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Design Of An LPG Leak Detection System Using Iot Based MQ-2 Sensor

Mhd. Iqbal Prananda[1], Siswan Syahputra[2], Mili Alfhi Syari[3]

mhdiqbalpramamda06@gmail.com[1], siswansyahputra90@gmail.com[2], milli.fhisya@gmail.com[3]*

Abstract

The IoT-based LPG gas leak detection system with MQ-2 and automatic regulator aperture is designed to protect the environment from the dangers of gas leaks and optimize gas use. The MQ-2 sensor is used to detect LPG gas accurately and sensitively. This system is connected to IoT which allows remote monitoring via smart devices. When the sensor detects that the LPG gas concentration exceeds a safe threshold, the system will send an alert with notification and automatically activate the regulator to cut off the gas supply. This helps prevent the accumulation of harmful gases. This design combines reliable gas detection with automatic operation to improve environmental safety and gas efficiency. LPG gas is very commonly used by the community because it has many advantages, but there are also many risks associated with using LPG gas, such as poisoning, shortness of breath and even fire. It is therefore important to have a leak detection system to prevent accidents that may occur, by integrating the programmable MQ-2 sensor and NoteMCU ESP8266.

Keywords: *LPG gas leak detection, MQ-2 sensors* ***Nodemcu Esp8266****, Aruino IDE, IoT*

1. Introduction

LPG (Liquefied Petroleum Gas) has become a source of energy that is commonly used by households, industry and commercial. Although LPG gas has many advantages, such as energy efficiency and cleanliness, LPG gas leakage can cause serious harm, including fire, explosion, or gas poisoning to humans. In the Internet of Things (IoT) era, technology has enabled the development of network-connected systems, including an LPG gas leak detection system. By utilizing internet connectivity, this system can be controlled and monitored remotely, as well as providing real-time notifications to users through their smart devices, such as smartphones. In a previous study researched by [1] with the title "Design of an LPG Gas Leak Detection Tool Using an Arduino-Based MQ-2 Sensor", it was explained that the design of an LPG gas leak detection tool using an Arduino-based MQ-2 sensor, this tool can detect gas leaks and will automatically provide information through the display on the LCD screen, sound a buzzer as an alarm, and send an SMS to the mobile number entered in the program. This tool is designed to extinguish fires due to frequent leaks of LPG gas cylinders and also as a solution to prevent losses due to LPG gas cylinder fires and also to prevent casualties from fires due to leakage of LPG gas cylinders.

2. Research Methods

2.1 .Leak detection

In assembling the LPG gas leak detector, several components are used. This research uses several components to design an LPG gas leak detection tool. The following components are required:

[1] NodeMcu ESP8266
[2] MQ-2 sensors
[3] LED (Light Emitting Diode)
[4] Buzzers
[5] Resistors

2.2 .NodeMcu ESP8266

NodeMCU ESP8266 is an open source microcontroller-based development platform supported by the ESP8266 chip. NodeMCU has 17 GPIO pins which can be integrated with other electronic components. Works at a voltage of 3.3 v – 5 v, with power consumption of 10uA~170mA. Processor speeds range from 80~160MHZ and have 32KB+80KB RAM and up to 16MB of flash memory [2]. NodeMCU ESP8266 is a microcontroller module designed with ESP8266 in it. ESP8266 functions for Wifi network connectivity between the microcontroller itself and the Wifi network. NodeMCU is based on the Lua programming language but can also use the Arduino IDE for programming.

2.3 .MQ-2 sensors

The MQ-2 sensor is a sensor that can detect pollutant gases in the air, including LPG gas, alcohol, smoke, propane, hydrogen, methane and carbon monoxide. The application can be applied to detect LPG gas and smoke leaks to prevent fires, as a tool to measure the alcohol content emitted from a person's breath, etc. [3]. According to Anonymous in the journal (Mauludin et al., 2014), this sensor has high sensitivity and fast response time. The output from this sensor is an analog signal, the MQ-2 requires a voltage of 5 V DC, the resistance of this sensor will change when there is gas, the output from this sensor is connected to the Analog pin on the microcontroller which will display a digital signal.[4]

