Gas Leak Detector Prototype Using MQ2 Sensor and Arduino Uno-Based Air Suction Tool

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Abstract

The Indonesian people as users of LPG gas cylinders are increasing from year to year. This situation occurs because of the implementation of a government program, namely the conversion of kerosene to LPG gas with the aim of diverting subsidies and the use of kerosene to gas. Users of LPG gas cylinders are not only limited to urban communities, but now they have penetrated into remote areas of the countryside. The LPG gas cylinders that are most widely used by the community are those measuring 3 Kg and 12 Kg. Because the price is affordable and relatively easy to find in residential areas. The many risks of gas leaks in the community make people nervous, therefore people need a tool that can provide early warning if a gas leak occurs. This gas leak detector uses the MQ2 gas sensor as a gas substance detector and the Arduino Uno as a processing tool. This tool will provide information in the form of sound and warning lights, as for prevention by using a fan that functions to remove gaseous substances in the room. This tool is designed to detect gas leaks in the room.

Keywords : Gas Leak Detector; MQ2 Sensor; Arduino Uno

1. Introduction

The risk of using LPG gas that often leaks is in the gas cylinder or gas installation. The solution given in this research is the manufacture of an early detection device for LPG gas leaks that can be detected quickly. At this time, the LPG gas leak detection tool sold in the community can only be monitored in the area where the device is placed. So to know if there is a gas leak, you can go through the sound of a buzzer and LED lights. In the design of this tool, to detect the presence or absence of LPG gas, an MQ2 gas sensor is used because this type of gas sensor can detect several types of gas and has been produced in the market, as a controller and data processor using Arduino Uno because Arduino Uno is easy to use and implemented into this tool. In addition, knowing LPG gas leaks early can prevent things like explosions and fires.

In previous studies, the use of the MQ2 gas sensor and the SIM800L module was used to detect gas leaks with a wireless connection using SMS 9 Mluyati and Sumardi (2019). In addition, the MQ2 gas sensor is also used in detecting indoor cigarette smoke using Arduino Uno Mauludi, et al (2016). From previous research, no one has made a gas leak detection device that uses an air vacuum.

From the background above, the problem is how to make a tool so that people know more quickly if there is a gas leak? How to design an Arduino Uno-based LPG gas leak detector using the MQ2 sensor and an air vacuum? and how does the LPG gas leak detector work ?. This research discusses how to design, manufacture and test a gas leak detector, describe the function of an air suction using an 8 cm fan and a gas sensor that can only detect a few centimeters of gas. The purpose of this research is to provide knowledge about the operating system of the LPG gas leak detector using the Arduino Uno-based MQ2 sensor, the use of an air vacuum is expected to prevent fires and LPG gas explosions, and to make a simple but widely useful tool in society.

2. Research Method

The design and manufacture of tools are grouped into sections. A circuit block diagram describes a general block of input, process, and output. The design of circuits and components describes the stages of the design of the tools, the components required along with their functions and the overall circuit. The working principle of a series contains a description of the work process in detail. The program flow diagram illustrates the work steps of the tool in the form of a diagram. The design of the microcontroller program contains stages of software programming.(Chandra and Kosdiana, 2020)

The design of the microcontroller program contains stages of software programming. Before compiling a program on the Arduino Uno microcontroller, the first step that must be done is to compile a flowchart that will be used as a reference for programming on the Arduino Uno microcontroller. In Figure 1 is the flowchart of the Arduino-Based Gas Detector, for the first time the microcontroller program initializes the system, declares the variables used and activates the ports needed for each Arduino Uno component (Rusmiadi and Deny, 2007)

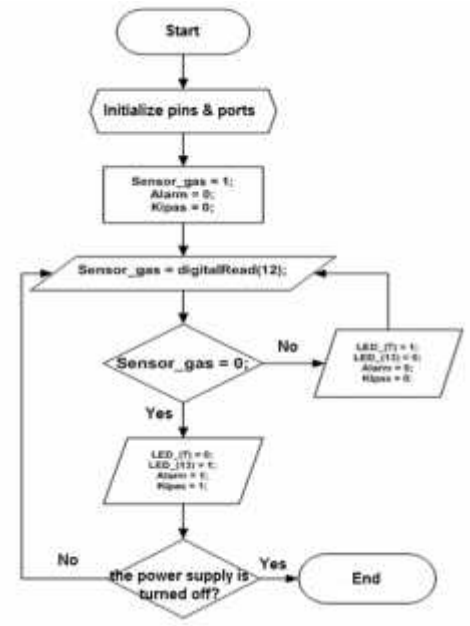


Fig. 1. Program Flowchart

This gas leak detector receives input from the MQ2 gas sensor and will then be processed by Arduino Uno and produce an output in the form of a HIGH / LOW condition which will activate the fan and Buzzer. Arduino Uno works by providing a 5V voltage via USB which is connected to the computer as shown in Figure 2 below. Dian, 2012).

