21AIE114 PRINCIPLES OF MEASUREMENTS AND SENSORS Project

GAS AND LDR SENSOR

GROUP 8

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ABSTRACT

A sensor is a device that detects and responds to physical world input. It is a module, machine, or subsystem that detects events or changes in its surroundings and conveys the data to other electronics, most frequently a computer processor.In this project, we are using gas and ldr sensors.

The presence and concentration of toxic or volatile organic compounds (VOCs), humidity, and odours are detected by a gas sensor.The principal applications include safety industries, indoor air quality industries, medical and life-science industries, aerospace industries, and others.

A photoresistor, also known as a light-dependent resistor (LDR), is a variable resistor that is controlled by light. Smoke detectors, automatic contrast and brightness management in television receivers, and optical coding are examples of applications.

The circuit acts as a gas and light detector simulator. If the gas sensor detects gas leak in a dangerous range, the buzzer sounds, the red led illuminates, and the LCD message "ALERT EVACUATE" appears; if it detects gas in a safe range, the green led illuminates, and the LCD message "SAFE ALL CLEAR" appears.

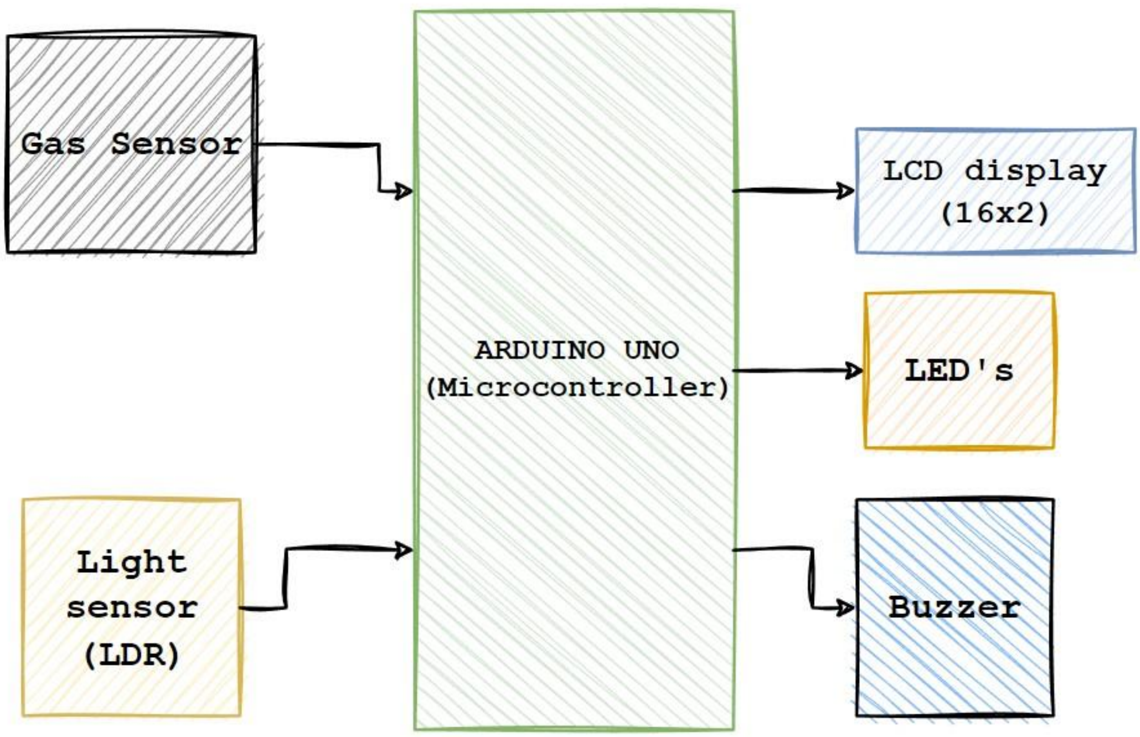
AIM

To implement the Gas sensor and LDR sensor and display the respective outcome.

COMPONENTS USED

- ❖ Piezo buzzer (for producing sound when gases arrive)
- ❖ Gas sensor
- ❖ LDR sensor (Photoresistor)
- ❖ LCD display
- ❖ Arduino UNO R3
- ❖ LEDs
- ❖ Resistors
- ❖ Connecting Wires

BLOCK DIAGRAM



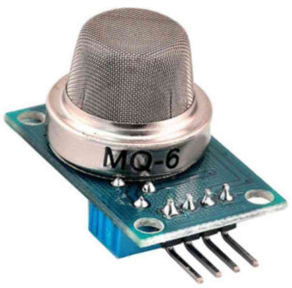
SENSORS USED

A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine.

