

Gas Leakage Detection with Exhaust On and Regulator Off

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Abstract: Gas leakage is a critical safety concern in both residential and industrial settings. The accidental release of gases like LPG (Liquefied Petroleum Gas) or natural gas can lead to explosions, fires, and health hazards. To mitigate these risks, the development of a gas leakage detection system is essential. This project focuses on designing a system that can detect gas leaks, activate exhaust fans to prevent accumulation, and ensure that the gas regulator is turned off to avoid further leakage.

The proposed system comprises three main components. 1) Gas Sensor like the MQ-6 is used to detect the presence of gases such as LPG. It generates an electrical signal when the gas concentration exceeds a predefined threshold. 2) Control Unit this unit processes the sensor's signal. If a gas leak is detected, it sends commands to activate the exhaust fan and shut off the gas regulator. A microcontroller (such as Arduino or Raspberry Pi) typically serves as the control unit. 3) Exhaust Fan and Regulator Mechanism Upon receiving a signal from the control unit, the exhaust fan is turned on to disperse the leaked gas, and a motorized valve is used to turn off the gas regulator, stopping the flow of gas.

The gas leakage detection system with exhaust on and regulator off is a vital safety measure that can significantly reduce the risks associated with gas leaks. By integrating sensors, control units, and automatic shut-off mechanisms, the system provides an effective solution for preventing gas-related accidents. This project has the potential to enhance safety in various settings where gas is used, contributing to a safer environment for all..

Keywords: Gas leakage

I. INTRODUCTION

Gas leakage is a serious problem and nowadays it is observed in many Places like residences, industries, and vehicles like Compressed Natural Gas (CNG), buses, cars, etc. It is noticed that due to gas leakage, Dangerous accidents occur. The Liquefied petroleum gas (LPG), or Propane, is a flammable mixture of hydrocarbon gases used as fuel in Many applications like homes, hostels, industries, automobiles, and Vehicles because of its desirable properties which include high calorific Value, less smoke, less soot, and meager harm to the environment. Liquid petroleum gas (LPG) is highly inflammable and can burn even at Some distance from the source of leakage. This energy source is Primarily composed of propane and butane which are highly flammable Chemical compounds. These gases can catch fire easily. In homes, LPG Is used mainly for cooking purposes. When a leak occurs, the leaked Gases may lead to an explosion. Gas leakage leads to various accidents Resulting in both material loss and human injuries. Home fires have been Occurring frequently and the threat to human lives and properties has Been growing in recent years. The risks of explosion, fire, suffocation are Based on their physical properties such toxicity, flammability, etc.

The number of deaths due to the explosion of gas cylinders has been Increasing in recent years. The Bhopal gas tragedy is an example of Accidents due to gas leakage. The reason for such explosions is due to Substandard cylinders, old valves, no regular checking of gas cylinders, Worn out regulators and a lack of awareness of handling gas cylinders. Therefore, the gas leakage should be detected and controlled to protect People from danger. An odorant such as ethane thiol is added to LPG, so that leaks can be detected easily by Most people. However, some people who have a reduced sense of smell May not be able to rely upon this inherent safety mechanism. A gas Leakage detector becomes vital and helps to protect people from the Dangers of gas leakage There are different gas detection techniques Used . In this

paper a low-cost advanced sensor-based gas leakage Detector, alert and control system is proposed and discussed. The System is very efficient, user friendly, portable, small in size and cost Effective

II. OPERATING PRINCIPAL

The operating principle of a Gas Leakage Detection system with Exhaust On and Regulator Off relies on sensors and control mechanisms to detect gas leaks and respond appropriately. Here's how it works:

Components:

1. **Gas Sensor:** Typically, a semiconductor sensor like MQ-2, MQ-6, or MQ-7, which detects flammable gas concentrations.
2. **Microcontroller:** Processes the sensor signals and controls the exhaust fan and regulator.
3. **Exhaust Fan:** Activates to dissipate leaked gas.
4. **Regulator Control Mechanism:** Turns off the gas supply to prevent further leakage.
5. **Alarm System:** Alerts users about the gas leak.
6. **Power Supply:** Powers the system components.

