ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY
(A Unit of Alva's Education Foundation, Moodabidri)
Autonomous Institute, Affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & NBA (CSE & ECE)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

INTERNET OF THINGS

Lab Manual

Subject Code: BCS701

[As per VTU 2022 Scheme]

SEMESTER – VII

PREPARED BY,

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VISION AND MISSION

INSTITUTION VISION AND MISION

VISION:

"Transformative education by pursuing excellence in Engineering and Management through enhancing skills to meet the evolving needs of community".

MISION:

1. **To bestow quality technical education to imbibe knowledge, creativity and ethos to students community.**
2. **To inculcate the best engineering practice through transformative education.**
3. **To develop a knowledgeable individual for a dynamic industrial scenario.**
4. **To inculcate research, entrepreneurial skills and human values in order to cater the needs of society**

DEPARTMENT VISION AND MISION

VISION:

"To empower Engendering competent, excellent professionals by transforming the knowledge and computing skills to individuals through modern innovative tools and techniques".

MISION:

- **To produce skilled, creative software developers through rigorous training.**
- **To conduct specific technical courses to keep abreast to the latest technological developments and transform action in the domain.**
- **To establish Industry-Institute Interaction programs to enhance the skills of employability and entrepreneurship.**
- **To implement the ideas of research and innovations in interdisciplinary domains.**

OUTCOMES (PO's)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration forthe public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSO’s)

A graduate of the Computer Science and Engineering Program will exhibit:

PSO1: Professional Skills: The ability to understand & implement the computer programs in the areas of Computer Architecture, System Software, Database Management Systems, Web Design, Multimedia and Computer Networking.

PSO2: Problem-Solving Skills: The ability to solve real-world problems by suitable mathematical model with strong technological concepts in rapidly growing arena of computer technology.

PSO3: Successful Career and Entrepreneurship: Knowledge in diverse areas of Software Engineering and Management &Entrepreneurship for IT Industry, conducive in cultivating skills for successful career development.

PROGRAM EDUCATION OBJECTIVES

PEO1: Exhibit fundamental strength in core courses of Computer Engineering to solve the problems of computing world.

PEO2: Adapt and contribute the emerging technological changes.

PEO3: Employed in computing profession or engaged in learning to pursue higher studies.

COURSE OUTCOMES (CO's)

CO	Course Outcomes	Blooms Level
BCS701.1	**Interpret** the architecture, components, and enabling technologies of IoT, and outline various levels and deployment templates used in real-world applications.	**Understand (L2)**
BCS701.2	**Apply** concepts of IoT and Machine-to-Machine (M2M) communication to analyze system architectures and implement basic network management using protocols such as NETCONF and YANG.	**Apply (L3)**
BCS701.3	**Apply** IoT design methodology and use Python programming to develop and demonstrate simple IoT-based applications such as weather monitoring systems**.**	**Apply (L3)**
BCS701.4	**Build** the setup and building of IoT physical devices like Raspberry Pi, Arduino uno and illustrate their use in real-world domains such as home automation, smart cities, and agriculture.	**Apply (L3)**
BCS701.5	**Make use** of big data frameworks such as Hadoop, Spark, and Storm to implement batch and real-time data analytics in IoT systems.	**Apply (L3)**

CO-PO/PSO Mapping Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO
CO1	2	2	2	2	2				2	2	2	2	2	2	2
CO2	2	3	3	3	2				2	2	2	2	2	2	2
CO3	2	3	3	3	2				2	2	2	2	2	2	2
CO4	2	3	3	3	2				2	2	2	2	2	2	2
CO5	2	3	3	3	2				2	2	2	2	2	2	2

1 indicates **Slight**, **2** indicates **Moderate**, **3** indicates **High**

EXPERIMENT INDEX

S. No	Content
1.	Develop a program to blink 5 LEDs back and forth.
2.	Develop a program to interface a relay with Arduino board.
3.	Develop a program to deploy an intrusion detection system using Ultrasonic and sound sensors.
4.	Develop a program to control a DC motor with Arduino board.
5.	Develop a program to deploy smart street light system using LDR sensor.
6.	Develop a program to classify dry and wet waste with the Moisture sensor (DHT22).
7.	Develop a program to read the pH value of a various substances like milk, lime and water.
8.	Develop a program to detect the gas leakage in the surrounding environment.
9.	Develop a program to demonstrate weather station readings using Arduino.
10.	Develop a program to setup a UART protocol and pass a string through the protocol.
11.	Develop a water level depth detection system using Ultrasonic sensor.
12.	Develop a program to simulate interfacing with the keypad module to record the keystrokes.

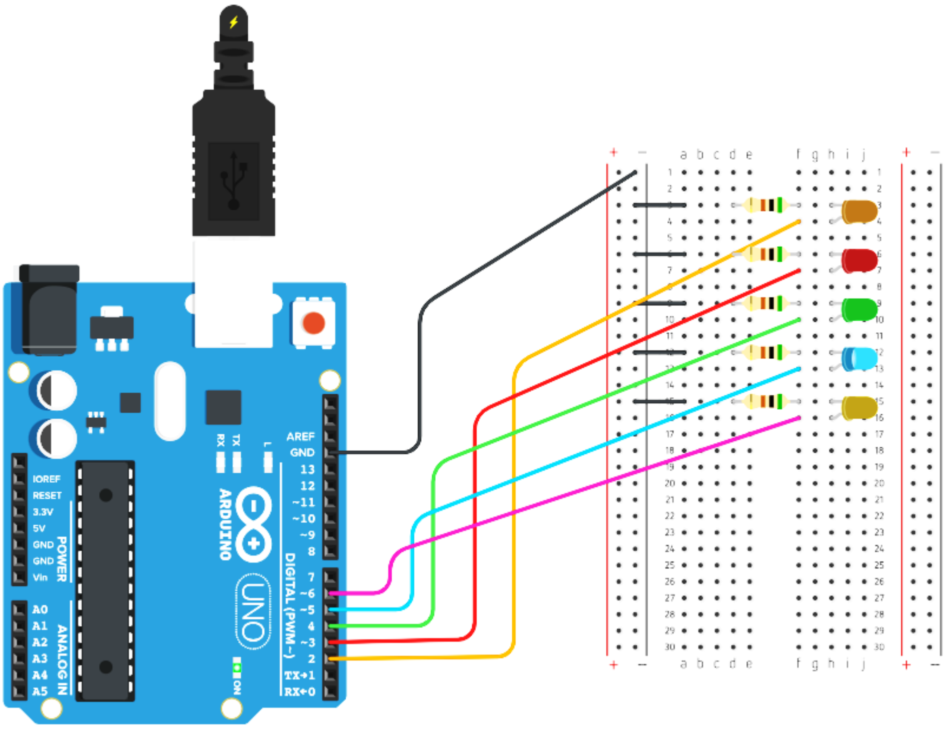
Exp. No. 1	Develop a program to blink 5 LEDs back and forth.

