

LPG Gas Leakage System with Instant Messaging Whatsapp Communication Media Based on Internet of Things

Kuswindarini^{1,*} Rendy Munadi¹ Sussi¹

¹Bachelor in Telecommunication Engineering, School of Electrical Engineering, Telkom University, Indonesia

*Corresponding author. Email: kuswindarini@student.telkomuniversity.ac.id

ABSTRACT

The rise of fires caused by gas leakage, Liquefied Petroleum Gas (LPG) often occurs in the community and can cause material damage, as well as fatalities, in general, gas leaks occur due to problems with the regulator. Therefore we need an LPG leak control system that can provide information on LPG that can be accessed anywhere by using the IoT. In this project, an LPG controller system is designed using the IoT MQ-6 gas sensor based on the HTTP protocol using an internet connection. Sensor data obtained will be processed on Wemos D1 ESP8266. Then Wemos D1 ESP8266 will give instructions to the motor driver as the driver to be allowed and instruct the regulator on the automatic gas cylinder. This system is designed to allow LPG leakage and the presence of hotspots using Buzzers, LED lights, and messages that support the LCD screen. The warning is forwarded to the user via Whatsapp instant messaging communication media in the form of chat notifications. The test results show that the LPG leak control system can work well. And users have managed to get information through chat notifications from the Whatsapp messenger application. From the testing and analysis of the detection distance of the MQ-6 sensor, the greater the source of the gas leak with the MQ-6 sensor, the lower the level of gas leakage is read. The highest average end to end delay in sending Wemos to the Whatsapp application is 1.475 s. The biggest throughput is 242.554 bps. Value of availability and reliability are 96.60% and 96.71% repetitively by the pre-determined scenarios.

Keywords: Internet of Things, LPG Leaks, MQ-6, Wemos D1 ESP8266, Fuzzy Logic, Instant Messaging.

1. INTRODUCTION

Fires caused by leakage of Liquefied Petroleum Gas (LPG) gas cylinders often occur in the community [1]. But sometimes leaks occur when no one is at home. If that happens, the gas will spread widely, this is very risky and an explosion will occur anytime [2]. Based on the Data Center for Public Policy Studies (PUSKEPI) shows, up to 2010 in Indonesia, there have been 189 LPG fires. The National Standardization Agency (BSN) states that research shows that LPG fires that often occur lately are not caused by problematic tubes, but because of regulators [3].

Based on these considerations, to minimize the presence of leakage due to LPG, technology is needed to build a system that can provide information on LPG leakage and early response using IoT technology. IoT is a technology of machine to machine communication, or object to

machine through the internet network [4]. IoT technology can provide convenience in everyday life such as the application of IoT on the smart home such as

smart light which allows to facilitate and activate lights through applications on smartphones [5].

In this journal, the author realizes the need to develop a tool that can detect LPG leaks, control leakage and notifications via Whatsapp instant messaging to make it easy for users to provide information on LPG leaks. In Whatsapp instant messaging, the user gets information in the form of notification regarding his gas leak with safe, alert and hazard parameters. And when it reaches the danger parameter, the regulator valve will open automatically and will lock again in a safe condition.

This system uses Wemos to process MQ-6 sensor values. The motor driver acts as a drive to open and lock the regulator on the gas cylinder automatically. This system is designed to give LPG leak warnings using Buzzer, LED, and gas ppm displayed on the

LCD screen. The warning is forwarded to the user through Whatsapp instant messaging communication media in the form of chat notifications.

Testing in this study includes system implementation, simulation testing based on test scenarios, and functional testing of tools as a whole. The testing parameters used in this study are divided into 3 parts, the first parameter is to see the performance capability of the MQ-6 sensor related to distance accuracy, the second parameter is to analyze the delivery system using HTTP including delay and throughput at each distance, and the third parameter is the testing and analysis of Reliability and Availability.

2. BASIC THEORY

2.1 MQ-6 Sensor

The MQ-6 gas sensor is a gas sensor used to detect propane, butane, and liquefied petroleum gas (LPG) gas. The MQ-6 gas sensor can detect gas concentrations anywhere from 200 to 10.000 ppm. MQ-6 sensor requires a Direct Current (DC) voltage of 5 Volts and has high sensitivity and fast response time [6].



