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Gas Leakage Detection and Prevention Using Sensors and IoT

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Abstract - In today's world, safety is critical, and good safety systems must be put in place. The principal objective of this study is to design a gas sensing and warning system based on Internet Of Things. LPG is used for cooking and in industries. Since LPG is stored and handled by civilian's, it is easily damaged. In any case, when the gas cylinder, controller, and tube are not in great state, breaks occur, resulting in an issue. Accidents can cause problems such as suffocation and can start fires. Installing gas leakage detectors in vulnerable areas is the most important measure to avoid accidents caused by gas spill. The primary purpose of this study is to propose a framework for detecting and eliminating gas leakage in vulnerable areas. The gas sensor is one such way of detecting and alerting people to gas spills in their initial stages. The gas leak detection system includes a GSM module that sends SMS messages when a gas leak is noticed. It also turns on the exhaust fan and alerts the firefighter department and helps us prevent unexpected disasters. This device can be used in households and industrial facilities, they can be controlled and observe conditions remotely.

Key Words: Node MCU, MQ6 Sensor, ESP2866 WIFI, Servo Motor, GSM module**.**

1.INTRODUCTION

As a result of LPG gas detection, many incidents, such as explosions and fires, have occurred. Such incidents can have serious consequences. This leakage detection system will detect external leaks and send data to a module. IoT systems do not need human intervention.

A system with large electric and mechanical power is used to detect gas. This detection system will notify us of the leakage and alsoturn off the gas cylinder's lever, preventing any further leakage. This technology also sends an email and a text message to the person who is affected. In every case, this improves the safety of any gas system.

Any flammable substance on the site that comes in touch with gas can result in property loss, harm lives and other consequences. Automobiles such as cars and buses, as well as the areas where they are manufactured, are among the primary sectors under constantthreat.

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2. Body of Paper

2.1 Objectives

LPG leaks are now a concern both in home and in the workplace. It is unavoidably dangerous if the problem is not identified and corrected as soon as possible.

The project's major purpose is to use the IoT devices to spot gas leaks from Gas cylinders. which are common in Indian homes, and to alert the user and the surrounding area. A servo motor will also turn off the supply gas, as will the knob, reducing the risk of an accident. A gas sensor is used as input.

2.2 LITERATURE SURVEY

For [1], the gas leakage detection system is developed to warn the humans from the gas toxic; the warning is a Short Message Service (SMS) and it goes to the corresponding person's cellphone using Arduino UNO and SIM900 GSM/GPRS gateway.
From [2], the designed gas detection leakage proposed that if any leakage is sensed through the gas sensor, a SMS will be sent automatically to the corresponding person's or family member using GSM. Their system has an additional function to measure the weight of the LPG cylinder and displayed on the LCD display. If the quantity of the gas cylinder is less or equal to 10kg, it will automatically book the LPG cylinder by sending an SMS to the dealer. Also, when the weight of the LPG cylinder comes down to 0.5 Kg, it alerts the persons in the house by SMS to change the cylinder.
In [5], the author has developed a system capable of measuring the amount of gases in ppm and percentage to save the human body from the various toxic gases and

hazardous elements or chemicals or compound consisting in the atmosphere. In his proposed system, he used Arduino Uno R3, nRF24L01Plus Wireless Transceiver Module, and the MQ2 gas sensor and the results was monitoring at the receiver side using Arduino IDE serial monitoring.

Within [6], the author proposed an IoT based gas detection prototype using Proteus design suite. He depends the Blink IoT platform for data visualization. He concludes the system said that the proposed technique wirelessly transfers alert notification to the user and therefore the user can easily connect the devices through a Smartphone from any location.

In [10], In this research, a computer program running online was created to detect leakage locations and act as an automatic supervisor in remote areas; simple gas leak detector is a simple device that is used to detect the leakage of gas and if the gas leak occurs, an equivalent message is conveyed by the means of a buzzer and powered by Wi-Fi, it is capable to broadcast messages to the stakeholders about the LPG leak through the Blynk application which is based on the IoT technology.

2.3 Proposed System

Many incidents, such as fires or explosions, have occurred as a result of LPG gas leakage. If the leak is not noticed early enough, such accidents might have catastrophic implications. The Microcontroller and IoT-based LPG leakage sensor is a project that will help detect gas in the environment while also providing data. An IoT and Arduino-based LPG leakage detection system uses an LPG gas sensor to detect LPG gas. Notification is triggered from sensor to MCU.