2.4 .Buzzer

A buzzer is an electronic component that functions to convert electrical vibrations into sound vibrations. Basically, the working principle of a buzzer is almost the same as a loudspeaker, so a buzzer also consists of a coil that is attached to a diaphragm, then the coil is electrified so that it becomes an electromagnet, the coil will be attracted in or out, depending on the direction of the current and the polarity of the magnet. because the coil is mounted on the diaphragm, every movement of the coil will move the diaphragm back and forth, making the air vibrate, thus producing sound.[1]

2.5 . Automatic Regulator Opener

Automatic Regulator Opener is a tool designed to regulate the opening and closing of gas regulator valves automatically based on instructions received from the control system. Its function is to control gas flow with a fast and precise response in emergency situations, such as gas leak detection. This device has integrated mechanical and electronic components to maintain a safe and efficient gas flow and the following describes the components
Component description:

2.5.1. Relay

Relay is an electronic component in the form of an electronic switch that is driven by an electric current. In principle, a relay is a switch lever that has a wire wrapped around a nearby iron rod (solenoid). When electric current flows through the solenoid, the lever will be attracted due to the magnetic force that occurs on the solenoid so that the switch contacts will close. Relay is an electronic component in the form of an electronic switch that is driven by an electric current. In principle, the relay is a switch lever that has a wire wrapped around a nearby iron rod (solenoid). When electric current flows through the solenoid, the lever will be attracted due to the magnetic force that occurs on the solenoid so that the switch contacts will close.[2]

2.5.2. Servo Motor

Servo motors are a type of motor that is specifically designed to produce precise movements according to the control commands given. Servo motors are often used in applications that require accurate movement and good control. However, for certain purposes, servo motors can be modified so that they can move continuously. In robots, these motors are often used on legs, arms or other parts that have limited movement and require large torque. In the case of automatic check valve opening, a servo motor can be used to drive the mechanism that controls the opening and closing of the check valve. The control valve is a device that regulates the flow of gas in the system, and by using a servo motor, the valve can be opened under certain conditions.[5]

2.6 . WiFi

Wi-Fi stands for Wireless Fidelity which is a wireless data communication medium that can be used to communicate or transfer programs and data with very fast capabilities[6]. Wi-Fi can also be interpreted as a technology that utilizes electronic equipment to exchange data using radio waves (wireless) through computer networks including internet connections. Because of its ability to allow Local Area Networks (LANs) to operate without the need for cables (wireless), WIFI technology is becoming increasingly popular and is becoming a practical choice for most business or household networks.[7]

2.7 . Blynk App

The Blynk App is an application designed for the Internet of Things. This application is able to control hardware remotely. Blynk functions to create application projects using various variations of the widgets that have been provided. However, the limit for using widgets in one account is only 2000 energy. This energy can be added by buying it through the playstore[2].

2.8 . Internet of Things

Internet of Things (IoT) technology has enabled the development of network-connected systems, including LPG gas leak detection systems. By utilizing internet connectivity, this system can be controlled and monitored remotely, as well as provide real-time notifications to users via their smart devices, such as smartphones [3].

3. Results and Discussion

This study uses the prototype method. Which uses the concept of direct monitoring and allows iterative changes to be made until the desired result is achieved. So this prototype method makes it possible to display the view directly.

3.1. Research Tools and Materials

The materials used to design an LPG gas leak detection system using the IoT-based MQ-2 sensor are as follows:
a) Windows
b) Arduino IDE
c) Frizting
d) Jaringan WIFI
e) NodeMCU ESP8266
f) Sensor MQ-2
g) Beberapa Resistor
h) Led
i) Relay 2 channel
j) Adaptor 12 V
k) Adaptor 5 V
l) Buzzer
m) Motor Servo
n) Smartphone
o) Lem
p) Solder
q) Timah
r) Regulator Gas LPG
s) Papan PCB
t) Micro USB
u) Baut dan mur