Figure 1 MQ-6 Sensor [6].

2.2 Liquefied Petroleum Gas (LPG)

Liquefied Petroleum Gas (LPG) is a mixture of hydrocarbon gas derived from natural gas. LPG consists of Propane (C₃H₈) and or Butane (C₄H₁₀). LPG has a lower energy density than gasoline or fuel oil [7].

Liquefied Petroleum Gas (LPG) is flammable or flammable. Within the limits of flammability, LPG is an open-source of fire so that the slightest spark can quickly strike Liquefied Petroleum Gas (LPG). LPG users need to know and be trained in how to use LPG properly to anticipate explosions, fires, health problems to death [8].



Figure 2 Liquefied Petroleum Gas (LPG) [9].

2.3 Wemos D1 ESP 8266

Wemos D1 ESP8266 is a WiFi-based ESP8266 board module that uses an Arduino layout with an operating voltage of 3.3V. Wemos D1 Esp8266 has a 32-bit processor flash memory capacity and consists of 11

digital Input / Output pins and 1 analog pin (input). This board utilizes Wi-Fi communication for hardware control via a microcontroller and can be programmed using the Arduino IDE [10].



Figure 3 Wemos D1 ESP8266 [10].

2.4 Motor Driver L298N

The L298 N motor driver is an L298 dual H-bridge IC-based motor driver. This motor driver serves to adjust the direction or speed of the DC motor. The advantage of this module lies in its excellent precision so that the motor will be easier to control. IC L298 is an H-bridge type IC that is able to control inductive loads such as relays, solenoids, DC motors and stepper motors [11].

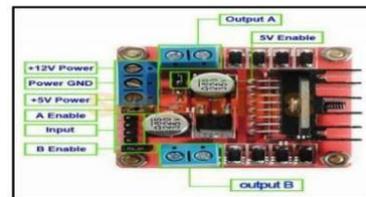


Figure 4 Motor Driver L298N [11].

2.5 Light Emitting Diode

Light Emitting Diode is an electronic component made from semiconductors that can emit light when given a voltage. The light produced is a form of electroluminescence the process of conversion from electrical energy into electromagnetic radiation. The results of white light are produced into a mixture of different colored light, such as red, green, and blue (RGB). Light Emitting Diode has two poles, namely the negative pole (N) and the positive pole (P). Light Emitting Diode will emit light if the voltage (Forward Bias) of about 1.8V-3V flows from the anode to the cathode [12].



Figure 5 Light Emitting Diode [12].

2.6 Liquid Crystal Display

Liquid Crystal Display is a flat panel display or an electronically modulated optical device using the modulation properties of liquid crystal light. Liquid crystals do not emit light directly, but instead, use backlights or reflectors to produce color or monochrome images. Liquid Crystal Display has two registers namely Command and Data. Liquid Crystal Display command instructions will be saved in the command register. These command instructions are to perform tasks such as initializing and cleaning the screen. And the data register function is to store data that will be displayed on the Liquid Crystal Display [13].



Figure 6 Liquid Crystal Display [13].

2.7 Twilio

Twilio is a cloud communication platform. Twilio cloud services include Cloud Communications Platform Services (Cpaas). Twilio allows applications to integrate or enhance communication functions, such as telephone calls, SMS, chat, MMS, video services, and conferencing programs [14].

2.8 Whatsapp Messenger

Whatsapp messenger is an instant messaging application through the internet to communicate with each other in sharing files, text, sound, video, or location. The Whatsapp messenger application uses the user's mobile phone number. The security of the Whatsapp messenger application uses end-to-end encryption. Where the entire Whatsapp messenger user data is given security so that it can only be read by the sender and recipient of the message [15].

2.9 Internet of Things

Internet of Things (IoT) is a network infrastructure that has the ability to combine communication between physical and visual objects [16]. The network of physical objects is embedded with electronics, software, sensors, and network connectivity, making it possible to collect and exchange data. The data collected is analyzed to take specific actions based on the services needed [17].

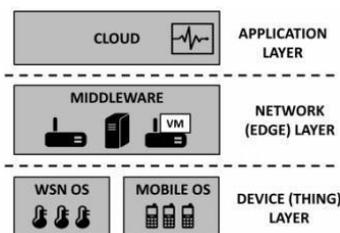


Figure 7 The IoT architecture layer [18].