LCD has a connection to MCU. Buzzer also has a connection to MCU. In this IoT LPG leakage detector project, the ESP8266 chipis employed.

GSM module is triggered to send message. Things speak displays the live data which has been analyzed. It has api keys for authentication. It is created on a private channel and the changes cannot be made without the api keys. Turning off of the cylinder knob is done using servomotor. It turns 180 degrees which in result turns off the knob.

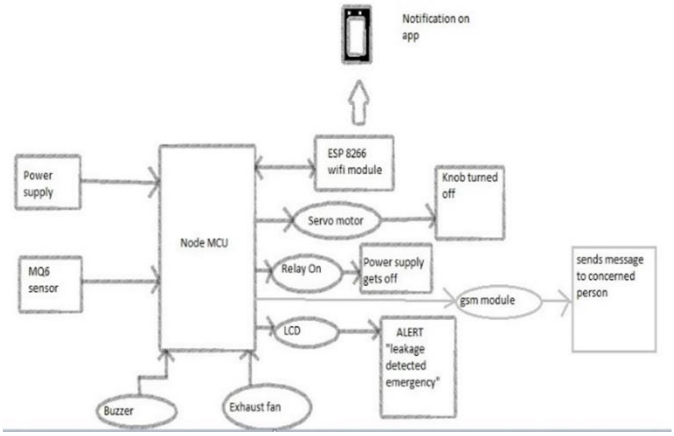


Figure.1 Shows the architecture of the proposed system

2.4 Hardware Components

1) ESP8266 NODE MCU: Node MCU is an open-source platform based on the ESP8266 that allows objects to be connected anddata to be transferred using the Wi-Fi protocol.

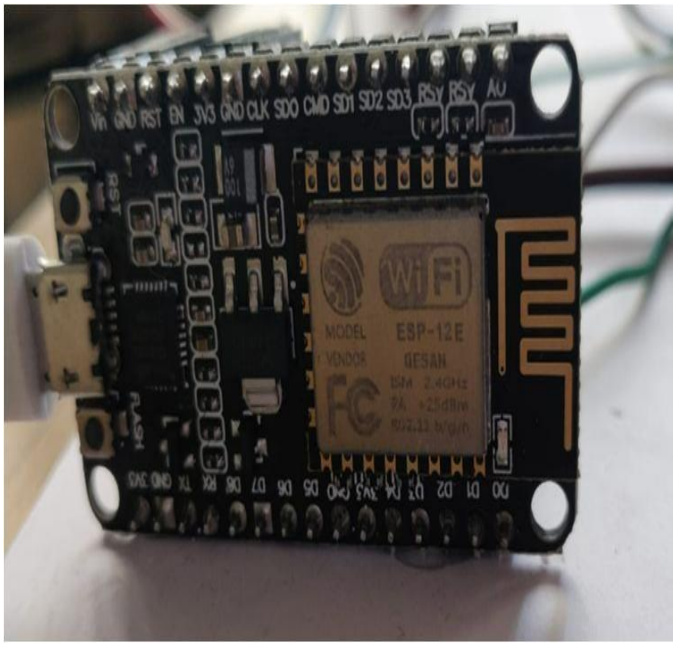
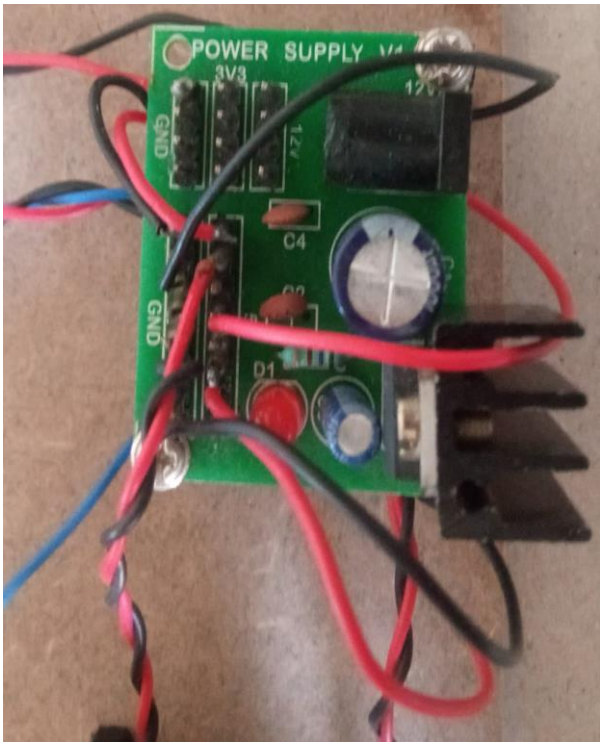


Figure.2 ESP8266 NODE MCU

2)Power Supply: A power supply is an electrical device that supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters.