AIM: Develop a program to blink 5 LEDs back and forth.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	6
3.	Bread Board	1
4.	LED	5
5.	Resistance (800 Ω)	5

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
void setup() {
         pinMode(2, OUTPUT);    // sets the digital pin 2-6 as output
         pinMode(3, OUTPUT);
         pinMode(4, OUTPUT);
        pinMode(5, OUTPUT);
        pinMode(6, OUTPUT);
    }
void loop() {
            digitalWrite(2, HIGH); // sets the digital pin 2 on
            delay(1000);           // waits for a second
            digitalWrite(2, LOW);  // sets the digital pin 2 off
            delay(100);
            digitalWrite(3, HIGH);
            delay(1000);
            digitalWrite(3, LOW);
             delay(100);
            digitalWrite(4, HIGH);
            delay(1000);
            digitalWrite(4, LOW);
             delay(100);
            digitalWrite(5, HIGH);
            delay(1000);
            digitalWrite(5, LOW);
             delay(100);
            digitalWrite(6, HIGH);
            delay(1000);
            digitalWrite(6, LOW); // Start Reverse Code
             delay(100);
            digitalWrite(5, HIGH);
             delay(1000);
            digitalWrite(5, LOW);
             delay(100);
            digitalWrite(4, HIGH);
            delay(1000);
            digitalWrite(4, LOW);
             delay(100);
            digitalWrite(3, HIGH);
            delay(1000);
            digitalWrite(3, LOW);
             delay(100);
            digitalWrite(2, HIGH);
            delay(1000);
}
```

Result: Successfully demonstrated blink 5 LEDs.

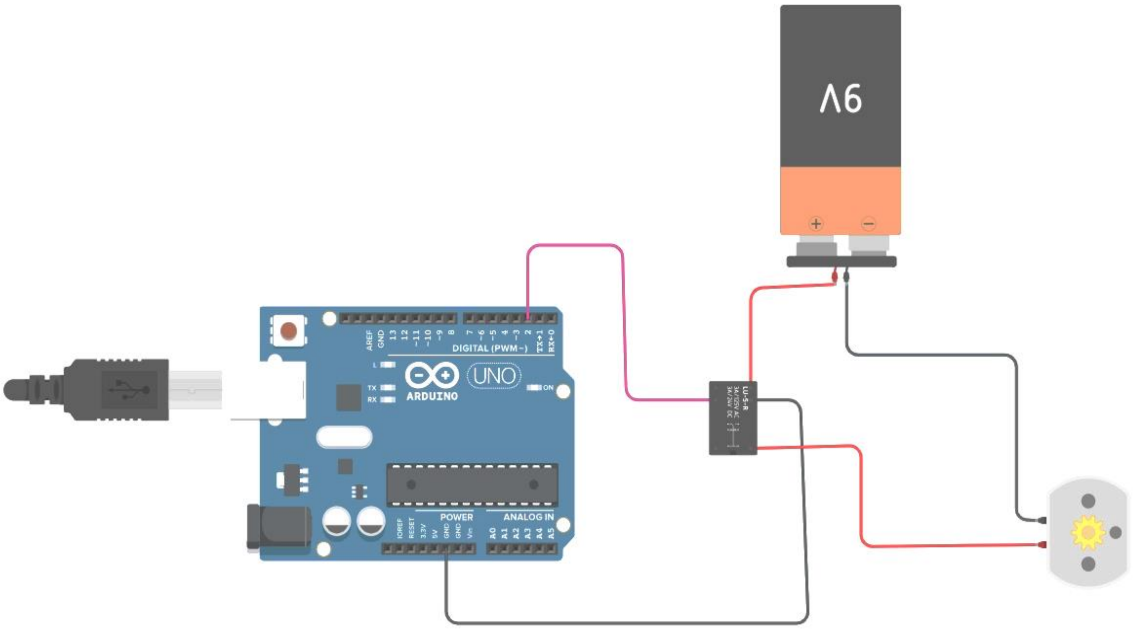
Exp. No. 2	Develop a program to interface a relay with Arduino board.

AIM: Develop a program to interface a relay with Arduino board.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	6
3.	Bread Board	1
4.	DC Motor	1
5.	Relay SPDT	1
6.	9V Battery	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

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

void loop()
{
  digitalWrite(2, HIGH);
  delay(10000); // Wait for 1000 millisecond(s)
  digitalWrite(2, LOW);
  delay(5000); // Wait for 1000 millisecond(s)
}
```

Result: Successfully demonstrated interface a relay with Arduino board

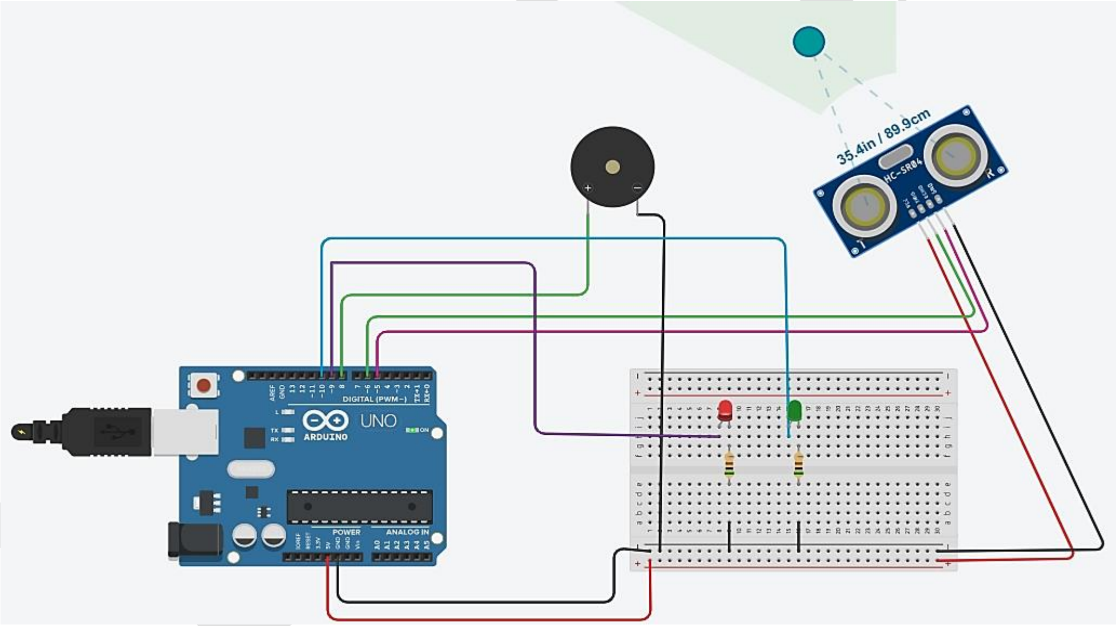
Exp. No. 3	Develop a program to deploy an intrusion detection system using Ultrasonic and sound sensors.

AIM: Develop a program to deploy an intrusion detection system using Ultrasonic and sound sensors.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	6
3.	Bread Board	1
4.	LED	2
5.	Resistance (800 Ω)	2
6.	Ultrasonic Distance Sensor (4-pin)	1
7.	Piezo	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