3.2. System Block Diagram

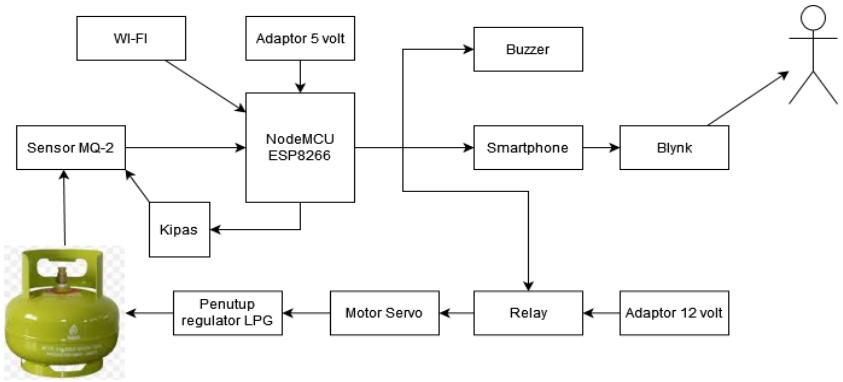

Fig. 1: Diagrams System Block on Nodemcu Esp8266

The definition of the function of each block is as follows:
1. The 5V adapter functions as an electrical power connector to power the NodeMCU ESP8266.
2. The 12V adapter functions as an electrical power connector to turn on the Servo Motor.
3. WI-FI functions to connect the NodeMCU module to the internet.
4. NodeMCU ESP8266 functions as a data processor, receiver and sender in the tool system.
5. The BLYNK application functions as a communication media application on smartphones.
6. Android smartphones function as signal input to turn on and turn off the output of electronic equipment
7. The Wi-Fi network functions as a communication medium between the device system and the Android smartphone.
8. The Relay Module functions as an electrical switch output to turn on and turn off the servo motor output.
9. The buzzer functions as an early warning alarm for users when the sensor is active.
10. The servo motor functions to move the regulator opener or LPG control valve.
11. The fan functions to clean the area of the MQ-2 sensor from the gas that came out previously, so that the sensor can find out whether the gas is still coming out or not.
12. The LPG regulator cover functions well to connect the LPG gas cylinder and hose.
13. LPG cylinders function as gas reservoirs.
14. Users are users.

3.3. Overall Tool Set

In this circuit, a whole series of LPG gas leak detection devices can be designed using the MQ-2 sensor, NodeMCU ESP8266, and a servo motor as an automatic regulator opener designed as following figure:

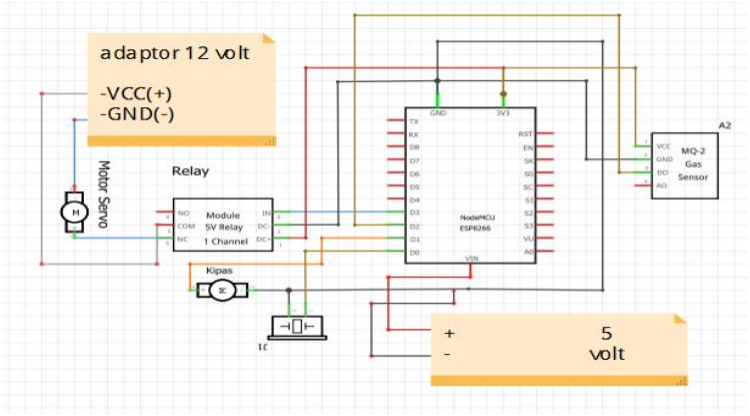

Fig. 2: Overall Series

3.4. Figures and tables

Design a design for the placement of hardware that will be used in the LPG gas leak detection system. After determining the subsystem that will be used in the LPG Gas Cylinder Leak Detection Tool Using the MQ-2 Sensor Based on the Internet of Things. Then proceed with designing a hardware placement plan that will be used in the LPG gas leak detection system, shown in Figure 3.10 below.