The application layer includes all infrastructure and devices used in the industry related to the IoT-based monitoring process. Applications in this layer will provide information processing, computing and data integration [18]. The network layer is responsible for receiving useful information in the form of digital signals from the Device Layer and transferred through transmission media such as WiFi, Bluetooth, WiMax, Zigbee, GSM, 3G with protocols such as IPv4, IPv6[6]. The device layer (device layer) consists of data sensors such as RFID labels, or other sensor networks that can sense temperature, humidity, speed and location of objects. The device layer is responsible for gathering information useful from the device sensors objects that are connected with them and converting information into digital signals which are then forwarded to the network layer for further action.

3. METHODOLOGY

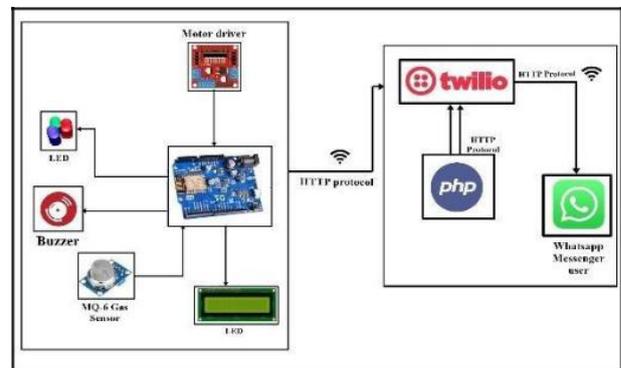


Figure 8 The Design System of LPG Gas Leakage System.

Figure 8 shows the block diagram of the LPG leak control system using Whatsapp instant messaging. LPG data leak detected by the MQ-6 gas sensor will be processed on the Wemos D1 microcontroller ESP8266 to be sent to the Twilio server. Then the server will send a notification of LPG leak to Whatsapp users. This system is equipped with dangerous LPG leak warnings in the form of buzzers, LED lights, and messages that are displayed on the LCD screen, to remind the closest people who are at the location. And when an LPG leak is detected in the danger parameter, the motor driver will automatically unlock the gas regulator. After LPG data leakage is obtained and processed in Wemos D1 will then be processed to Twilio server to be sent and processed all requests sent by Wemos is connected to Whatsapp Messenger to send notifications for LPG leakage.

The gearbox will adjust the speed of movement and rotate the spindle according to clockwise or vice versa. When in dangerous condition the gearbox will open the regulator lock, when it returns to safe condition the lock will automatically return to the lock position or closed.

4. RESULT & ANALYSIS

Base on the result of experiments the MQ-6 sensor can detect LPG leaks of a distance of 5 cm to 40 cm. The farther away from the source of the gas leak with the MQ-6 sensor, the lower the level of gas reserves read. Conversely, the closer the gas source is to the MQ-6 sensor, the higher the level of gas read by the sensor. Related to the placement of the MQ-6 sensor it should not be too far away, because if the distance is too far the oxygen level sensor is lower properly.

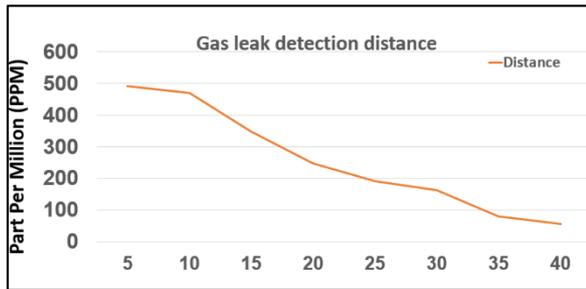


Figure 9 Gas leak detection distance.

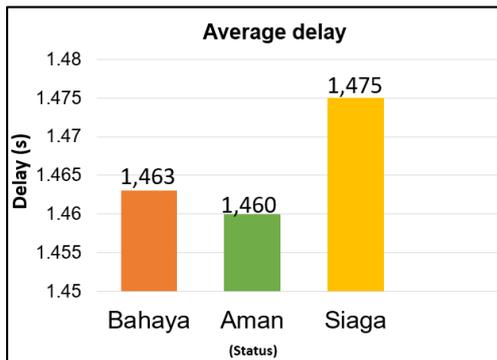


Figure 10 Average delay.