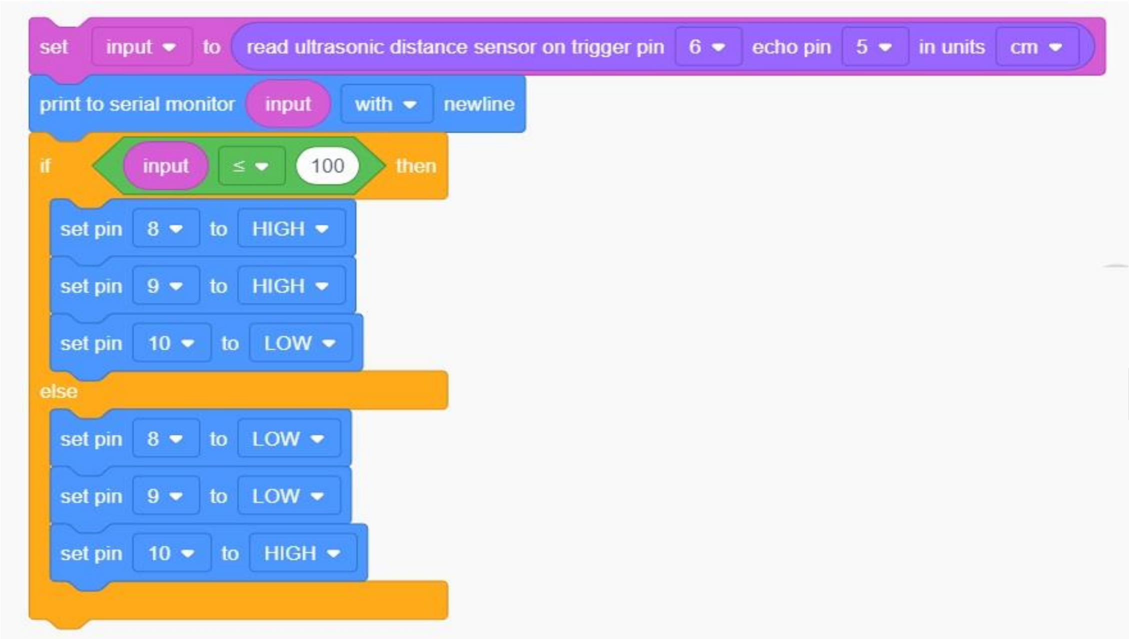
b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:



```
set input ▾ to read ultrasonic distance sensor on trigger pin 6 ▾ echo pin 5 ▾ in units cm ▾
print to serial monitor input with ▾ newline
if input ≤ ▾ 100 then
    set pin 8 ▾ to HIGH ▾
    set pin 9 ▾ to HIGH ▾
    set pin 10 ▾ to LOW ▾
else
    set pin 8 ▾ to LOW ▾
    set pin 9 ▾ to LOW ▾
    set pin 10 ▾ to HIGH ▾
```

Result: Successfully demonstrated deploy an intrusion detection system using Ultrasonic and sound sensors.

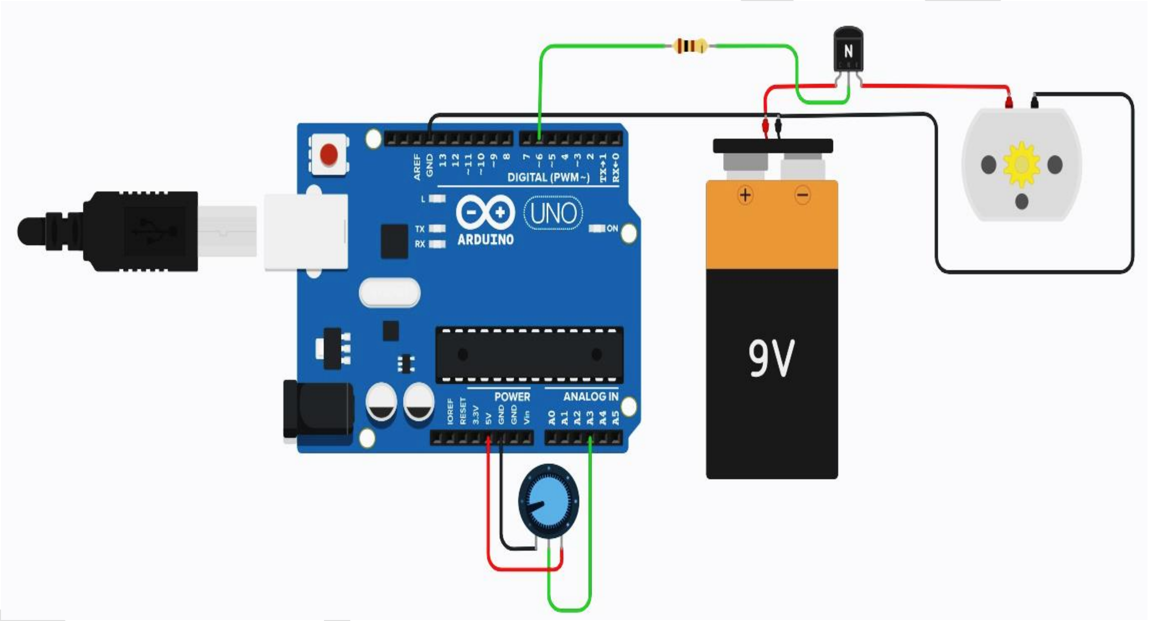
Exp. No. 4	Develop a program to control a DC motor with Arduino board.

AIM: Develop a program to control a DC motor with Arduino board.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	6
3.	Bread Board	1
4.	Resistance (800 Ω)	1
5.	DC Motor	1
6.	NPN Transistor (BJT)	1
7.	9V Battery	1
8.	250 kΩ Potentiometer	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
const int poten = A3;
 int var;

void setup()
{
pinMode(6, OUTPUT);
}

void loop()
{
var = analogRead(poten);
analogWrite(6,var);

}
```

Result: Successfully demonstrated control a DC motor with Arduino board

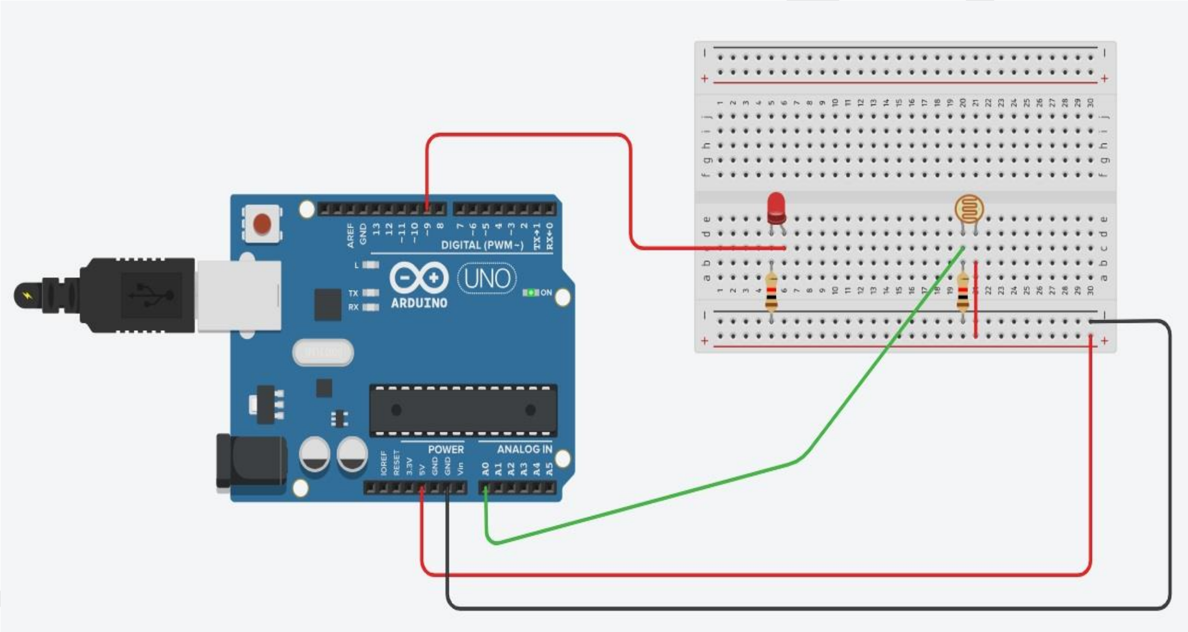
Exp. No. 5	Develop a program to deploy smart street light system using LDR sensor.

AIM: Develop a program to deploy smart street light system using LDR sensor.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	4
3.	Bread Board	1
4.	LED	1
5.	Resistance (850 Ω)	2
6.	LDR	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
int sensorPin = A0;
int sensorValue = 0;
int led = 9;
void setup() {
pinMode(led, OUTPUT);
Serial.begin(9600);
}
void loop(){
sensorValue = analogRead(sensorPin);
Serial.println(sensorValue);
if(sensorValue < 100){
Serial.println("LED light on");
digitalWrite(led,HIGH);
delay(1000);
 }
digitalWrite(led,LOW);
delay(sensorValue);
}
```