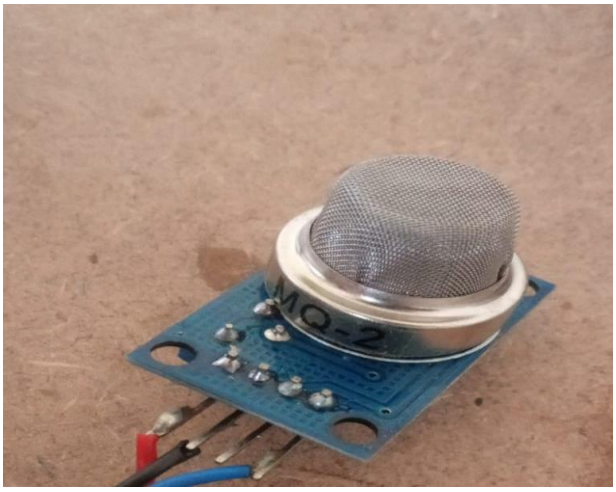


3) **Gas Sensor:** The MQ2 sensor is one of the most widely used in the MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also known as Chemiresistors because sensing is based on the change in resistance of the sensing material when exposed to gasses.

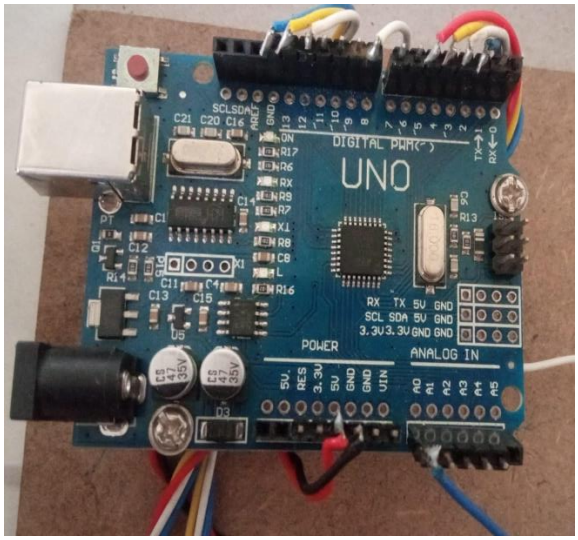
The MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm.

Note that the MQ2 gas sensor detects multiple gases, but cannot identify them!

Therefore, it is best suited for measuring changes in a known gas density rather than detecting which one is changing



4) **Arduino UNO:** Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.



2.5 Working System

The proposed system has the following components:

A. Circuit for Power Supply

This circuit is made up of a 9V DC battery that powers the Node MCU.

B. The Sensing Circuit

The sensing circuit includes an MQ6 sensor with high sensitivity to Propane, Butane, LPG, and Natural Gas. The sensor can detect a variety of combustible gases. The sensor detects the value and sends it to the Node MCU to be updated in the app, and the sensor-derived gas value is displayed on the LCD screen.

C. Transmit Circuit for GSM

GSM module is used to trigger SMS. A message will be sent to the user.

D. Circuit for Threat Awareness and Mitigation

A buzzer and an exhaust fan make up this module. A buzzer is used to alert neighbours and people in the area of a leak. Exhaust Fans are used to remove excess gas from the atmosphere.

E. Relay and Servo Motor

The knob is connected to a servo motor; when the leakage is detected, the node MCU causes the servo motor to rotate 180 degrees, causing the knob to be turned off.

In our project, we used two relays: the first is connected to the buzzer and the fan, and the second is

connected to the power supply. When there is an indication of a gas leak, both relays will be activated, acting as a switch; the first relay will power on the fan and buzzer, while the second relay will cut off the power supply to the entire system, preventing further accidents.

