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Design Build of IoT Based Smart Liquefied Petroleum Gas Leakage Detector with NodeMCU ESP8266 Module

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ABSTRACT
Gas is a molecule that is not bound, formless, invisible, and can change to liquid or solid at a certain temperature. LPG gas is a factor that often occurs the cause of LPG gas fires is the gas regulator that is not installed properly. The purpose of this study was to determine the performance of the Smart Liquefied Petroleum Gas Leakage Detector device Design sistem based on the Internet of Things with the ESP8266 NodeMCU Module, as well as to determine the sensor response of Smart Liquefied Petroleum Gas Leakage Detector device Design Based on the Internet of Things with the ESP8266 NodeMCU Module at a distance different. The method used is experimental. This sistem is equipped with an MQ-6 sensor, IR flame sensor, solenoid valve, buzzer, and the Internet of Things. This sistem uses the Blynk application to find out the PPM value of the MQ-6 gas sensor. This sistem has been tested with a sensor distance of 1 cm to 10 cm and the result is that the maximum detected distance is 7 cm. In sistem testing that has been carried out the sistem designed in this study has been able to control and monitor well. The LPG gas sensor value gets an average gas value of 5467 PPM at a distance of 1 cm, then an average gas value of 1052.6 PPM at a distance of 2 cm, an average gas value of 798 PPM at a distance of 3 cm, an average gas value of 557.4 PPM at a distance of 4 cm, an average gas value of 489 PPM at a distance of 5 cm. an average gas value of 387.2 PPM at a distance of 6 cm, an average gas value of 231.4 PPM at a distance of 7 cm, an average gas value of 152.4 PPM at a distance of 8 cm. an average gas value of 141.8 PPM at a distance of 9 cm, and then average gas value of 121.6 PPM at a distance of 10 cm.

Keywords: *Internet of Things, ESP8266, Liquefied Petroleum Gas, Sensor MQ-6, Blynk.*

1. INTRODUCTION

The development of science and technology is now making human life easier. Another impact that is felt is the increasing need for energy resources, where all this energy is taken from nature. Many natural resources are beneficial to humans and other living things on earth. LPG is one of the non-renewable natural resource products that are widely used today. The role of liquefied petroleum gas is currently very important for human life in industry and households. LPG (Liquefied Petroleum Gas) is a hydrocarbon gas that is liquefied at low pressure and a certain temperature to facilitate storage, transportation, and handling which consists of propane (C_3H_8), butane (C_4H_{10}), or a mixture of both [11].

Currently, due to the influence of government programs, people use LPG gas stoves so that LPG is the fuel for stoves that are currently widely used [4]. With this energy, humans can do daily activities, such as cooking using LPG (Liquefied Petroleum Gas). Almost all people in Indonesia use LPG for kitchen activities. This can be evidenced by an article published by Kompas media which states that only entering the second quarter of the 2019 fiscal year, consumption of 3 kilograms of LPG subsidized by the government has reached 2.2 billion kilograms. In addition, the 2019 State Budget has set a quota for 3-kilogram LPG consumption of 6.98 billion kilograms. Through this, the need for 3 kg LPG has exceeded the specified target [2].

The benefits provided by LPG for community activities are many, but some disadvantages must be estimated when using LPG. Such as the installation of LPG cylinders with regulators which sometimes do not comply with the recommended procedures, resulting in gas leaks. In addition to the installation of the regulator according to the procedure, good air circulation must be

considered. Leakage of LPG cylinders or features is still one of the primary causes of fires. So it takes special attention to this type of fuel. The gas can trigger explosions and fires, therefore a gas leak detector is needed [9]. Where every day LPG is used as the main cooking fuel. In addition, this tool is equipped with a solenoid valve that can cut off the flow of gas that leaks, as well as an additional buzzer as a warning alarm when the homeowner is in the house.

This study designs a prototype that functions to detect LPG gas leaks and fire detectors that are integrated into a system using the MQ-6 sensor and IR flame sensor based on the Internet of Things. The leaked gas will be received by the MQ-6 sensor as a response to LPG gas input as well as the IR flame sensor as a fire detector input response which is then processed by the ESP8266 to get notifications on the Blynk application on Android phones. By entering the email and token from the email that has been registered in the Blynk application.

This study aims to determine the performance of the IoT-Based Smart Liquefied Petroleum Gas Leakage Detector System Design with the ESP8266 NodeMCU Module, as well as to determine the sensor response to the IoT-Based Smart Liquefied Petroleum Gas Leakage Detector Device Design with the ESP8266 NodeMCU Module at different distances.