Measurement of the overall delay in the monitoring tool is done by calculating the length of time the data takes from origin to destination.

Based on the calculating in Figure 10 is the average delay graph, the largest delay is 1.475 s, and the smallest delay is 1.460 s. Based on the TIPHON standard, the delay in the results can be categorized as poor [19].

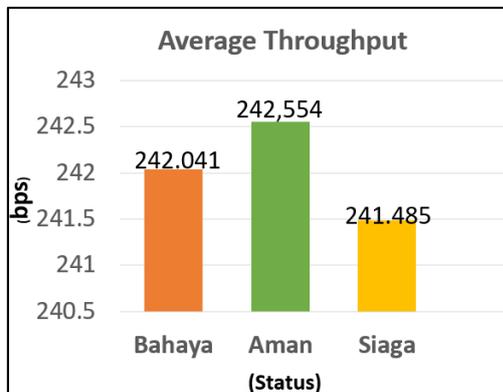


Figure 10 Average throughput.

Based on the graph above throughput is the number of bytes that can be sent at a certain time. Based on this test, the highest average throughput is 242.554 bps.

Wireshark application is used in checking throughput by filtering IP Wemos ESP8266 which is 69.171.250.60 with the destination is Whatsapp Messenger which has IP 52.2.53.80. Based on the TIPHON standard, the value of throughput obtained is categorized as good [20]. In measuring availability and reliability, the writer sends information from Wemos to Whatsapp messenger application where the test is carried out by sending messages 65 times with random time. In the Availability and reliability test shows that the reliability of the system when working with the availability value of 96.71% and reliability of 96.60%.

5. CONCLUSIONS

1. Design and Implementation of the IoT technology LPG leak control system by preparing the needs of the device used both the right software and hardware to be implemented. Next with the implementation of the system and ascertain whether the system can work with testing and analysis.
2. The workings of the LPG leak detection system begin with data retrieval via the MQ-6 sensor with safe, standby and hazard parameters. After the LPG leak data is obtained and processed on Wemos D1 it will then be processed to the Twilio server to accommodate and process all requests sent by Wemos that are connected to Whatsapp Messenger to send notification of LPG leakage to the user.
3. In testing and analysis of the distance measurement sensor MQ-6 shows that the farther the source of leakage with the sensor MQ-6, the lower the level of gas leak read. Sothe MQ-6 sensor placement cannot be too far from the LPG gas source.
4. Quality of Service test results have an average delay on the delivery of the gas ppm value untilthe notification application Whatsapp messenger reaches the largest average delay which reaches 1.475 s, and the smallest delay is 1.460 s. And the average throughput on Wemos communication - the largest Whatsapp messenger application reaches 242.554 bps. In testing the sending of data from Wemos to Whatsapp messenger application, the value of Reliability is 96.71% and Availability is 96.60% from the predetermined scenarios.

REFERENCES

[1] L. Dewi and Y. Somantri, "Wireless Sensor Network on LPG Gas Leak Detection and Automatic Gas Regulator System Using Arduino," IOP Conf. Ser. Mater. Sci. Eng., vol. 384, no. 1, 2018.

