Kathmandu University

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Dhulikhel, Kavre

A project report on

"Gas Leak Detection System"

[Code No: COMP 306]

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Chapter 1: Project Title and Brief Description

1.1 Gas Leak Detection System

The Gas Leak Detection System is designed to detect the presence of leakage of gas in the environment using a gas sensor. When a gas leak is detected, the system triggers an audible alarm, displays a warning message on an LCD screen, and activates an LED indicator to signal the detection. The project aims to enhance safety by providing an early warning system to prevent potential accidents.

Chapter 2: Component Breakdown

2.1 Components Used

- **LM044L (LCD display)**

  The LM044L is a monochrome LCD display module featuring a 4-line by 20-character display. It is commonly used in embedded systems and microcontroller projects, providing clear, high-contrast text readouts. The module includes an HD44780-compatible controller, allowing for straightforward integration and control using standard libraries and interfaces.

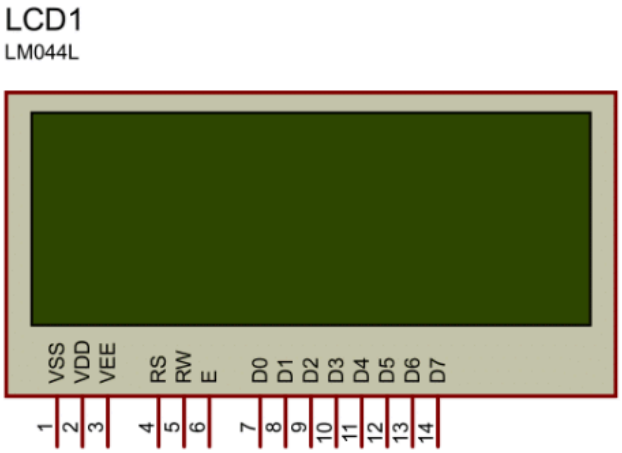

Fig 1 LCD Display

- **Buzzer**

  A buzzer is an audio signaling device that emits sound when activated. It is commonly used in electronic devices and systems for alerting, notifications, and user feedback. Buzzers can be electromechanical or piezoelectric, producing tones, beeps, or alarms, and are easily integrated into circuits with simple control signals.

Fig 2 Buzzer

- **Arduino Simulino Uno**

  The Arduino Simulino Uno is a simulated version of the Arduino Uno microcontroller, used within simulation environments like Proteus for virtual prototyping and testing of Arduino-based projects. It replicates the functionality and pin configuration of the physical Arduino Uno, allowing users to write, upload, and debug Arduino sketches in a virtual setting. This simulation tool is useful for designing, testing, and troubleshooting circuits and code without the need for physical hardware, making it an ideal resource for education and project development. As a microcontroller, it provides control over connected components and sensors, enabling complex interactions and automation in simulated environments.

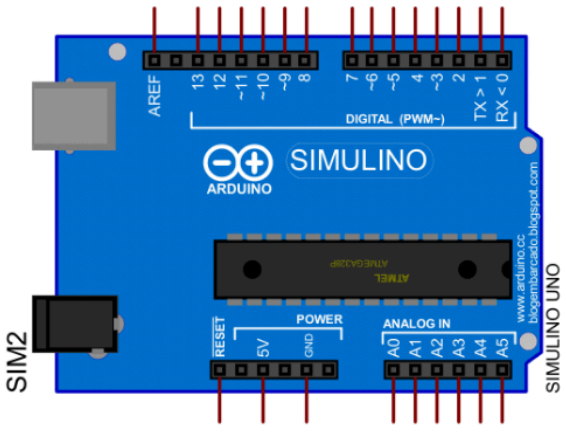

Fig 3 Simulino Uno Arduino

- **Relay**

  A relay is an electromechanical switch used to control a high-power circuit with a low-power signal. It consists of an electromagnetic coil and a set of contacts. When the coil is energized, it generates a magnetic field that either opens or closes the contacts, thereby switching the connected circuit. Relays are widely used for automation, protection, and control in various electrical and electronic applications.

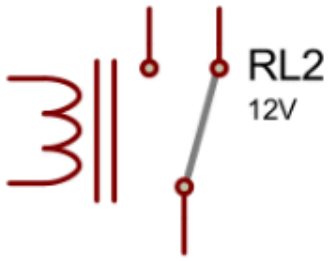

Fig 4 Relay

- **LED**

  An LED (Light Emitting Diode) is a semiconductor light source that emits light when an electric current flows through it. LEDs are highly efficient, long-lasting, and available in a variety of colors. They are commonly used for indicators, displays, and lighting applications due to their low power consumption and compact size.

Fig 5 Red LED

- **Logic state**

  A logic state refers to the binary condition of a digital signal in an electronic circuit, representing either a high (1) or low (0) voltage level. These states are fundamental in digital electronics and computing, forming the basis for operations in logic gates, microprocessors, and digital systems.