Result: Successfully demonstrated deploy smart street light system using LDR sensor

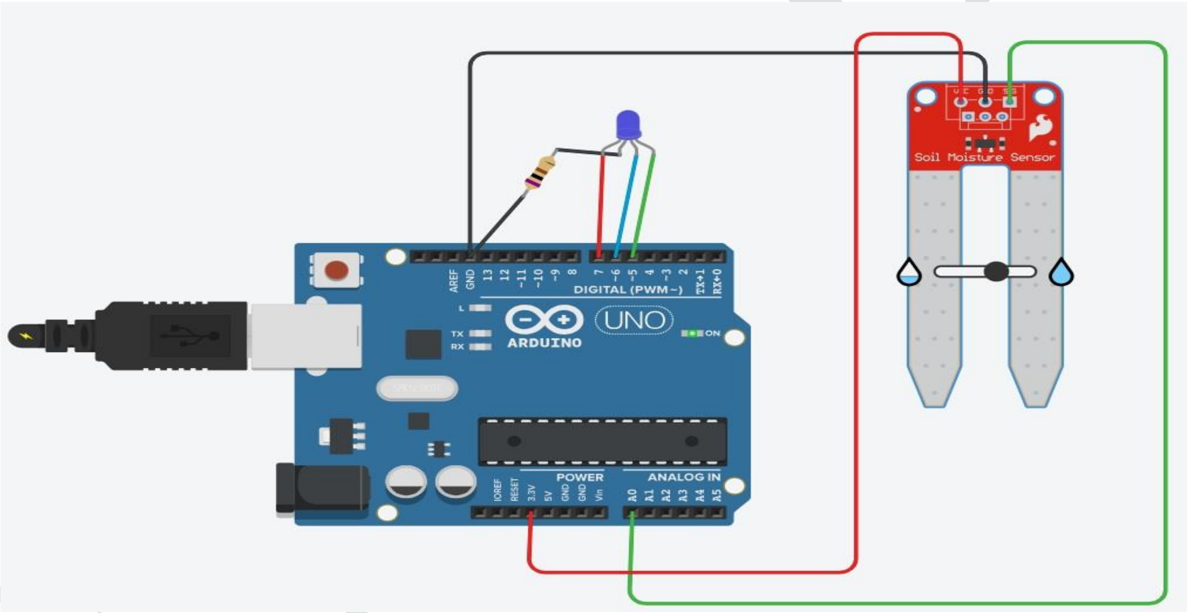
Exp. No. 6	Develop a program to classify dry and wet waste with the Moisture sensor (DHT22).

AIM: Develop a program to classify dry and wet waste with the Moisture sensor (DHT22).

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	8
3.	Bread Board	1
4.	LED	1
5.	Resistance (1KΩ)	1
6.	Moisture sensor (DHT22)	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
int moistureValue;
float moisture_percentage;

void setup()
{
  pinMode(7, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(5, OUTPUT);
  Serial.begin(9600);
  }

void loop()
{
moistureValue = analogRead(A0);
  moisture_percentage = ((moistureValue/539.00)*100);
  if ( moisture_percentage>0 && moisture_percentage<25 )
  {  digitalWrite(7,HIGH);
     digitalWrite(6,LOW);
     digitalWrite(5,LOW);
  }
  if ( moisture_percentage>25 && moisture_percentage<80 )
  {  digitalWrite(7,LOW);
             digitalWrite(6,HIGH);
     digitalWrite(5,LOW);
  }
  if ( moisture_percentage>80 && moisture_percentage<100 )
  {  digitalWrite(7,LOW);
             digitalWrite(6,LOW);
     digitalWrite(5,HIGH);
  }
  Serial.print("\nMoisture Value : ");
  Serial.print(moisture_percentage);
  Serial.print("%");
  delay(1000);
}
```

Result: Successfully demonstrated dry and wet waste with the Moisture sensor (DHT22)

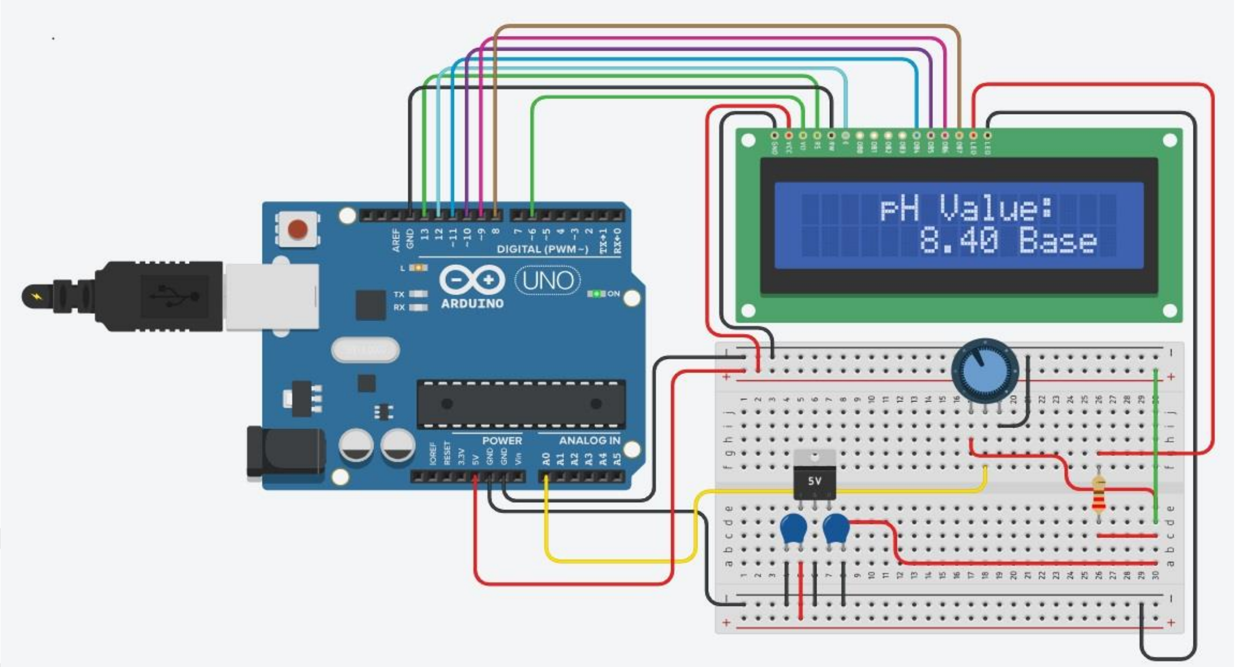
Exp. No. 7	Develop a program to read the pH value of a various substances like milk, lime and water.

AIM: Develop a program to read the pH value of a various substances like milk, lime and water.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	12
3.	Bread Board	1
4.	Resistance (220 Ω)	1
5.	LCD 16 x 2	1
6.	10 MΩ Potentiometer	1
7.	5V Regulator [LM7805]	1
8.	0.22 uF Capacitor	1
9.	0.1 uF Capacitor	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
#include<LiquidCrystal.h>
const int rs =13,en = 12,d4 =11,d5 =10,d6 =9,d7 =8;
LiquidCrystal lcd(rs,en, d4,d5,d6,d7);
int Contrast = 0;
void setup()
{
Serial.begin(9600);
 analogWrite (6,Contrast);
lcd.begin(16,2);
 lcd.setCursor(4,0);
lcd.print("pH Value:");
}

void loop()
{
int sensorValue = analogRead(A0);
float ph = sensorValue * (14.0/1023.0);
Serial.println(ph);
lcd.setCursor(6,1);
if (ph>0.0 && ph<5.0)
 {
 lcd.print (ph);
 lcd.print (" ACID");
 }
 if (ph>5.0 &&ph<7.0)
{
lcd.print (ph);
lcd.print (" Normal");
 }
if (ph>7.0 && ph<14.0)
  lcd.print (ph);
{
lcd.print (" Base");
}
}
```

