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IOT-BASED SMART SENSE GAS DETECTION AND ALERT SYSTEM

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ABSTRACT - The Leakage of gas is a major issue in the industrial sector, residential buildings, and gas-powered vehicles, one of the preventive methods to stop accidents associated with gas leakage is to install gas leakage detection devices. The focus of this work is to propose a device that can detect gas leakage and alert the owners to avert problems due to gas leakages. The system is based on a microcontroller that employs a gas sensor as well as a GSM module, an LCD display, and a buzzer. The system was designed for gas leakage monitoring and alerts with SMS via an Arduino microcontroller with a buzzer and an MQ2 gas sensor. The circuit contains a Microcontroller MQ2 gas sensor, buzzer, LCD display, and GSM module, when the sensor detects gas leakage it transmit the information to the Microcontroller while the microcontroller makes a decision and then forwarded a warning message to the user as SMS to a mobile phone for decision to be taken accordingly. The output of this research will be significant in averting problems associated with gas leakages now and in future.
Keywords: Gas leakage detector, GSM module, Gas sensor

INTRODUCTION: The IoT-Based Smart Gas Detection and Alert System is designed to enhance safety by continuously monitoring the presence of hazardous gases in a given environment. This system integrates advanced gas sensors with IoT technology to detect the concentration of gases such as methane (CH4), carbon monoxide (CO), or LPG.

Upon detection of abnormal gas levels, the system triggers real-time alerts via various methods, such as alarms, notifications on smartphones, or automated responses.LPG is a significant and effective fuel, for the most part utilized as a part of private spots for cooking.

LPG for the most part filled in cylinder which is solid and can't be harmed effortlessly.In any case, breaks may happen from gas cylinder, controller and gas pipe tube when these are definitely not in a decent condition and may cause a mishap.

Mischances may prompt medical problems like suffocation and potentially cause an impact on the start of any fire or electric supply. There are generally over 80% LPG customers in the country in which generally 35% of the gas related accidents occur because of gas leakage. So the real concern is spillage of LPG. Various guidelines are also executed for the gas spillage identification system.An alert framework which is basically required to distinguish a Gas leakage in the house and commercial premises. message is passed on and a signal send to the PWM(Arduino) module it is skilled to communicate messages to the partners about the LPG spill with the utilization of MQ Sensor.

Key Features:

1. Real-Time Monitoring: Continuous detection of gas concentration levels.
2. IoT Integration: Data is transmitted to cloud platforms for remote access and analysis.
3. Alerts and Notifications: Immediate alerts sent via alarms, SMS, or app notifications.

3. HARDWARE COMPONENTS:

The short introduction of distinct modules used in this undertaking is mentioned below:

3.1 MQ2 Sensor:

MQ2 gas sensor can be used to detect the presence of LPG, Propane and Hydrogen, also could be used to detect Methane and other combustible steam, it is low cost and suitable for different application. Sensor is sensitive to flammable gas and smoke. Smoke sensor is given 5 volt to power it. Smoke sensor indicate smoke by the voltage that it outputs. More smoke more output.

A potentiometer is provided to adjust the sensitivity. Sn02 is the sensor used which is of low

conductivity when the air is clean. But when smoke exist sensor provides an analog resistive output based on concentration of smoke. The circuit has a heater. Power is given to heater by VCC and GND from power supply. The circuit has a variable resistor. The resistance across the pin depends on the smoke in air in the sensor. The resistance will be lowered if the content is more. And voltage is increased between the sensor and load resistor.

Fig: MQ2 Sensor

The MQ2 sensor is a widely used gas sensor that detects a variety of flammable gases and smoke by measuring changes in its electrical resistance when exposed to these substances; it operates based on the principle of a Metal Oxide Semiconductor (MOS) where the conductivity of the sensing material (typically tin dioxide) alters depending on the concentration of target gases present, allowing for detection of gases like propane, methane, alcohol, hydrogen, and carbon monoxide, making it commonly used in gas leak detection applications due to its broad sensitivity and affordability.

3.2 LED:

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability.

Working:

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light-emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode.