- [2] R. Amorin, E. Broni-Bediako, D. Worlanyo, and S. A. Konadu, "The Use of Liquefied Petroleum Gas (LPG) as a Fuel for Commercial Vehicles in Ghana: A Case Study at Tema Community 1," *Curr. J. Appl. Sci. Technol.*, vol. 29, no. 2, pp. 1–8, 2018.
- [3] E. Fatkiyah, D. Persada, and D. Andayati, "Early Detection of Leaks on Gas Cylinders Using Arduino Based MQ-6 Sensors," *J. Phys. Conf. Ser.*, vol. 1413, no. 1, 2019.
- [4] M. Bayani, K. Leiton, and M. Loaiza, "Internet of Things (IoT) Advantages on E-learning in the Smart Cities," *Int. J. Dev. Res.*, vol. 7, no. 12, pp. 17747–17753, 2017.
- [5] C. Gomez, S. Chessa, A. Fleury, G. Roussos, and D. Preuveneers, "Internet of Things for enabling smart environments: A technology-centric perspective," *J. Ambient Intell. Smart Environ.*, vol. 11, no. 1, pp. 23–43, 2019.
- [6] Rashmi, "IoT (Internet of Things) Concept and Improved Layered Architecture," *Int. J. Eng. Dev. Res.*, vol. 6, no. 2, pp. 481–484, 2018.
- [7] M. Sourove, S. Momin, M. Dutta, M. Sahid Hassan, M. Golam Kader, and S. Md Iftakher, "Study of LPG (Liquefied Petroleum Gas) And CNG (Compressed Natural Gas) Vehicles And It's Future Aspects," no. February 2019, pp. 0–6, 2016.
- [8] R. Amorin, E. Broni-Bediako, D. Worlanyo, and S. A. Konadu, "The Use of Liquefied Petroleum Gas (LPG) as a Fuel for Commercial Vehicles in Ghana: A Case Study at Tema Community 1," *Curr. J. Appl. Sci. Technol.*, vol. 29, no. 2, pp. 1–8, 2018.
- [9] M. Paczuski, M. Marchwiany, R. Pulawski, A. Pankowski, K. Kurpiel, and M. Przedlacki, "Liquefied Petroleum Gas (LPG) as a Fuel for Internal Combustion Engines," *Altern. Fuels, Tech. Environ. Cond.*, vol. 13, no. February 2017, 2016.
- [10] V. Mithya, N. Divya Prabha, S. Sisma Samlein, and M. Madhumitha, "Smart toilets using turbidity sensor," *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, no. 5s, pp. 413–417, 2019.
- [11] Kyaw Zin Latt | Than Htike Aung | Zaw Min Min Htun, "PC Based DC Motor Speed Control using PID for Laboratory," *Int. J. Trend Sci. Res. Dev. Int. J. Trend Sci. Res. Dev.*, vol. 3, no. 5, pp. 2398–2400, 2019.
- [12] Y. Oktarina, M. Nawawi, and W. G. Tulak, "Analysis of The Sensor Line on Line Follower Robot as an Alternative Transport The Tub Trash in The Shopping Center," *VOLT J. Ilm. Pendidik. Tek. Elektro*, vol. 2, no. 2, p. 101, 2017.
- [13] M. Vora, S. Rajan, H. Lotekar, N. Kheratkar, P. Thingalaya, and D. Dave, "IOT and RFID based Shopping mall," pp. 7711–7714, 2019.
- [14] C. Y. Chang, C. H. Kuo, J. C. Chen, and T. C. Wang, "Design and implementation of an IoT access point for smart home," *Appl. Sci.*, vol. 5, no. 4, pp. 1882–1903, 2015.
- [15] S. F. E. S. A. Fattah, "The Effectiveness of Using WhatsApp Messenger as One of Mobile Learning Techniques to Develop Students' Writing Skills," *J. Educ. Pract.*, vol. 6, no. 32, pp. 115–127, 2015.
- [16] A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols, 6 and Applications," *IEEE Commun. Surv. Tutorials*, vol. 17, no. 4, pp. 2347–2376, 2015.
- [17] A. Pandey, A. Azhar, A. Gautam, and M. Tiwari, "IOT Based Home Automation Using Arduino and ESP8266," *Int. J. Comput. Sci. Eng.*, vol. 6, no. 4, pp. 267–270, 2018.
- [18] M. Agent, W. F. For, T. H. E. Internet, and O. F. Things, "Resourceoriented mobile agent and software framework for the Internet of Things," no. March, 2018.
- [19] M. I. Kurniawan, U. Sunarya, and R. Tulloh, "Internet of Things: Home Security Systems based on Raspberry Pi and Telegram Messenger," *ELKOMIKA J. Tek. Energi Tek. Telekomun. Tek. Elektron.*, vol. 6, no. 1, p. 1, 2018.
- [20] R. Ratnasih, D. Perdana, and Y. G. Bisono, "Performance Analysis and Automatic Prototype Aquaponic of System Design Based on Internet of Things (IoT) using MQTT Protocol," *J. Infotel*, vol. 10, no. 3, p. 130, 2018.