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IOT BASED GAS LEAKAGE DETECTION SYSYTEM

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Abstract - Accidents are on increasing day by day. Here, we are talking about those accidents that are being occurred due to combustible gases, i.e., LPG, CNG. Frequently we hear, explosion in cylinder of household and vehicles. Several people have been injured and some got dead. So we are making this project for security purpose that will detect combustible gases and alert candidates. Now a day's, LPG Gas leakage detector's comes in the market with the LPG sensor that only senses any gas leakage and sends a SMS to the emergency no. provided to it and alerts the user via audio or visual indications while we are on a project in which we are using a stepper motor also in addition to the normal LPG Gas leakage detectors which helps in turning off the switch when there an emergency in our absence. In this paper, we are reviewing on the use of LPG Gas leakage detector along with the stepper motor instead of using other simple Gas leakage detector. The sensor we are using here has excellent sensitivity combined with a quick response time. The sensor can also sense iso butane, propane, LNG and cigarette smoke. The report consists of a background into the area of 8051 microcontroller and mobile communication, how they are interfaced to each other and AT commands set used in communication.

I. INTRODUCTION

In the evolving landscape of technology, practical and effective projects play a vital role in driving advancements. This project utilizes the MQ-6 semiconductor sensor, crafted from SnO2, to detect the presence of combustible gases. The MQ-6 sensor is characterized by its lower conductivity in clean air, which increases as the concentration of target combustible gases—such as butane, isobutane, smoke, and even alcohol—rises in the environment. This change in conductivity, proportional to the gas concentration, enables the sensor not only to detect various combustible gases but also to act as an alcohol tester.

The project harnesses the MQ-6 sensor's capabilities for an important safety application. When the sensor identifies a gas leak from an LPG storage unit, its output signal decreases. This signal reduction is detected by a connected microcontroller, triggering a series of responses.an LED light and a buzzer are activated to alert nearby individuals to the danger, and after a short delay, a fan is switched on to help perse the accumulated gas. Simultaneously, the system sends an SMS alert labeled "GAS LEAKAGE" to a predefined Finally, a stepper motor is engaged to turn off the gas cylinder's valve, effectively stopping the gas flow and mitigating the risk of a combustible event.

This paper navigates through various developments in gas leakage detection technologies and introduces our proposed enhancements in this domain. By integrating the MQ-6 sensor with a microcontroller and additional safety mechanisms like LED alerts, buzzer warnings, automatic ventilation (fan activation), and remote notifications via SMS, we propose a comprehensive solution to detect and respond to gas leaks promptly. This system not only identifies the presence of dangerous gases but also takes immediate action to reduce the risk of fire or explosion, thereby ensuring a safer environment in domestic and industrial settings.

II. STATEMENT OF PROBLEM

Gas leaks are a critical concern in both homes and industrial areas, with the potential to cause devastating losses of lives and property if not detected and remedied swiftly. The invisible danger of carbon monoxide also presents a significant risk to safety.

Leaks of natural gas are particularly dangerous due to their increased risk of leading to fires or explosions. To combat this danger, gas service providers have adopted strategies to facilitate early detection of leaks. Given that methane, the main component of natural gas, lacks a natural odor, these companies introduce a distinctive "rotten-egg" smell by adding substances like mercaptan or similar sulfur-based compounds, making it easier for people to identify leaks.

However, this precaution may not be foolproof for those with impaired smell. Furthermore, there's the risk of leaks occurring unnoticed when no one is present to detect the added odor, raising the chances of explosive situations.

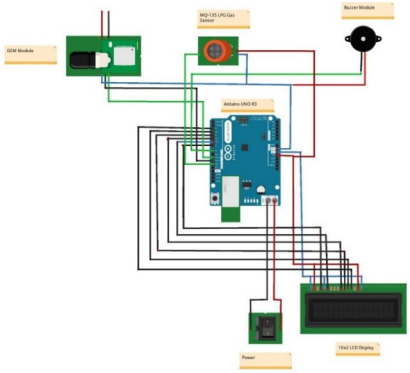

Fig. 2.1. Description

III. PROPOSED SYSTEM

The sensors are powered by microcontrollers or relays and LCDs and a buzzer. This voltage rule sector is accountable for converting alternate power to direct current as well as lowering the transmitted signal. The sensors can detect a gas leak. The sensor MQ-2 is working here to detect LPG levels in the air. The gasses on the scale between 200 and 10000 ppm maybe identify as well as the reaction time is completely speedy. The result of the sensors would be an analog power. A sequential communication circuit makes over the change from an analog resistor to voltage. The microcontroller report that voltage. This analog voltage is digitally converted using a 12-bit Analog to a digital converter. In the advanced system of a gas detection system, the implementation quells both the monitoring and detection of the gases which are very dangerous to the surrounding.

In the observation of the gas, the sensor which is used to hear many gases is MQ 2 sensor. After the detection of leakage in the gas, the sensor sends the signal to the Arduino UNO for further operation where other hardware components are connected. Through Arduino UNO, it sends the signal to the LCD for displaying the alert message as LPG Detected, suitably, the buzzer be on so that the backdrop people will the warn, as well as the main power supply, will be cut off. Using the relay of 5V, the power supply is given to the expend fan to detach the harmful gas from the surrounding. Even the container of the application will accept the message through the GSM module..