Operating Principle:

1. Detection Phase:

The gas sensor continuously monitors the surrounding air for flammable gas concentrations. When the concentration exceeds a predefined threshold, the sensor sends a signal to the microcontroller.

2. Activation Phase:

Exhaust Fan On: The microcontroller activates the exhaust fan to ventilate the area, reducing the gas concentration to safe levels.

Regulator Off: The microcontroller or an actuator closes the gas regulator valve to stop the gas flow and prevent further leakage.

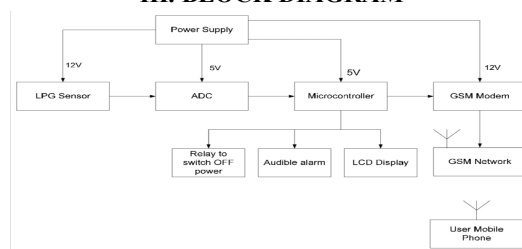
3. Alert Phase:

The system triggers an alarm (audible, visual, or both) to alert nearby individuals of the gas leak. Optionally, the system can send notifications via IoT or GSM modules for remote alerts.

4. Safety Phase:

The exhaust fan remains on until the gas concentration drops below the safe threshold. The regulator stays off until manual intervention or confirmation of safe conditions.

III. BLOCK DIAGRAM



In this semiconductor sensors are used to detect LPG gas. An MQ6 semiconductor sensor is used. Sensitive material of the MQ-6 gas sensor is SnO₂, which has lower conductivity in clean air. When the target combustible gas exists, the sensor conductivity increases along with the rising gas concentration. The MQ6 gas sensor has a high sensitivity to Propane, Butane and LPG, and response to Natural gas.

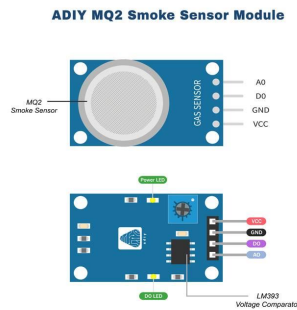
The sensor could be used to detect different combustible gasses, especially Methane; it has a low cost and is suitable for different applications. The MQ-6 can detect gas concentrations anywhere from 200 to 10,000 ppm. The sensor's output is an analog resistance. Figure above shows the block diagram of the gas leakage detection and alert system.

This system is based on the Arduino UNO R3 and MQ-6 gas sensor. When the sensor detects gas in the atmosphere, it will give digital output 1 and if gas is not detected the sensor will give digital output 0. Arduino will receive the sensor output as digital input. If the sensor output is high, then the buzzer will start tuning along with the LCD that will show that “Gas detected: Yes”. If the sensor output is low then buzzer will not be tuning, and the LCD will show that “Gas detected: No”. The buzzer most commonly consists of a number of switches or sensors connected to control unit that determines which button was pushed or whether a preset time has lapsed, and usually illuminates a light on the appreciate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

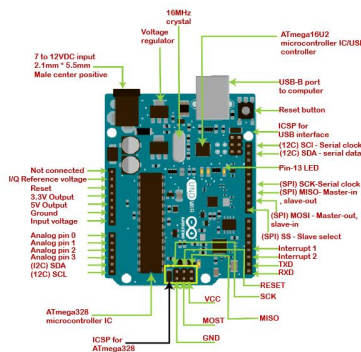
IV. COMPONENTS REQUIRED

MQ6 Gas Sensor

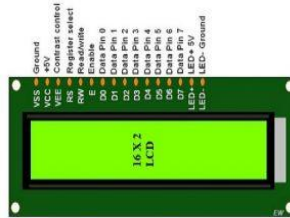
Each MQ series sensor has a heating element and a sensing resistance. Depending on the concentration of the gas, the sensing resistance gets changed and by detecting the changing resistance, the gas concentration can be measured. To measure the gas concentration in PPM all MQ sensors provide a logarithmic graph which is very important. The graph provides an overview of the gas concentration with the ratio of RS and RO.



