D.3. *Sensor MQ2 Analysis*

For LPG gas sensor used MQ2 sensor. MQ2 is an electronic component for detecting hydrocarbon gas levels such as iso butane (C4H10 or isobutane), propane (C3H8 or propane), methane (CH4 or methane), ethanol (ethanol alcohol, CH3CH2OH), hydrogen (H2 or hydrogen), smoke, and LPG (liquid petroleum gas). This gas sensor can be used to detect gas leakage at home and factory, in this research MQ2 is used to detect leakage of LPG.

By using MQ2 hydrocarbon Gas Sensor, the researchers can detect the levels of hirdokarbon gas in the air by connecting the MQ2 sensor to the Arduino nano microcontroller. Thus the researcher can make electronic devices to determine the action based on readable data, such as sending notification on the smartphone android warning sign of danger when gas leak is detected.

The output of this sensor is analogue resistance which can easily be converted to voltage by adding one ordinary resistor can also use potentiometer so threshold detection sensitivity can be adjusted as needed. By converting this impedance into voltage, the sensor reading result can be read by ADC pin (analog to digital converter) on arduino nano microcontroller. This MQ2 gas sensor can be installed close to the gas installation so that when LPG gas leak occurs, this sensor can easily detect it. The description of how the sensor works can be seen on the Figure 5.

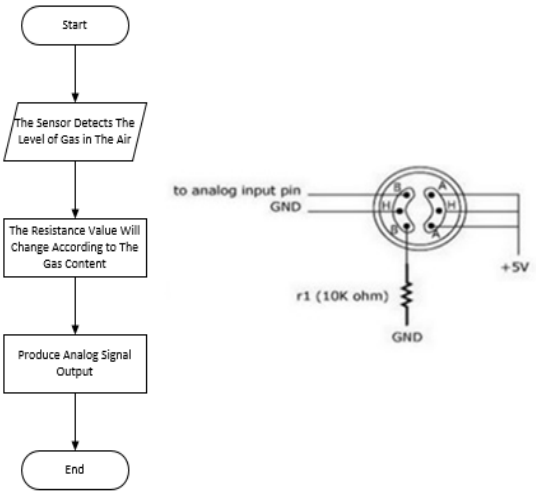

Fig 5. How Sensors Works

D.4. *Relay Switch Analysis*

This research uses a switch as an electrical voltage relay. A relay is an electromechanical component that acts as a switch operated by an electric voltage. The relay consists of two parts namely the Coil electromagnet and a set of switch contacts. Relays use electromagnetic principle to drive the Switch Contacts so that with a small electric current (low power) can conduct higher voltage electricity. For example, with Relays using 5V and 50mA Electromagnets capable of moving Armature Relay (which serves as a switch) to conduct 220V.

E. *Functional Needs Analysis*

This section discusses the use case diagrams of mobile applications, class diagrams and relational schemes of the table structure on the web backend.

E.1. *Use Case Diagram Mobile Application*

Use Case Diagram is a diagram showing the functionality of a system or class and how the system interacts with the outside world and describes the system functionally visible to the user. From the identification of actors involved above then Use Case Diagram can be described as follows in Figure 6.

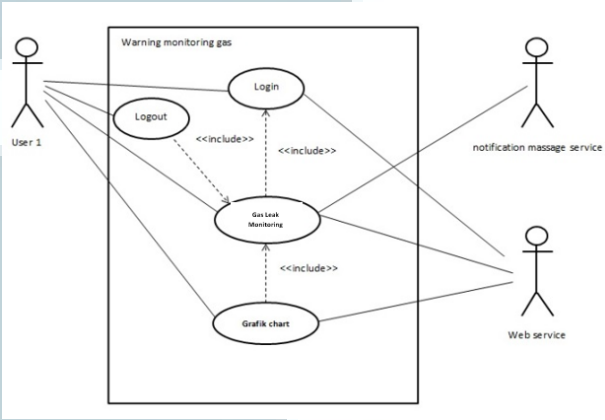

Fig 6. Use Case Diagram

E.2. *Class Diagram Aplikasi Mobile*

Class Diagram is a structural diagram that modeled a set of classes, interfaces, conditions and relationships. The class diagram is depicted with a box that is essentially divided into three parts, namely class name, attribute, and operation. For the class diagram in this study are as follows in Figure 7:

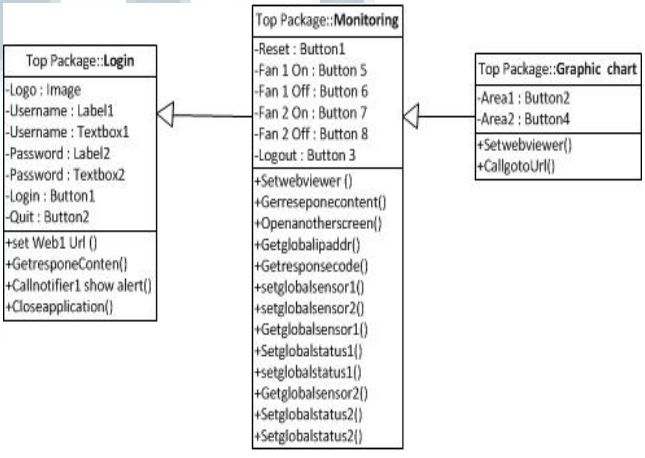

Fig 7. Class Diagram

E.3. *Table Structure Database*

The table structure describes the detail of the table containing fields, data types, data lengths, and other information. Figure 8 is a description of each of these tables databases.

Fig 8. Table Structure Database

F. *Implementation and System Testing*

Stage Implementation and system testing is a design translation phase based on the results of analysis into a particular programming language and application of software built in the real environment.

F.1. *Hardware Implementation*

The hardware used to implement the system can be seen in the table III and Figure 9 below.

TABLE II. Spesification Hardware Implementation

Hardware	Spesification
Processor	Intel Core i3
Mini PC	Raspberry Pi 3
Mikrokontroler ADC	Arduino Nano
Relay	2 channels
Sensor	MQ2
Fan Voltage	5 Volt

Fig 9. Hardware Implementation

F.2. *Raspberry Implementation*

In Raspberry pi can be seen the value generated by the MQ2 sensor sample results. Visible on the image the value changes when there is a leak in the gas..

MQ2 sensor sample results when no leaks can be seen in the Figure 10.

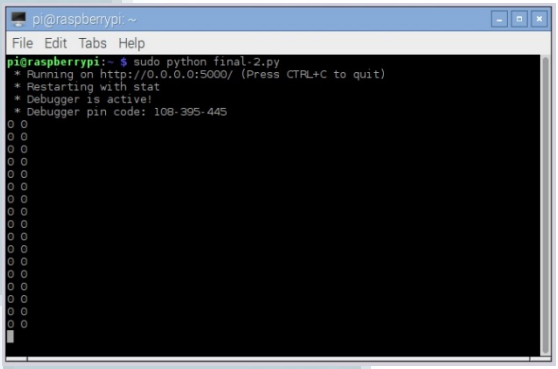

Fig 10. Sensor Value Without Gas Leakage

MQ2 sensor sample results when have leaks can be seen in the figure 11.

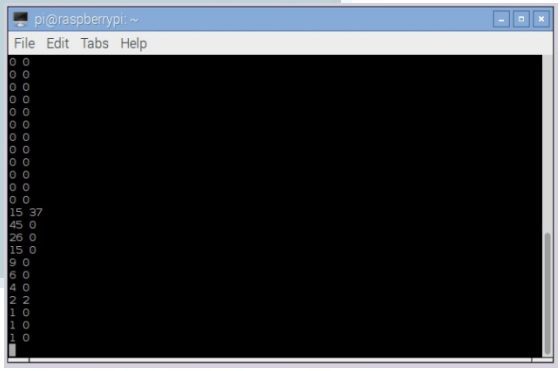

Fig 11. Sensor Value With Gas Leakage

F.3. *Mobile Android Implementation*

Here is an implementation of several interfaces of the android mobile platform system that can be built.

F.3.1 *Login Page Interface*

In login page interface, user fill in Username and Password on the login page to be able to enter Warning Monitoring Gas Application. The appearance can be seen in the Figure 12.

Fig 12. Login Page Interface

F.3.2. *Chart Page Interface*

Chart Charts On this page Users can see images of Graphic Chart from MQ2 sensor that detects gas leak in warehouse.

