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Automatic LPG Gas Detection and Exhausting

Mr.P.G.Kamble[1], Aditya Gaikwad[2], Sakshi Koli[3], Virendra Bodake[3] Sarvesh Katkar[3]
[1,2,3,4,5]*Electronics & Telecommunication Engg., Sanjay ghodawat university, Kolapur-416118,Maharastra, India.*

Abstract - Liquefied Petroleum Gas (LPG) is a main source of fuel, especially in urban areas because it is clean compared to firewood and charcoal. Gas leakage is a major problem in the industrial sector, residential premises, etc. Nowadays, home security has become a major issue because of increasing gas leakage. Gas leakage is a source of great anxiety with ateliers, residential areas and vehicles like Compressed Natural Gas (CNG), buses, and cars which are run on gas power. Liquefied PetroleumGas (LPG) is a main source of fuel, especially in urban areas because it is clean compared to firewood and charcoal. Leakage of gas is a major issue in the industrial sector, residential buildings, and gas-powered vehicles such as CNG (Compressed Natural Gas) buses, cars, and other vehicles. Installing a gas leakage detection device at vulnerable locations is one of the preventive methods for preventing accidents caused by gas leaks. The goal of this project is to create a device that can detect, alert, and control gas leaks in vulnerable areas automatically. When the LPG concentration in the air reaches a certain level, the system detects LPG leakage with a gas sensor, activates the exhaust fan, and closes the gas valve automatically.

***Key Words*:** Liquefied Petroleum Gas(LPG), Compressed Natural Gas(CNG).

1.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 recentyears. 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 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.

2. Body of Paper

MQ-5 is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemoreceptors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. It has a digital and analog pin. As our purpose is to measure the gas in ppm, the analog pin has to be used. The sensor gives the analog values (0-5V) as integers ranging from 0 to 1023. The analog output voltage provided by the sensor changes according tothe concentration of the gas. The greater the gas concentration, the higher is the output voltage. But the analog values do not give any useful meaning in measuring the gas ppm. So, we need to convert these values into gas ppm using the MQ-5 datasheet [6].

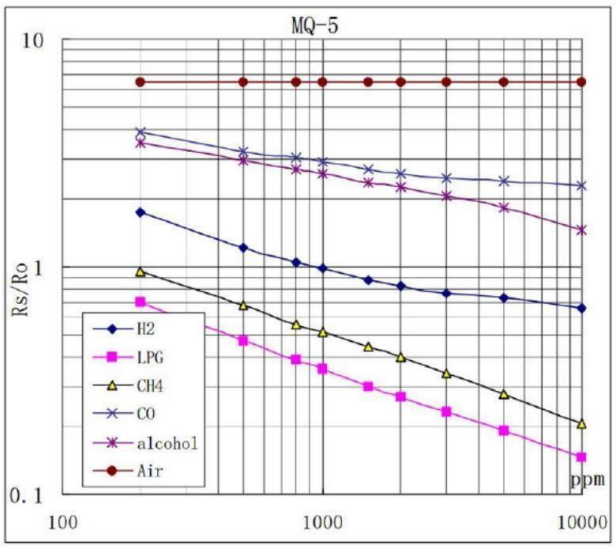

Fig 3: Resistance ratio (Rs/Ro) vs ppm graph in MQ-5 Datasheet

Rs is the resistance of the sensor that changes depending on the concentration of gas, and Ro is the resistance of the sensor at a known concentration without the presence of other gases, or in fresh air. From the graph, we can see that the resistance ratio is a constant in fresh air.

BLOCK DIAGRAM:

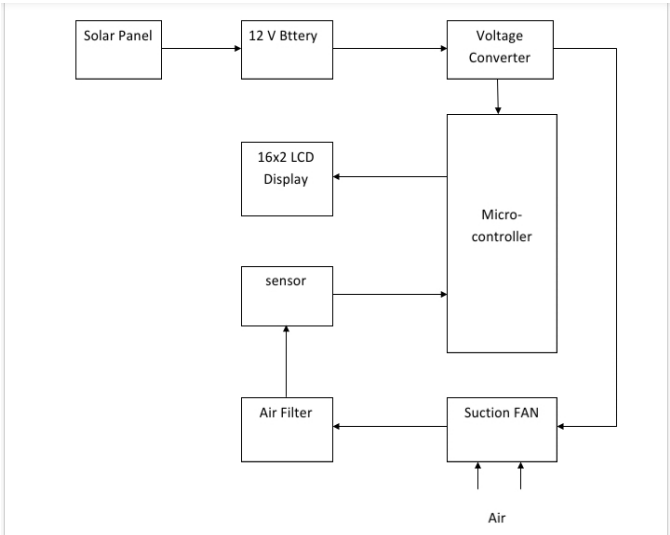

Fig 2.block diagram

LITERATUREREVIEW

Many papers have been published on work related to GSM systems and gas leakage detection systems [1]. These works have proved helpful in controlling hazards impacts. We have built runtime preventive system. In [2], wireless sensor-based home system has been developed for the elderly but does not take into account gas leakage detection. In [3], ZigBee based smart residential. neighborhood system is introduced but does not work for detecting hazardous gas particles. A remote wireless security system discussed in ref [4] that can detect theft leakage of gas and fire but lacks automatic control.