In our project we have used 2 sensors, they are;

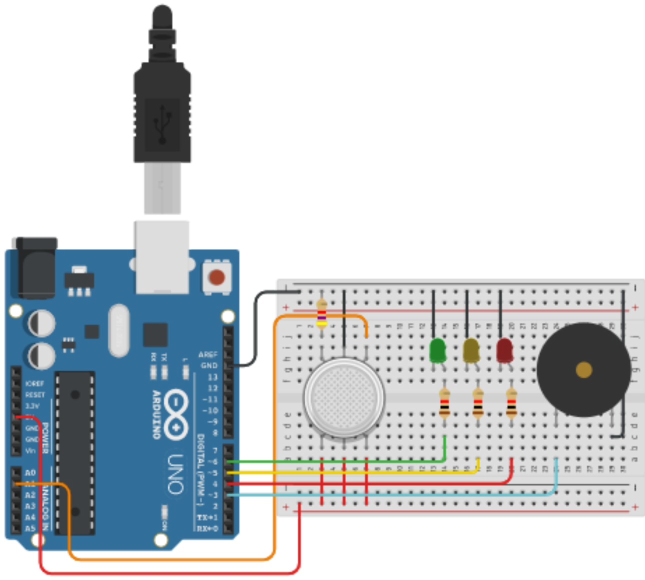
1. Gas Sensor
2. LDR sensor

1. GAS SENSOR



Gas sensors or Gas detectors are devices that can detect the presence and concentration of various hazardous gases and vapours, such as toxic or explosive gases, volatile organic compounds (VOCs), humidity, and odours. Based on the concentration of the gas, the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage, the type and concentration of the gas can be estimated.The type of gas the sensor could detect depends on the sensing material present inside the sensor. Gas sensors are employed in factories and manufacturing facilities to identify gas leaks, and to detect smoke and carbon monoxide in homes. They usually serve as a component of a larger embedded system, such as security and hazmat systems, and are typically connected to an interface or audible alarm. Gas sensors need to be calibrated more frequently than many other types of sensors since they interact with air and other gases constantly.The metal oxide-based gas sensor is one of the most popular gas sensors for hazardous identification and smoke detection.This type of sensor detect concentration of various types of gases by measuring the resistance change of the metal oxide due to adsorption of gases. Most home-based smoke detection systems are oxide-based sensors.

Gas Sensor (Tinkercad Circuit)



WORKING MECHANISM & APPLICATION

Gas sensors contain Tin dioxide chemiresistor (SnO_2) , Nickel chromium heater coil , Platinum electrode line , Aurum (gold)electrode , Aluminium oxide tubular ceramic and a Metal mesh.

- Tin oxide chemiresistor (SnO_2) : The detecting element is composed of Tin Dioxide (SnO_2), which possesses surplus electrons in general (donor element). As a result, whenever harmful gases are detected, the resistance of the element changes. The current flowing through it varies, representing the change in gas concentration.
- Nickel Chromium heater coil: The heater coil's purpose is to burn-in the sensor element, hence increasing its sensitivity and efficiency. It is made of Nickel-Chromium, which has a high melting point and can therefore be heated without melting.
- Platinum electrode line: Since the sensing element generates a very small current when the gas is detected, it is more necessary to maintain the efficiency of conveying those small currents. As a result, platinum wires come into play, assisting in the efficient movement of electrons.
- Aurum (gold) electrode:Since gold (Au -Aurum) is an excellent conductor, it is used in this junction where the sensor layer's output is connected to the electrode line. In order for the output current to reach the appropriate terminal.
- Aluminium oxide (Al_2O_3) tubular ceramic: A tubular ceramic constructed of aluminium oxide exists between the heater coil and the gas detecting layer due to its high melting point, it aids in the maintenance of the sensing layer's

burn-in (ignition), which provides high sensitivity for the sensing layer to provide efficient output current.

- Metal mesh: A metal mesh is utilised over the sensing components and the setup to protect them and to prevent dust particles from entering the mesh and injuring the gas sensing layer from corrosive particles.

When the sensor is exposed to poisonous or flammable gases, the reducing gas (orange hue) reacts with the adsorbed oxygen particles, breaking the chemical connection between oxygen and free electrons and releasing them. Because the free electrons have returned to their original location, they can now conduct current; this conduction will be proportional to the quantity of free electrons accessible in SnO_2, with more free electrons available if the gas is extremely poisonous and if no free electrons available output current will be zero. When current is flowing through the sensor, analogue voltage readings were produced. These voltage readings are taken in order to determine the gas concentration. When there is a high concentration of gas, voltage levels are higher.