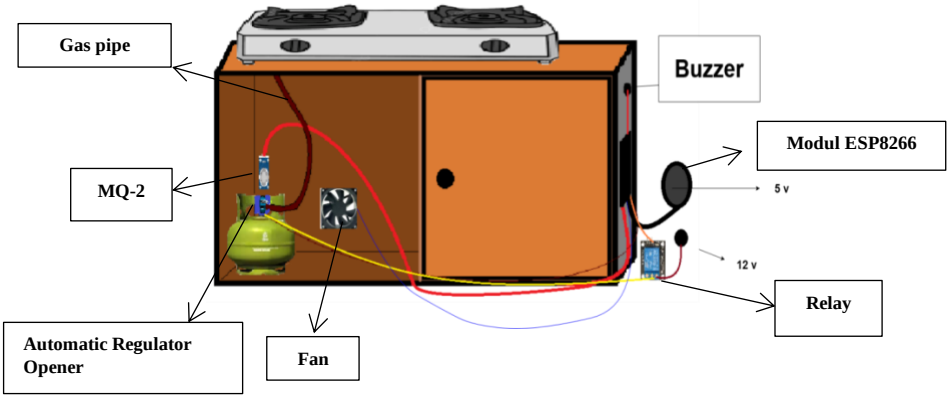

Fig. 3: Figures and tables

3.4.5. Android Output Package

The Blynk application design aims to design an LPG gas condition monitoring system that displays measurement results and a description of the gas condition. Information that will be displayed on the Blynk applicationis the gas level detected by the MQ-2 sensor. Here's what blynk looks like on a smartphone.

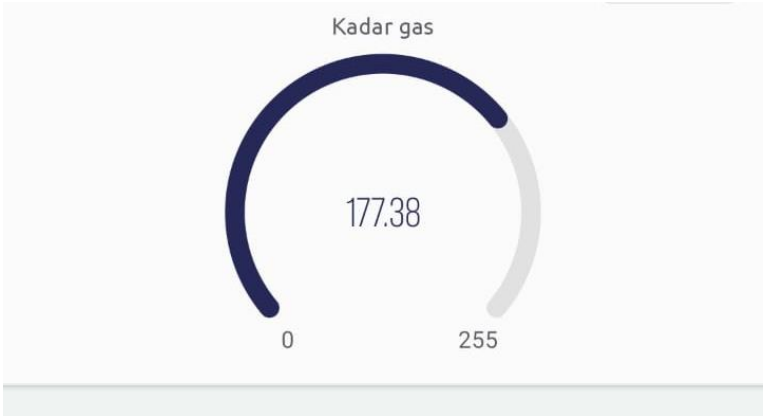

Fig. 4: Android Output Package

3.6. System FlowChart

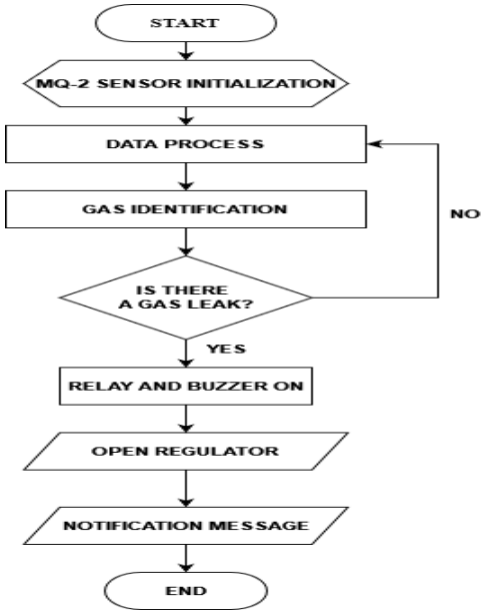

Fig. 5: System FlowChart

Information :
From the flowchart above it can be explained that the design of this tool consists of several paths.
1. start
2. MQ-2 Sensor initialization
3. Enter process data
4. Then identify the gas
5. Is There a Gas Leak?
6. If no leak occurs then return to data processing
7. If a leak occurs, the buzzer and relay will turn on
8. Then the regulator will open
9. Then the tool will send a notification

4. Conclusion

An IoT-based LPG gas leak detection system with an MQ-2 sensor and automatic aperture control is an effective solution for protecting the environment from gas leak hazards and optimizing gas use. By combining accurate and sensitive gas detection with automatic operation, the system improves environmental safety and gas efficiency. In the IoT era, the ability to remotely monitor and control systems provides an added advantage in the face of potential hazards. With this system, people can be more calm in using LPG gas in their daily lives, without having to worry about the risk of leaks that might occur.

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