Result: Successfully demonstrated read the pH value of a various substances like milk, lime and water

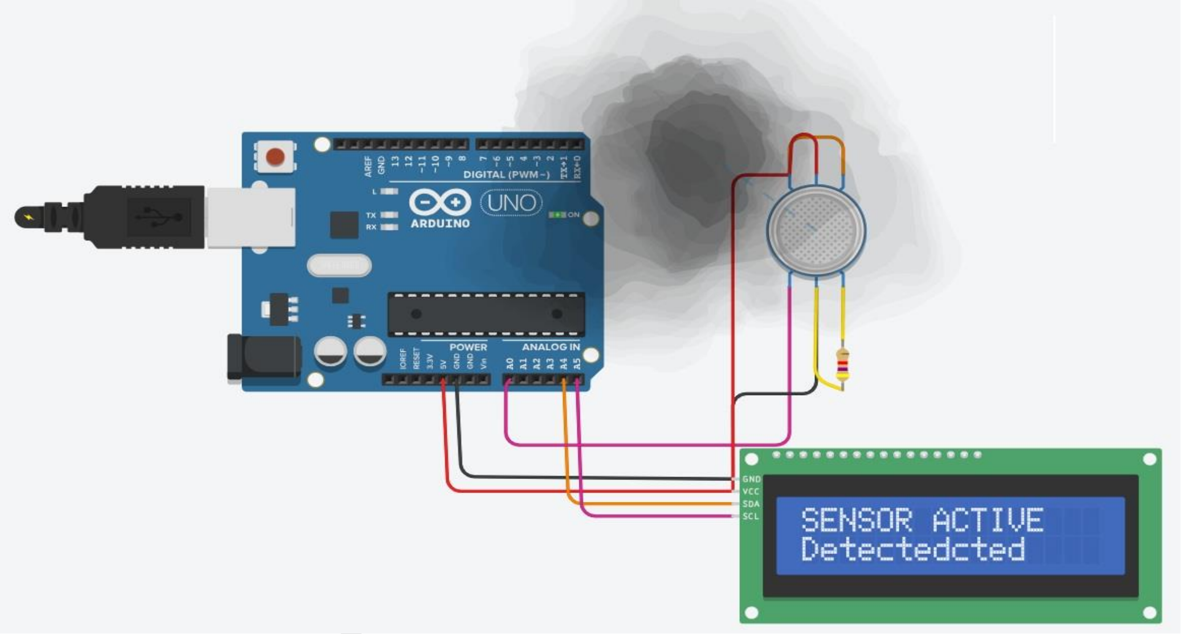
Exp. No. 8	Develop a program to detect the gas leakage in the surrounding environment.

AIM: Develop a program to detect the gas leakage in the surrounding environment.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	6
3.	Gas Sensor	1
4.	MCP23008-based, 32 (0x20) LCD 16 x 2 (I2C)	1
5.	Resistor (4.7 kΩ)	1
6.	Gas Sensor	1

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

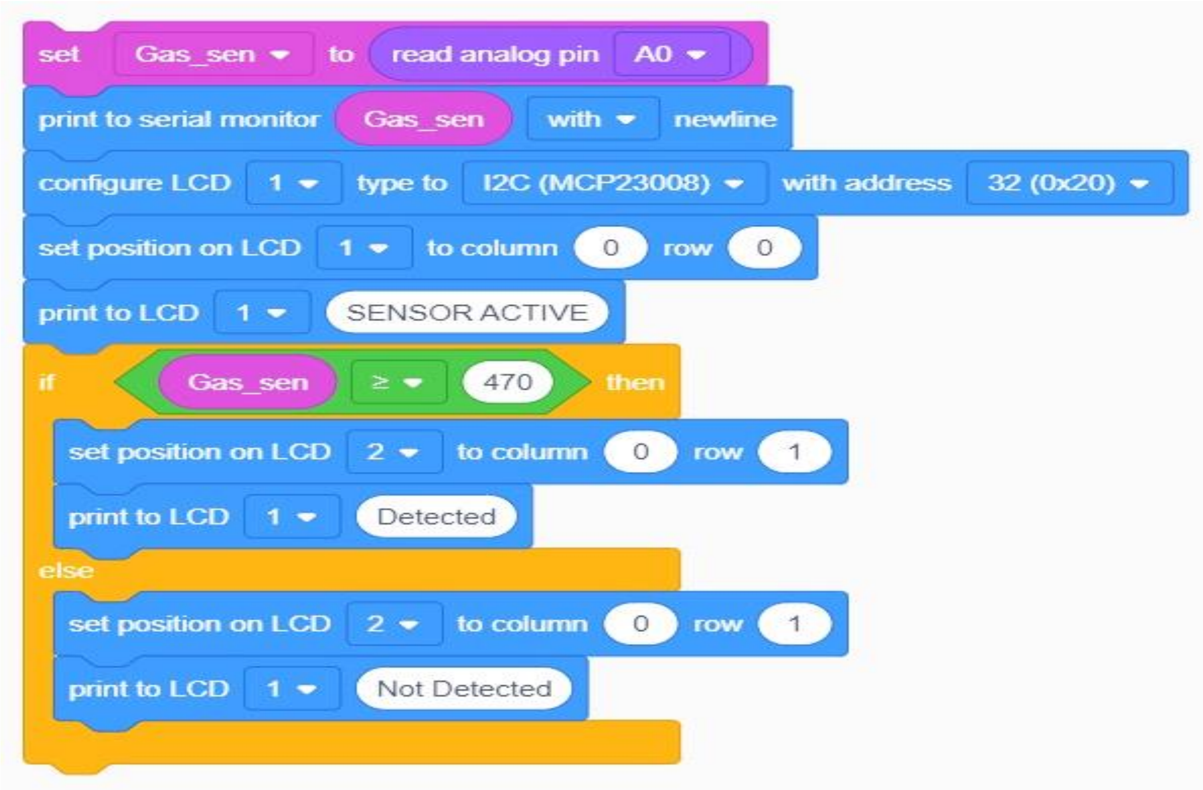
b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:



```
set Gas_sen to read analog pin A0
print to serial monitor Gas_sen with newline
configure LCD 1 type to I2C (MCP23008) with address 32 (0x20)
set position on LCD 1 to column 0 row 0
print to LCD 1 SENSOR ACTIVE
if Gas_sen ≥ 470 then
    set position on LCD 2 to column 0 row 1
    print to LCD 1 Detected
else
    set position on LCD 2 to column 0 row 1
    print to LCD 1 Not Detected
```

Result: Successfully demonstrated detect the gas leakage in the surrounding environment

