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Design of Cloud Computing Based Gas Detection Systems using NodeMCU ESP8266 Microcontroller

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Abstract— **Liquefied Petroleum Gas (LPG) is a fuel that is currently widely used by the community in meeting their daily needs. Safety in the use of LPG) is one of the important aspects for Indonesian people both at home, eating-places, tourist attractions, campuses and other places that use LPG. Fires often occur caused by LPG leaks that are not realized by the owner and the people around him, causing fires. The fire caused by gas leakage not only harms the owner but also people who are not far from the fire. From these problems, the authors make a design of cloud computing-based detection system of gas leak using a microcontroller NodeMCU Esp8266 that can provide notifications via smartphone in case of fire and automatically do the first treatment by turning on the exhaust. Notifications sent via the smartphone appear not only when opening the application, but also when it does not open the application.**

Keywords-Liquefied Petroleum Gas (LPG); Cloud Computing; NodeMCU Esp8266 Microcontroller

I. INTRODUCTION

At this time, technological advances have an impact on increasing natural resources and energy. One source of energy used by humans, especially in meeting their daily needs is the use of LPG. LPG or Liquefied Petroleum Gas is a hydrocarbon gas production from oil refineries and gas refineries with the main components are propane gas (C_3H_8) and butane (C_4H_{10}) and packaged in a tube. LPG consumers vary, ranging from households, commercial circles (restaurants, hotels) to industry. In industry, LPG is used as fuel in the food, ceramics, glass and forklift fuels. In addition, LPG can also be used as a raw material in the aerosol industry and environmentally friendly refrigerant. LPG cylinders consist of several sizes, ranging from gas cylinder sizes from 3 kg to 50 kg.

Safety in the use of LPG is one of the important aspects for Indonesian people both at home, eating places, tourist attractions, campuses and other places that use LPG and are prone to fire. Fires often occur that are caused by LPG leaks that are unknown to the user and the people around him, so they do not pay attention to situations that will cause sparks such as cigarettes, electricity and so on which result in a fire at that location.

More recently on March 4, 2019, due to a gas leak and 14 people suffered burns [1]. In addition, in October 2019 in Jakarta, there was a fire caused by a gas leak and five people were injured in the fire [2].

From the cases above related to fires caused by gas leakage, we need a security system that can know the characteristics of gas leaks and information in the event of a gas leak. This requires the existence of technology that can detect when a leak occurs and provides information in the form of a warning to users of LPG and take the first countermeasures, the system will automatically turn on the exhaust when the density of LPG in the room is very dangerous

Based on this background, the authors make research material with the title "design of cloud computing-based gas leak detection systems using the NodeMCU ESP8266 microcontroller". By conducting this research, we aim to reduce the level of fire caused by a gas leak

II. LITERATURE REVIEW

A. Discussion of Relevant Research Theory Results

Several previous studies relate with our research are including:

1. Research title "Design of LPG Gas Leak Detection Devices with Microcontroller-Based MQ-6 Sensors through Android Smartphones as information media" by Mifza Ferdian Putra, Awang Harsa Kridalaksana, Zainal Arifin. In this study, a tool designed and built can monitor the presence of gas leaks that can be observed directly through an android smartphone, the difference with that done by researchers of the system designed and built there is a notification in the event of a gas leakage, notifications will be sent repeatedly [3].
2. Research title "Design of Gas and Fire Leak Detectors by Using MQ-2 Sensor and Flame Detector" by Deanna Durbin Hutagalung. In this research, the tool can detect gas leakage and spark. A message will be sent to the LCD screen and the buzzer, and the fan will automatically turn on. The difference is the usage of microcontrollers. In this research, it uses Arduino NodeMCU to be able to provide notifications directly via smartphone using Wi-Fi around [4].
3. Research Title "Internet-Based Liquefied Petroleum Gas Leakage and Monitoring System" by Aulia Faqih Rifa'i. In this study, the system can monitor gas leaks in the room and their contents and is able to report continuously at intervals of 1 minute, the difference with what is done by the author is that notifications that occur when a gas leak occurs will be sent repeatedly until there is an action taken [5].
4. Research title "Designing LPG Gas Cylinder Leak Detection Devices Using MQ-6 Sensors to Overcome Fire Dangers" By Rimbawati, Heri Setiadi, Ridho Ananda, Muhammad Ardiansyah. In this study, the tool works when the gas cylinder has a leak, where the tool can provide a warning in the form of an alarm and LED lights, the difference with what is done by researchers is that the system not only gives a warning with an alarm but also provides notifications repeatedly [6].
5. Research title "LPG Tube Leakage Detection Through SMS Gateway Using Arduino Uno-Based MQ-2 Sensor" by Desi Nurnaningsih. In this research, the tool will give a message if a gas leak is detected in the form of a notification in the form of SMS and the data that has been processed by the microcontroller will be forwarded to the LED and buzzer so that both of them will turn on automatically [7].