The figure 6 and figure 7 below illustrates the dataflow of the proposed system

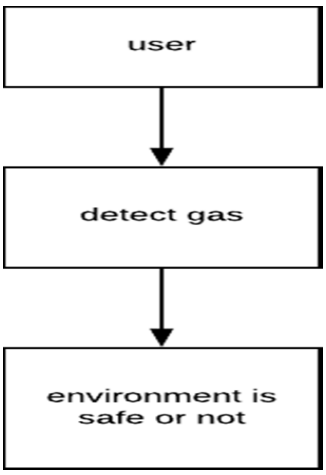


Figure.6 Data Flow Diagram

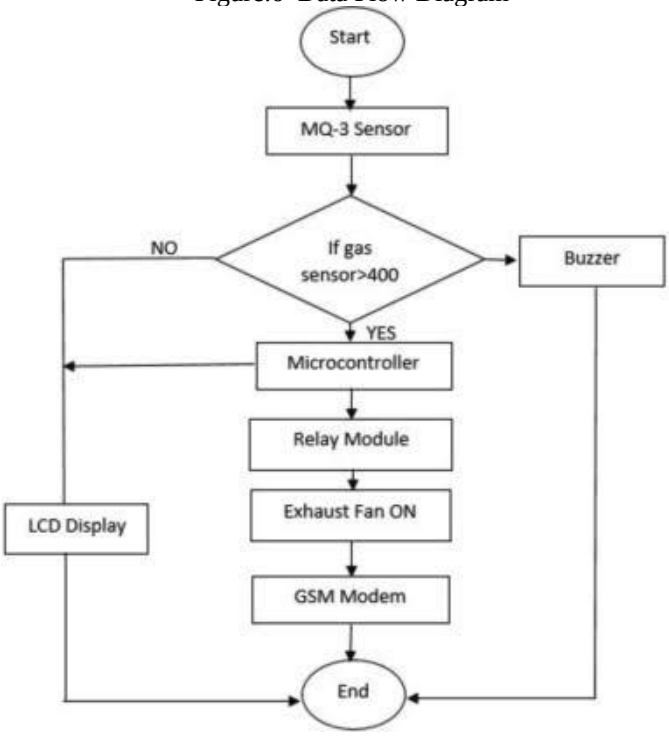


Figure.7 Data Flow Diagram

The system is started by the user by connecting to a hotspot or a WIFI connection. The sensor will sense or detect the gas value in the atmosphere and, based on that, determine whether the environment is safe or not, and a message will be sent accordingly.

The MQ6 sensor detects the gas value in the atmosphere and sends the information to the Node MCU, which sends the information to the LCD screen, which displays the gas content in the atmosphere at all times. This data is also sent to the Thingspeak where it is displayed. A certain threshold value will be established; if the calculated value is less than the threshold value, the system takes no action and continues to sense the gas value in the atmosphere. If the calculated value exceeds the threshold value. The Node MCU will then tell the buzzer to ring, the exhaust fan to turn on, and the servo motor to rotate, causing the knob to be turned off. Concerning the gas leak, a message will be sent to the concerned user.

2.6 Results

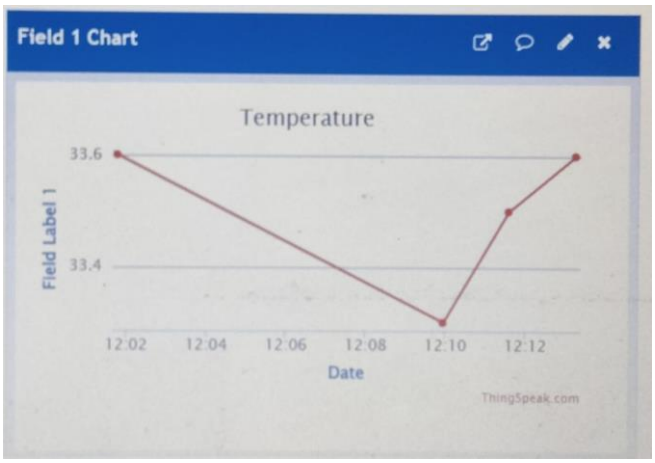
The Gas Detection system is developed using IoT. Uses node MCU and GSM module.First the components are connected to the WIFI module.
The initial value of the gas is noted.

When the threshold value is reached, that value is shown and the buzzer is switched on, servo motor will turn 180 degrees which in result turns off the knob.

A private channel has been created on Thingspeak where all the data which has been collected from the objects will be displayed. As it is a private channel, we need an API key for authentication.

API key allows us to read to or write from a private channel.