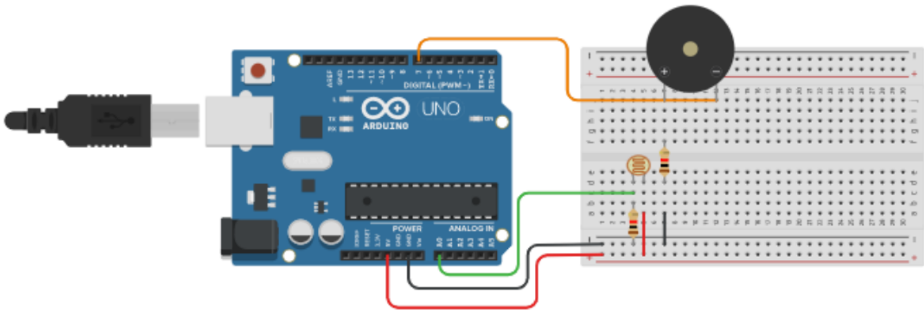
APPLICATION

It is employed in transportation, fire suppression testing, university research applications, modified atmosphere packaging (MAP), indoor air quality/HVAC industries, science industries, and safety industries.

2. LDR SENSOR

Photoresistors, also known as light dependent resistors (LDR), are light sensitive devices that are commonly used to detect the presence or absence of light, as well as to measure the intensity of light. Their resistance is quite high in the dark, sometimes reaching 1 M, but when exposed to light, the resistance reduces rapidly, perhaps to a few ohms, depending on the light intensity. LDRs are nonlinear devices with a sensitivity that varies with the wavelength of the light applied. They are utilised in a variety of applications, but other devices, such as photodiodes and phototransistors, are frequently used to detect light. Some countries have outlawed lead or cadmium-based LDRs due to environmental concerns.

LDR Sensor (Tinkercad Circuit)



WORKING MECHANISM & APPLICATION

LDR is made up of a semiconductor.This resistor works on the principle of photo conductivity.When the light falls on its surface, then the material conductivity increases and also the electrons in the valence band of the device are excited to the conduction band. These photons in the incident light must have energy greater than the band gap of the semiconductor material.This makes the electrons jump from the valence band to conduction. This happens because electrons in LDR absorb the energy of photons. When a LDR is kept in the dark place, its resistance is high and, when the LDR is kept in the light its resistance will decrease. If a constant "V' is applied to the LDR, the intensity of the light is increased and current increases. On increasing the intensity of light that falls on the surface of LDR or photoresistor, more and more electrons jump from the valence band to the conduction band causing an increase in conductivity or decrease in resistance of the LDR.

APPLICATION

Security System Controlled by an Electronic Eye,Light Intensity Control for Street Lights,Lighting Switch from Sunset to Sunrise, light metre, smoke detector, optical coding, camera light metre, infrared astronomy, light metre, photosensitive relay, proximity switch are examples of light dependent resistor applications.

TINKERCAD SIMULATION

Tinkercad link:
https://www.tinkercad.com/things/86ZDiWxyUMt?sharecode=_8E9g4pyEoryOOMA-jy1J8KjqlBibsk009gB95YLPlk

WORKING OF THE SENSOR WITH ARDUINO

The circuit simulates a smoke and light detector. If the gas sensor detects smoke in a dangerous range, the buzzer sounds, the red led illuminates, and the LCD message "ALERT EVACUATE" appears; if the gas sensor detects smoke in a safe range, the green led illuminates, and the LCD message "SAFE ALL CLEAR" appears, whereas the LED (Light Emitting Diodes) glows instantaneously when it dims and turns off when it gets bright. The circuit functions as follows.

