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# Web-Based Room Fire Protection Datalog Monitoring Due to Liquefied Petroleum Gas (LPG) Leaks

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## Article Info

### Article history:

Received December 19<sup>th</sup>,  
2024

Revised February 20<sup>th</sup>, 2025

Accepted March 01<sup>th</sup>, 2025

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### Keyword:

MQ2 Sensor

NodeMCU ESP8266

PHP MySQL

Relay

Light Extinguisher (APAR)

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## ABSTRACT

The use of LPG gas is increasingly being utilized by the Indonesian people after the conversion of kerosene to LPG. The use of LPG is more effective, efficient, and easier than that of kerosene. Although LPG gas is more practical to use than kerosene, it still has disadvantages, namely the dangers that can be caused by LPG gas if there is a gas leak. This danger can cause an explosion to a fire that can endanger the surrounding community. Based on these dangers, a tool is needed that can detect leaks and warning signs of leaks and is equipped with initial handling to avoid explosions in the room. This study designs a system to inform residents of houses/companies and reduce the concentration of LPG gas in the room to minimize explosions. This study uses NodeMCU ESP8266, with MQ2 sensor input and relay output for exhaust fans and alarm bells. Based on the results of this system test, the MQ2 sensor captures the concentration of gas leaks in the room, and the device sends data from the NodeMCU ESP8266 to the PHP MySQL database, which controls the exhaust fan to remove gas in the room and the alarm bell as a signal to the occupants of the house if there is a gas leak, and the gas concentration value is recorded by the database for display on the web. For fire protection, there is already a light extinguisher (APAR), namely a fire extinguisher ball.

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DOI: <https://doi.org/10.30736/ihees.v1i01.870>

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## I. Introduction

Liquefied petroleum gas (LPG), also known as LPG, is a processed gas compound that has become one of the main energy sources used by the public for household and commercial purposes [1]. Pertamina LPG, branded as ELPIJI, is produced from oil refineries (fuel refineries) and gas plants, with its main components being propane (C<sub>3</sub>H<sub>8</sub>) and butane (C<sub>4</sub>H<sub>10</sub>), which make up approximately 99%, while the remainder consists of liquefied pentane gas (C<sub>5</sub>H<sub>12</sub>). ELPIJI is heavier than air, with a specific gravity of approximately 2.01 (compared to air), and the vapor pressure of liquid Elpiji in cylinders is approximately 5.0 – 6.2 kg/cm<sup>2</sup>. The

component ratio is propane (C<sub>3</sub>H<sub>8</sub>): butane (C<sub>4</sub>H<sub>10</sub>) = 30:70. The calorific value is + 21,000 BTU/lb. Mercaptan is usually added to LPG to give it a distinctive odor; this allows quick detection of gas leaks. Pertamina LPG is marketed in cylinder packaging (3 kg, 6 kg, 12 kg, 50 kg) and in bulk [1]. Currently, many people use LPG (liquefied petroleum gas) stoves because they consider LPG gas easier to use than kerosene. Although LPG is more practical to use than kerosene, it still has the drawback of posing hazards if there is a gas leak. Such hazards can lead to explosions and fires that may endanger the surrounding community. Given these dangers, there is a need for a device that can detect leaks, provide a warning sign if a leak occurs, and include initial countermeasures to prevent explosions in the area. To create a system that operates automatically, a microcontroller is needed to control the device. This system was designed using an LPG gas sensor that functions to detect gas leaks early on gas stove equipment [2]. The system is specifically designed to alert house/office occupants and reduce the concentration of LPG gas in the room, thus minimizing the risk of explosion inside the premises.

## II. Research Methods

### Research Stages

In the research method process, there are several stages that must be undertaken. These research stages include the following: (a) literature study, (b) design stage, (c) system integration, and (d) system testing and analysis stage.

### Block diagram of the circuit

Overall, the functional blocks of the system are shown in Figure 1.