The data analyzed is displayed on Thingspeak



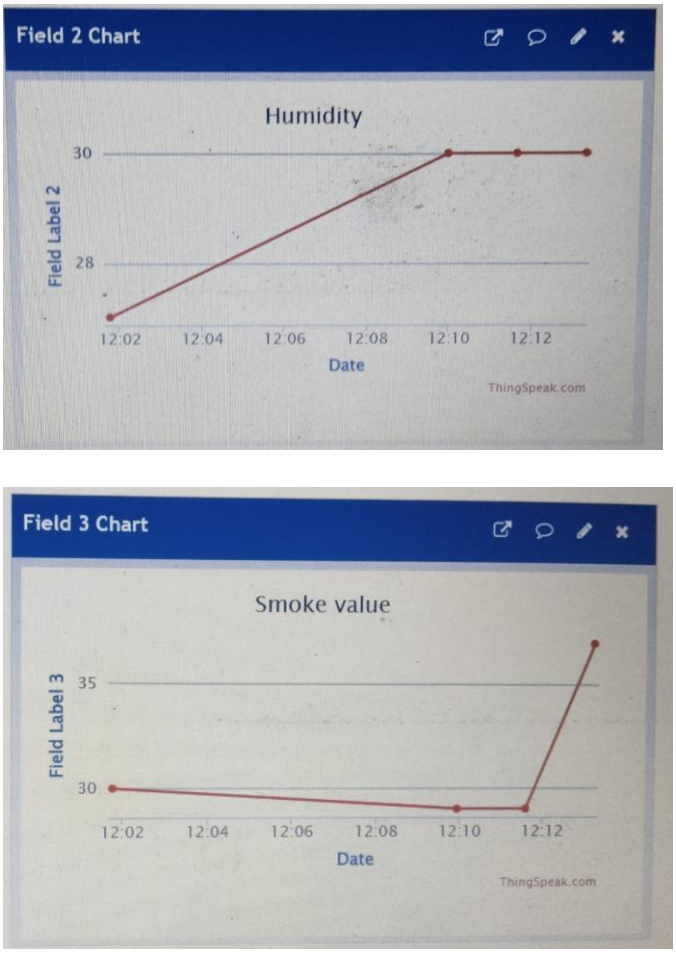


Figure.9 Shows the live data.

3. CONCLUSIONS

This project aims to develop a monitoring and detection system to meet safety standards and avoid free accidents caused by leakage. The system detects gas in the atmosphere and will continuously update and display the gas value, which the user can easily see via the mobile app.

This system has a faster response rate and can disseminate critical information faster than manual methods. In the event of a leak, the system alerts and responds quickly by sending SMS to the appropriate authority.

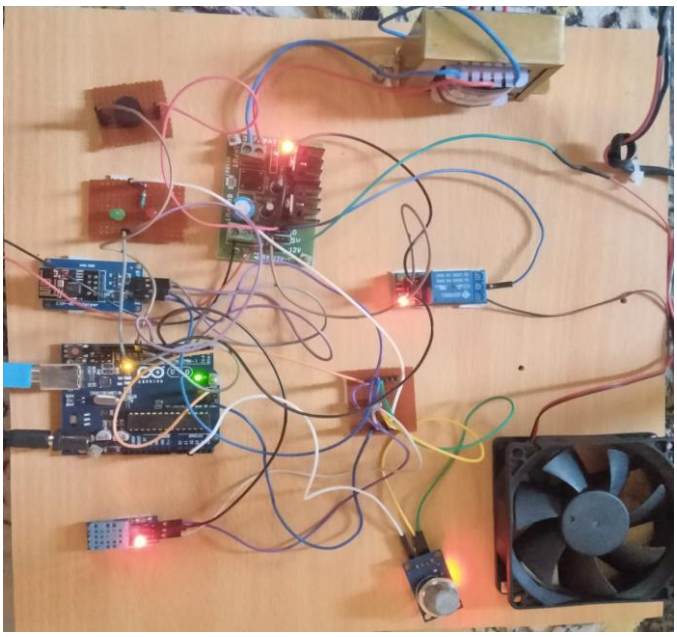


Figure.12 Shows the circuit connection

3.1 Future Enhancement

In addition to the gas sensor, a temperature sensor can be used which detects the high-pressure gas and display the alert SMS when ahigh temperature is reached. The use of a pressure sensor along with the system can provide an extra feature of automatic gas booking. Further development in industries.

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