LED Control Using an Ultrasonic Sensor:

An ultrasonic sensor is a type of proximity sensor that measures the distance to an object by emitting ultrasonic sound waves and detecting the time it takes for the sound to bounce back to the sensor. The basic principle behind the ultrasonic sensor is the use of sound waves, which travel through the air at a known speed (approximately 343 meters per second). By calculating the time delay between sending and receiving the sound waves, the distance to an object can be determined.

In this experiment, the sensor's output is used to control an LED. The microcontroller reads the distance measured by the ultrasonic sensor and compares it to a predefined threshold. If the object is within a certain range, the LED is turned on; otherwise, it remains off.

2. Analog and Digital Sound Using Active and Passive Buzzers:

Buzzers are sound-generating devices commonly used in electronic projects to provide audio feedback or alerts. There are two main types of buzzers: active and passive.

- **Active Buzzers:** Active buzzers contain an internal oscillator, meaning they can produce sound when a steady DC voltage is applied. The sound produced is typically a single frequency tone, and the buzzer will continue to emit this sound as long as power is supplied. This makes active buzzers easy to use, as they do not require complex driving signals.
- **Passive Buzzers:** Passive buzzers, on the other hand, do not have an internal oscillator and therefore need an external signal to produce sound. The frequency of the sound generated depends on the frequency of the input signal. By varying this signal, different tones and sounds can be created, making passive buzzers more versatile for applications that require varying audio outputs, such as generating melodies or sound effects.

3. Controlling Active and Passive Buzzers Using Variable Voltage by a Potentiometer:

A potentiometer is a type of variable resistor that allows for the adjustment of voltage within a circuit. By turning the knob of the potentiometer, the resistance changes, which in turn alters the voltage across its terminals. This varying voltage can be used to modulate the input to other components, such as buzzers, affecting their output.

In this experiment, the potentiometer is used to control the voltage supplied to both active and passive buzzers. For the active buzzer, adjusting the voltage affects the loudness and clarity of the sound, as higher voltages typically result in a louder output. For the passive buzzer, changing the voltage can influence both the volume and the frequency of the sound, depending on how the signal is modulated.

Part B

1. LED control using Ultrasonic sensor

```
int ledpin = 8;
int trigpin = 3;
int echopin = 2;
int duration;

void setup()
{
  Serial.begin(9600);
  pinMode(ledpin, OUTPUT);
  pinMode(trigpin, OUTPUT);
  pinMode(echopin, INPUT);
}

void loop()
{
  digitalWrite(trigpin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigpin, LOW);

  duration = pulseIn(echopin,HIGH);
  float distance = (duration/2.)*0.0011253;
  Serial.println(distance);

  if(distance <= 2.0){
  digitalWrite(ledpin, HIGH);

  }
  else{
    digitalWrite(ledpin, LOW);
  }
}
```

2. Analog and digital sound using active and passive Buzzers

```
int ledpin = 8;
int buzzpin = 6;
int trigpin = 3;
int echopin = 2;
int duration;

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

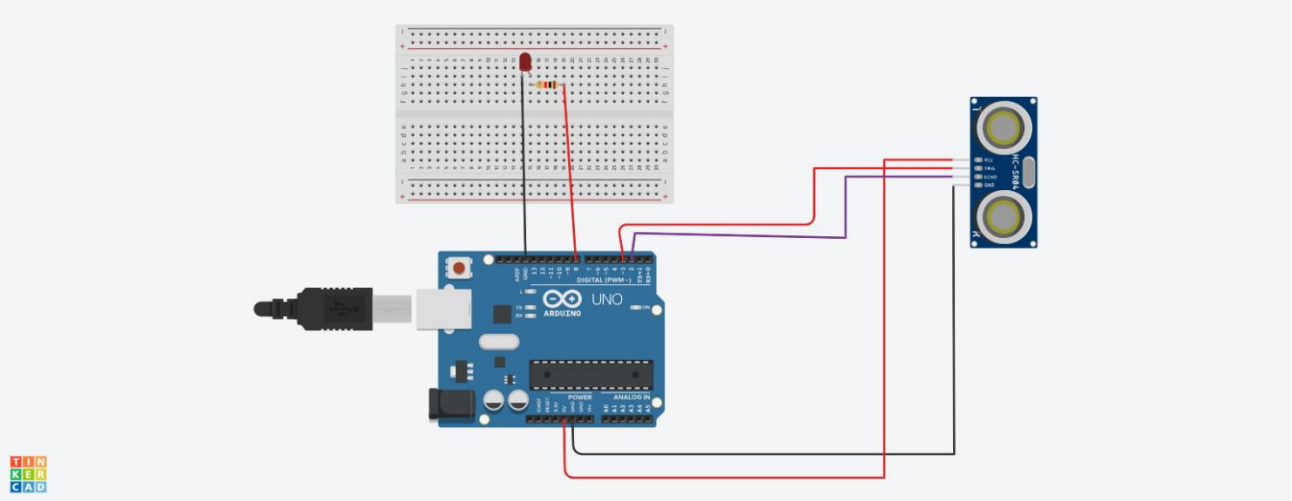
```
  pinMode(ledpin, OUTPUT);
  pinMode(buzzpin, OUTPUT);
  pinMode(trigpin, OUTPUT);
  pinMode(echopin, INPUT);
}