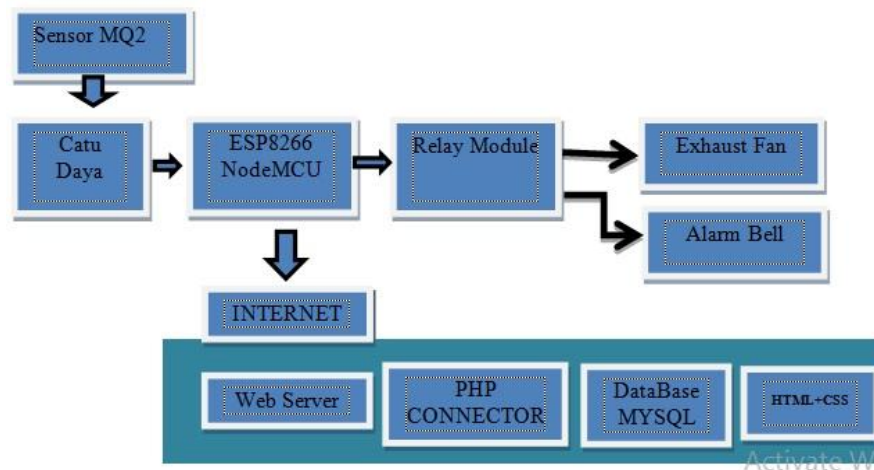


Table 1. Block function

Power Supply Block	Sebagai Sumber Tegangan
ESP8266 Sensor Block	As a controller and converter of analog sensor data to digital
MQ-2 Sensor Block	Reading the concentration of LPG gas
Relay Module Block	Turning on the alarm and blower fan
WebServer Block	As a service that receives requests from HTTP or HTTPS on known clients—commonly referred to as web browsers—and sends back the results in the form of web pages
Internet Block	As an internet or Wi-Fi access service on the server

### How the System Works

The MQ-2 sensor measured the concentration of LPG gas, and the value from the sensor was converted by the NodeMCU from analog to digital data. After conversion, the NodeMCU checked the value; if the sensor reading fell within the specified range, the NodeMCU sent the data to the web server database and activated the relay module to turn on the fan blower and alarm.

### Hardware System Series

The following is a series of hardware components that will be created as an overview of the system to be developed:

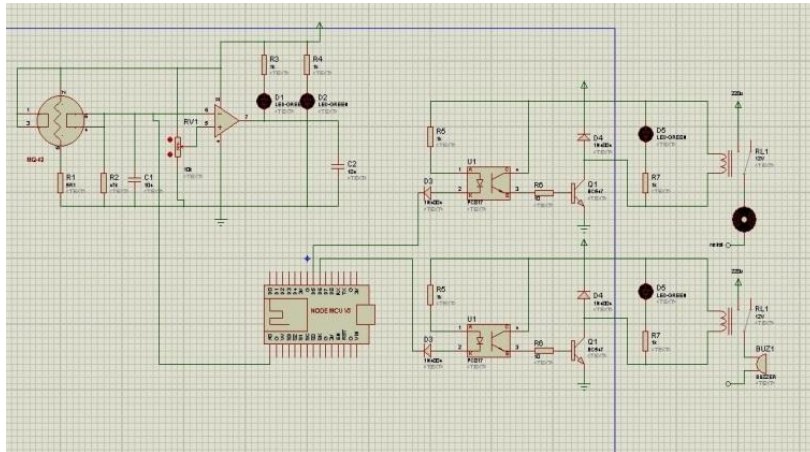


Figure 2. System Hardware Circuit

### Web Server Software Suite

In the system to be studied, there is a series of software that will be presented on a web server; the web server can use Chrome or Firefox.

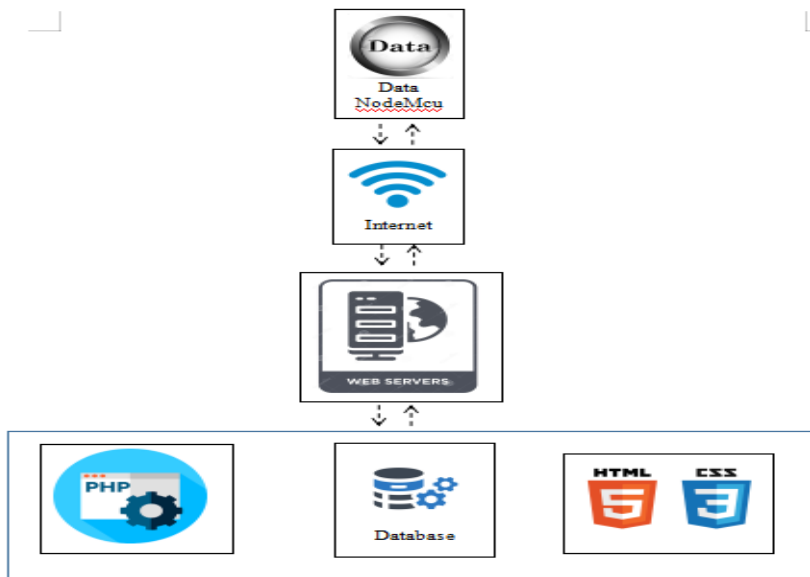


Figure 3. Web Server Circuit

### Fire Protection

The Light Fire Extinguisher (APAR) used to handle fires employs a Fire Ball extinguisher, which, in its application, will explode when it comes into direct contact with fire. This fire ball extinguisher contains dry chemical powder.