Various research groups are working all over the world for the development of Microcontroller based LPG Gas Leakage Detectors using to Node-MCU. LPG, first produced in 1910 by Dr. Walter Snelling is a mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons. Before the development of electronic household gas detectors in the 1980s and 90s, gas presence was detected with a chemically infused paper that changed its color when exposed to the gas[5].

Since then, many technologies and devices have been developed to detect, monitor, and alert the leakage of a wide array of gases. Gas leakage is a common problem which can cause a lot of accidents [6].

Some of the accidents that happened recently due to gas leakage are moghbazar explosion on June 27, 2021 [7], explosion at Baitul Salah mosque in Narayangonj on September 5, 2020 [8]. If we can detect gas leakage before it gets dangerous, we can control the situation. For this reason, gas detectors are produced. Many kinds of the gas detector can be found in market. But most of them only detect the gas, nothing farther. In our project, we tried to take the precautionary steps that should be followed into our consideration and applied them, like closing valve, turning on exhaust fan, alerting system [9].

Components Used:

1) Node-MCU wi-fi module

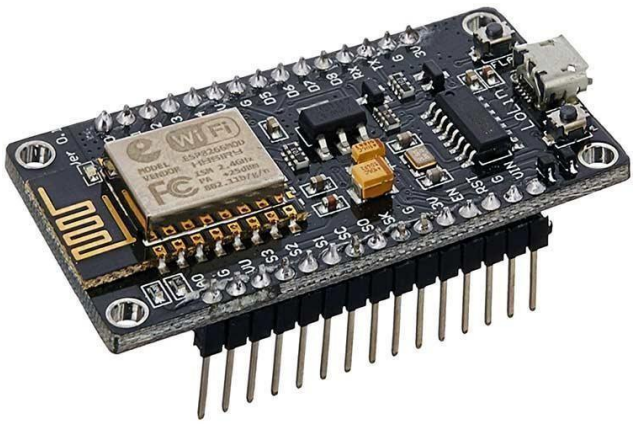

Fig 2 NODE MCU

The NodeMCU (Node Microcontroller Unit) is an open-source software and hardware development environment built around an inexpensive System-on- a- Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Expressive Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have Wi-Fi capabilities, and some even have a serial data port instead of a USB port.

NodeMCU Specifications:

The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint – an important consideration tobe aware of.

The most common models of the NodeMCU are the Amica (based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board. The open-source design of the base ESP8266 enables the market to design new variants of the NodeMCU continually

LCD 16X2Display:

What is the LCD 16×2?

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Fig 2 LCD

12 volt Relay:

Fig 3 Relay

Relay is a remote control electronic switch normally controlled by another switch, computer or control module. Functioning as a standard 12 volt replacement

or addition for full voltage, these relays are a great option for equipment existing in vehicles today. The mounting bracket included with the relays allows for the relay to be mounted directly to a vehicle or other electrical application. These relays are an optimal solution for full voltage applications on a variety of vehicle equipment including head lamps, auxiliary lamps, fog horns, motors for fans, window lifters, air conditioners, heated rear windows, and more. Choose from a 12V DC relay without a resistor. Both are designed to deliver superior, long lasting performance.

MQ135 Air Quality sensor:

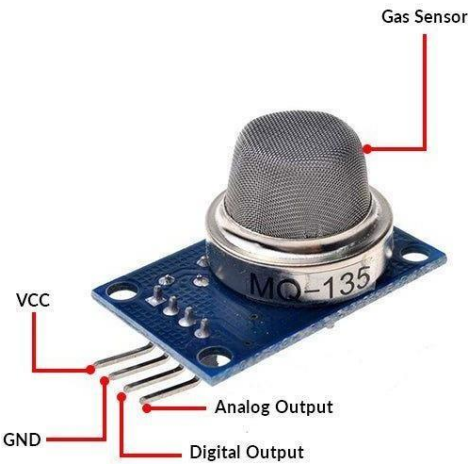

Fig 4 sensor

The MQ-135 gas sensor module is a device that is used for sensing a range of gases, including ammonia (NH3), sulfur dioxide (SO2), and carbon monoxide (CO). It is based on a metal oxide semiconductor (MOS) gas sensor, which uses a semiconductor material to detect gases.

The MQ series of gas sensors utilize a small heater inside with an electrochemical sensor these sensors are sensitive to a range of gasses are used at room temperature. MQ135 alcohol sensor is a Sno2 with a lower conductivity of clean air. When the target explosive gas exists, then the sensor's conductivity increases more increasing more along with the gas concentration rising levels. By using simple electronic circuits it converts the charge of conductivity to a corresponding output signal of gas concentration.

