Gas Leak Detection in Laboratory Pharmacy using Fuzzy Logic Method

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Abstract. The use and utilization of gas in various aspects of daily activities is commonplace. One aspect is the use of LPG gas in the Pharmaceutical Laboratory. By paying attention to this, there is a big risk, namely the potential for a fire to occur when LPG gas leaks. In an effort to improve the prevention of work accidents, a system is needed that can automate in providing triggers for both the prevention system and the delivery of laboratory state status information. Therefore we need a system that can support in carrying out gas readings and conditions in the laboratory. Arduino as a microcontroller in processing the system is supported by MQ-6 and DHT22 LPG gas sensors as detection in reading laboratory situations. Early detection in the form of an active buzzer and fan installed in the Laboratory is expected to reduce the level of risk of such an accident. Systems that work automatically in providing information to related parties can have an earlier countermeasure impact.

Keywords: LPG, Gas Sensor, Laboratory, Monitoring, leakage

1. Introduction

Laboratories become access to various scientific fields, especially those that will be discussed, namely the pharmaceutical laboratory. One of the elements in the pharmaceutical laboratory is heating of various chemical and non-chemical substances. Gas leaks in the Laboratory must be of particular concern because it will have an impact and indicate an explosion and fire. Therefore, a system is needed that can perform automation in detecting when a gas leak occurs and how to be able to overcome it.

The system that can perform this automation must be able to perform and create a safe and standardized pharmaceutical laboratory scope. The main system is a detector on a device that can detect a gas leak. The existence of a standardization such as temperature and humidity must be a point that is considered (Edar, 2021). Fuzzy logic can make an output whether a pharmaceutical laboratory is safe and comfortable to use in accordance with existing standards. Research by Cokorda Gde Indra Raditya (Raditya et al., 2022) utilizes telegram as a medium in making notifications.

The working principle of the existing system was previously carried out by Ilham Istiyanto, Rizki Solehudin, Yosari Nofarenzi and Tyas Setiyorini with the journal title (Istiyanto et al., 2022) "LPG Gas Leak Early Detection Tool With MQ2 Sensor And IoT-Based Fire Sensor Using NodeMCU" using the same concept, namely when a gas leak occurs, the microcontroller will respond by sending a notification to the telegram and giving a trigger to the fan to turn on. Based on the research that has been made before, it feels that there are weaknesses, namely the absence of data records that can be used as a

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reference for analysis, there is no command feature that can be done from a telegram and there is no system that can display data to a web.

The data record is displayed on a web-based information system, some components of the sensor value that can be analyzed will be displayed. As a special place, the pharmaceutical laboratory also has a different characteristic (Akbar & Kunang, 2021) from other places such as homes, kitchens and offices. In addition, access to information on various sensor data values in the Pharmacy Laboratory Gas Leak Detection Using Fuzzy Logic Method.

The data can be retrieved at any time with a predetermined command on the telegram application. The result is the final output, namely a prediction analysis model. The results of various calculations can conclude whether it is safe when entering the pharmaceutical laboratory or not (Margarini et al., 2021).

2. Research Metodology

The methodology used in this research is object-oriented methodology. The object-oriented method is a way of how software systems are built through a systematic object approach mechanism.

2.1 Stages of Research

The model used for the software and hardware development stages is the prototype development model. The prototype model is a process of making software and hardware that is carried out in stages and structured by going through the stages of its creation.

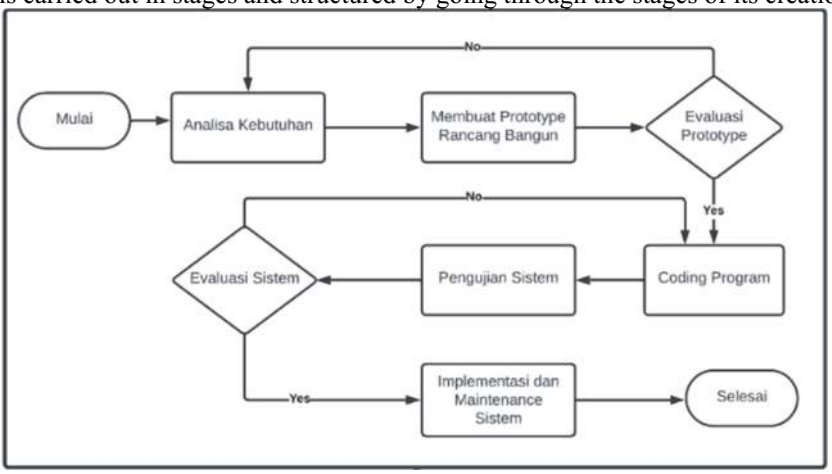

Fig 1. Flowchart of Prototype Modelling

In detail, it can be seen in Figure 1 that an evaluation will be carried out when a need arises or there is a need for a prototype. improvements in both software and hardware.