IV. BLOCK DIAGRAM

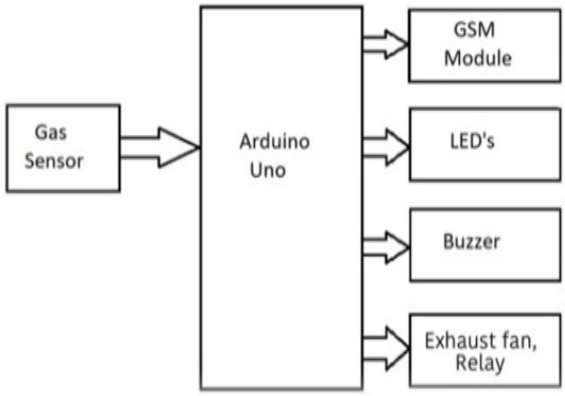

Fig 4.1. Block diagram Block diagram

V. CIRCUIT DIAGRAM

LPG gas sensor module's DO pin is directly connected to pin 12 of Arduino and Vcc and GND are connected to Vcc and GND of Arduino. LPG gas sensor module consist a MQ3 sensor which detects LPG gas. A comparator circuit is used for converting Analog output of MQ3 in digital. A 16x2 LCD is connected with Arduino in 4-bit mode. Control pin RS, RW and directly connected to Arduino pin 2, GND and 3. And data pin D0-D7 are connected to 4, 5, 6, 7 of Arduino. A buzzer is connected with Arduino pin number 8 through a NPN BC547 transistor having a 4.7 kilo ohm resistor at its base.

Fig.5.1 Circuit Diagram

VI. HARDWARE DESCRIPTION

6.1 *ARDUINO BOARD*

Ardunino board is an open-source physical computing platform based on a simple I/O board and development environment that implements the processing/wiring language. Arduino can be used for software on your computer (e.g. flash, processing, MaxMSP). The open-source IDE can be downloaded for free (currently for Mac OS X, Windows, and Linux). The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs, 16 analogs inputs, 4 UARTs (hardware serial ports), a 16 MHZ crystal oscillator, 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. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila. This controllers widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on.

Fig.6.1 Arduino Board

6.2 *POWER SUPPLY*

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU.

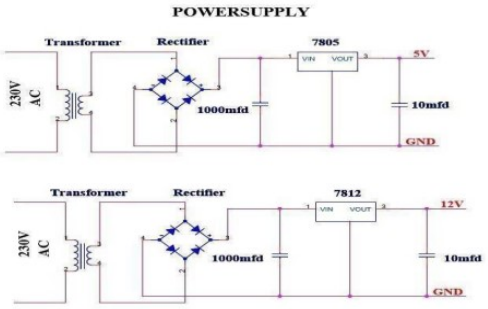

Fig.6.2 Power Supply

6.3 GSM MODEL

GSM stands for Global System for Mobile Communication. It is a digital cellular technology used for transmitting mobile voice and data services. GSM is a circuit-switched system that divides each 200 kHz channel into eight 25 kHz time-slots. GSM operates on the mobile communication bands 900 MHz and 1800 MHz GSM makes use of narrowband Time Division Multiple Access (TDMA) technique for transmitting signals. GSM was developed using digital technology. It has an ability to carry 64 kbps to 120 Mbps of data rates. Presently GSM supports more than one billion mobile subscribers. GSM digitizes and compresses data, then sends it down through a channel with two other streams of user data, each in its own timeslot.

Fig.6.3 GSM Model

6.4 *LCD DISPLAY*

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The

command register stores the command instructions given to the LCD.

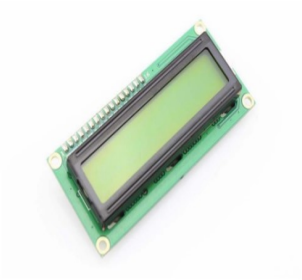

Fig 6.4 LCD Display

6.4 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 general lighting. LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness. When a light-emitting diode is 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 band gap of the semiconductor. An LED is often small System in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. However, LEDs powerful enough for room lighting are relatively expensive, and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

Light-emitting diodes are used in applications as diverse as aviation lighting, automotive lighting, advertising, general lighting, and traffic signals. Infrared LEDs also used in the remote-control units of many commercial products including televisions, DVD players and other domestic applications. LEDs are also used in seven-segment display.

6.5 12V TRANSFORMER 1 AMP

Most households run on 240-volt power. This is perfect for interior lighting that utilises high voltage lighting. Landscape lighting, however, is typically supplied in lower voltage (12 Volts) spread out through several different lights. Transformer can convert the 240v electrical currently supplied from your house down to the 12v needed for each low voltage.