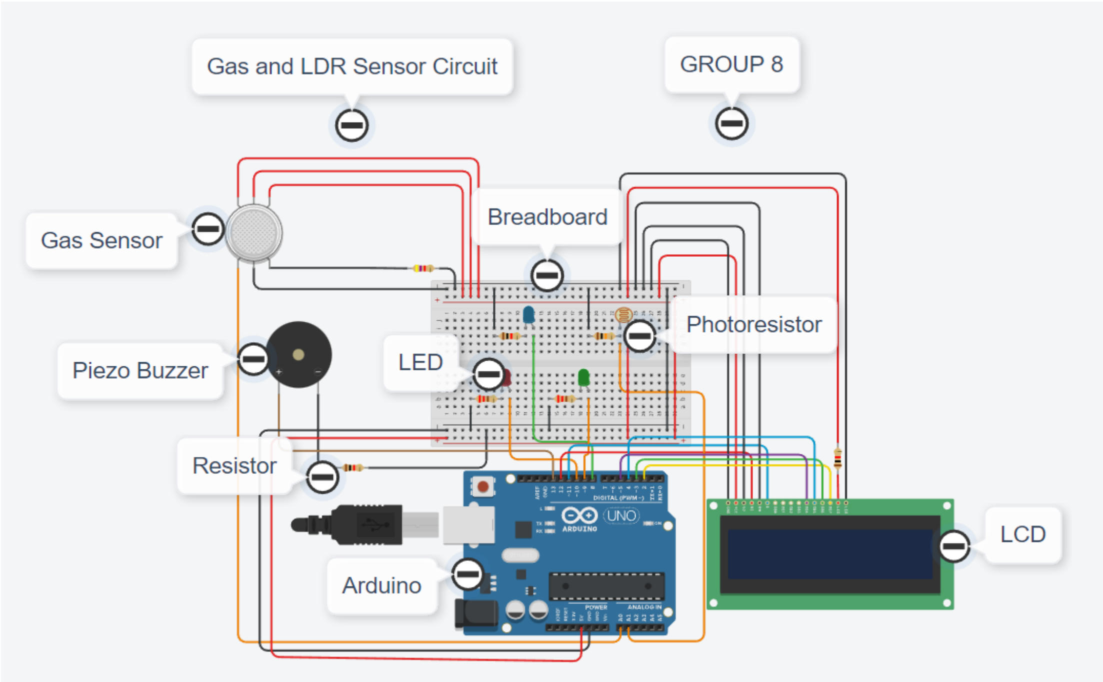
Gas Sensor

Anytime a gas leak is detected, the gas sensor sends a HIGH pulse to its A0 pin, which Arduino constantly monitors. When the Arduino receives a HIGH pulse from the LPG Gas detection unit, the green led shuts off and the red led switches on, and a 5v buzzer begins to sound until the LPG gas detection unit detects it. When the Arduino receives a LOW pulse from the LPG Gas detection unit, the red light, buzzer, and green LED turn off and then on. But when there is no gas leak/hazard during operation, the LCD will indicate "SAFE ALL CLEAR." If gas is detected, the LCD will flash "ALERT EVACUATE." And we shall hear a buzzer sound (Piezo)

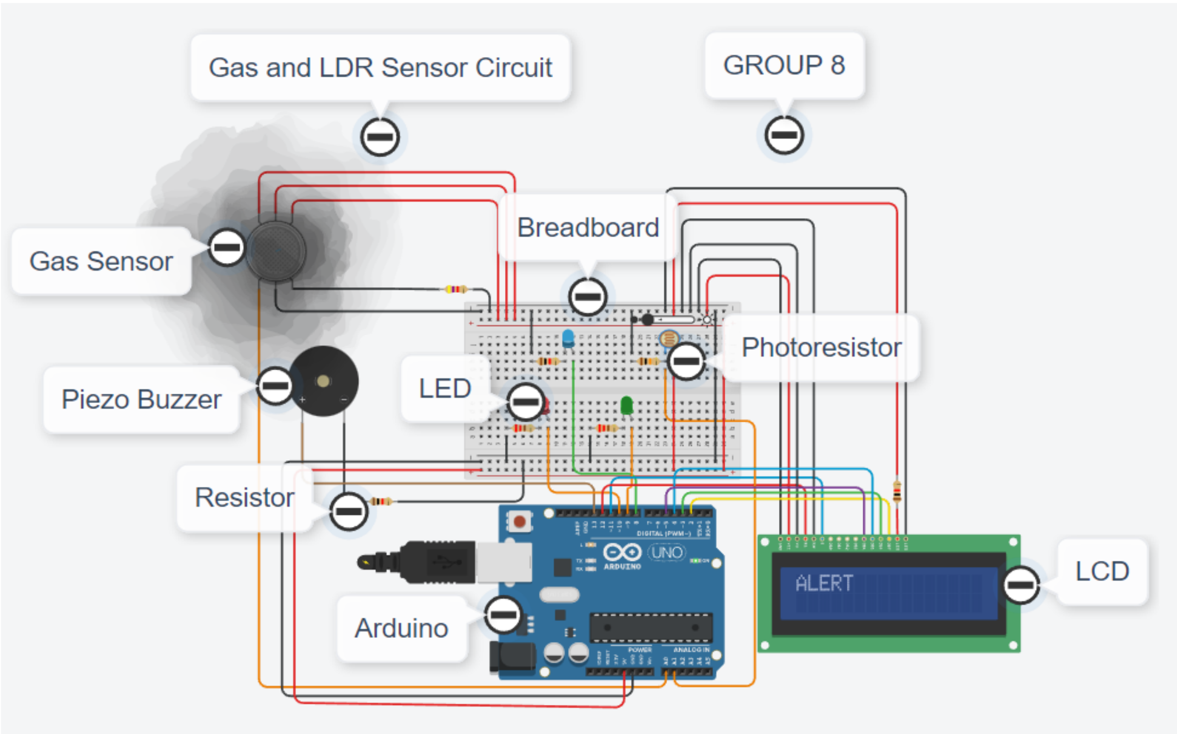
LDR Sensor

When connected to VCC (5V), the LDR produces an analog output voltage that fluctuates in magnitude and has direct correlation to the input luminosity. That seems to be, the greater the luminosity, the higher the associated voltage out from the LDR. Also because LDR outputs an analog voltage, it is linked to the Arduino's analog input pin. The Arduino then converts the analog voltage (range 0-5V) to a digital value in the range of using its built-in ADC (analog-to-digital converter range 0-1023).

