Gas Leakage Detector Using Arduino Nano

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Abstract: *Gas leakage is one of the major causes of fire accidents in homes, industries and laboratories, Liquefied Petroleum Gas (LPG) is widely used for cooking and industrial purposes, but leakage can lead to serious harmful such as fire, explosion, and health problem. This paper presents a low cost and efficient gas leakage detection system using Arduino nano and MQ gas sensor. The system continuously monitors gas level in the surrounding environment and provides immediate alert through a buzzer and LEDs when gas level increases a safety limits. The proposed system is compact, affordable, and suitable for domestic as well as small-scale industrial use.   .*

Keywords: Gas leakage detection, Arduino nano, MQ sensor, LPG monitoring, safety system

I. INTRODUCTION

In today's world, LPG and other gases are commonly used in homes, hotel, laboratories, and industries. Although these gases are useful, leakage can cause serious accidents. Many incidents occur due to unnoticed gas leaks, faulty cylinders, improper pipes connection.

To reduce such risks, an automatic gas detection and alert system is essential. The main purpose of this project is to design a simple, reliable, and cost-effective gas leakage detection using Arduino nano. This system is capable of detecting gas in real time and providing immediate alert to users, helping prevent dangerous situation.

This project focus on safety, affordable and ease of implementation so that is can be used widely in households.

Problem Statement

Gas leakage accident occurs due to:
- Poor monitoring systems
- Lack of early detections
- Human negligence
- Absence of low-cost safety devices

Many existing gas detection systems are expensive and not affordable for small households. Therefore, there is a need to develop a simple and low-cost gas leakage detection system that provides quick response and reliable performance.

Objectives of the systems
- The main objective of this project are:
- To detect the presence of LPG or harmful gases in the environment
- To provide an immediate alert then gas level increases a safe level
- To design a low-cost and compact safety device.
- To ensure fast response time.
- To make the system suitable for domestic use.

The system is designed keeping common people in mind, so it is simple, effective, and affordable.

II. LITERATURE REVIEW

Several researchers have developed gas detection systems using microcontrollers and sensors. Traditional system used complex circuits and expensive components. With the advancement of microcontroller like Arduino, gas detection system has become simpler and more affordable.

MQ sensor are widely used due to their high sensitivity and low-cost. Arduino nano is preferred for compact designs because of its small size and efficient performance.

However, many existing systems are designed mainly for industrial use. This project focuses on creating a used friendly and economical solution for household safety.

Proposed Systems

The proposed gas leakage detection system is designed to detect harmful gases in the environment and provide an immediate alert to users. This system uses a simple electronic component to ensure safety and fats detection. The main components of the system explain below.

- Arduino nano:
- MQ gas sensor (MQ-2 / MQ-6)
- Buzzer
- LED indicator
- Power supply

System Architecture

The overall architecture of the proposed system is shown in fig.1

GAS DETECTION SYSTEM BLOCK DIAGRAM
SYSTEM OVERVIEW
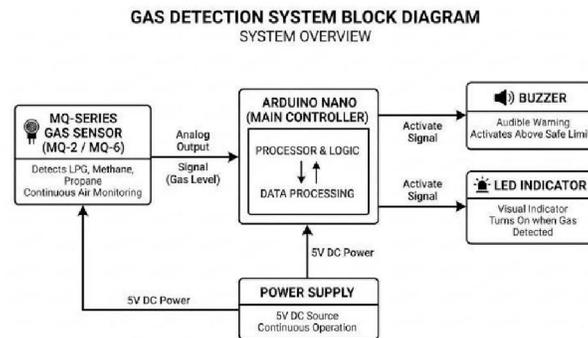
Arduino nano:

It acts as a main controller of the system. It revises signals from the gas sensor and processes the data. Them the detected gas level crosses the safety limits, Arduino Nano activates the buzzer and led to alert the users.

MQ gas sensor (MQ-2 / MQ-6)

The MQ has sensor is used to detect gases such as LPG, methane, propane. It continuously monitors the surrounding air and produces an analog output signal based on gas level. This signal is sent to the Arduino Nano for future processing.

Buzzer

The buzzer provides an audible warning when gas leakage is detected. When the gas level increases the safe limit, Arduino Nano activates the buzzer to alert people nearby.
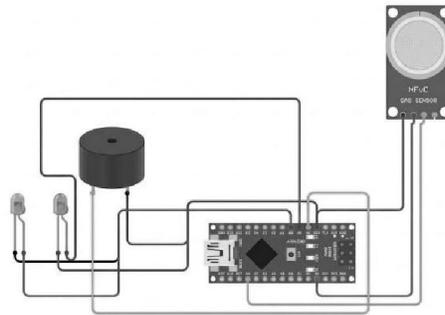
LED indicator

The led works as a visual indicator. It turns on when gas leakage is detected, providing a clear visual signal that there is a potential danger.