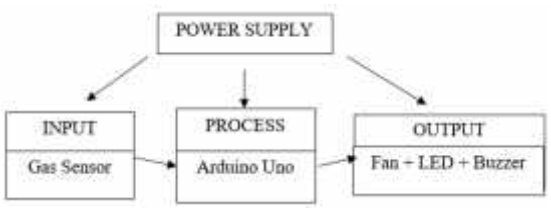


Fig. 2. Circuit Block Diagram

Based on the Circuit Block Diagram in Figure 2, this gas leak detector receives input from the MQ2 gas sensor and will then be processed by Arduino Uno and produce an output in the form of a HIGH / LOW condition which will activate the fan and Buzzer. (Suhariningsih, 2012). Arduino Uno works by providing a voltage of 5V via USB which is connected to the computer. You can see how each block of the existing circuit works, here is a description of how it works:

1. Gas sensor as a gas leak detector
2. Arduino Uno as processing of the input block
3. Buzzer as notification that there is a gas leak
4. Fan as an action to inhale the gas in the room

5. LED as an indicator of the state in the room

3. Result And Discussion

The Arduino microcontroller system cannot work if it is not supported by the software used as a working tool which is applied to the Arduino microcontroller. This design is divided into three stages, namely the design circuit, the program flow diagram, and the Arduino program design. The whole series of gas leak detectors can be seen in Figure 4. This series is connected to a gas leak detector at home, works based on the MQ2 gas sensor, then processed by the Arduino Uno microcontroller so that it will produce a sound output on the Buzzer, changes to the LED , and turned on the fan.(Malik and Juwana, 2009; Zainudin, 2011; Budiharto, 2008)

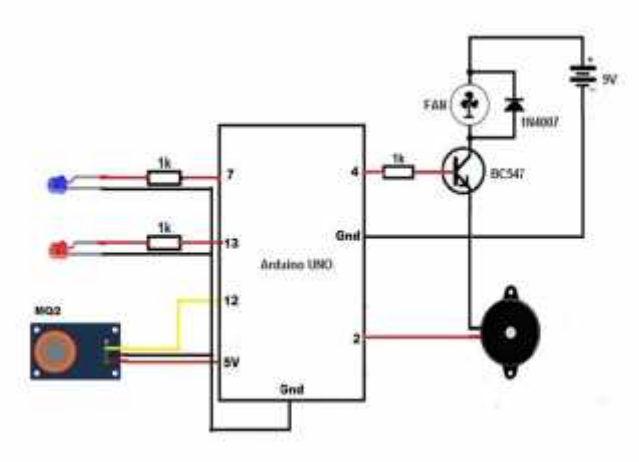


Fig. 4. Circuit Design

The tools prepared before making the tools are Arduino Uno, 2 red and blue LEDs, jumper cables, transistors, resistors, MQ2 gas sensors, buzzers, fans that are arranged into a series before becoming the whole tool. Following are the components before heating the tool in Figure 5 below.

Fig. 5. Before Assembling Tools

Figure 6 (a) shows the input component of the circuit, consisting of the MQ2 Gas Sensor as an input which functions as a gas leak. The tool will work if a gas is detected which is processed by Arduino as a trigger to detect a gas leak. Figure 6 (b) is the output component of the circuit, consisting of an LED, a fan, and a buzzer. The LED functions so that the occupants of the house know information about a gas leak in the house, the fan functions to get rid of the gas in the room, and the Buzzer functions as a warning sign. Figure 6 (c) is the overall component from input, process to output after installation is complete.