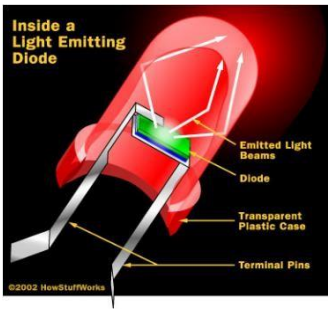

Fig: Inside a LED

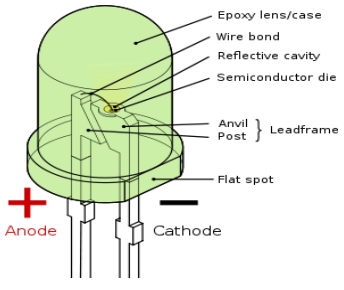

Fig: Parts of a LED

However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output. They also enjoy use in applications as diverse as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals.

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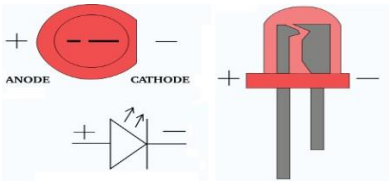

Fig: Electrical Symbol & Polarities of LED

3.3 Buzzer:

A buzzer is an electronic device that produces sound. It is commonly used in alert systems to signal alarms or notifications. Buzzers are compact, simple to use, and widely implemented in IoT systems, home appliances, and industrial equipment.

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

Fig: Buzzer

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the GND terminal.

A buzzer is an audio signaling device that emits a buzzing or beeping noise. Unlike speakers, which can reproduce a wide range of sounds, buzzers are intended to emit a single, repeated sound pattern. They are typically small and require little power, making them suitable for various applications.

Working:

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors.Once a potential disparity is given across these crystals, then they thrust one conductor & drag the additional conductor through their internal property.

So this continuous action will produce a sharp sound signal.A buzzer is an efficient component to include the features of sound in our system or project. It is an extremely small & solid two-pin device thus it can be simply utilized on breadboard or PCB.

So in most applications, this component is widely used. There are two kinds of buzzers commonly available like simple and readymade. Once a simple type is power-driven then it will generate a beep sound continuously. A readymade type looks heavier & generates a Beep. Beep. Beep. This sound is because of the internal oscillating circuit within it.This buzzer uses a DC power supply that ranges from 4V – 9V. To operate this, a 9V battery is used but it is suggested to utilize a regulated +5V/+6V DC supply. Generally, it is connected through a switching circuit to switch ON/OFF the buzzer at the necessary time interval.

Advantages:

- Size is small
- Energy Consumption is less
- The Range of Voltage usage is Large
- Sound Pressure is high

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3.4 Bread Board:

A breadboard, solderless breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike a perfboard or stripboard, breadboards do not require soldering or destruction of tracks and are hence reusable. For this reason, breadboards are also popular with students and in technological education.

Compared to more permanent circuit connection methods, modern breadboards have high parasitic capacitance, relatively high resistance, and less reliable connections, which are subject to jostle and physical degradation. Signaling is limited to about 10 MHz, and not everything works properly even well below that frequency.

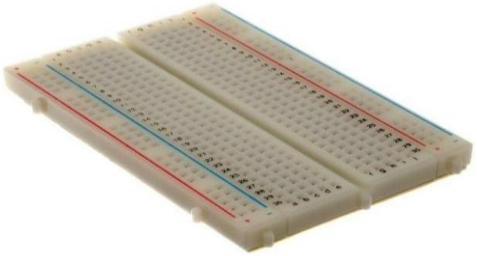

Fig: Bread board

A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

A breadboard is a versatile and reusable tool used in electronics for building and testing circuits without soldering. It consists of a plastic board with a grid of holes, under which metal strips provide electrical connections.

The breadboard is divided into sections: terminal strips in the center for connecting components like resistors and LEDs, and power rails on the sides for distributing voltage and ground. The central gap is designed to fit Integrated Circuits (ICs) without causing short circuits between their pins. Breadboards are ideal for prototyping and debugging circuits due to their flexibility and reusability.

They are widely used in educational settings, IoT projects, and by hobbyists to quickly test ideas before making permanent designs. However, they are unsuitable for high-power circuits and can become unstable if connections are loose. Despite these limitations, breadboards remain an essential tool for electronics experimentation and learning.

