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Internet of Things-based gas leak detection with Alerts Via SMS and Blynk App

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Abstract: Gas cylinders are one of the needs that humans use every day. The use of gas cylinders is often used for cooking, both for household needs and industrial needs. Gas leaks are a big problem that can give rise to explosions and fires due to combustible gas. Explosions and fires that occur as a result of this gas leak can cause a lot of losses. This study aims to build an Internet of Things-based gas leak detection tool using NodeMCU ESP8266 as a microcontroller that functions as a brain to execute commands that have been made. Blynk App and SMS to provide information to users in case of gas leaks detected by MQ-6 sensors. This tool will detect gas leaks that occur by receiving data from the MQ-6 sensor which is then processed by NodeMCU ESP8266. If a gas leak is detected, the buzzer will sound and the tool will give an alert by popping up a notification on the Blynk application with an internet connection and sending an alert via SMS so that the alert can be sent even in the absence of an internet connection. With this tool, users can find out earlier if there is a gas leak by getting a notification on the Blynk application and receiving a gas leak SMS, to avoid explosions and minimize damage and losses caused by gas leaks.

Keywords: Blynk App, Gas leak, Internet of Things, NodeMCU ESP8266, SMS

INTRODUCTION

Gas cylinders have many benefits for humans, especially in the culinary sector, gas cylinders are often used for household needs, restaurants, as well as street vendors who use gas cylinders to cook and keep the food they sell warm. Nevertheless, these useful gas cylinders can be disastrous for humans. A leak in the gas cylinder caused an explosion, as reported by the sumselupdate.com in July 2021, a gas explosion in one of the residents' homes in South Sumatra resulted in three people being injured (Rizal, 2021). This also happens because there is flammable gas or combustible gas in LPG (Samudera & Sugiharto, 2018). Therefore, gas leaks should be detected early and given a direct warning so that explosions caused by gas cylinder leaks can be avoided and gas cylinders that have leaked can be handled directly.

In 2018, Metta Santiputri and Muhammad Tio conducted research on gas leaks using MQ-2 and IoT-based gas sensors using firebase, if there is a gas leak, the sensor will detect and send alerts through the android application (Santiputri & Tio, 2018). Then Sony Shrestha, V. P. Krishna Anne, and R. Chaitanya also researched gas leaks using Arduino and sent alerts via SMS (Shrestha, Krishna Anne, & Chaitanya, 2019). The research will be developed by combining alerts sent through the Blynk App and SMS. The tool will provide alerts through the Blynk App with the help of an internet connection. And in the absence of an internet connection, the tool will give a warning in case of gas leakage via SMS.

This study aims to build a tool that can anticipate the occurrence of gas explosions caused by gas cylinder leaks and gas cylinders that have leaked can be handled directly. With the tools from the results of this research, it is hoped that it will become a useful tool for the community and participate in building internet of things technology in Indonesia. Also as a preventive measure so that unwanted things do not happen due to gas leaks.

LITERATURE REVIEW

Gas leaks will be detected by the MQ-6 gas sensor. The MQ-6 gas sensor has four pins consisting of VCC and GND as power supply, ao, and do as output in the form of analog and digital voltages. The MQ-6 gas sensor can detect propane and butane gases contained in LPG gas with fast and highly sensitive responses (Putra, Kridalaksana, & Arifin, 2017). The MQ-6 gas sensor can detect with high sensitivity in propane and butane

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compounds found in LPG (Hidayatullah & Muchtar, 2015), while the MQ-6 gas sensor detects with low sensitivity in alcohol and cigarette smoke (Munandar, Notosudjono, & Machdi, 2020).

The gas data that has been received and processed by the MQ-6 gas sensor is then sent to the microcontroller for processing. The microcontroller used is NodeMCU ESP8266. NodeMCU is an electronic board that functions as a microcontroller based on the ESP8266 chip (Ibrahim & Setiyadi, 2021). NodeMCU ESP8266 is a board in which there is wi-fi. With wi-fi, NodeMCU ESP8266 can connect with the internet of things platform. There are several pins on the NodeMCU ESP8266 that can be used as inputs and outputs. Data from the MQ-6 gas sensor will be received by analog pin 0 as input.