Without Simulation



With Simulation



CODE USED

```
#include <LiquidCrystal.h>

const int rs = 12, e = 11, db4 = 5, db5 = 4, db6 = 3, db7
= 2;
LiquidCrystal lcd(rs, e, db4, db5, db6, db7);

//gas sensor
int redLed = 10;
int greenLed = 9;
int gasSensor = A0;
int buzzer = 13;
int sensorThresh = 400;

//ldr sensor
const int blueLed = 8;
const int ldrPin = A1;


void setup()
{
  //gas sensor
  pinMode(redLed, OUTPUT);
  pinMode(greenLed, OUTPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(gasSensor, INPUT);

  //ldrsensor
  pinMode(blueLed, OUTPUT);
  pinMode(ldrPin, INPUT);

  Serial.begin(9600);
  lcd.begin(16,2);
}

void loop()
{
  int analogValue = analogRead(gasSensor);
  Serial.println(analogValue);

  int ldrStatus = analogRead(ldrPin);

  //ldr sensor
  if (ldrStatus <= 300)
  {
```

```
     digitalWrite(blueLed, HIGH);
     Serial.print("Its DARK, Turn on the LED : ");
    Serial.print(ldrStatus);
  }
  else
  {
     digitalWrite(blueLed, LOW);
    Serial.print("Its BRIGHT, Turn off the LED : ");
    Serial.print(ldrStatus);
  }

  //gas sensor
  if(analogValue > sensorThresh)
  {
     digitalWrite(redLed, HIGH);
     digitalWrite(greenLed, LOW);
    tone(buzzer, 1000, 10000);
     lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("ALERT");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("EVACUATE");
    delay(1000);
  }
  else
  {
     digitalWrite(redLed, LOW);
     digitalWrite(greenLed, HIGH);
    noTone(buzzer);
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("SAFE");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("ALL CLEAR");
    delay(1000);
  }
}
```

SIGNAL CONDITIONING CIRCUITS AND REQUIREMENTS

SIGNAL CONDITIONING :

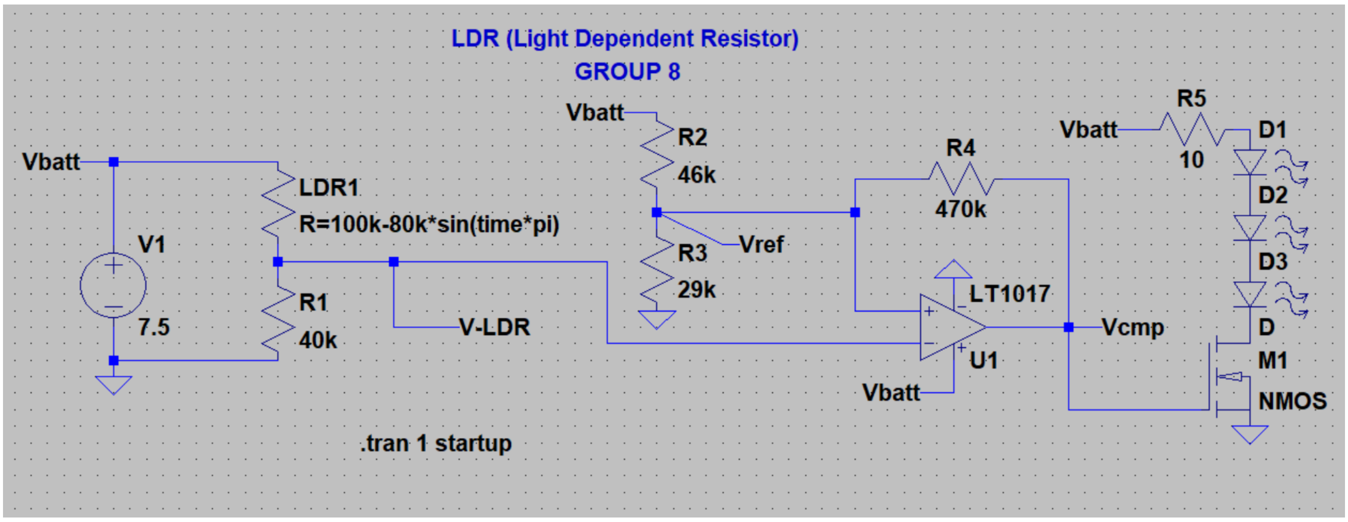
1. LDR SENSOR CIRCUIT

A light sensitive signal conditioning circuit is used to simulate and test the performance of a circuit as a function of discrete resistive component values. LDR's dark resistance has the highest value. LDR resistance decreases as light intensity increases. The signal conditioning circuit converts changes in LDR resistance to millivolt output voltage. In the inverting amplifier arrangement, an opamp is employed. It is predicted that the relationship between output voltage and simulated input resistance will be linear.