void loop()
{
  digitalWrite(trigpin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigpin, LOW);

  duration = pulseIn(echopin,HIGH);
  float distance = (duration/2.)*0.0011253;
  Serial.println(distance);

  if(distance <= 2.0){
  digitalWrite(ledpin, HIGH);
  digitalWrite(buzzpin, HIGH);

  }
  else{
    digitalWrite(ledpin, LOW);
    digitalWrite(buzzpin, LOW);
  }
}
```

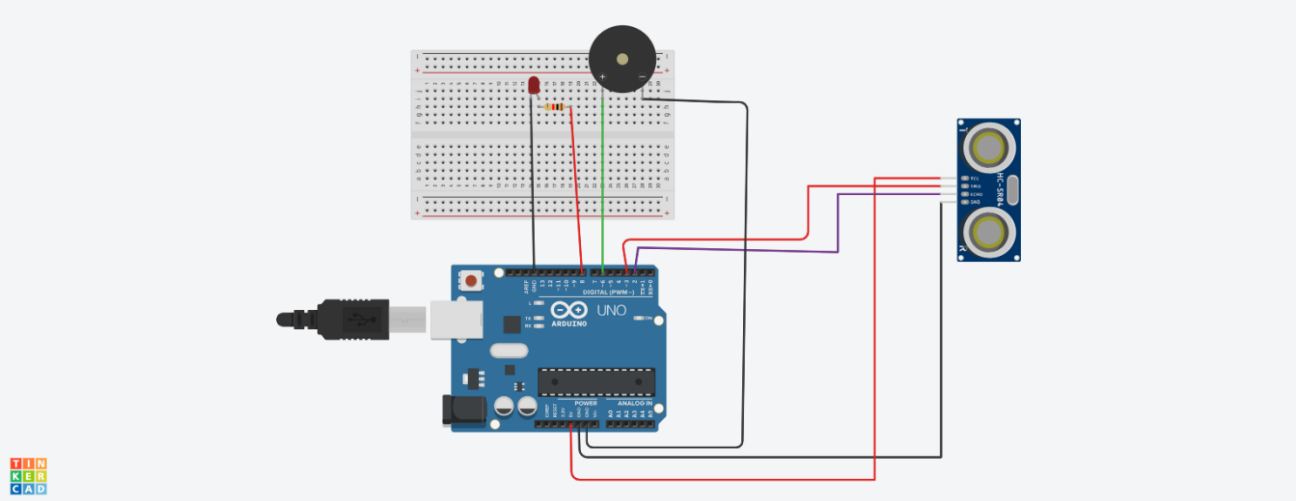
3. Controlling active and passive buzzers using variable voltage by Potentiometer

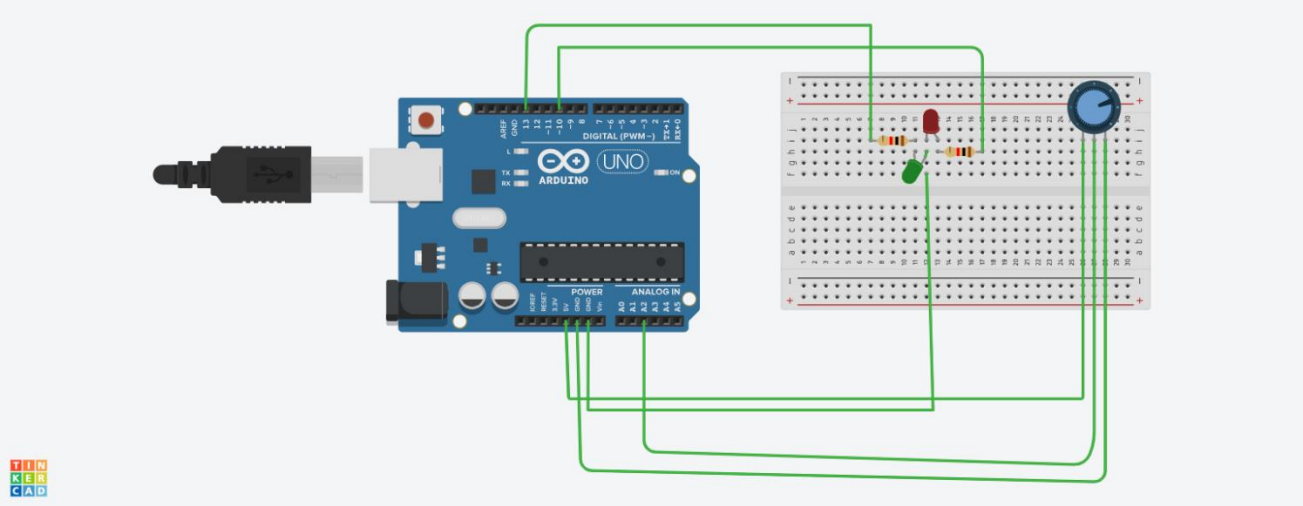
```
int ledpin1 = 13;
int ledpin2 = 10;
int potpin = A2;
int readVal;