Figure 4. *Fire Ball extinguisher AFO*

### III. Results and Discussion

The results and discussion carried out by the author aim to identify the stages involved in the process of analyzing and experimenting with the sensor, methods of data transmission, techniques for sending gas data to the cloud database system, and the interface method using HTML combined with PHP language within the website. The testing stages conducted are as follows: (a) sensor testing, (b) relay circuit testing, (c) database and program file creation, (d) database testing, (e) interface testing, and (f) analysis of test result data.

#### Testing of the Entire Device Circuit

Before conducting the test, ensure that there are no sources of fire or electronic devices containing electrical induction to minimize the risk of explosions during the LPG gas leak test.



Figure 5. *Gas Sensor Sensitivity Test*

Based on the results of sensitivity testing of the gas sensor using height or position tests of the sensor relative to the gas leak source. The following table presents the results of the LPG gas sensor test.

Table 2. MQ-2 Sensor Test Table

Experiment	Sensor distance (CM)	Alarm responding(Sec)
1	2	1
2	4	1
3	6	2
4	8	2
5	10	4
6	12	4
7	14	4
8	16	7
9	18	8
10	20	9

Table 3. LPG Level Log Data

ID	Date	GAS	ALARM
1	2024-06-04 12:57:09	190	ON
2	2024-06-04 12:58:22	190	OFF
3	2024-06-04 13:25:01	600	ON
4	2024-06-04 13:25:27	500	OFF
5	2024-06-05 12:18:39	746	ON
6	2024-06-05 12:19:14	718	ON
7	2024-06-05 12:19:25	1024	ON
8	2024-06-05 12:19:35	1024	ON
9	2024-06-05 12:20:26	1024	ON
10	2024-06-05 12:20:57	1024	ON
11	2024-06-05 12:21:25	618	ON
12	2024-06-05 12:22:58	867	ON
13	2024-06-05 12:25:31	1024	ON
14	2024-06-05 12:25:49	906	ON
15	2024-06-05 12:26:46	787	ON
16	2024-06-05 12:29:30	691	ON
17	2024-06-05 12:29:51	759	ON
18	2024-06-05 12:30:34	798	ON
19	2024-06-10 11:48:54	1021	ON
20	2024-06-10 11:49:12	729	ON
21	2024-06-10 11:49:30	925	ON
22	2024-06-10 11:49:56	814	ON
23	2024-06-11 11:59:02	190	On
24	2024-06-11 15:27:55	860	ON
25	2024-06-11 15:28:07	796	ON
26	2024-06-11 20:59:18	681	ON
27	2024-06-11 21:08:39	868	ON
28	2024-07-05 06:13:52	660	ON
29	2024-07-05 15:11:48	883	ON
30	2024-07-05 15:16:12	661	ON
31	2024-07-05 15:24:13	897	ON
32	2024-07-07 19:37:10	693	ON
33	2024-07-07 19:37:34	857	ON

From the results of the experiment above, it can be seen that in the first experiment, when a gas stove was leaked and the distance between the sensor and the edge of the stove was 2 cm, the alarm sounded immediately within 1 s. In the tenth or final experiment, with the distance between the sensor and the edge of the stove at 20 cm, the alarm only went off after 9 s when the gas was leaked. Below is an example of a table that can be downloaded from the database: Database: id20558166\_gasku23, Table: datagas, Purpose: Deleting data.

The table above shows the LPG concentration log data during a gas leak, with the latest test conducted on July 7, 2023, resulting in a gas value of 857. At that time, the alarm bell and exhaust fan were activated for 8 s and sounded twice; therefore, the interval for each device to detect gas was 16 s.

#### IV. Conclusion

This device uses an NodeMCU ESP8266 with an MQ2 sensor as the input and a relay for the exhaust fan and alarm bell. It employs a 15 × 15 × 45 cm acrylic enclosure for air release in enclosed spaces. The database is hosted on <https://000webhost.com/>, with parameters: ID, Date, Gas, and Alarm. An API connects the NodeMCU ESP8266 to the web server. Interface testing is done via <https://monitoringgasku23.000webhostapp.com/app/index.html>. When the MQ2 sensor detected gas, the NodeMCU ESP8266 activated the exhaust fan and alarm. The website <https://monitoringgasku23.000webhostapp.com/app/index.html> shows data like DATE TIME, Gas Value, and Sensor Status, allowing remote gas concentration monitoring. Data is recorded and downloadable from <https://000webhost.com/>. Fire safety included an APAR Fireball.

#### V. Acknowledgement

The author thanks God Almighty, his parents, and the Faculty of Science and Technology at the Universitas Islam Lamongan.

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