COMPONENTS USED:

- ❖ Op-Amp
- ❖ NMOS
- ❖ Voltage sources
- ❖ LEDs
- ❖ Resistors
- ❖ Connecting wires

TRANSIENT TYPE SIMULATION



2. GAS SENSOR CIRCUIT

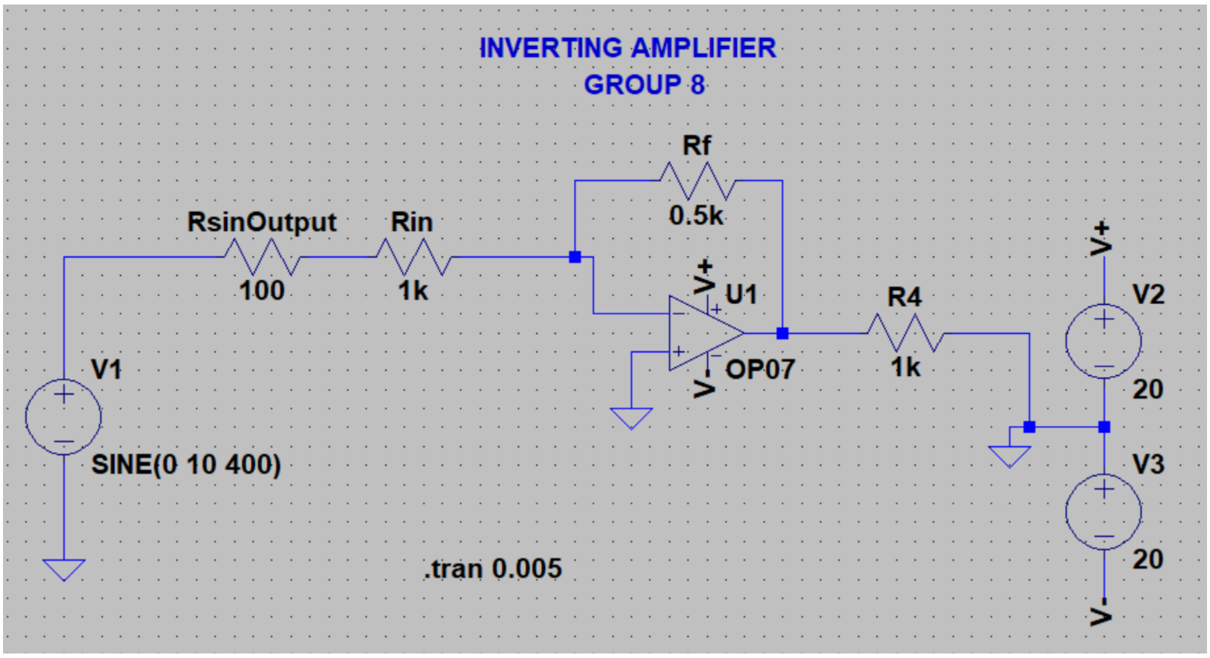
Among the various gas sensors, semiconductor metal oxide -based (pre-transition-metal oxide Al_2O_3) gas sensors have garnered research interest because of advantages such as fabrication simplicity, low cost, and low power consumption.The signal conditioning circuit that will be used to drive the sensor is divided into two parts: the first produces the bias voltage, and the second creates the current to voltage converter circuit.

COMPONENTS USED:

- ❖ Voltage sources
- ❖ Resistors
- ❖ Capacitor
- ❖ Ground
- ❖ Connecting wires
- ❖ Simulation type transient with stop value 0.01
- ❖ Sine graph varying from 0 to 10 to 400

