International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

IoT Application for Gas Leakages Monitoring

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Abstract**—** *Gas leaks are a potential risk in homes and other areas that use gas, so monitoring equipment is needed to limit the risk of harm. This paper presents the design and construction of IoT-based gas leak detector and alarm. This is an intelligent device with a highly sensitive gas sensor and LCD display that displays the device's status as well as the gas value in the environment. The device is placed in a position where there is a possibility of gas leaks. If the device detects that gas exists in the environment beyond the limit, it will immediately turn on the light, warning the buzzer. At the same time, the device will automatically call the phone number to notify in time, in case the owner is not in the area where the gas leak occurs. Also, the device is connected to the Internet so the gas value in the environment will be posted to the internet for online monitoring. This project contributes to the application of IoT to life to help families feel more secure in the matter of using gas.*

Keywords**—** *Gas Leakage Monitoring, IoT, MQ-2, NodeMCU.*

I. INTRODUCTION

In today's modern life, gas is widely used, especially gas which is used very popularly from households, restaurants to businesses. The gas plays a really important role in life. Therefore, a situation poses that the use of gas is likely to leak. In the event that the user does not detect it in time, it is forced to inhale a significant amount of gas, affecting the health, even the worst case scenario is death if in a closed room. Besides, the possibility of fire is very high if gas is leaked in the space exposed to flammable substances or small sparks.

The Internet of Things (IoT) is an inter-network in which devices, vehicles, rooms, and other equipment are embedded with electronic components, software, sensors, and actuators. With network connectivity, these devices can collect and transmit data. More and more applications of IoT applications in monitoring household devices are being used [1].

There are many studies in the field of gas monitoring that have been carried out. Jolhe, B. D., et al. [2] proposed a gas leak system and automatically monitored the LPG level where the gas leak was. Liu, Z. Y. et al. [3] have implemented intelligent residential anti-theft alarm, emergency alarm when there is a toxic gas leak and control system based on IC89C51.

Kodali, R. K. et al. [4] conducted a gas detection project using sensors MQ6, MQ4, MQ135 and ESP-32 to warn gas leakages on the internet.

Suma, V. et al. [5] designed LPG gas detector with function of sending SMS, connecting to wifi, warning buzzer.

Spachos, P. et al. [6] designed a gas leak monitoring system to detect and locate gas leak points in real time.

The authors of Varma, A. et al. [7] have developed an Arduino-based gas detection system, which can detect toxic gas and alert the staff.

The authors Banik, A. et al. [8] implemented an LPG gas leak detection system, when the gas leaks, the device will send an alarm via SMS.

In this paper, the authors design and construct gas monitoring equipment with the following functions:

- Monitor gas level in the environment and display it on LCD.
- The device is connected to the Internet.
- If detecting gas leak, the device will alarm through light, buzzer.
- Alarm of danger of gas leak via SMS and phone call to pre-set phone number.
- This automatic gas detection application makes it safer to use gas in the household as well as in some areas that need fire control.

II. GAS LEAKAGE DETECTION AND MONITORING SYSTEM

The gas detection system includes the components described in Fig. 1. The components used in the device include Arduino Mega 2560, sensor MQ-2, Module SIM800L, Module ESP8266 NodeMCU, Module LM2596, LCD 16x2, Buzzer 5V is listed as table 1.

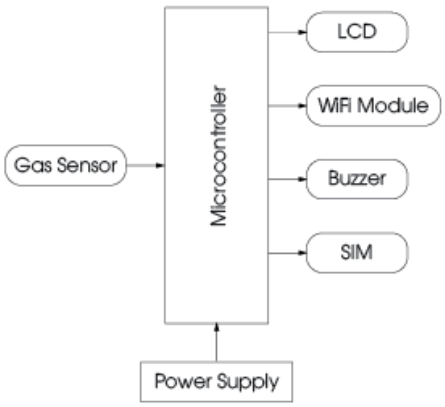

Fig. 1. System block diagram

Function blocks:

- Central processing unit: Processing signals received from sensors and transmitting alarm signals to alarm devices.
- Power block: Provides the operational source to the system.
- Gas sensor block: Measure the level of gas and send it to Arduino for processing.
- LCD display unit: Displays measured gas level and safe or dangerous state.
- Spot alarm block: Emits local alarms such as horns, warning lights when the sensor in the system detects danger.