Power supply

A 5V DC power supply is used to operate the Arduino Nano and other component of the system. It ensures that the system works continuously and reliably.

Hardware implementation

The hardware implementation on Arduino nano, MQ sensor, buzzer, LEDs, and a power supply. These components are connected to detect gas leakage and provide alert signals

In the circuit, the MQ gas sensor is used to detect the presence of LPG or other gases in the environment. the sensor continuously monitors the air and produces an analog output signal depending on the gas level. This output pin of the sensor is connected to the analog input pin of the Arduino nano**.**

The Arduino nano acts as the main processing unit of the system. It receives the signal from the gas sensor and compares the detected gas level with a given limited value. When the gad level increases the safety limits, Arduino send signal to activate alert components.

A buzzer is connected to one of the digital output pins of the Arduino nano. When gas leakage is detected, the buzzer produces a sound alert to warm nearby people. Additional**,** LED indicator is connected to provide visual alerts when gas is present.

All components are powered using a 5V power supply, which ensures stable operation of the system. The entire hardware setup works together to detect gas leakage quickly and provide immediate warning signals to prevent accidents.

What is Arduino nano?

Arduino nano is the small microcontroller board based on the ATmega328p microcontroller. It is used to control electric devices and process signals from sensors. In the gas leakage detection system, Arduino nano reads the data from the MQ gas sensor and processes it to detect gas level. If the gas level increase the safe limit, Arduino nano activates the buzzer and LED to alert the user. Its compact size, low power consumption, and easy programming make it suitable for embedded system projects

Component	Arduino Nano Pin	Description
MQ Gas Sensor VCC	5V	Provides power supply to the gas sensor
MQ Gas Sensor GND	GND	Ground connection

MQ Gas Sensor A0	A0	Analog output connected to Arduino analog pin
Buzzer Positive	D8	Digital pin used to activate buzzer
Buzzer Negative	GND	Ground connection
LED Positive	D7	Digital pin used for LED indication
LED Negative	GND	Completes the LED circuit

Pin configuration

SR.NO	Pin type	Pin Numbers	Function
1.	Digital input/output pins	D0 - D13	Used for digital input and output operations such as connecting LEDs, buzzer, and other devices.
2.	Analog input pins	A0 – A7	Used to read analog signals from sensors like the MQ gas sensor.
3.	Power Pins	5V, 3.3V	Provide power supply to external components and sensors.
4.	Ground Pins	GND	Used to complete the electrical circuit and provide common ground connection.
5.	External power Input	VIN	Used to supply external voltage to the Arduino nano board.
6.	Serial communication Pins	D0 (RX), D1 (TX)	Used for serial communication between Arduino and other device.

III. WORKING PRINCIPLE

The gas leakage detection system works by continuously monitoring the surrounding air using an MQ gas sensor. The sensor detects the presesnce of gases such as LPG or mrthane and converts the gas level into an analog electrical signal. This signal is sent to the Arduino Nano, which processes the sensor data and compares it with a given limited value. If the detected gas level is below the safe limit, the system remains in the normal condition.

When the gas level increases the given limited gas level, the Arduino Nano immediately activates the buzzer and LED to provide an audible and visual alert, indicating the presesnce of gas leakage. The system continuously repeats this process to ensure realtime monitoring and quick detection.

IV. CHALLENGES FACED

1. Sensor calibration

Setting the correct limit value for the MQ gas sensor was challenging, as proper calibration is required for accurate gas detection.

2. Connection and circuit setup

In correct wiring or loose connection between the Arduino Nano, sensor, buzzer, and LED caused the sytem to malfunction during initial testing.

3. Sensor warm-up time

The MQ gas sensor required same warm-up time before providing stable and accurate reading, which initially affected the system's response time.

V. RESULT AND DISCUSSION

The gas leakage detection using Arduino Nano was successfully implemented and teste dunder different condition. The MQ ga ssensor was able to detect the presesnce of gas such as LPG. When gas was released near the sensor, the sensor detected the increase in ags level and sent the signal to the Arduino Nano. The microcontroller then activated the buzzer and LED, providing both audible and visual alerts to indicate gas leakage.

V. CONCLUSION

The system showed a quick response time and worked effectively in detecting gas leakage. It was observed that the detection sensitivity depended on the distance between the gas source and the sensor. Overall, the system proved to be reliable, low-cost, and suitable for use in homes, kitchens, and small industrial environments for improving safety.

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