(a) (b) (c)

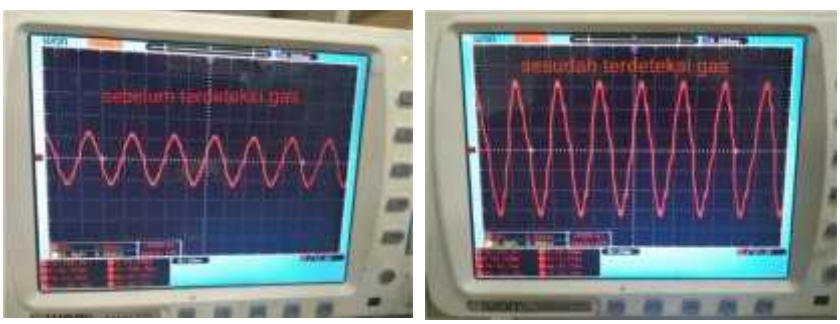
Fig. 6. Circuit Components : a – Input components; b – Output components; c – Overall components

The design of the Arduino Uno microcontroller program is done by writing the program to the Arduino microcontroller memory with the help of the Arduino software. The first step taken for programming is to open the Arduino software. The next step is to create a program. After that the program is compiled first to check whether there is an error or not. The way to compile programs in the Arduino software is by clicking the check button on the software. If there are no errors or errors, the words "Done Compiling" will appear. If the words "Done Compiling" appear, the program can be used and is ready to be uploaded to the microcontroller. The way to upload it is by clicking the arrow buttons on the software. Figure 7 shows the display after uploading the program to the Arduino microcontroller (Harumy et al, 2016)

Fig. 7. Display after Uploading

Technical testing is carried out by measuring the specifications of the electrical quantity acting on the components, carried out using a multimeter which functions to determine the amount of voltage or voltage and using a digital oscilloscope to determine the period, frequency and waves generated by the gas sensor. Measurements are made when the entire circuit in each block of the early warning system in the room is connected. This circuit consists of a series of LEDs, gas sensors, buzzers, and fans which are carried out by taking measurements at a specific point (Agung dan Farhan, 2012; Budiharto, 2004)

Testing using an oscilloscope to find out the waves issued by MQ2, by connecting the positive (+) pin and negative (-) pin. The positive pin (+) is connected to the 5V pin on the microcontroller, while the negative pin (-) is connected to the GND pin on the microcontroller. In the gas sensor, when the gas has not been detected, the wave produced on the oscilloscope is lower than the wave when the gas is detected, which means that the voltage when gas is detected is greater than the voltage when the gas is not detected. Figure 8 shows the results of the experiment on the sensor using an oscilloscope.



(a) (b)

Fig. 8. Test Using the Oscilloscope on the MQ2 sensor: a – before gas is detected; b – after gas is detected

From these experiments, it was concluded that when the MQ2 sensor detects gas or when it receives data input, it has a peak voltage (VP) of 134.4 V and a frequency of 50 Hz, it can be seen in table 1 below.

Table 1. MQ2 Sensor Trial Results

Distance (cm)	Pin A0 (Gas Sensor)	*Analog Output* (AO)	Voltage (V)
1	LOW	51	134.4
2	LOW	52	134.4
3	HIGH	1001	128,2
4	HIGH	1002	128,2

5	HIGH	1005	128,2
6	HIGH	1002	128,2
7	HIGH	1001	128,2

The average value when the sensor detects gas is 50 to 53, this value is a logic active low and will activate the gas sensor. While the average value when the sensor does not detect gas is 1000 to 1007, this value is a high active logic value, which means that the gas sensor does not detect a gas leak.

In the LED circuit, the blue LED is on pin 7 and connected to a 1k resistor so that the LED does not receive excess voltage. The red LED is on pin 13 and connected to a 1k resistor. Arduino Uno will turn on the LED on pin 7 if it does not detect a gas leak, and Arduino Uno will turn on the LED on pin 13 if the gas sensor detects a gas leak, the LED test can be seen in table 2.

Table 2. Led Test Results

No	LED Condition	Voltage (V)
1	off	0,23
2	on	2,11

The following is an LED display when it does not detect a gas leak, this blue LED will continue to light until the gas sensor detects a gas leak. When the gas sensor detects a gas leak, the blue LED will turn off and the red LED will flash until the gaseous substance is not detected, it can be seen in Figure 9.