2.2 System Design

The system works by reading data values from the MQ-6 and DHT-22 sensors. The MQ-6 sensor provides data in the form of gas levels detected around the sensor area, while the DHT-22 sensor provides data in the form of temperature and humidity around the sensor coverage area (Kevin Diantoro, 2020). Telegram can do 2-way communication, which can receive information and can also send commands to the microcontroller. Previously, the microcontroller had also processed the problem solving method, namely fuzzy logic.

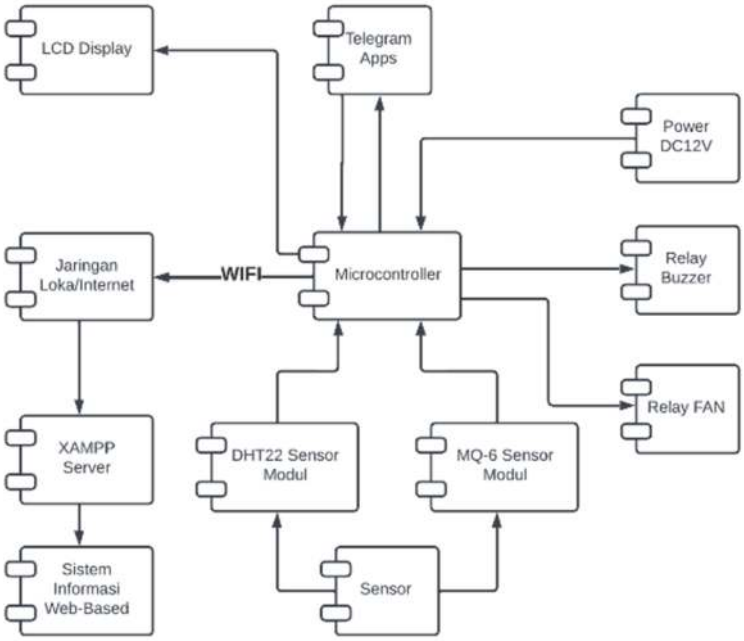

Fig 2. Component Diagram

2.3 Hardware Design

The hardware system is made by utilizing the MQ-6 sensor (Fachrureza et al., 2021). The use of the sensor is intended to be able to read the gas levels contained in the area around the installed sensor, namely the laboratory area. The output issued by the gas sensor is a voltage that can determine whether LPG gas is detected or not. Through calculations that the LPG gas sensor is technically read at a voltage above 2 Volts. The microcontroller send data to a server that has been prepared beforehand, namely a computer unit that has been set up so that it can manage the database.

The data transmission uses a wifi connection that is already built-in in the microcontroller device so that it can be connected to the available network. The data is in the form of temperature, humidity, fuzzy values and also the IP address of the microcontroller device.

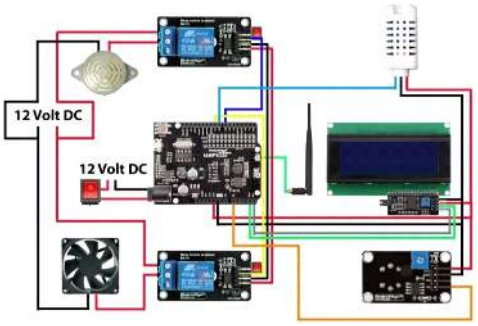

Fig 3. Hardware Design

2.4 Fuzzy and Analysis of System

Software design serves to perform calculations in synergizing or connecting between software and hardware so that the expected results are obtained.

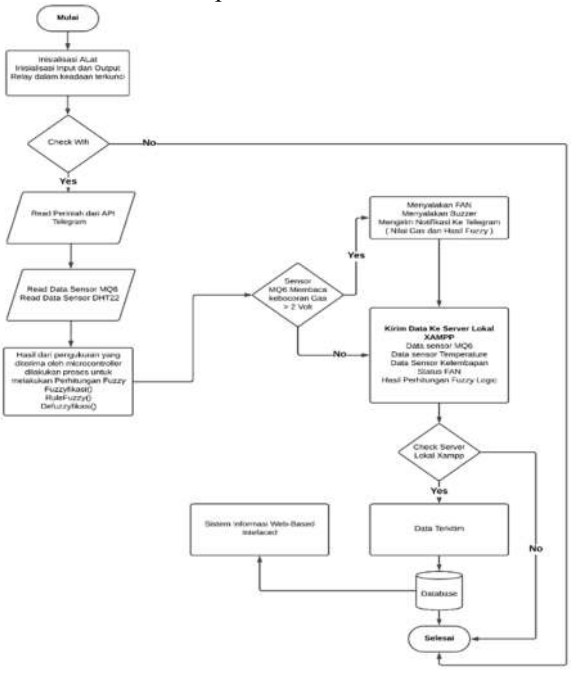

Fig 4. Flowchart of System Workflows

In the study focuses on a goal, namely to implement by maintaining room temperature within a certain temperature limit by comparing the wind speed on the air cooler and also the number of people in the room. In this study, a conclusion was obtained that the fuzzy logic problem solving method can help maintain room temperature in the temperature range 26.8 C - 28.1 C with an error of 3.6%. In this study, the fuzzy method used is Sugeno fuzzy (Hayami et al., 2021).