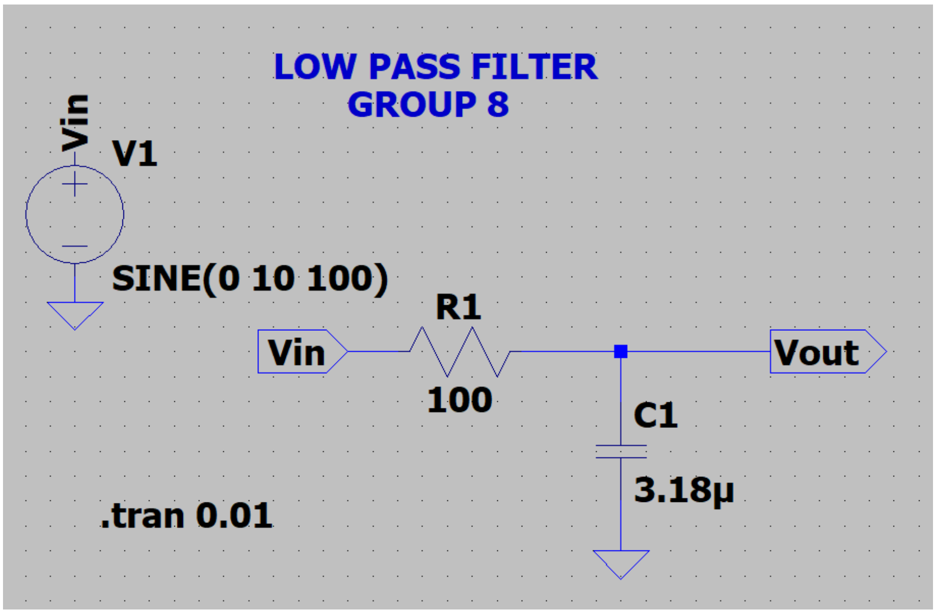
Inverting Amplifier

- Transient Type Simulation



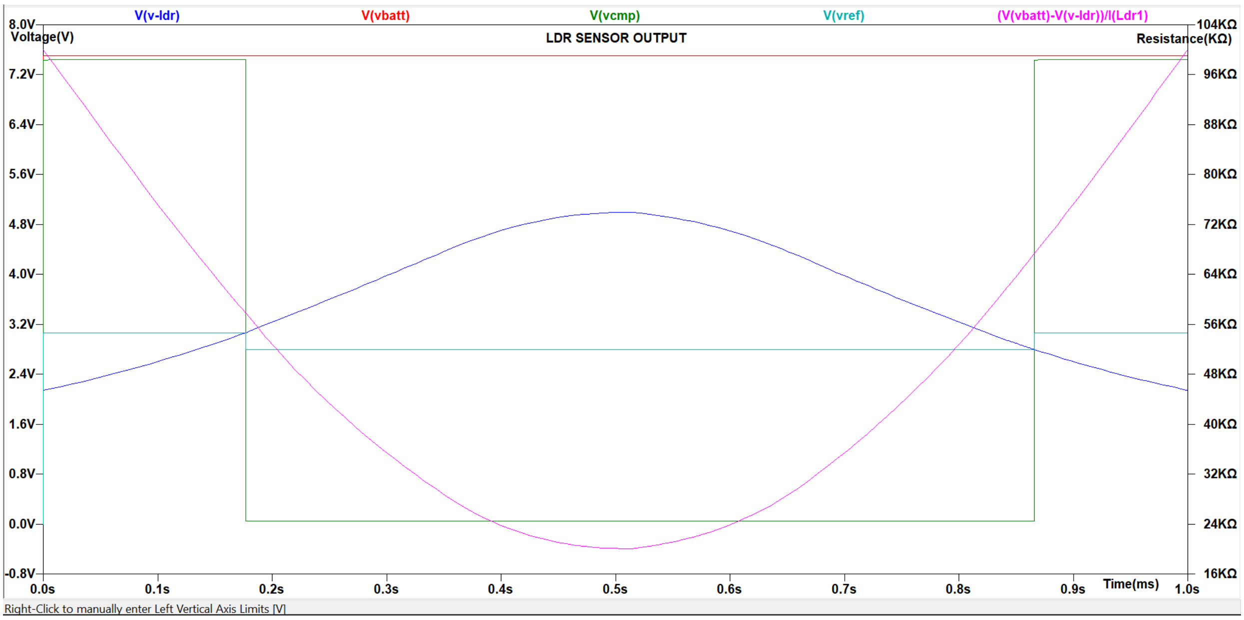
Low Pass Filter

- Transient Type Simulation



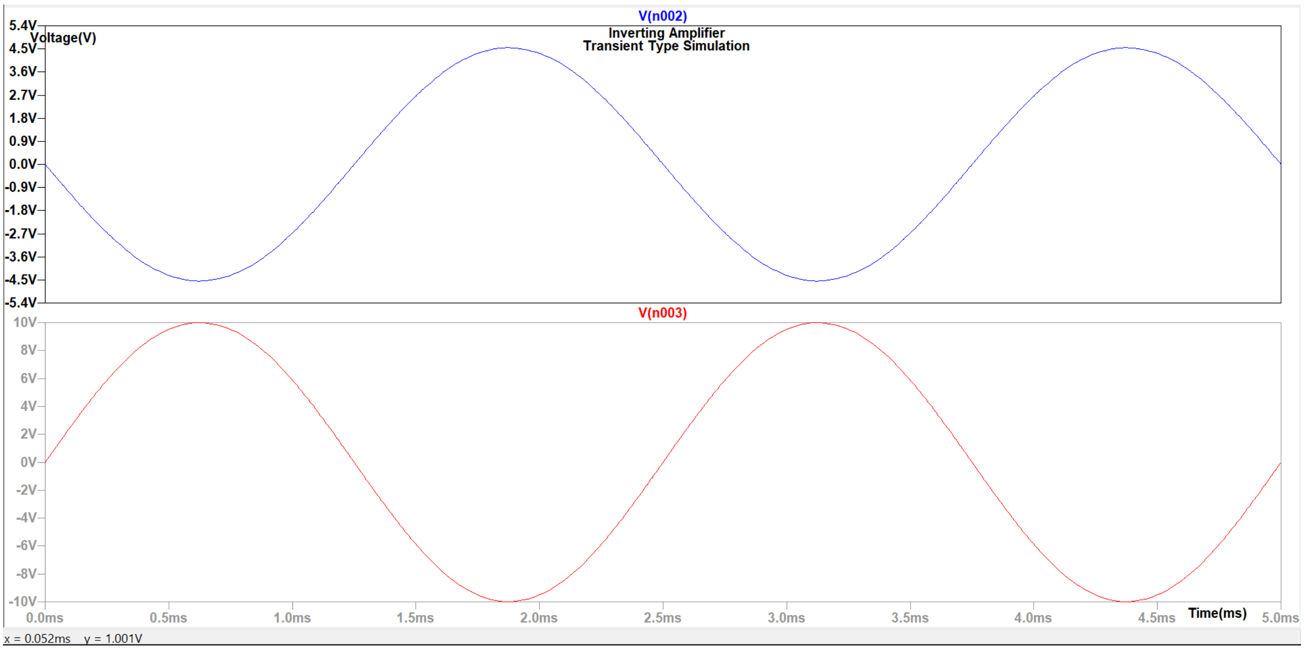
RESULTS AND ANALYSIS

LDR SENSOR OUTPUT

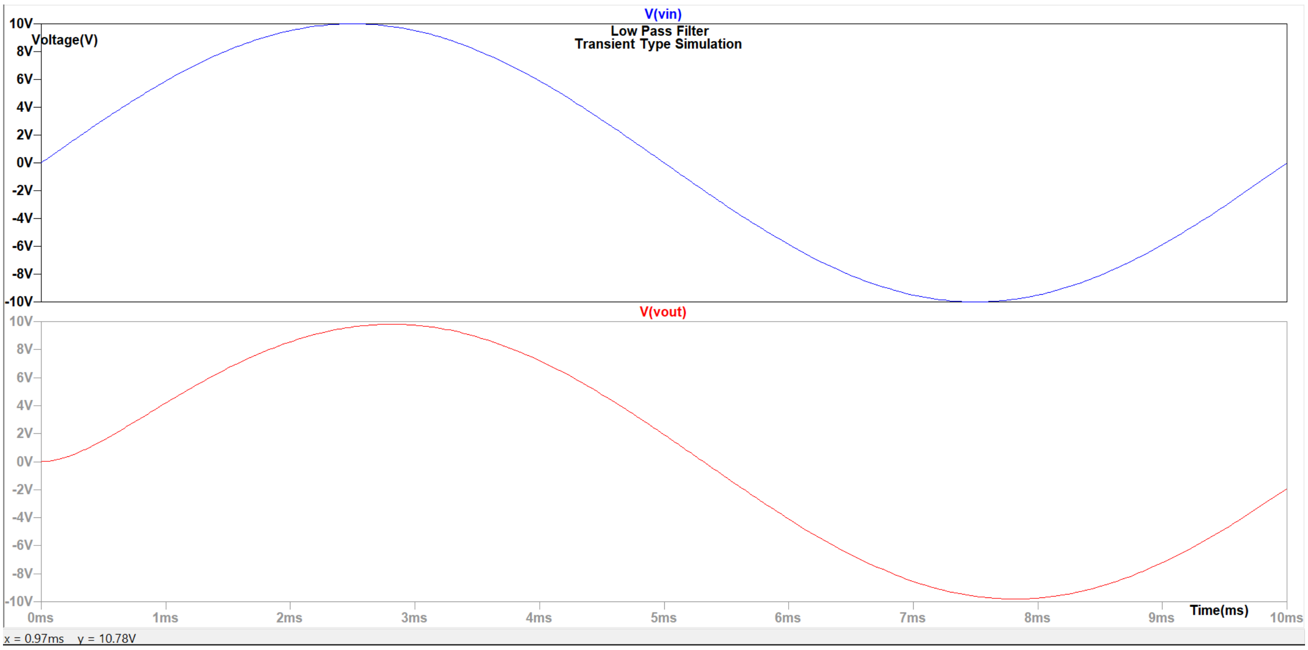


GAS SENSOR OUTPUT

Inverting Amplifier Output:



Low-Pass Filter Output:



CONCLUSION

In this experiment, we clearly saw the use of the LDR sensor and the gas sensor. We studied each sensor's operation and application in a variety of fields, including If the gas sensor detects smoke in a hazardous range, the buzzer sounds, the red led flashes, and the LCD message "ALERT EVACUATE" appears; otherwise, the green led illuminates and the LCD message "SAFE ALL CLEAR" appears. By doing so, we have created a ldr and gas sensor that may be employed as a gas detector in hotels, offices, and other institutional facilities. We also saw the intricacy and benefit of sensors and acknowledged their importance. We can create more fantastic technology if we put in the effort with great zeal.

REFERENCE

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