void setup()
{
  Serial.begin(9600);
  pinMode(ledpin1,OUTPUT);
  pinMode(ledpin2, OUTPUT);
  pinMode(potpin, INPUT);
}

void loop()
{
  readVal = analogRead(potpin);
  Serial.println(readVal);
  delay(500);
```

```
  if(readVal <= 300){
    digitalWrite(ledpin1, HIGH);
    digitalWrite(ledpin2, LOW);
  }
  else{
    digitalWrite(ledpin1, LOW);
    digitalWrite(ledpin2, HIGH);
  }
}
```

Output:







Observation & Learning:

- **LED Control with Ultrasonic Sensor**: The LED responded accurately to the distance measured by the ultrasonic sensor. As the object moved closer or farther away from the sensor, the LED's state changed as expected, turning on or off depending on the threshold distance set in the code. This highlighted the reliability of the ultrasonic sensor in detecting proximity and controlling outputs based on real-time measurements.

- **Analog and Digital Sound with Buzzers**: Active buzzers produced a consistent tone with a steady digital signal, requiring no additional modulation. In contrast, passive buzzers required a varying input signal to generate sound, which allowed for a range of tones and frequencies to be produced. This illustrated the difference between the two types of buzzers and their respective applications.

- **Controlling Buzzers with a Potentiometer**: Adjusting the potentiometer resulted in a noticeable change in the sound produced by both active and passive buzzers. As the voltage varied, the intensity and frequency of the sound changed, demonstrating the direct relationship between input voltage and the buzzers' output characteristics.

Conclusion:

In this experiment, we explored the control of LEDs and buzzers using various sensors and components, demonstrating how hardware inputs can influence outputs in practical applications. We first focused on controlling an LED using an ultrasonic sensor. By utilizing the sensor's ability to measure distance, we successfully controlled the LED's state based on proximity. This part of the experiment showcased how ultrasonic sensors can be effectively used in automation and object detection scenarios, where an LED could serve as an indicator or alert based on the detected distance.