SOFTWARE REQUIREMENTS:

In this project we have used one software to build the entire circuit that is:

6.1 Arduino UNO:

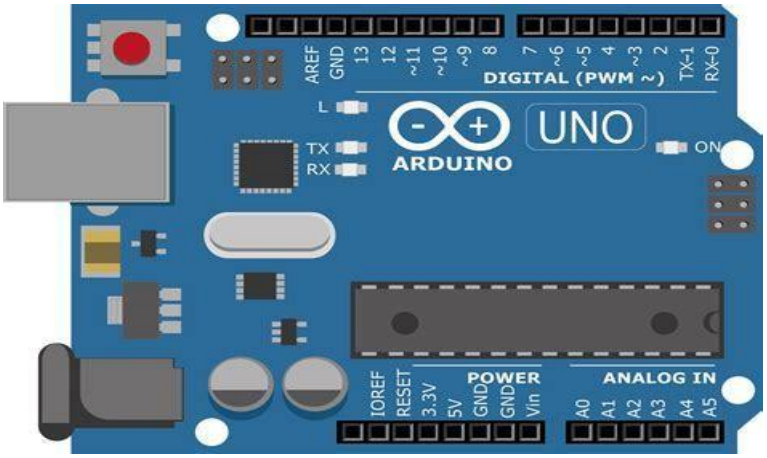

Fig: Fig 6.1: Arduino UNO

The Arduino UNO is one of the most popular and widely used microcontroller development boards, particularly suited for beginners in electronics and programming. It is based on the ATmega328P

microcontroller and provides a user-friendly platform for building a variety of hardware and software projects.
The Arduino Uno is a popular microprocessor board that's widely used for various electronics projects. Here's a breakdown of its key components and how it works.The Arduino Uno is a widely used microcontroller board based on the ATmega328P chip, designed for beginners and professionals to create and prototype electronic projects.
It features 14 digital input/output pins (6 of which support PWM output), 6 analog input pins, a USB connection for programming and power, a power jack, a reset button, and a crystal oscillator for accurate timing.
The board is open-source, making it highly accessible and customizable, and it is programmed using the Arduino IDE, which simplifies coding with its user-friendly interface and extensive library support. The Arduino Uno is widely appreciated for its versatility, ease of use, and compatibility with various sensors, actuators, and shields, making it ideal for applications in IoT, robotics, automation, and interactive systems. Its robust design and strong community support have made it a staple in the world of electronics and embedded systems development.

Working:

The Arduino UNO is a microcontroller board that serves as a platform to control and interact with electronic components. It works by executing programs written in the Arduino programming language (a simplified version of C++) to perform specific tasks, like reading sensor data, controlling LEDs, motors, or sending data wirelessly.

Components:

1. **Programming**:
   - The board is programmed via the Arduino IDE, which allows you to write and upload code (called a "sketch") to the board using a USB connection.
   - The sketch tells the microcontroller how to behave—for instance, to blink an LED, read sensor data, or control a motor.
2. **Input**:
   - The board can receive input signals from sensors (e.g., temperature, light, sound) connected to its analog or digital input pins.
   - Example: A temperature sensor sends an analog voltage signal that the Arduino reads and converts into a temperature value using its ADC (Analog-to-Digital Converter).
3. **Processing**:
   - The microcontroller (ATmega328P) processes the input based on the uploaded program. For instance, if the temperature is too high, the program might instruct the board to turn on a fan.
4. **Output**:
   - The board can output signals to devices like LEDs, motors, and displays through its digital or PWM pins.
   - Example: Sending a PWM signal to a motor to control its speed.
5. **Power**:
   - The Arduino UNO can be powered via the USB port or an external power source (7–12V). It has a voltage regulator to ensure stable operation at 5V.

Key Components and Their Roles:

- **Microcontroller (ATmega328P)**: The brain of the board; executes the program.
- **Digital I/O Pins**: For connecting digital devices like LEDs, switches, and motors.
- **Analog Input Pins**: For reading analog signals from sensors.
- **PWM Pins**: For creating analog-like outputs using Pulse Width Modulation.
- **USB Port**: For programming the board and providing power.

