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Implementation of a Gas Leakage Detection System Using the MQ-6 Sensor

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ABSTRACT

The role of gas at this time is very important for human life. The use of gas is expanding from household, industrial to transportation needs.Remember the depletion of petroleum supplies. This makes gas as an alternative fuel to replace the main role of petroleum. The risk of using gas as fuel is the occurrence of gas leaks which can have an impact on large-scale fires. A detection system is designed to detect gas leaks with the MQ-6 sensor and solenoid valve to close the gas line. The research was conducted by testing the voltage from the sensor using a predetermined program. The maximum reading distance from the gas sensor is 18 cm with a time of 45.26 seconds based on tests carried out by narrowing the gas exit path to provide a faster rate effect so that the sensor can detect gas.

INTRODUCTION

The use of gas is very practical and easy to obtain, but in terms of its use, early vigilance is needed by using a reliable security system. In this case, it cannot be separated from the danger of gas leakage, therefore it is necessary to protect it by early detection of gas leaks [1]. Gas is an alternative fuel in the form of methane and butane gas which produces less polluting emissions than kerosene fuel [2]. Many house fires are caused by gas leaks. This incident caused people to become nervous about using gas as fuel for household or industrial purposes.

Along with the increasing use of gas by the community, the producers of gas cylinders also experience a decrease in quality which can pose a danger due to the lack of supervision of these gas cylinder products. Since the government has converted kerosene to gas stoves, there have been many incidents of gas cylinders exploding which are dangerous for users and the surrounding community. The gas cylinder explosion disaster as a result of human error or errors in the production process of LPG gas cylinders and gas hoses should receive immediate treatment so that there are no more victims [3][4]. The community needs a solution to avoid the danger of a gas cylinder exploding disaster, as a result of a gas leak.

LITERATURE REVIEW

Microcontroller

Microcontroller is a chip in the form of an IC (Integrated Circuit) that can receive input signals, process them and provide output signals according to the program that is loaded into it. The microcontroller input signal comes from the sensor which is information from the environment while the output signal is addressed to the actuator which can have an effect on the environment. So in simple terms the microcontroller can be likened to the brain of a device/product that is able to interact with the surrounding environment.

The microcontroller is arranged in a single chip where the processor, memory, and I/O are integrated into a single unit control system so that the microcontroller can be said to be a mini computer that can work innovatively according to system requirements as shown in Figure 1. The running system is independent and independent. with the computer while the computer parameters are only used to download instructions or programs. The steps for downloading a computer with a microcontroller are very easy to use because it does not use many commands. The microcontroller provides additional facilities for the development of memory and I/O that are tailored to the needs of the system. The price for obtaining this tool is cheaper and easier to obtain [5].

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Figure 1. Microcontroller

Arduino

Arduino is a microcontroller-based board or open source electronic circuit board in which the main component is a microcontroller chip with the AVR type from the Atmel company. The microcontroller itself is a chip or IC (integrated circuit) that can be programmed using a computer. The purpose of embedding the program on the microcontroller is so that the electronic circuit can read the input, process the input and then produce the desired output. So the microcontroller serves as the brain that controls the input and output processes of an electronic circuit [6].

In Figure 2, the Arduino Mega type 2560, Arduino Mega 2560 is an Arduino-based microcontroller development board using the ATmega2560 chip. This board has quite a lot of I/O pins, 54 digital I/O pins (15 of which are PWM), 16 analog input pins, 4 UART (serial port hardware) pins. The Arduino Mega 2560 is equipped with a 16 Mhz oscillator, a USB port, a DC power jack, an ICSP header, and a reset button. This board is very complete, already has everything needed for a microcontroller.

Figure 2. Arduino Type 2560

Arduino Mega2560 has a number of facilities to communicate with computers, other Arduinos, or other microcontrollers. The ATmega2560 provides four *UART hardware*for TTL (5V) serial communication. An ATmega8U2 lines up one of the USB's top boards and provides a virtual com port for software on the computer (Windows machines will need an .inf file), but OSX and Linux machines will recognize the board as a COM port automatically. The Arduino software includes a serial monitor that allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the ATmega8U2 Chip and USB.

MQ-6 . Gas Sensor

The MQ 6 sensor in Figure 3 is a gas sensor suitable for detecting LPG (Liquefied Petroleum Gas) gas, it can detect LPG gas and includes gas consisting of LPG gas, namely propane and butane gas. This sensor can detect gas at concentrations in the air between 200 to 10000 ppm. This sensor has high sensitivity and fast response time. The sensor output is an analog resistance. The circuit of this sensor is very simple, what this sensor requires is to provide a voltage of 5 V, add load resistance, and connect the output to the ADC [7].

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Figure 3. MQ-6 . Gas Sensor

Solenoid Gas Valve

Solenoid Valve is a faucet that works electromechanically. The faucet will actively work if the input of the solenoid valve circuit gets a high signal which will activate the work of the valve contained in the electric faucet. In this study, the solenoid valve functions to open and close the faucet [8]. The shape of the solenoid valve is shown in Figure 4.