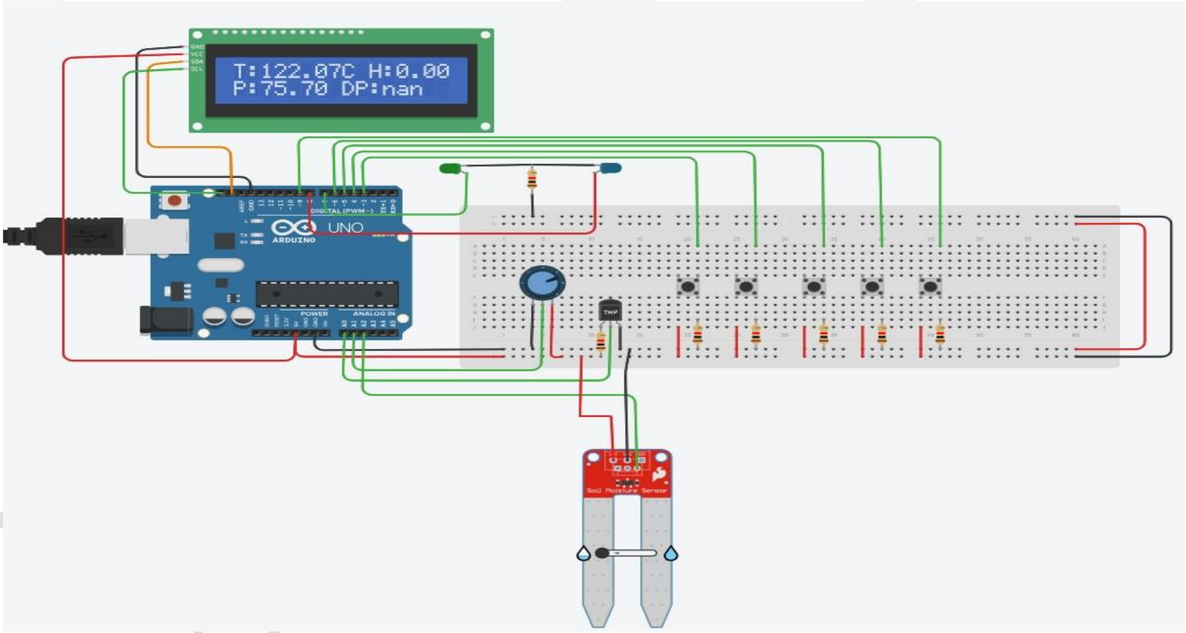
Exp. No. 9	Develop a program to demonstrate weather station readings using Arduino.

AIM: Develop a program to demonstrate weather station readings using Arduino.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	10
3.	Bread Board	1
4.	LED	2
5.	Resistance (1KΩ)	7
6.	LCD 16 x 2 (I2C)	1
7.	Potentiometer (250 kΩ)	1
8.	Temperature Sensor [TMP36]	1
9.	Soil Moisture Sensor	1
10.	Push Button	5

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

```
#include <Adafruit_LiquidCrystal.h>
#include <EEPROM.h>

Adafruit_LiquidCrystal lcd(0);

const int tempPin = A0;
const int humPin = A2;
const int baroPin = A1;

const int buttonPins[] = {3, 4, 5, 6,9};

const int ledPins[] = {7, 8};

float temperature, humidity, pressure, dewPoint;
float minTemp = 100, maxTemp = -100;
float minHumidity = 100, maxHumidity = 0;
float minPressure = 1000, maxPressure = 0;

float tempAlertThreshold = 30.0;
float humAlertThreshold = 80.0;

float tempHistory[10] = {0};
float humHistory[10] = {0};
float pressHistory[10] = {0};
int historyIndex = 0;

int currentScreen = 0;

const int eepromStartAddr = 0;
int eepromIndex = 0;

float calculateDewPoint(float temp, float hum) {
  float a = 17.27;
  float b = 237.7;
  float alpha = ((a * temp) / (b + temp)) + log(hum / 100.0);
  return (b * alpha) / (a - alpha);
}

void logDataToEEPROM(float temp, float hum, float pres) {
  int addr = eepromStartAddr + eepromIndex * 12;
  if (addr + 12 > EEPROM.length()) eepromIndex = 0;
  EEPROM.put(addr, temp);
  EEPROM.put(addr + 4, hum);
```

```
    EEPROM.put(addr + 8, pres);
    eepromIndex++;
}

void readSensors() {
    temperature = analogRead(tempPin) * 5.0 / 1024.0 * 100.0;
    humidity = map(analogRead(humPin), 0, 1023, 0, 100);
    pressure = analogRead(baroPin) / 10.0;
    dewPoint = calculateDewPoint(temperature, humidity);

    if (temperature < minTemp) minTemp = temperature;
    if (temperature > maxTemp) maxTemp = temperature;
    if (humidity < minHumidity) minHumidity = humidity;
    if (humidity > maxHumidity) maxHumidity = humidity;
    if (pressure < minPressure) minPressure = pressure;
    if (pressure > maxPressure) maxPressure = pressure;

    tempHistory[historyIndex] = temperature;
    humHistory[historyIndex] = humidity;
    pressHistory[historyIndex] = pressure;
    historyIndex = (historyIndex + 1) % 10;

    logDataToEEPROM(temperature, humidity, pressure);
}

void checkAlerts() {
    if (temperature > tempAlertThreshold) {
        digitalWrite(ledPins[0], HIGH);
    } else {
        digitalWrite(ledPins[0], LOW);
    }

    if (humidity > humAlertThreshold) {
        digitalWrite(ledPins[1], HIGH);
    } else {
        digitalWrite(ledPins[1], LOW);
    }
}

void exportData() {
    Serial.println("Exporting data:");
    for (int i = 0; i < eepromIndex; i++) {
        int addr = eepromStartAddr + i * 12;
        float temp, hum, pres;
        EEPROM.get(addr, temp);
        EEPROM.get(addr + 4, hum);
        EEPROM.get(addr + 8, pres);
        Serial.print("T:");
        Serial.print(temp);
        Serial.print(" H:");
        Serial.print(hum);
        Serial.print(" P:");
        Serial.println(pres);
    }
}

void displayGraph() {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("T:");
    for (int i = 0; i < 10; i++) {
        lcd.print(tempHistory[i] > tempAlertThreshold ? "*" : ".");
    }
    lcd.setCursor(0, 1);
    lcd.print("H:");
    for (int i = 0; i < 10; i++) {
        lcd.print(humHistory[i] > humAlertThreshold ? "*" : ".");
    }
}
String forecast = "N/A";

void calculateWeatherForecast() {
    float pressureChange = pressHistory[9] - pressHistory[6];
    float humidity = humHistory[9];
    float temperature = tempHistory[9];

    if (pressureChange < -2.0 && humidity > 70) {
        forecast = "Rain expected";
    } else if (pressureChange > 2.0 && humidity < 50) {
        forecast = "Clear skies";
    } else if (temperature > 30.0) {
        forecast = "Hot weather";
    } else if (temperature < 5.0) {
        forecast = "Cold, frost";
    } else {
        forecast = "Stable";
    }
}
void displayForecast() {
    lcd.clear();
```

```
  lcd.setCursor(0, 0);
  lcd.print("Forecast:");
  lcd.setCursor(0, 1);
  lcd.print(forecast);
}
void updateDisplay() {
  lcd.clear();
  if (currentScreen == 0) {
    lcd.setCursor(0, 0);
    lcd.print("T:");
    lcd.print(temperature);
    lcd.print("C H:");
    lcd.print(humidity);
    lcd.setCursor(0, 1);
    lcd.print("P:");
    lcd.print(pressure);
    lcd.print(" DP:");
    lcd.print(dewPoint);
  } else if (currentScreen == 1) {
    // Экстремумы
    lcd.setCursor(0, 0);
    lcd.print("Tmin:");
    lcd.print(minTemp);
    lcd.print(" Tmax:");
    lcd.print(maxTemp);
    lcd.setCursor(0, 1);
    lcd.print("Hmin:");
    lcd.print(minHumidity);
    lcd.print(" Hmax:");
    lcd.print(maxHumidity);
  } else if (currentScreen == 2) {
    displayGraph();
  } else if (currentScreen == 3) {
    exportData();
    lcd.setCursor(0, 0);
    lcd.print("Export Complete");
  }
  else if (currentScreen == 4) {
    displayForecast();
  }
}

void handleButtonPress() {
  for (int i = 0; i < 5; i++) {
    if (digitalRead(buttonPins[i]) == HIGH) {
            currentScreen = i;
            updateDisplay();
            delay(300);
        }
    }
}

void setup() {
    lcd.begin(16, 2);
    lcd.setBacklight(1);
    Serial.begin(9600);

    for (int i = 0; i < 4; i++) pinMode(buttonPins[i], INPUT_PULLUP);
    for (int i = 0; i < 2; i++) pinMode(ledPins[i], OUTPUT);

    lcd.setCursor(0, 0);
    lcd.print("Weather Station");
    delay(2000);
    lcd.clear();
}

void loop() {
    readSensors();
    checkAlerts();
    updateDisplay();
    handleButtonPress();
    calculateWeatherForecast();

    delay(2000);
}
```