The gas sensor input data is then processed by the NodeMCU ESP8266. If the gas sensor detects a gas leak, the NodeMCU ESP8266 will output in the form of a buzzer that sounds loud. The buzzer is one of the electronic components that convert electrical energy into sound energy (Fani, Sumarno, Jalaluddin, Hartama, & Gunawan, 2020). Then it will be given a notification on the android with the help of the internet and the Blynk App. The Blynk App will provide notifications if given a command by the NodeMCU ESP8266.

The gas sensor reading value is in the form of an analog voltage value on the A0 pin of the Esp8266 NodeMCU which is converted into numbers 0 to 1023. Blynk is a server service that is compatible with the internet of things (Hariri, Novianta, & Kristiyana, 2019). In the Blynk App, there is a gauge widget used for numbers 0 to 1023 from sensor readings, and a notification widget to provide notifications on android (Wibisono Darmawan, U A Sompie, & Kambey, 2020).

To anticipate the absence of an internet network, if there is a gas leak, a warning will be given via SMS short message. SMS which stands for Short Message Service is a service that can send alphanumeric messages from one terminal to another with wireless communication. There are two SMS modes or formats used, namely the text mode and the data unit protocol mode (Rahmawati & Anshori, 2016). SMS will be sent without detecting the destination to be sent actively or not (Mirza & Firdaus, 2016). SMS will be sent via GSM SIM900A Module. The process of sending SMS using AT Commands is written in the program.

In the SIM900A GSM Module, there is a SIM Card holder for SIM Card storage which is used to send data by SMS. There is a feature on the SIM900A GSM Module, which has 4 frequencies at 850/900/1800/1900MHz, there are also indicator LEDs for PWR and LED status. AT Commands are provided by communication using the UART protocol (Aryza, Lubis, & Lubis, 2020).

METHOD

In this study, the gas leak detector will receive and process the data received by the gas sensor using a microcontroller and will turn on the buzzer, providing alerts in the form of notifications on android and short messages via SMS in case of gas leakage. Block diagrams are one of the important parts of the design process (Ray, Kusumanto, & Risma, 2022). With the block diagram given in Figure 1.

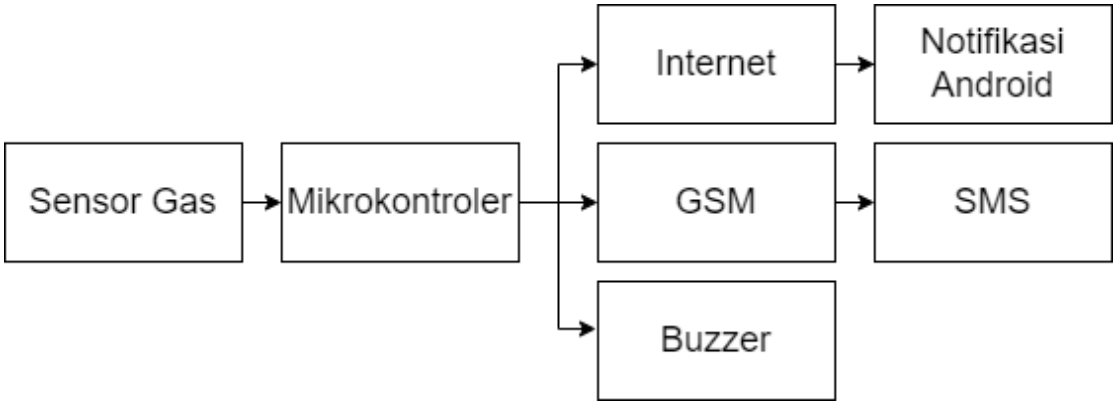

Figure 1. Gas leak detection block diagram

Before testing, the gas leak detection device will be assembled and connected according to the predetermined pins as shown in Figure 2. Then the program that has been created is compiled and uploaded to NodeMCU ESP8266.