5.RESULT:

An IoT-based smart gas detection and alert system is designed to monitor and detect the presence of

hazardous gases in the environment while providing timely alerts to prevent potential health risks or accidents. The system typically measures its performance based on factors like accuracy, response time, and sensitivity range. For instance, it may achieve ±5% accuracy in detecting gases such as LPG or carbon monoxide, with a response time of fewer than 10 seconds.
Alerts are triggered when gas concentration crosses predefined thresholds and are delivered through sound alarms, visual indicators like LEDs, or notifications via mobile apps or SMS. The system integrates with IoT platforms such as AWS IoT, ThingSpeak, or Firebase to enable real-time monitoring, data logging, and analytics through a user-friendly dashboard.
Testing results often include performance validation in different environments, such as confined spaces or open areas, and are compared against calibrated devices to ensure reliability. Additionally, the system's power efficiency, including battery life and potential use of solar energy, is assessed to ensure practical deployment. This technology finds applications in various domains, such as home safety for detecting LPG leaks in kitchens, industrial monitoring of harmful gases, and environmental air quality tracking. Overall, the results highlight the system's effectiveness, consistency, and real-world applicability, while identifying areas for future enhancement, such as incorporating additional sensors, leveraging AI for anomaly detection, and weatherproofing for outdoor use.

Fig 7.1: Hardware Kit

6.CONCLUSION:

The advantage of this simple gas leak detector is its simplicity and its ability to warn about the leakage of the LPG gas. This system uses GSM technique to send alert massage to respective person if no one is there in the house and then gas leaks occurs, GSM module is there to send immediate messages to the respective person regarding the gas leak. The main advantage of this system is that it off the regulator knob of the cylinder automatically when gas leakage detected.

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REFERENCES:

Mr. Sameer Jagtap, Prajkta Bhosale, Priyanka Zanzane, Jyoti Ghogare, “LPG Gas Weight and Leakage Detection System Using IoT”, International Journal for Research in Applied Science & Engineering Technology”, Volume 4, Issue 3, March 2016, Pg – 716 to 720.
[2]. Arun Raj, Athira Viswanathan, Athul T S, “LPG Gas Monitoring System”, International Journal of Innovative Technology and Research,
Volume 3, Issue 2, February 2015, Pg – 1957 to 1960.

[3]. S Shyamaladevi, V. G. Rajaramya, P. Rajasekar, P. Sebastin Ashok, "ARM7 based automated high- performance system for lpg refill booking & leakage detection", Journal of VLSI Design and Signal Processing", Volume 3, Issue 2, 2014.
[4]. S. Sharma, V. N. Mishra, R. Dwivedi, R. Das, "Classification of gases/odours using Dynamic Response of Thick Film Gas Sensor Array", IEEE Conference on Sensors Journal, 2013.
[5]. Rajeev B. Ahuja, Jayant K. Dash, Prabhat Shrivastava, "A comparative analysis of liquefied petroleum gas (LPG) and kerosene related burns", Burns, Volume 37, Issue 8, December 2011, Pg – 1403 to 1410.
[6]. Prof. Pankaj C. Warule, Shivam Upadhyay, Snehal S. Shelke, Sumitra K. Khandade, "LPG Detection, Metering and Control System Using Microcontroller", IJARIIE, Volume 2, Issue 2, 2016, Pg – 648 to 652.
[7]. Ankit Sood, Babalu Sonkar, Atul Ranjan, Mr. Ameer Faisal, "Microcontroller Based LPG Gas Leakage Detector Using GSM Module", international Journal of Electrical and Electronics Research, Volume 3, Issue2, April-
June 2015, Pg – 264 to 269.
[8]. Ashish Shrivastava, Ratnesh Prabhakar, Rajeev Kumar, Rahul Verma, "GSM Based Gas Leakage Detection System", International Journal of Technical Research and Applications", Volume 1, Issue2, May- June 2013, Pg – 42 to 45.
[9]. Shivalingesh B. M, Ramesh C, Mahesh S. R, Pooja R, Preethi K. Mane, Kumuda S, "LPG Detection, Measurement and Booking System", IJRSI, Volume 1, Issue 4, November 2014, Pg – 7 to 10.
[10]. C. Selvapriya, S. Prabha Sathya, M. Abdulrahim, C. K. Aarthi, "LPG Leakage Monitoring and Multilevel Alerting System", International Journal of Engineering Sciences & Research Technology, Volume 2, Issue 11, November 2013, Pg – 3287 to 3290.
[11]. H. Huang, H. Bainand, S. Zhu, "A Greenhouse Remote Monitoring System Based on GSM", in Proceedings of IEEE International Conference on Information Management, 2011, Pg – 357 to 360.