The MQ135 gas sensor has high sensitivity for ammonia, sulfide, benzene steam, smoke, and other harm full gas. It is low cost and suitable for different applications

12 Volt Motor:

Fig 5 fan

12V straight DC fan are a type of simple direct current fan that do not have a gearbox. They are designed to be used with a DC speed controller and have a widerange of power output

I2C Serial interface module:

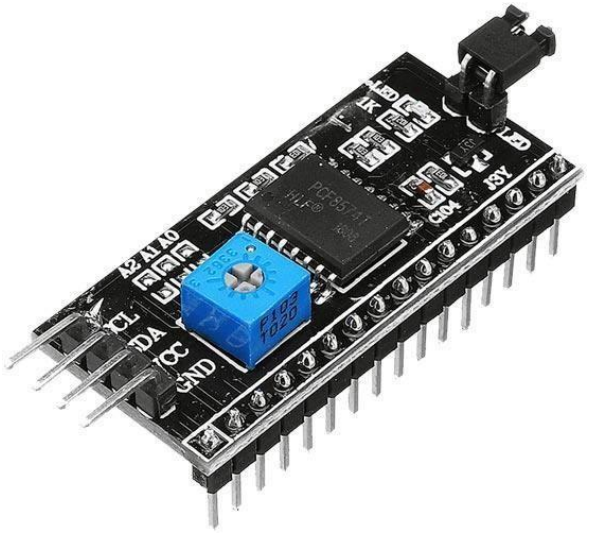

Fig 6 I2C

Due to limited pin resources in a microcontroller/microprocessor, controlling an LCD panel could be tedious. Serial to Parallel adapters such as the I2C serial interface adapter module with PCF8574 chip makes the work easy with just two pins. The serial interface adapter can be connected to a 16x2 LCD and provides two signal output pins (SDA and SCL) which can be used to communicate with an MCU/MPU.

Features and Specifications of I2C Serial Interface Adapter Module This section mentions some of the features and specifications of the I2C Serial Interface Adapter Module.

Operating Voltage: 5V DC I2C control using PCF8574 Can have 8 modules on a single I2C bus I2C Address: 0X20~0X27 (the original address is 0X20, you can change it yourself via the

onboard jumper pins)

Result:

The results obtain from the implemented of the gas leakage system. The lighter was used as a gas that be detect by the detector and using the hairdryer to get the changes of the temperature. The response of the reading was obtained using the liquid crystal display. The sensitivity of the MQ- 2 sensor to detect the concentration of the gas is by changing the sensor resistance value. The resistor value obtains from the serial monitor display by Arduino Ide

The resistor value (RO) that be testing is from 6.00 Ω to 9.30 Ω. From the result obtained, the relationship between the resistance value and the concentration of gas per time. The MQ-135 sensor not only detect the concentration of the gas but it's also detect the concentration of the smoke. The result of the relationshipwas showed in table 4.1 and table 4.2.

Fig.4.1 GasDetection

The DHT-11 was testing using hairdryer to detect the changes of the temperature. Based on the result that obtained the notification of the system willalert the user when the temperature exceeds the value of 30oC. This experimentis to assume the condition if the fired occurred.

Fig.4.2 Exhaust system

The experimental was setup as shown in figure 4.1. This system has a simple implemented circuit and the output of the system shown in the figure 4.2, 4.3, 4.4, 4.5 and 4.6 as the result obtained by LCD the reading of the concentrationgas will safe

Fig.4.3 Output display

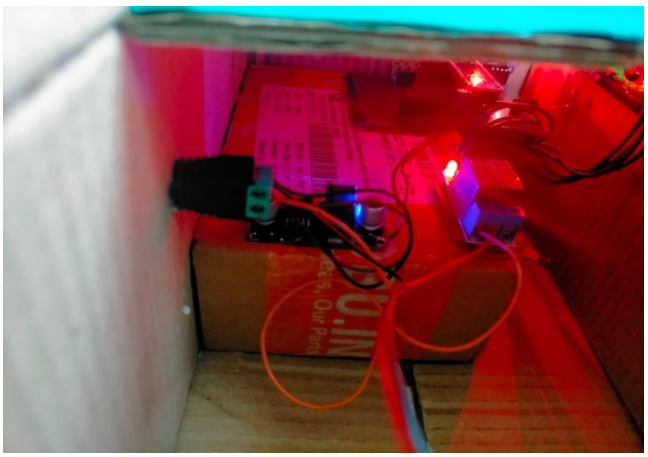

Fig.4.4 Circuitry

3. CONCLUSIONS

The 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.

We can conclude that detection of LPG gas leakage is nearly accurate after the project is completed. Despite its low cost, the system can ensure precise detection of gas leaks and potentially save lives in life-threatening situations. The system will be mass produced, resulting in cost savings and improved performance. Many future accidents can be avoided with public awareness and funding for this project.

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Aditya P Gaikwad(21ST116332013)
Sakshi S Koli(21ST116332018)
Virendra R Bodake(21ST116332010)
Sarvesh A Katkar(21ST116332017

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