Figure 4 Selenoid Gas Valve

METHOD

In the design of a gas leak detector, the sensor used is the MQ-6 sensor and uses an Arduino Mega-2560 based on an Atmega-2560 microcontroller. The output of this tool is a 2x16 LCD as an output display on the tool, a buzzer as a sound output from the tool when a gas leak is detected, and the solenoid gas valve will close the gas line. The test is carried out starting with measuring the pressure of the gas first. When the sensor detects a gas leak, the buzzer will make a sound, and the 16x2 LCD will display information about a gas leak, then the gas solenoid valve will close the gas line, so that gas will no longer enter the stove or the gas stove will turn off. The whole system consists of inputs, processes, and outputs. The input is the MQ-6 sensor. Process is arduino mega 2560 microcontroller, and output is, Buzzer, LCD, and solenoid gas valve as gas line cover. The block diagram of this design is shown in Figure 5.

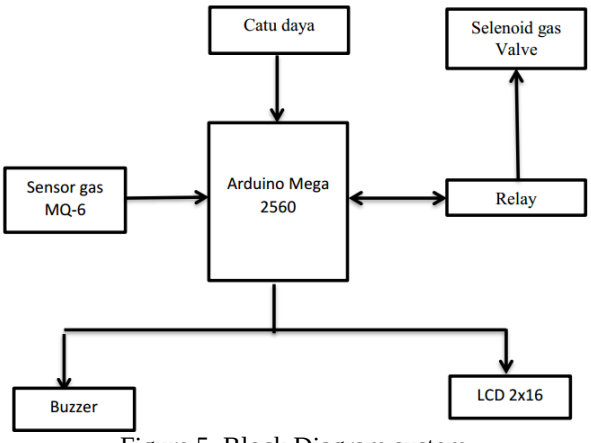

Figure 5. Block Diagram system

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To see the whole circuit, it can be seen in Figure 6. Circuit modules such as LCD, buzzer module and solenoid gas valve are connected to Arduino Mega 2560.

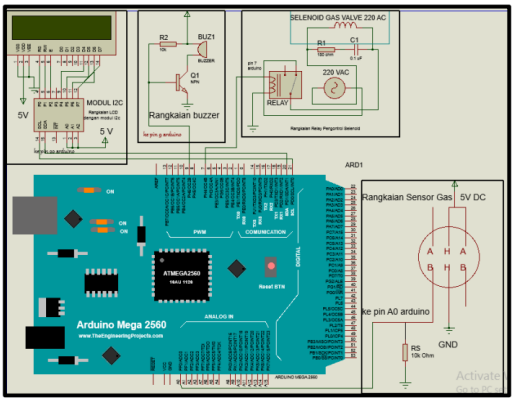

Figure 6. The circuit connected to the arduino

RESULT

In the program above, the LCD will display the sensor voltage when it is in LOW condition and display "Safe Status", or in standby condition. When the sensor voltage reaches a certain number, and is categorized as HIGH, the LCD will display "Gas Leaking Status". The image of the gas sensor voltage test can be seen in Figure 7

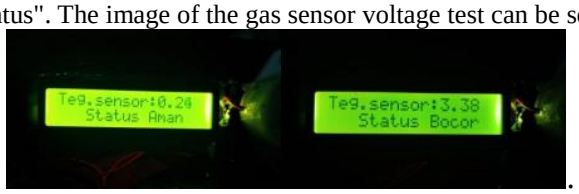

Figure 7. Sensor Testing for Safe and Leaking Conditions

The sensor voltage test is carried out to determine the working voltage of the sensor when there is a gas leak and in standby condition. This test is carried out by programming the microcontroller as needed, which will then display the sensor voltage on the LCD. The results of the test can be seen in table 1.

Table 1. Sensor voltage test

Sensor Voltage (volts)	LCD Display
0.24	Safe Status
1.63	Safe Status
2.11	Safe Status
2.34	Leaking Status
3.40	Leaking Status

DISCUSSION

The sensor reading distance test is carried out to find out how far the gas sensor can detect and how long it takes the sensor to detect the leak. Based on Figure 8 shows that the gas leak sensor can detect at a distance of 2-18 cm, a distance greater than 18 cm the sensor cannot detect a gas leak. The sensor response time is 45.26 seconds.

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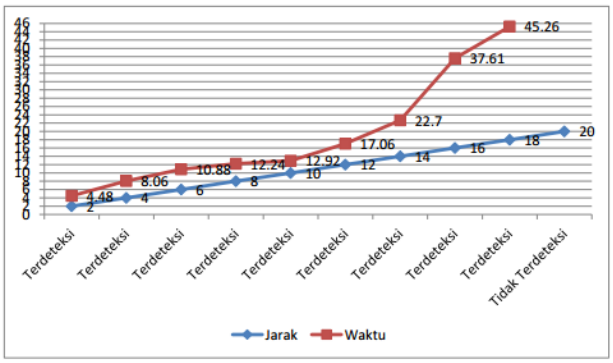

Figure 8. Sensor Reading Distance Test Results

CONCLUSION

The test is carried out by programming the coding on the device so that it displays the voltage on the sensor in standby or LOW and HIGH conditions. From the results of the tests carried out, the device is on standby or in a LOW condition at a voltage of 0.24 volts. The tool will detect or be in a HIGH state at voltages from 2.33 Volts onwards. Tests are carried out to determine the sensor reading distance to detect gas leaks. In this test, the application of gas is carried out by narrowing the gas outlet hole to determine the gas detection limit within centimeters. The results obtained are the maximum distance detected by the gas sensor is 18cm.

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