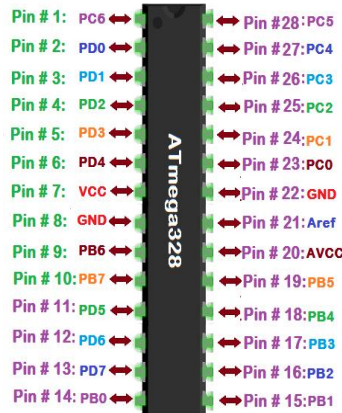
Arduino-Uno:- Arduino-uno is a low-cost, flexible, and easy-to-use programmable open source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.



LCD Display:- More microcontroller devices are using 'smart LCD' displays, as shown in fig 2.12 to output visual information. The following discussion covers the connection of a Hitachi LCD display to a PIC microcontroller. Hitachi LCD displays have a standard ASCII set of characters plus Japanese, Greek and mathematical symbols.



ATmega328p:- The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core. The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz.



V. LITERATURE SURVEY

The device which is used to detect the gas is already present the market which is widely used in many places like industries where there is plenty of chances of the explosion which may lead to massive destruction and the loss of man power; in homes, where the LPG gas used most widely in our daily necessity where it can detect the leakage of LPG gas; in cars, where most of the vehicles contains the cylinder and many more places. Dr. Walter Snelling was the first to introduce LPG gas in 1910. It's a blend of butane and commercial propane. It is very combustible, and numerous accidents occur as a result of LPG leaks. As a result, it is necessary to identify and prevent gas leakage. Gas Detectors can be classified in a variety of ways. They're divided into categories based on the type of gas they detect, the technologies that power the sensor's output, and the components that impact the sensor's operation (semiconductors, oxidation, catalytic, photoionization, infrared, etc.). In our daily lives, we utilize a variety of gadgets for various purposes, and the majority of them have the ability to emit any type of gas or chemical when in operation in the air. In many scenarios, it is difficult for human to keep an eye on the levels of the concentration of the leaked gas or to detect whether there is leakage of gas or not. If there is any leakage in gas when there is no one around, it may cause explosion when there is even a spark or the surrounding will have the harmful gas which may lead to suffocation and will lead to have health issues in breathing. There are many application for detection and monitoring of the leakage of gas, but still the researchers will make the efforts in making the advanced application where the cost of the application will be lesser. Authors proposed system defines that detection and monitoring of the LPG gas is sensed using MQ – 5 sensors. In the system, when the leakage of gas is detected, the buzzer will be on, along with that the alert message will be displayed in the LCD. And while monitoring of gas based on the cylinder weight, which is measured using the load sensor, it will

send the message to the owner of the application or system. Authors of proposed system, the authors used the pushbullet for the rapid transfer of the data of the message using the Wi-Fi module which functions when there is leakage of gas which is connected to the Arduino UNO. Authors proposed system, the sensor which is used to detect LPG gas is MQ – 6, for methane gas, the sensor used is MQ – 4, and benzene is detected using the sensor using MQ – 135 respectively. The output of the sensors will be given in form of PPM. Further, ESP32 is used for the sending and receiving of the messages. Authors proposed system, the application is for the monitoring of the gas where it sends the message. Node MCU's is powered as the sensors where the load sensors always monitor the cylinder. If the weight is less, then it will be displayed using ubidots. Authors of [5] proposed system, where the LPG gas management is proposed for the cost which is low. Along with detection and monitoring, the system also calculate the temperature and humidity concentration.

VI. SCOPE OF THE PROJECT

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals. Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacturing processes and emerging technologies such as photovoltaic. They may be used in firefighting. In this work when ever the gas is leaked it is sensed by the sensor and it sends signal through the processor to buzzer .The ppm can be seen in the lcd display . when ever the gas leakage reaches the ppm of 100 it will send signal to the buzzer and the buzzer will ring and it will alert the people around that the gas is leaking .

VII. CONCLUSION

He design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this paper. This is a low-cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere but also wastage of gases will hurt our economy. The proposed system will cost only USD 10 which is easily affordable even for poor people. In the open literatures it is noticed that much work has not been done for a smart gas detection system. In future, more advanced features will be integrated with this system which will provide users with more safety and relaxation. The proliferation of handheld devices has led to developments in the field of smart gas sensors, which has considerably widened their scope of application. The need for ensuring safety in workplaces is expected be the key driving force for the market over the coming years.

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