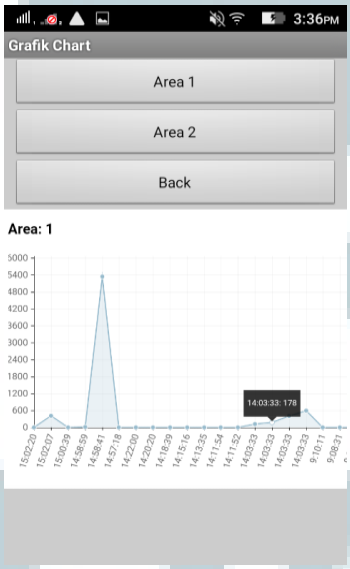

Fig 13. Chart Page Interface

F.4. *Website Implementation*

Chart graph display on server can be seen through web application. In this web application can be seen graphs, historical tables, and time tables of events.

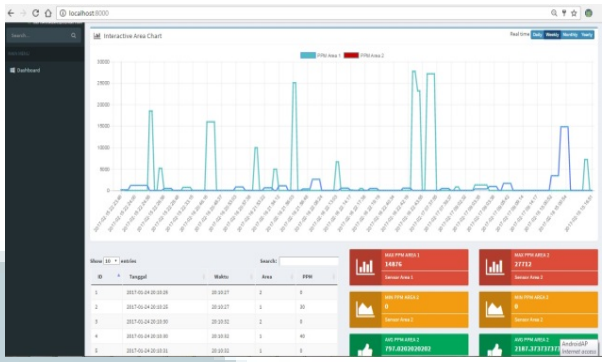

Fig 14. Chart Page Interface on Web Server

G. *System Testing*

This software testing uses two stages, the first stage is alpha testing that focuses on software functionality built with black box testing methods. The second stage is beta testing that focuses on user assessment of the software built, data collection methods in the form of interviews to parties who involved in the system. Alpha testing is a test of functionality against software built. Alpha testing is done by users who use software that has been built previously and accompanied by the builder. The builder notes the mistakes and problems felt by the user. Alpha testing is divided into three stages, namely test scenario, case and test results, and test conclusions.

G.1. *Gas Leak Monitoring Testing*

Table III below is the result of blackbox testing of gas leakage with this application.

TABLE III. Gas Leak Monitoring Testing

Test Cases	Test Scenarios	Expected Results	Test Result
Gas leak monitoring (status "safe", "alert") and notification	User gets status information ("safe", "alert")	Displays status ("safe," "alert")	[√] Succeed [ ] Failed
	User Gets notification in case of gas leak	Displays notifications of text and vibration	[√] Succeed [ ] Failed
	Users press the button ON button to turn on the Exhaust Fan no 1	Exhaust fan no 1 is on	[√] Succeed [ ] Failed
	Users press the OFF button to turn off exhaust fan no 1	Exhaust fan 1 is off	[√] Succeed [ ] Failed

Test Cases	Test Scenarios	Expected Results	Test Result
	Users press the ON button to turn on the exhaust fan no 2	Exhaust fan 2 is on	[√] Succeed [ ] Failed
	Users press the button OFF button to turn off exhaust fan no 2	Exhaust fan 2 is off	[√] Succeed [ ] Failed

Figure 15 below shows an example of test scenario implementation result that the user gets the status of safe or alert information. On this page the user can see the status of the gas condition in case of leak it appear notification in the form of a warning that there has been a leak.

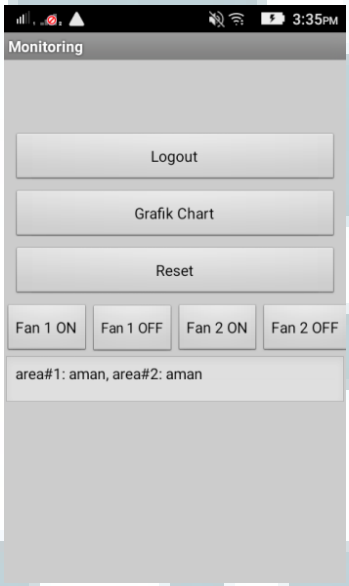

Fig 15. Monitoring Page Interface

G.2. Blackbox Testing Conclusion

Based on the results of blackbox testing that has been done can be drawn the conclusion that the process still allows an error, but the system functionality can produce output, validation and error handling process is expected.

IV. CONCLUSION

Based on the results obtained from research conducted this study, it can be concluded :

1. Security system for leakage on gas LPG installation in chemical warehouse at The Company in this research can be improved
2. Time to monitor gas installation condition in chemical at The Company in this research becomes more efficient

Furthermore, this monitoring system can be developed in all aspects of safety not only used for gas leakage only but can be developed to monitor all security systems in The Company, for example wastewater disposal security systems, security systems on production machines and so on so that all systems can be centralized and easy to monitor.

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