The contribution to this research is to be able to produce a gas leak detector whose system performance is connected to the Internet of Things with the ESP8266 NodeMCU Module. As well as knowing the response of the MQ-6 sensor to different distances. The IoT features used can be used as controlling and monitoring the concentration of LPG gas leaks via a smartphone WiFi connection and sending notifications to smartphones.

2. METHOD

2.1. Software

Creation of a program script to run tools on the Arduino IDE Software. The flowchart system progam as shown in Figure 1.

Design an application on an Android Smartphone as an interface, using the Blynk application. This application design consists of 1 SuperChart (a), 1 Notification Setting (b), and 1 Setting Gauge (c). As shown in Figure 2.

2.2. Hardware

The tool is made in the form of a box using acrylic. Consists of MQ-6 sensor, IR Flame sensor, NodeMCU V3 ESP8266, Buzzer, relay 1 channel and solenoid valve.

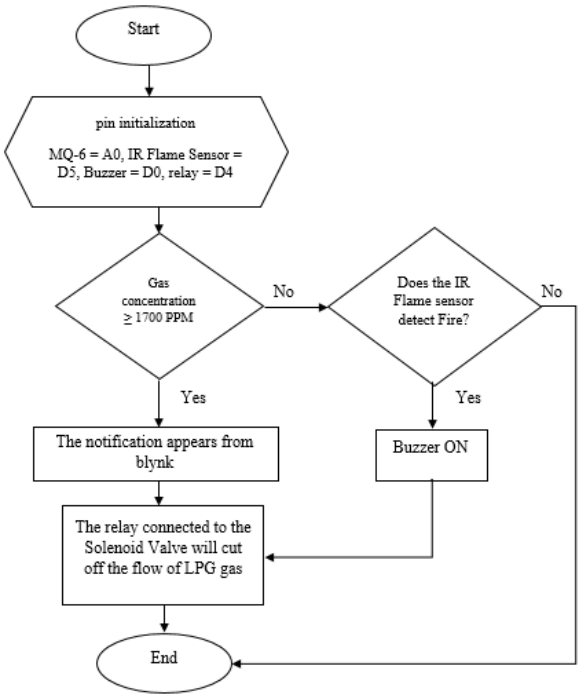

Figure 1 Software flowchart.

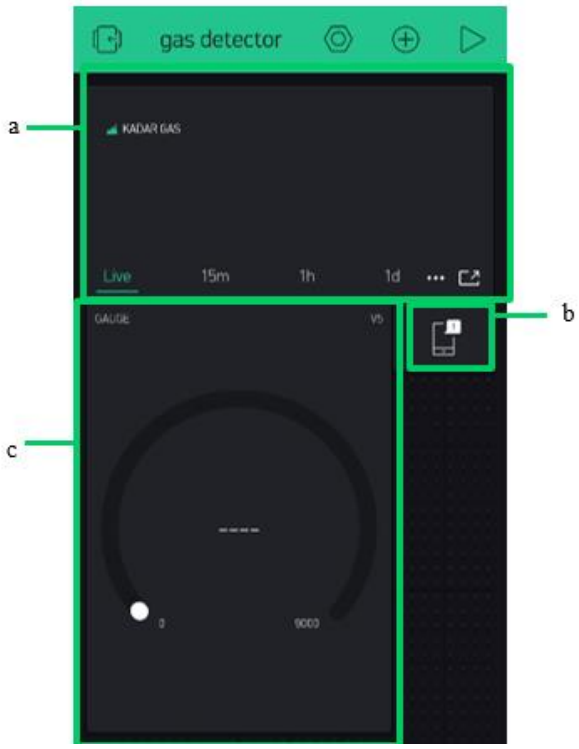

Figure 2 Application view.

Figure 3 Hardware box.

3. RESULTS AND DISCUSSIONS

3.1 Testing Preparation

The following is a display of the results of the LPG gas concentration data from the tool displayed on the monitoring graph through the Blynk application. The application will run when the Play button is pressed. And must be connected to WiFi first to connect. There are two conditions, namely when the normal condition is <1700 PPM and when a leak occurs, namely when the gas is ≥ 1700 PPM.

3.2 Data MQ-6

Below are the results of the LPG gas concentration data for 5 trials with different sensor distances as follows:

Table 1 First gas sensor test results.

Distance	PPM result	time (s)
1 cm	18887	4
2 cm	1429	6
3 cm	1003	9
4 cm	543	11
5 cm	519	12
6 cm	413	15
7 cm	135	17

Table 2 Second gas sensor test results.