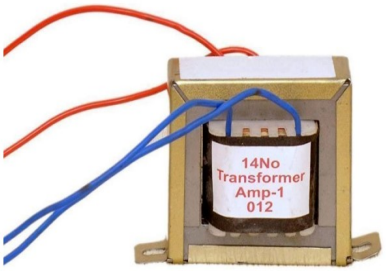

Fig 6.5 Transformer

6.6 FLOW CHART

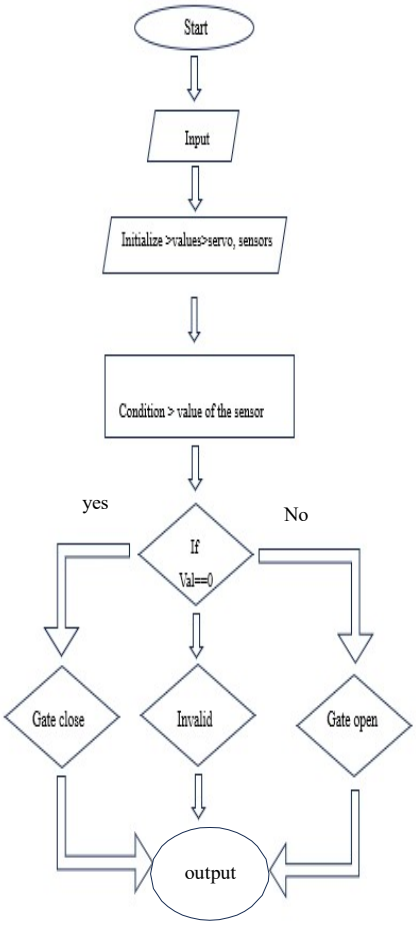

Fig.6.6. Flow Chart

7. *ADVANTAGES AND APPLICATIONS:*

The Arduino Uno-based LPG detection system provides a plethora of benefits and has wide-ranging uses. It alerts users to LPG leaks with remote notifications via SMS, significantly improving safety by quickly informing them of potential dangers. This system is incredibly flexible, suitable

for environments ranging from residential homes to industrial sites, offices, educational institution canteens, and eateries that utilize LPG cylinders. Adding a GPS modem enhances the system, enabling it to detect hazardous gases, prevent fire risks, and measure oxygen levels. With its high sensitivity and quick response, the sensor ensures that gas leaks are detected accurately and without delay. The system is also designed to be highly secure and tamper-resistant, offering consistent and efficient gas leak detection. Compared to traditional systems, it is more cost-effective over time, due to lower maintenance costs. Its portability and low power requirements make it ideal for additional applications, such as smoke detection. Homeowners, in particular, find it valuable for monitoring gas leaks when away, while it is indispensable in industrial settings for detecting flammable gases and monitoring oxygen levels. The system also supports firefighting by enabling early detection of fires, and it plays a crucial role in ensuring the safety and health of workers by promptly alerting them to gas leaks, thereby helping to avoid fire-related accidents.

8. *CONCLUSION*

This project presents a comprehensive gas leakage detection and prevention system. In addition to detecting LPG leaks, the system takes proactive measures to prevent further leakage in cases where the cause is accidental or intentional tampering with the cylinder head. Moreover, it promptly sends a short SMS alert to a predefined phone number via GSM infrastructure, notifying relevant individuals about the gas leakage incident. The results obtained from the tests conducted post-implementation demonstrate the effectiveness of this system. It is concluded that the developed system is well-suited for deployment in both residential homes and commercial establishments like restaurants. Its primary objective is to anticipate and mitigate the risks associated with LPG leakage, thereby averting potential disasters that could result from such incidents. Installation of the device involves simply placing it on or near the LPG cylinder head, ensuring convenient and straightforward implementation for users

9..FUTURE SCOPE

Enhancing the monitoring system by incorporating Bluetooth technology instead of GSM for alert messages introduces a new dimension of real-time applications. This adaptation not only streamlines communication between the system and the user within a Bluetooth range but also aligns with modern smart home technologies. For the industrial domain, leveraging the data collected via the mobile application becomes invaluable for data analytics purposes, allowing for more informed decision-making based on the analysis of gas leakage incidents, trends, and potential risk areas.

Integrating additional sensors, such as temperature and pressure sensors, transforms this system into a comprehensive home automation solution. This holistic approach enables a multifaceted monitoring environment, where variations in gas levels, temperature, and pressure can be tracked simultaneously, enhancing safety protocols.

The implementation of IoT technology further extends the capabilities of this system, transforming drones into mobile gas observation platforms. Such an innovation allows for the expansive and dynamic monitoring of large or inaccessible areas, providing real-time data on gas concentrations that could be critical for early detection of leaks or hazardous conditions.

A particularly novel enhancement would be the deployment of recurring receiver MODEMS across a geographical area, each equipped with duplicate SIM cards. This network of MODEMS would ensure robust coverage and redundancy, minimizing the risk of communication failures and ensuring that alerts and data are reliably transmitted to the necessary parties.

Adding a display to the system introduces an immediate visual component to the alerts, enabling users to quickly assess the situation at a glance. Moreover, incorporating audio outputs enhances the system's user-friendliness, providing audible alerts that can promptly capture the user's attention in case of a gas leak or another emergency.

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