There are two inputs, namely gas level readings and temperature inputs. The first input is the result of the MQ-6 sensor reading, while the temperature input is the reading result of the DHT-22 sensor. DHT-22 SENSOR. Here are the fuzzy sets of gas and temperature levels.

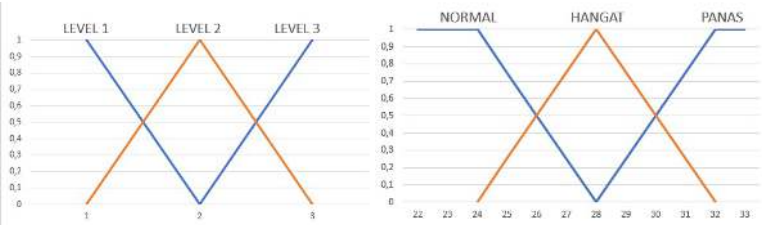

Fig 5a and 5b. Gas Level Function and Temperature Function of Fuzzy Level

The next stage is defuzzification. This settlement uses the Sugeno type WA (Weighted Average) method. The output set has each predetermined value, which is as follows.

Table 1. Fuzzy Result Status

No	Status	Nilai
1	Aman	20 s/d 49
2	Berbahaya	50 s/d 99
3	Sangat Berbahaya	1

3. Discussion

3.1 Implementation

The overall workings of this system are an MQ-6 sensor module that reads LPG gas levels, the results of the sensor voltage measurement will detect whether the gas levels in the laboratory are within safe limits or not. Another module, DHT22, reads the temperature and humidity in the room. The value of LPG gas levels and temperature values are processed to produce a problem solving method, namely fuzzy logic. The fuzzy value is used as a reference to be able to determine whether the laboratory is suitable for use or not.

When LPG gas levels are detected in the laboratory, it will automatically turn on the fan and buzzer. The fan function is to be able to decompose LPG gas so that it is in a wider range, while the buzzer function is to be able to provide an early warning to every user who is in the laboratory room. In the telegram group there will be information in the form of gas voltage values and fuzzy values. This indicates that the laboratory is in an unsafe condition. All data and values must be recorded on a database server and can be displayed on a website-based information system. Fuzzy output values, automation processes on relays, sending notifications to telegrams and displaying data on information systems indicate the system can work well.

3.2 System Testing

This implementation consists of several stages, namely database implementation, web-based interfaced implementation and telegram connection implementation. The database is used to be able to store various existing records, these records are values

sent from the microcontroller. The value is in the form of a value generated from the sensor module or the results of calculations that have previously been carried out by the fuzzy process on the microcontroller.

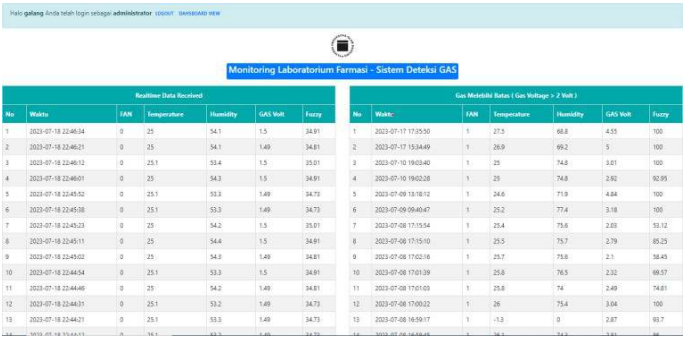

Fig 6. Monitoring First Pages

This test is carried out to determine the function and suitability between input and output. Testing was carried out including the results of measuring input LPG gas levels, temperature and humidity (Rustami et al., 2022). As an output, namely in the form of tool functions and how the system can receive commands and send values and notifications to various desired platforms. The tests also carried out on telegram apps.

Table 2. Result of Fuzzy on System

Temperature (℃)	Kadar Gas (V)	Nilai Fuzzy (%)
27.3	1.2	28.28
26.9	1.31	31.32
27.1	1.32	31.37
26.4	2.66	79.72
27.1	2.09	57.76
26.8	2.83	87.31
29.4	1.67	55.86
30	4.96	100

4. Conclusion

In the results previously described, the gas detection process can provide a good impact and response when a gas leak occurs. The gas leak detection process can be done well, namely by the trigger on the relay which functions to provide a warning and also as an actuator to turn on the exhaust fan which can decompose gas levels in the laboratory. The system can also notify well to telegram apps and send data to the server computer properly. Fuzzy values can perform calculations by comparing the value of gas levels and temperature. The fuzzy value results are appropriate and provide a reference that can convince users to enter the Laboratory.

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