Fig. 9. LED display before and after a gas leak

For testing the fan sucks air out when the gas sensor detects a leak. The fan uses pin 4 on the Arduino and is connected to a 1k resistor so that the transistor does not receive excess voltage from the Arduino, then there is a diode that is useful for protecting the transistor components from the excess voltage generated by the 9V battery. The

condition of the fan when it is off has a voltage of 7.8V and the condition of the fan when it is on has a voltage of 8.1V as shown in table 3 below.

Table 3. Fan Test Results

No	LED Condition	Voltage (V)
1	Off	7,8
2	On	8,1

The buzzer test sounds when the gas sensor detects a gas leak. This buzzer circuit uses Arduino pin 2 which is directly connected to the buzzer component. The buzzer condition when off has 0.15V voltage, and the buzzer condition when off has a voltage of 5.03V.The buzzer test results can be seen in table 4

Table 4. Buzzer Testing Results

No	Buzzer Condition	Voltage (V)
1	Off	0,15
2	On	5,03

3.1 Functional Test

The functional test is carried out to find out whether the set of tools is functioning and working as expected. This test is carried out on the MQ2 gas sensor, measuring the intensity of the gas in the room, so Pin 12 will give a value of "HIGH", while pin 2 and pin 4 will give a value of "LOW" depending on the intensity of the gas in the room. Pin 12 covers the MQ2 gas sensor, pin 2 covers the buzzer, pin 4 covers the fan, if gas in the room is detected by the sensor, the buzzer, the fan will automatically turn on and the red LED will turn on alternately. Meanwhile, if the sensor does not detect gas, the buzzer, fan will not turn on, and the blue LED will light up while the red LED will turn off. When detecting a gas leak, the red LED flashes, the fan rotates which is useful for removing gaseous substances, and the buzzer sounds as information that there is a gas leak. The results of this experiment can be seen in Figure 10.

(a) (b)

Fig. 10. Functional test tool: a – before gas is detected; b – after gas is detected

3.2 Implementation

If PIN 12 of the MQ2 gas sensor has LOW logic, the sensor will be worth 50 to 55, which means the gas sensor is on because the gas sensor uses LOW logic, the blue LED will turn off if the gas sensor detects a gas substance, while the buzzer, fan and red LED have logic HIGH which means that the buzzer, fan and red LED are on. If PIN 12 of the MQ2 gas sensor has HIGH logic, the sensor will be worth 1000 to 1007, which means that the gas sensor is off, while the buzzer, fan and red LED have LOW logic, which means that the buzzer, fan and red LED are off, then the blue LED will light up. The results of this experiment can be seen in table 5.

Table 5. Experiment Results Of Tool Design

Gas Intensity	Pin 12 (Gas Sensor)	Pin 2 (Buzzer)	Pin 4 (Fan)	Pin 7 (Blue LED)	Pin 13 (Red LED)	Battery
51	LOW	HIGH	HIGH	LOW	HIGH	1
52	LOW	HIGH	HIGH	LOW	HIGH	1
1001	HIGH	LOW	LOW	HIGH	LOW	0
1002	HIGH	LOW	LOW	HIGH	LOW	0
1005	HIGH	LOW	LOW	HIGH	LOW	0
1002	HIGH	LOW	LOW	HIGH	LOW	0
1001	HIGH	LOW	LOW	HIGH	LOW	0

4. Conclusion

From the results of tests that have been carried out on the Arduino Uno Microcontroller-based Gas Leak Detector prototype, it can be concluded that:

1. A prototype gas leak detector designed to work in accordance with the research objectives based on the trials that have been carried out.
2. When the sensor knows the gas leak in the room, the input will be sent to the microcontroller with the MQ2 gas sensor module for processing, resulting in an output in the form of alternating red LEDs, the 5 volt buzzer lights up and the 12 volt fan lights up.
3. In this tool the fan only uses 9 volts of power.
4. The gas sensor can only detect gaseous substances at a maximum distance of 2 cm

To make a simple tool you can use minimal costs, if you choose an unsuitable component you can find a replacement by asking or looking for components with the same value and function, and in making a circuit you must be very careful and careful, if you make a circuit wrong then the appliance cannot function properly. For the

development of the tool, an Android-based Internet of Things (IoT) feature can be added so that there is a function to send a message to the owner of the residence when gas is detected, and can turn off the device with a remote control.

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