B. Theoretical Explanation

1) Liquefied Petroleum Gas

Liquefied Petroleum Gas (LPG) is a common fuel in several sectors such as households, industry, and transportation [8]. LPG is a mixture of several variables; the main ones are propane (C3H8) and butane (C4H10) or a combination of both [9]. When stored in liquid form, it will have an energy density comparable to other liquid hydrocarbon fuels and has an advantage over natural gas. LPG combustion produces low greenhouse gas emissions and effect [10].

2) Microcontroller

The microcontroller is an IC that contains CPU, ROM, RAM, and I/O. With the CPU, the microcontroller can do the thinking process based on the program that has been given to him. Microcontrollers are widely available in all electronic equipment, fax machines, and other electronic equipment. A microcontroller can also be called a small-sized computer that is low power so that a battery can provide power [10].

3) NodeMCU

NodeMCU ESP8266 is a microcontroller module that is designed with ESP8266 in it. ESP8266 functions for Wi-Fi network connectivity between the microcontroller itself and the Wi-Fi network. NodeMCU is based on the Lua programming language but can also use the Arduino IDE for its programming [11].

4) Arduino IDEAS

Arduino was created for beginners who do not have a basic programming language at all because it uses the C ++ language which has been facilitated through the library. Arduino uses Processing Software that is used to write programs into Arduino. Arduino is not just a development tool, but also a combination of hardware, programming languages and a sophisticated Integrated Development Environment (IDE). IDE is a piece of software that is very instrumental in writing programs, compiling it into binary code and uploading it into a microcontroller memory [12].

5) Sensor MQ-2

MQ-2 sensor is a sensor that can detect several types of flammable gases such as butane, methane, LPG, propane, alcohol, hydrogen and can detect PPM carbon fumes [13]. MQ2 sensor is used to detect LPG; this sensor is very easy to use and saves the use of microcontroller digital pins. This sensor uses a small heating device with an electrochemical sensor that reacts with several types of gas, which then releases the output in the form of the detected gas density [7].

6) Buzzer

The buzzer is a component that has the function of converting electric current into sound. In addition, basically, the working principle of the buzzer is almost the same as the speaker. Buzzer consists of a diaphragm that has a coil. When the coil has electrically flowed so that it becomes an electromagnet, the coil will be drawn in or out depending on the magnetic polarity. Because the coil is mounted on the diaphragm, each diaphragm vibration back and forth so that it makes the air vibrate and produce sound [14].

III. RESULT AND DISCUSSION

A. Architecture System

The results of the design made by researchers in accordance with Figure 1:

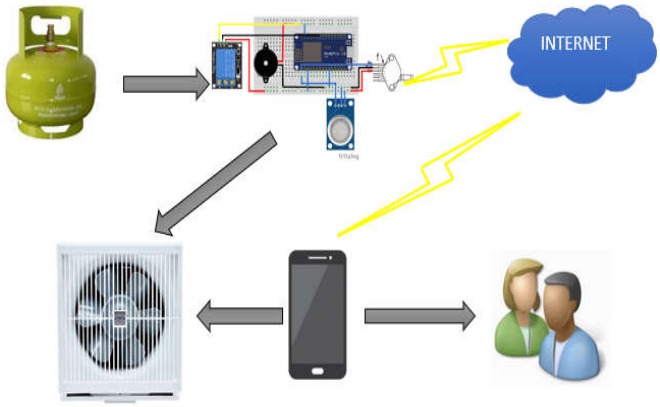

Figure 1. Architecture of a Gas Leak Detection System

B. Tool Design

The tool is designed to be able to detect gas leaks consisting of several important components (Fig. 2), including:

1. Arduino NodeMCU
2. MQ-2 Sensor
3. Buzzer
4. Smartphone
5. USB
6. LED

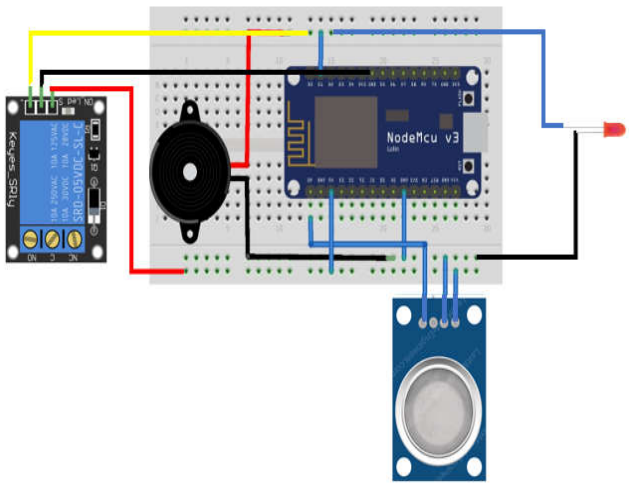

Figure 2. Tool Design

C. Implementation

1) Tool Implementation

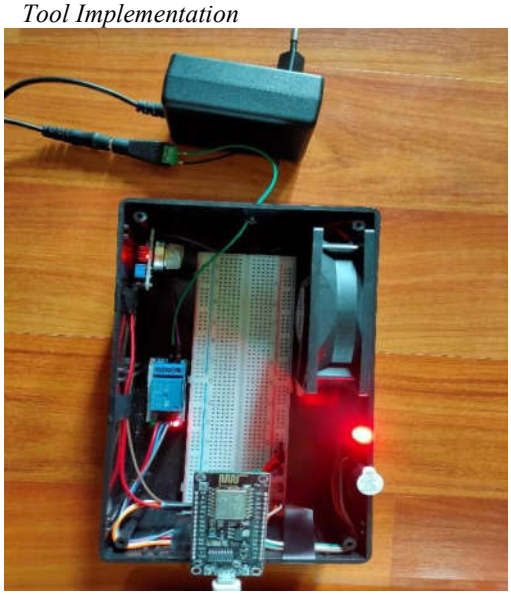

Figure 3. Tool Implementation

Figure 3 is an implementation of a device built for gas leak detection.

2) System Implementation

Figure 4. Notification on the application

Figure 4 and Figure 5 are notification displays whose data is sent from a device that was built during a gas leak.

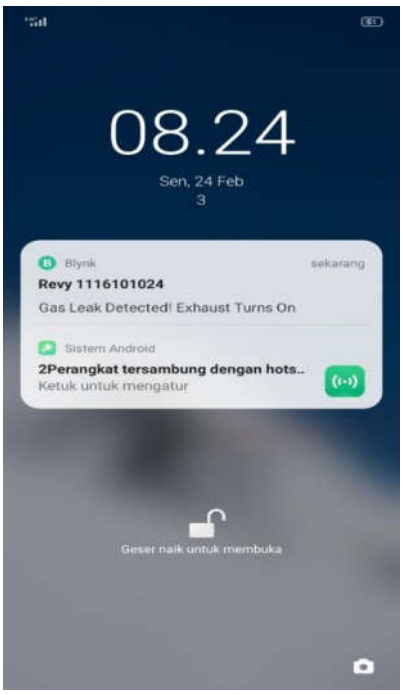

Figure 5. Notification display on the smartphone screen

D. Source code Implementation

```
#include <SoftwareSerial.h>
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

//To connect with the Bynk application
char auth[] =
"lXNdNrVXItQrmdewfDyjQzeSON75A5Iq";
char ssid[] = "RevyCahya";
char pass[] = "Revy2310";

const int pinLpg = A0;
const int pinBuzzer = 5;
const int pinLed = 16;
const int RELAY = 13;
int sensorGas;

void setup(){
    Serial.begin(9600);
    pinMode(pinLpg, INPUT);
    pinMode(pinBuzzer, OUTPUT);
    pinMode(pinLed, OUTPUT);
    pinMode(RELAY, OUTPUT);
    Blynk.begin(auth, ssid, pass);
}
```

```
void loop(){
    int sensorValue = analogRead(A0);
    Serial.println(sensorValue);

      if (sensorValue <= 550){
        digitalWrite(pinBuzzer, LOW);
        digitalWrite(pinLed, LOW);
        digitalWrite(RELAY, HIGH);
        Blynk.virtualWrite(V0, LOW);
        Blynk.virtualWrite(V1, LOW);
      }

      else if (sensorValue > 550){
        digitalWrite(pinBuzzer, HIGH);
        digitalWrite(RELAY, LOW);
        digitalWrite(pinLed, HIGH);
        delay(200);
        digitalWrite(pinLed, LOW);
        delay(200);
        Blynk.virtualWrite(V0, HIGH);
        Blynk.virtualWrite(V1, HIGH);
        Blynk.notify("Terdeteksi Kebocoran
        Gas! Exhaust Menyala");      }
        delay(1000);

       Blynk.run();
      }
```

3.4. System Testing

Requirements tested	Test Point
Gas Sensor Connection	Connect the MQ-2 Sensor to the gas leak system.
LED Connection	Connect the LED to the gas leak system.
Buzzer Connection	Connect the buzzer with the gas leak system.
Relay Connection	Connecting the relay with a gas leak system.
Fan connection	Connect the fan to the gas leak system
NodeMCU connection ESP8266	Connecting modules with the system and web server

Figure 3.6 System testing

IV. CONCLUSION

With the design of cloud computing-based, gas leaky detection systems using the NodeMCU ESP8266 microcontroller is expected to reduce fires caused by LPG leaks. The other benefits are as follows:

1) *Adding public knowledge about safety in the use of LPG as a fuel, so they can be more careful in their use.*
2) *It can do the first countermeasure through a smartphone that is owned so that it can reduce the concentration of gas levels in the room and can avoid fire by automatically turning on the exhaust.*
3) *Can use a smartphone to get information about LPG leakage and LPG pressure contents.*

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