Result: Successfully demonstrated weather station readings using Arduino

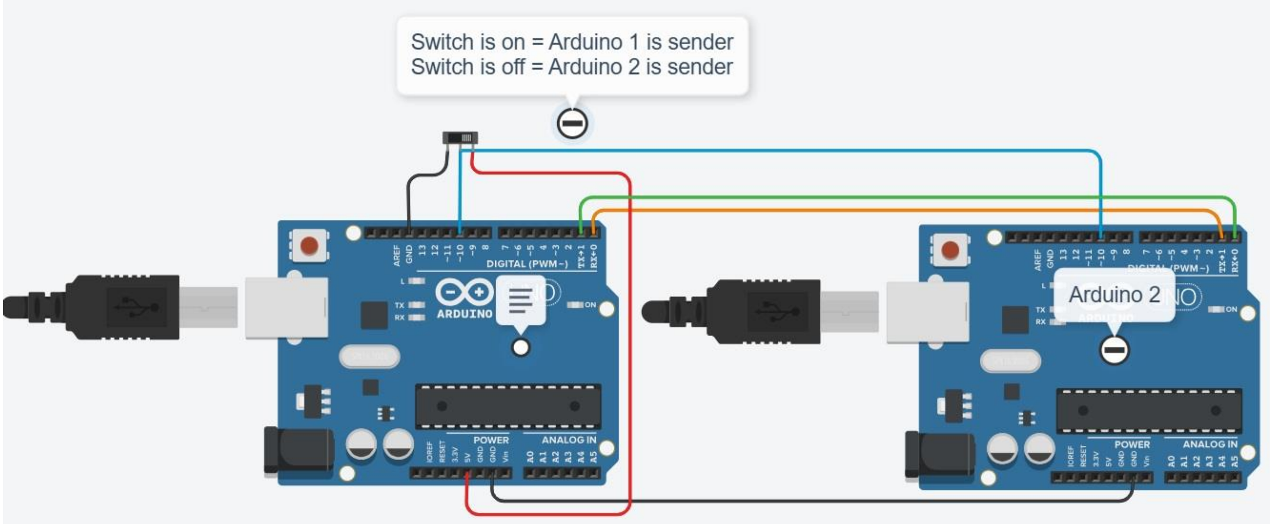
Exp. No. 10	Develop a program to setup a

AIM: Develop a program to setup a UART protocol and pass a string through the protocol.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	2
2.	Jumper Cable	7
3.	Slideswitch	1

CIRCUIT DIAGRAM:


Switch is on = Arduino 1 is sender
Switch is off = Arduino 2 is sender
Arduino 2
ARDUINO
DIGITAL (PWM~)
POWER
ANALOG IN

SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

f) Then goto code serial monitor to check working output

CODE:

```
const int MAX_LEN =30;
char sendMsg[MAX_LEN] = "Hello i'm Arduino-2\n";
char receiveMsg[MAX_LEN];
int switchState = 1; // Active HIGH input
int switch_pin = 10;

void setup() {
  Serial.begin(9600);
  pinMode(switch_pin, INPUT);
}

void loop() {
  switchState = digitalRead(switch_pin);

  if (switchState == HIGH) {
    // Receive if switch is off
    if (Serial.available() > 0) {
      int len = Serial.parseInt();        // Read the length as number
      Serial.read();                      // Consume the newline after the number

      int n = Serial.readBytes(receiveMsg, len);
      receiveMsg[n] = '\0';               // Null-terminate the received string

      Serial.print("Message = ");
      Serial.println(receiveMsg);
    }
  } else {
   // Send if switch is on
    int len = strlen(sendMsg);
    Serial.write(receiveMsg, len); // send raw message

    delay(1000);
  }
}
```

Result: Successfully demonstrated UART using two Arduino

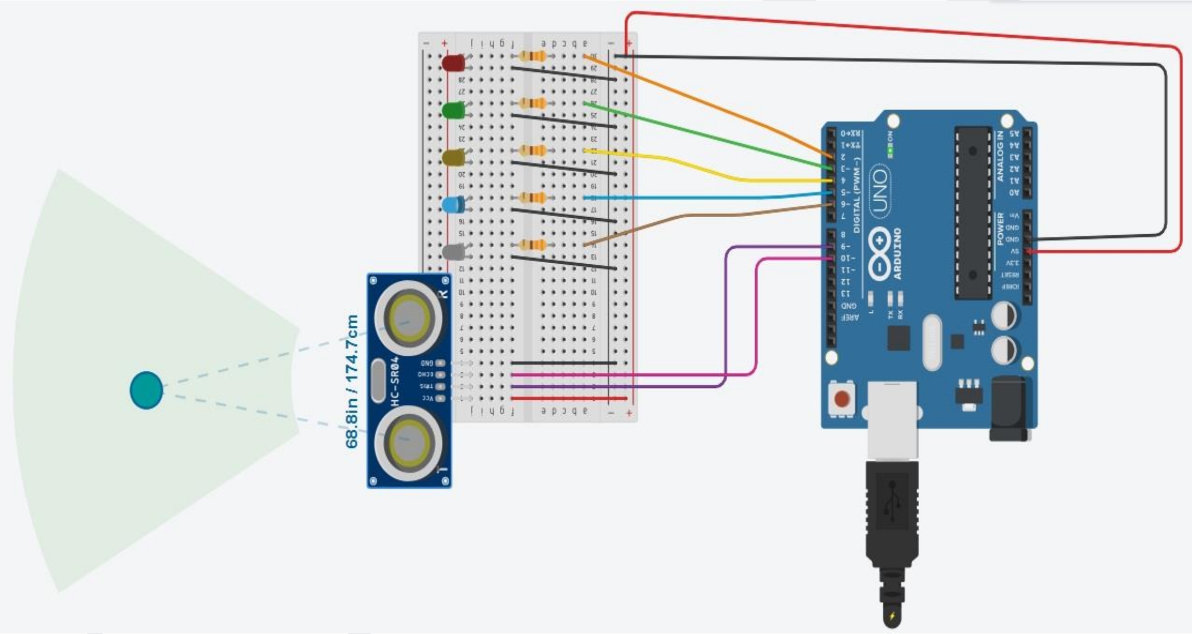
Exp. No. 11	Develop a water level depth detection system using Ultrasonic sensor.