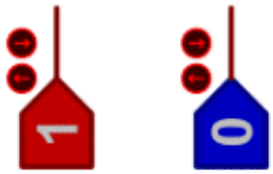

Fig 6 Different Logic States

- **MQ-2 Gas Sensor**

  The MQ-2 gas sensor is a versatile sensor used for detecting a range of gasses including methane, propane, hydrogen, alcohol, smoke, and carbon monoxide. It features a sensitive material that changes resistance in the presence of gas, allowing it to produce an analog signal proportional to the concentration of the detected gas. This sensor is widely used in safety and security applications, such as gas leakage detection and air quality monitoring.

Fig 7 Gas Sensor

Chapter 3: Simulation Details

Gas Leakage Detection System

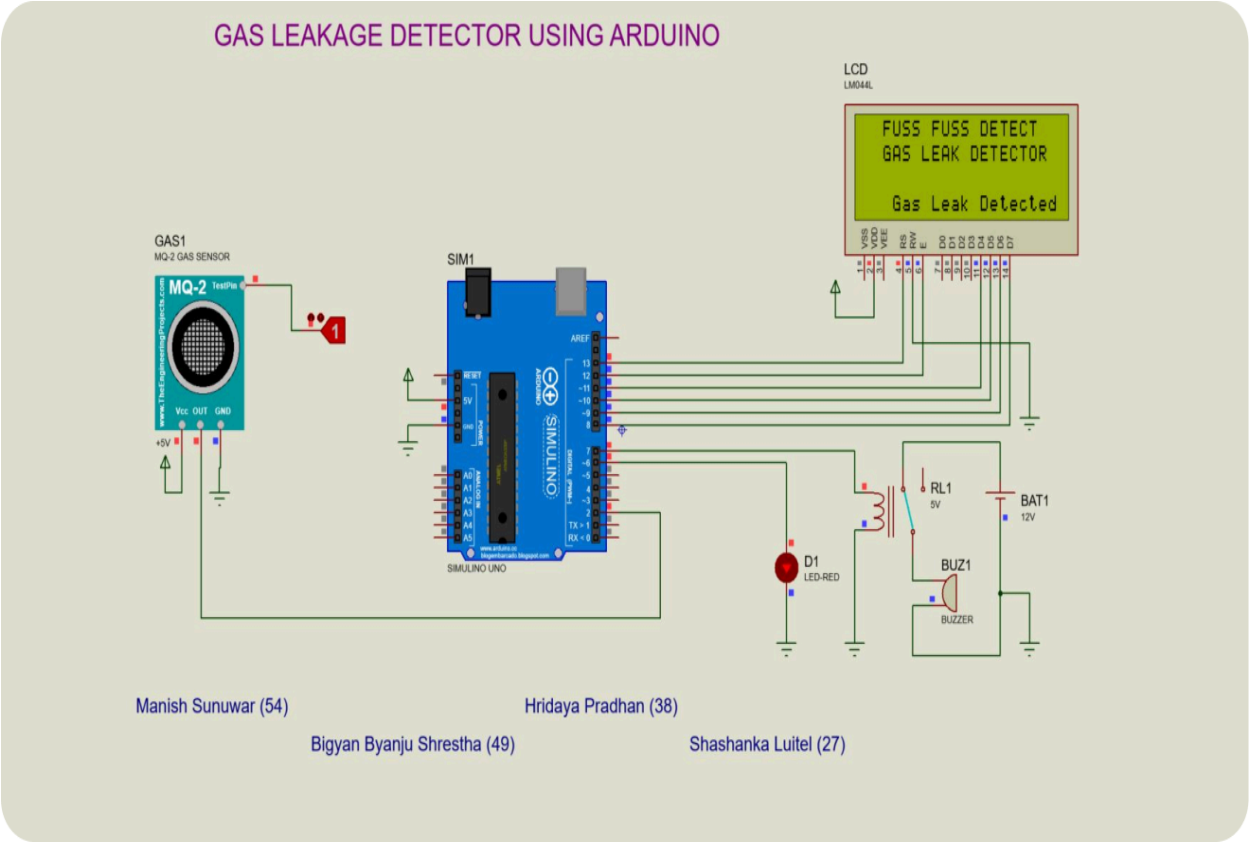

Fig 8 Gas Leak Detection System

Circuit Connections:

1) MQ-2 Gas Sensor:
   - Vcc to 5V.
   - GND to GND.
   - OUT to analog pin 2 on Arduino.
   - TestPin to Logic State
2) LCD Display:
   - VDD to 5V.
   - V0 to GND (for contrast adjustment).
   - RS to digital pin 13 on Arduino.

- RW to GND.
- E to digital pin 12 on Arduino.
- D4 to digital pin 11 on Arduino.
- D5 to digital pin 10 on Arduino.
- D6 to digital pin 9 on Arduino.
- D7 to digital pin 8 on Arduino.

3) LED:
    - Anode to digital pin 6 on Arduino.
    - Cathode to GND .
4) Relay:
    - Control signal to digital pin 7 on Arduino.
    - One terminal of the relay connected to the 12V battery.
    - Another terminal of the relay connected to one end of the buzzer.
5) Buzzer:
    - One end of the buzzer connected to Relay
    - Another end of the buzzer connected to GND.