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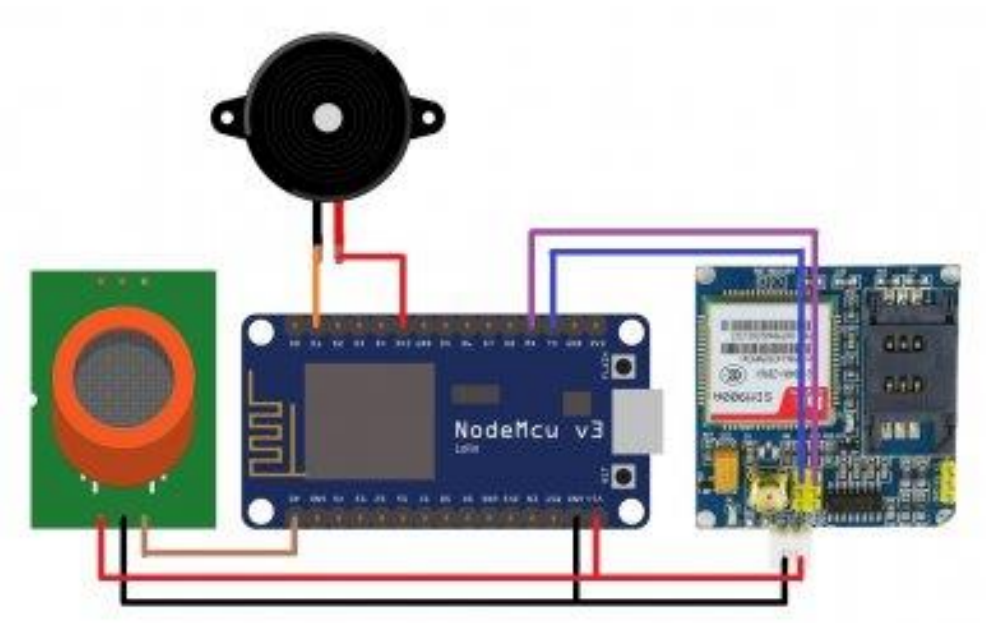

Figure 2. Interconnection of gas leak detection devices

The interface of the Blynk App is created by adding gauge and notification widgets. The gauge widget is used to display the readings of the MQ-6 gas sensor in the form of analog voltage conversion as shown in Figure 3. And the notification widget is used to display notifications on android.

Figure 3. Gas sensor reading display on Blynk App

The test was carried out by storing a gas leak detection device in a box with dimensions of 32 x 28 x 29 cm^3 shown in Figure 4. The box is used to close the air chamber so that the gas remains in the box and the gas readings by the MQ-6 gas sensor are not disturbed. The gas leak detection device is laid vertically with a gas cylinder.

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Figure 4. Gas leak detection device in the box

If a gas leak is detected by the gas sensor, NodeMCU ESP8266 will carry out commands according to the program that has been made, which is to make the buzzer sound loud and provide alerts by providing notifications and giving short messages in the form of SMS as shown in Figures 5. The buzzer will sound and an SMS will be sent continuously until the gas leak is no longer detected by the MQ-6 gas sensor.

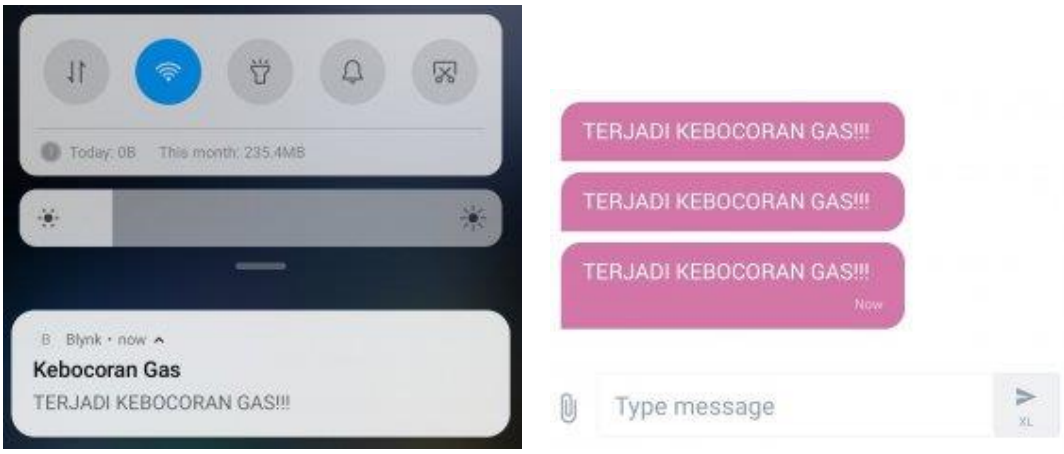

Figure 5. Gas leak alert notification on blynk app and message via SMS

RESULT

The test results of the gas leak detection device by calculating the speed of the MQ-6 gas sensor in detecting gas leaks in units of seconds. The gas sensor readings if there is no gas leakage are worth between 30 and 40. Gas leaks are detected by gas sensors with reading values above 50. The test results at a distance of 5 to 15 cm are shown in Table 1. From the table, the timing of the gas sensor readings affects the distance between the gas sensor and the gas cylinder, this data can also be information on the ideal distance between the gas sensor and the gas cylinder.