Distance	PPM result	time (s)
1 cm	871	18
2 cm	722	18
3 cm	616	18
4 cm	394	19
5 cm	273	19
6 cm	190	20
7 cm	135	20

Table 3 Third gas sensor test results.

Distance	PPM result	time (s)
1 cm	3766	17
2 cm	1147	17
3 cm	809	18
4 cm	591	18
5 cm	519	18
6 cm	339	19
7 cm	216	20
8 cm	190	20
9 cm	167	21
10 cm	145	21

Table 4 Fourth gas sensor test results.

Distance	PPM result	time (s)
1 cm	1517	16
2 cm	1185	16
3 cm	840	17
4 cm	668	17
5 cm	591	17
6 cm	497	18
7 cm	258	18
8 cm	216	19
9 cm	203	19
10 cm	190	19

Table 5 Fiveth gas sensor test results.

Distance	PPM result	Time (s)
1 cm	2294	14
2 cm	780	14
3 cm	722	14
4 cm	591	14
5 cm	543	15
6 cm	497	16
7 cm	413	16
8 cm	356	17
9 cm	339	17
10 cm	273	18

Table 6 Sensor test average results.

Distance	PPM result
1 cm	5467
2 cm	1052.6
3 cm	798
4 cm	557.4
5 cm	489
6 cm	387.2
7 cm	231.4
8 cm	152.4
9 cm	141.8
10 cm	121.6

The following is an average graph of the MQ-6 gas sensor test results against distance:

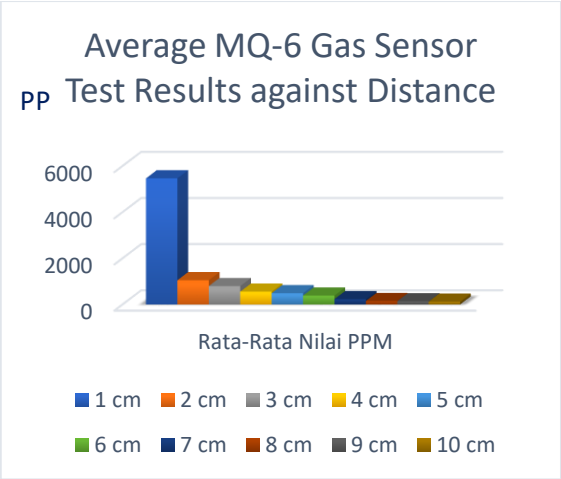

Figure 4 Graph of the average test of gas sensors with different distances.

3.3 Data IR Flame sensor

The following are the results of the LPG gas concentration data for 11 times of testing with different sensor distances as shown in Table 7.

Table 7 IR Flame Sensor Response Results with Different Distances by the IR Flame sensor.

Distance	IR Flame sensor Response	Voltage (V)	Buzzer
1 cm	Terdeteksi	0.15	ON
2 cm	Terdeteksi	0.19	ON
3 cm	Terdeteksi	0.21	ON
4 cm	Terdeteksi	0.25	ON
5 cm	Terdeteksi	0.30	ON
6 cm	Terdeteksi	0.23	ON
7 cm	Terdeteksi	0.22	ON
8 cm	Terdeteksi	0.27	ON
9 cm	Terdeteksi	3.07	ON
10 cm	Terdeteksi	3.20	ON
11 cm	Tidak Terdeteksi	3.30	OFF

Based on Table 7, it can be concluded that the farther the distance, the less fire is detected.

4. CONCLUSION

From the results and discussion in the study, it can be concluded from the Design of Smart Liquefied Petroleum Gas leakage detector based on IoT with the NodeMCU ESP8266 module, which can monitor gas leaks and can cut off gas flow in LPG hoses with solenoid valves in one server.

The contribution to this research is to be able to produce a gas leak detector whose system performance is connected to the Internet of Things with the ESP8266 NodeMCU Module. The LPG gas sensor value got an average gas value of 5467 PPM at a distance of 1 cm, then the average gas value was 1052.6 PPM at a distance of 2 cm, the average gas value was 798 PPM at a distance of 3 cm, the average gas value was 557.4 PPM at a distance of 4 cm, the average value of gas is 489 PPM at a distance of 5 cm, the average value of gas is 387.2 PPM at a distance of 6 cm, the average value of gas is 231.4 PPM at a distance of 7 cm, the average value of gas is 152.4 PPM at a distance 8 cm, the average gas value is 141.8 PPM at a distance of 9 cm, and the average gas value is 121.6 PPM at a distance of 10 cm. It can be concluded that the farther the distance, the fainter the concentration of scattered gases.

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