AIM: Develop a water level depth detection system using Ultrasonic sensor.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	17
3.	Bread Board	1
4.	LED	5
5.	Resistance (800 Ω)	5
6.	Ultrasonic Distance Sensor (4-pin)	1

CIRCUIT DIAGRAM:



SET UP:

g) Connect the circuit as per circuit.

h) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

i) Open Arduino IDE then goto tools and select appropriate Arduino board.

j) Select tool then select the port select the com port to which board is connected.

k) Type sketch (Program) and upload to board.

CODE:

```
int trigPin=9;
int echoPin=10;
int a=2,b=3,c=5,d=6,e=4;
long dist;
long ival;
void setup()
{
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(a,OUTPUT);
  pinMode(b,OUTPUT);
  pinMode(e,OUTPUT);
  pinMode(c,OUTPUT);
  pinMode(d,OUTPUT);
  Serial.begin(9600);
}

void loop()
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  ival=pulseIn(echoPin,HIGH);
  dist=(ival/2)/29.154;
  Serial.print("dist:");
  Serial.print(dist);
  Serial.println("CM");

  if(dist<=50){
  digitalWrite(a,HIGH);
    digitalWrite(b,LOW);
    digitalWrite(e,LOW);
    digitalWrite(c,LOW);
    digitalWrite(d,LOW);
  }
    else if(dist<=100){
      digitalWrite(a,LOW);
    digitalWrite(b,HIGH);
    digitalWrite(e,LOW);
    digitalWrite(c,LOW);
    digitalWrite(d,LOW);
    }
    else if(dist<=150){
      digitalWrite(a,LOW);
    digitalWrite(b,LOW);
    digitalWrite(e,HIGH);
    digitalWrite(c,LOW);
    digitalWrite(d,LOW);
    }
    else if(dist<=200){
      digitalWrite(a,LOW);
    digitalWrite(b,LOW);
    digitalWrite(e,LOW);
    digitalWrite(c,HIGH);
    digitalWrite(d,LOW);
    }
    else if(dist<=250){
      digitalWrite(a,LOW);
    digitalWrite(b,LOW);
    digitalWrite(e,LOW);
    digitalWrite(c,LOW);
    digitalWrite(d,HIGH);
      }
    else
    {
      digitalWrite(a,HIGH);
    digitalWrite(b,HIGH);
    digitalWrite(e,HIGH);
    digitalWrite(c,HIGH);
    digitalWrite(d,HIGH);
  }
delay(50);
}
```

Result: Successfully demonstrated water level depth detection system using Ultrasonic sensor

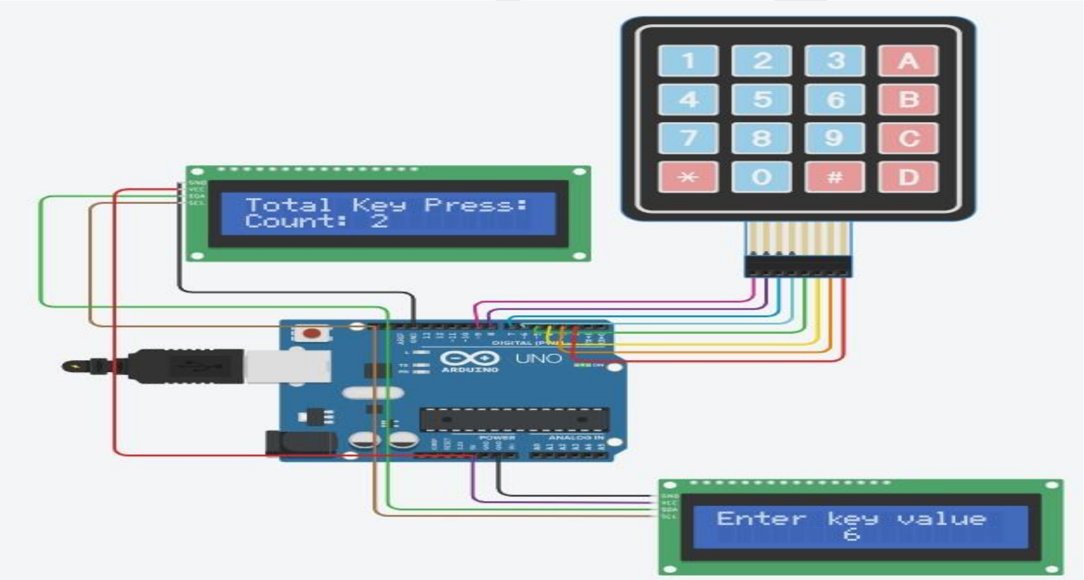
Exp. No. 12	Develop a program to simulate interfacing with the keypad module to record the keystrokes.

AIM: Develop a program to simulate interfacing with the keypad module to record the Keystrokes.

COMPONENT:

S.NO.	Name	Quantity
1.	Ardiuno Uno	1
2.	Jumper Cable	8
3.	Bread Board	1
4.	Keypad 4x4	1
5.	LCD 16 x 2 (I2C)	2

CIRCUIT DIAGRAM:



SET UP:

a) Connect the circuit as per circuit.

b) Make sure VCC and Ground pins connected properly to avoid any damage to Arduino board.

c) Open Arduino IDE then goto tools and select appropriate Arduino board.

d) Select tool then select the port select the com port to which board is connected.

e) Type sketch (Program) and upload to board.

CODE:

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

// LCD 1 – Shows key pressed
Adafruit_LiquidCrystal lcd_1(0x20);

// LCD 2 – Shows total key count
Adafruit_LiquidCrystal lcd_2(0x21);

const byte ROWS = 4;
const byte COLS = 4;

char hexaKeys[ROWS][COLS] = {
  {'1','2','3','A'},
  {'4','5','6','B'},
  {'7','8','9','C'},
  {'*','0','#','D'},
};

byte rowPins[ROWS] = {9, 8, 7, 6};
byte colPins[COLS] = {5, 4, 3, 2};

Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins,
colPins, ROWS, COLS);

int keyPressCount = 0;

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

  // Initialize both LCDs
  lcd_1.begin(16, 2);
  lcd_1.setBacklight(1);
  lcd_1.print("Enter key value");
  lcd_1.setCursor(0, 1);

  lcd_2.begin(16, 2);
  lcd_2.setBacklight(1);
  lcd_2.print("Total Key Press:");
  lcd_2.setCursor(0, 1);
  lcd_2.print("Count: 0");
}
```

```
void loop() {
  char customKey = customKeypad.getKey();
  if (customKey) {
    Serial.println(customKey);

    // Display key on LCD 1
    lcd_1.setCursor(7, 1);
    lcd_1.print(" ");
    lcd_1.setCursor(7, 1);
    lcd_1.print(customKey);

    // Increment and show count on LCD 2
    keyPressCount++;
    lcd_2.setCursor(0, 1);
    lcd_2.print("Count: ");
    lcd_2.print(keyPressCount);
    lcd_2.print("   "); // Clear extra digits if count goes down

    delay(100);
  }
}
```

Result: Successfully demonstrated simulate interfacing with the keypad module to record the keystrokes.