Working of the System:

1) Initialization:
   When the system is powered on, the Arduino initializes all the components. The LCD displays a welcome message, indicating that the gas leak detection system is active.
2) Gas Detection:
   When the logic state is low, MQ-2 gas sensors do not detect the presence of gas and when the logic state is high, MQ-2 gas sensors detect the presence of gas. The sensor's analog output is connected to the analog pin 2 of the Arduino. The Arduino reads the analog value from the sensor
3) Alarm Activation:
   When a gas leak is detected (i.e. when the logic state is high), the Arduino performs the following actions:
    a) Audible Alarm: The relay is activated, which in turn powers the buzzer. The buzzer produces a loud sound to alert nearby individuals during gas leak.
    b) Visual Indicator: The LED is turned on, providing a visual indication of the gas leak.
    c) LCD Message: The LCD displays a warning message indicating that a gas leak has been detected.

Arduino Code Explanation

Code.ino

```ino
// include the library code:
#include <LiquidCrystal.h> //library for LCD

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);

// defines pins numbers
const int SensorPin = 2;
const int LEDPin = 6;
const int BuzzerPin = 7;

void setup()
{
  pinMode(SensorPin, INPUT); // Sets the Pin as an Input
  pinMode(LEDPin, OUTPUT); // Sets the Pin as an OUTPUT
  pinMode(BuzzerPin, OUTPUT); // Sets the Pin as an OUTPUT

  lcd.begin(20, 4); // set up the LCD's number of columns and rows:
  lcd.setCursor(0,0); // set the cursor position:
  lcd.print("  FUSS FUSS DETECT    ");
  lcd.setCursor(0,1);
  lcd.print("  GAS LEAK DETECTOR   ");
}
void loop()
{
  if(digitalRead(SensorPin) == HIGH)
  {
    digitalWrite(LEDPin,HIGH);
    digitalWrite(BuzzerPin,HIGH);
    // Prints Message on the LCD
    lcd.setCursor(0,3);
    lcd.print("    Gas Leak Detected     ");
    delay(70);
    lcd.setCursor(0,3);
    lcd.print("    Gas Leak Detected.    ");
    delay(70);
    lcd.setCursor(0,3);
    lcd.print("    Gas Leak Detected..   ");
    delay(70);
    lcd.setCursor(0,3);
    lcd.print("    Gas Leak Detected...   ");
    delay(70);
  }
  else
  {
    digitalWrite(LEDPin,LOW);
    digitalWrite(BuzzerPin,LOW);

    // Prints Message on the LCD
    lcd.setCursor(0,3);
    lcd.print("  No Gas Leak    ");
  }
}
```

This Arduino code is for a gas leakage detection system that uses an MQ-2 gas sensor to monitor the presence of gas. When gas is detected, indicated by the sensor pin reading HIGH, the Arduino activates an LED and a buzzer to alert the user and displays a “Gas Leak Detected” message on an LCD. The LED and buzzer are controlled through designated output pins. If no gas is detected, the system turns off the LED and buzzer and updates the LCD to display “No Gas Leak”. The LCD is initialized to display a welcome message when the system starts, and the code continuously checks the sensor's status in the loop, providing real-time monitoring and alerting.

Chapter 4: Functionality Testing

Testing Scenarios and Data Inputs:

4.1 Normal Condition (No Gas Leak)

- Digital input set to 0 (LOW), indicating no gas leak.
- LCD displays "No Gas Leak", LED and buzzer remain off.

4.2 Gas Leak Detected

- Digital input set to 1 (HIGH), indicating gas leak.
- LCD displays "Gas Leak Detected!", LED turns on, and buzzer activates.

Chapter 5: Results and Analysis

5.1 Outcomes of Simulation

The system successfully detected gas leaks and provided immediate alerts through the LED, buzzer, and LCD display. The simulation demonstrated the reliability of the MQ-2 gas sensor in detecting gas leakage and highlights how the sensor after detecting gas presence triggers corresponding alerts through visual and auditory signals on the LCD, buzzer, and LEDs. The relay's involvement illustrates its role in potentially activating external safety mechanisms.

5.2 Insights gained

The simulation highlighted the importance of properly interfacing and calibrating the gas sensor with the microcontroller to ensure accurate gas detection. Additionally, the simulation showed that the system effectively provided immediate alerts when gas was detected, demonstrating its potential to enhance safety. This project also pointed to the possibility of future improvements, such as integrating wireless alerts for remote monitoring and using more advanced sensors to detect a broader range of gasses.

Chapter 6: Conclusion

In conclusion, the mini project of creating a gas detector simulation using Proteus and components such as the MQ-2 gas sensor, LCD display (LM044L), buzzer, relay, and LEDs effectively demonstrates the integration of hardware and software for safety applications. This project showcases practical application of digital and analog components in developing responsive and reliable gas detection systems.

Chapter 7: Contribution

Individual Contributions:

- Hridaya Pradhan: Arduino Coding
- Shashanka Luitel: Design and Simulation
- Bigyan Byanju Shrestha: Design and Simulation
- Manish Sunuwar: Testing and result analysis.