Ba Thanh Nguyen and Anh Vu Nguyen, "IoT Application for Gas Leakages Monitoring," *International Research Journal of Advanced Engineering and Science*, Volume 5, Issue 4, pp. 51-53, 2020.

- SIM alarm block: call the phone number set before detecting a gas leak beyond the allowed limit.
- Sending data to the Web: Collect sensor data and post it on the Web for easy online monitoring.

TABLE 1. List of components

No.	Items
1	MQ-2 Gas Sensor
2	Arduino Mega 2560 R3
3	Module ESP8266 NodeMCU
4	Module SIM800L GSM GPRS
5	Module DC LM2596
6	LCD 16x2, I2C
7	LED
8	Buzzer 5V

III. SYSTEM OPERATION

The system is designed and simulated on Proteus software as shown in Fig. 2 and the operating procedure is shown in Fig. 3.

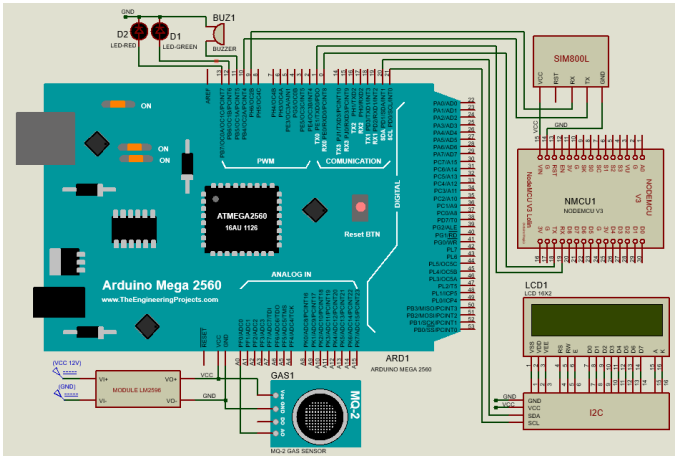

Fig 2. Diagram of the System in Proteus Software

When powering the device, the initial values and the script are initialized to help communicate between the modules. Then turn on the indicator light, sensor value is updated and converted to percentage displayed on the 2nd line of LCD and display “Gas Scan is ON” on the first line of LCD.

The gas sensor value is then posted on Thingspeak [9] web which can be viewed on an online chart and the data is stored here.

If the gas level value is more than 20%, turn on red light, buzzer and display "Gas is Detected !!!" on the 1st of the LCD, simultaneously displays “Call, sent SMS” on the 2nd line of the LCD. Then the device calls and sends a text message to the pre-set phone number that says “Warring: Gas is Detected. Dangerous area !!! ”.

If the value of gas level is less than or equal to 20%, turn off the red light and buzzer, display “Safe Area” on the LCD.

IV. EXPERIMENTAL RESULTS

A. *The System Operates in a Normal State*

When there is no gas leak, the sensor continuously updates its value and compares it with the danger level and displays the value on the screen. Also displays notification of no gas leaks and safe area. Data will be posted to thingspeak.com every 15 seconds below 20%.