Table 1. Gas Sensor Reading Speed Data

No	Distance (cm)	Sensor Readings (Analog)	Time (seconds)
1	5	> 50	2,87
2	6		3,14
3	7		3,26
4	8		3,70
5	9		4,10

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6	10		3,58
7	11		4,24
8	12		4,17
9	13		4,23
10	14		4,68
11	15		5,18

The test results in the form of graphs are shown in Figure 6. From the graphic form, the speed of reading of the gas sensor differs at a certain distance. The longer the distance between the sensor and the gas cylinder, the reading speed of the gas sensor becomes longer and longer, but at a distance of 10 and 12 cm it is slightly faster than the time at the previous distance. This data can also be taken into a consideration for determining the best distance between the MQ-6 gas sensor and the gas cylinder.

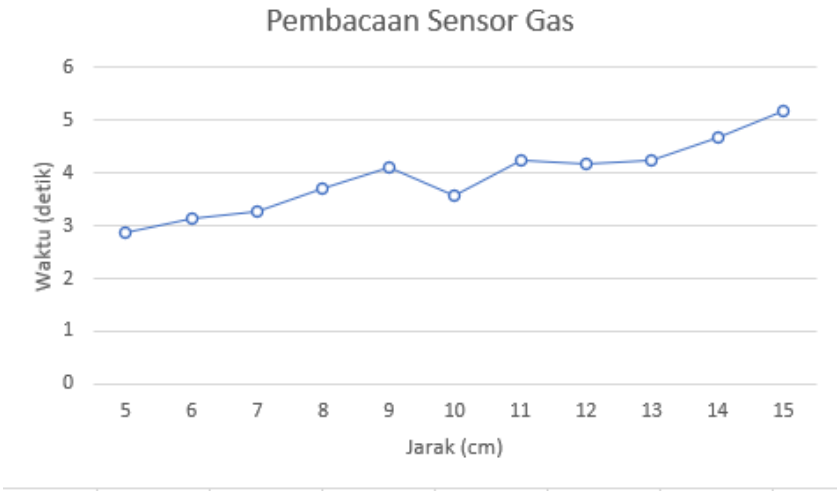

Figure 6. Gas sensor reading speed data graph display

The gas sensor reading speed at a distance of 5 to 15 cm takes an average of 3.92 seconds. The fastest time of the gas sensor reading is at a distance of 5 cm with a time of 2.87 seconds, while the longest time of gas sensor reading is at a distance of 15 cm with a time of 5.18 seconds.

DISCUSSION

From the research that has been carried out, it has been described how the speed of the gas sensor reads the gas leak value according to the specified distance which can be a reference for the placement distance between the gas sensor and the gas cylinder. The connection of alerts from previous studies has also been carried out, with alerts through the Blynk App and via SMS so that alerts are still sent in the absence of an internet connection. This study adds data on the reading speed of gas sensors that were not present in previous studies.

CONCLUSION

The design of the gas leak detection device has been outlined. Gas leak readings using the MQ-6 gas sensor are then processed by the NodeMCU ESP8266 microcontroller. If a gas leak is detected, where the gas sensor reading value is more than 50, the buzzer will sound and will pop up notification by the Blynk App, and a message will be sent with SMS. The gas sensor reading results can be monitored through the Blynk App which runs with the Android operating system. The distance between the gas sensor and the gas cylinder can affect the reading speed of the gas sensor in detecting gas leaks, the closer the distance between the gas sensor and the gas cylinder, the faster the reading time by the sensor. The gas sensor reading speed value can be considered to regulate the best distance between the gas sensor and the gas cylinder. Thus, if there is a gas leak that is detected by the gas sensor quickly, direct action can be taken to anticipate the occurrence of an explosion caused by a gas leak.

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