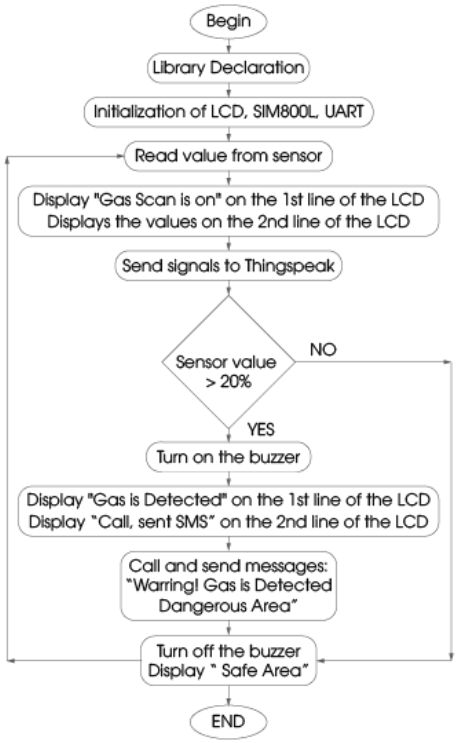

Fig. 3. Flow diagram of the gas leakages monitoring system

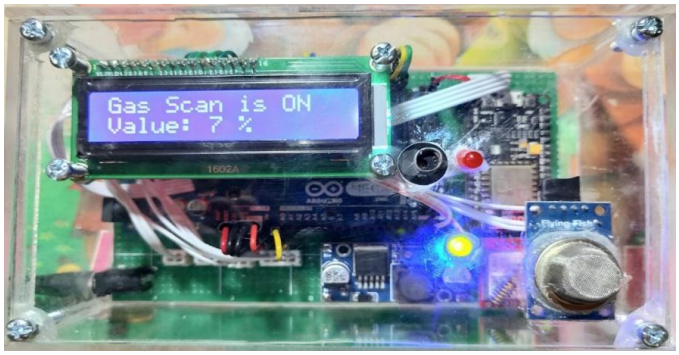

Fig 4. The system works in normal mode

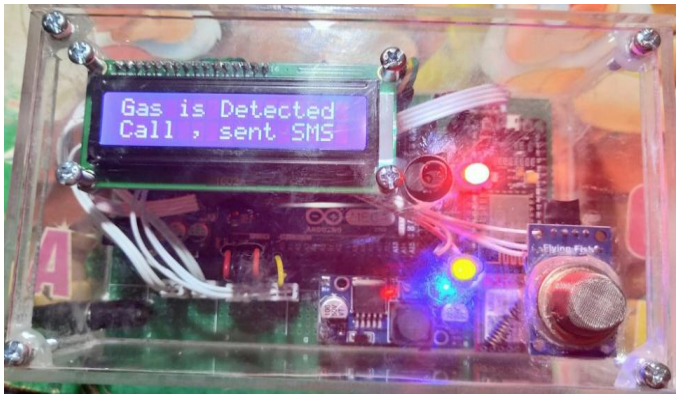

Fig. 5. The system works in gas leakge mode

B. *The System Operates in a State of Gas Leakage*

In the event of a gas leak to the environment, the sensor will

Ba Thanh Nguyen and Anh Vu Nguyen, “IoT Application for Gas Leakages Monitoring,” *International Research Journal of Advanced Engineering and Science*, Volume 5, Issue 4, pp. 51-53, 2020.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

detect a comparison with the safety level of 20% (Fig. 5). If the sensor value exceeds the threshold of 20%, the device will issue a spot warning such as lights, buzzer and make a call and text message to pre-installed subscribers to promptly report the leak situation to fix the problem (Fig. 6). Data posted to thingspeak.com will draw lines above the 20% threshold (Fig. 7).

Fig. 6. Warning of gas leak via the phone

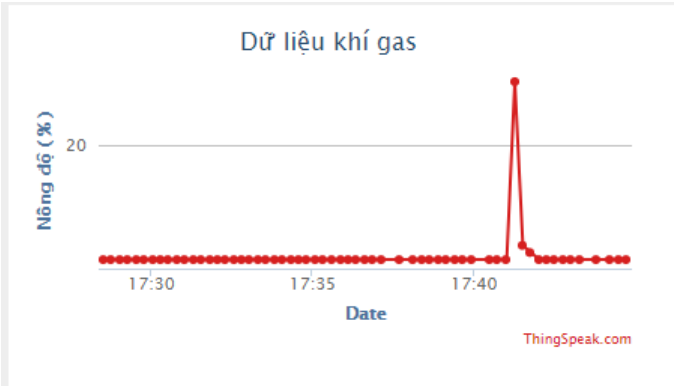

Fig. 7. Gas level monitoring on ThingSpeak

V. CONCLUSION

Internet of Things has been used a lot in recent years, with many useful applications for human life. One of the areas of application is in gas leak detection. The gas is used in many households, however it is very flammable. In this paper, an intelligent gas leak monitoring system based on IoT is implemented. The device is capable of detecting gas leaks and displaying the status on the LCD screen, alarming sirens, sending alerts via phone and Thinkspeak. This system consists of main components: gas sensor MQ-2, Arduino Mega 2560 central processor connected to the internet via ESP8266 Module, SIM800L Module. The system helps detect and warn to prevent possible accidents. This project contributes to the development of smart home applications and helps people to be safer in using gas.

ACKNOWLEDGMENT

The authors appreciate the support from Thu Dau Mot University in Vietnam.

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