Prototype of Gas Leak Detector System Using Microcontroller and SMS Gateway

Marchel Thimoty Tombeng
Fakultas Ilmu Komputer, Universitas Klabat
Jl. Arnold Mononutu Airmadidi, Minahasa Utara, Sulawesi Utara, Indonesia 95371
Jurusan Teknik Informatika

e-mail: **marcheltombeng@unklab.ac.id**

Abstract

On of the very important things in human life is home safety. Home Safety refers to the awareness of risks and potential dangers in and around home which may cause bodily harm, or even death. Awareness and vigilance is indispensable in preventing the threatening risks and potential dangers. Therefore, people needs a timely warning information about gas leak for prevention of home safety threatening risks and potential dangers. This warning information will allow people, users, or residents to reduce the risks and potential dangers caused by gas leak, especially when they are away from home. This paper describes the development of system technology regarding the gas leak detector which integrates the MQ2 gas sensor, Arduino Uno R3 Microcontroller and the Sim900 SMS Gateway.

Keywords : MQ2 Sensor, Arduino Uno R3, Sim900, LPG

1. INTRODUCTION

One of the very important things in human life is home safety. The home safety refers to the awareness of risks and potential dangers in and around a home which may cause bodily harm, or even death [1]. There are several kinds of risks and potential dangers which threaten the safety of many house and lives. One of the risks and potential dangers is the gas leak which may affect to serious damage of a house.

To prevent the threatening risks and potential dangers, awareness and vigilance is absolutely necessary. Human requires timely warning information regarding the occurrence of gas leak for prevention of home safety threatening risks and potential dangers. By providing with that such warning information allow people, users, or residents to reduce the risks and potential dangers of the gas leak, especially when they are away from home. This background is the major motivation behind this study and the development of the warning information system to help people or residents monitoring their home safety. This study is to develop a technology system that integrates the LPG Sensor Detector, Microcontroller, and SMS Gateway Module. Moreover, this study will develop a low cost, quick response, easy to use and implement and low maintenance gas leak prototype.

The procedures of the Gas Leak Detector System are as follows: to monitor the parameters of LPG leak we use Gas Sensor, all the parameters produced by the sensor will be sent to control centre (microcontroller) using cable. Afterward, the microcontroller will process the parameters/data and then give warning message and alert via SMS Gateway and Alarm to users whenever the input parameters/data shows exists gas leak in the air. The alarm will remain on until the gas sensor detects no gas leak in the air.

2. RESEARCH METHODOLOGY

In performing this research study, the Prototyping Process Model was chosen as the basic theoretical framework. Prototyping is a engineering-based approach for developing a software of system. This approach is an iterative process that involve a close working relationship between designer and user through feedback process.

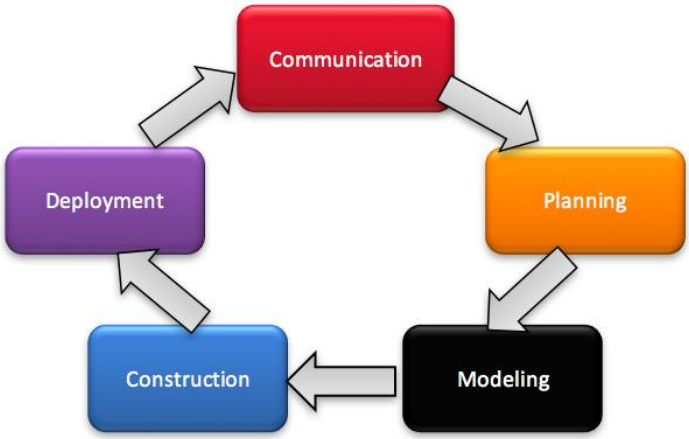

Figure 1 Prototyping Process Model

Figure 1 show several process stages [2]:

1. Communication: the objective is to gather all the information required in developing the system. Communication is done through direct relationship between user and the researcher/developer to identified all the information and tools that are needed to support the system development.
2. Planning: in this stage, rapid planning is performed after all the information of are identified in the previous stage.
3. Modelling: in this stage, the researcher analyses the requirement and then design the system.
4. Construction: in this stage, the result of design and analysis are translated into programming language in other word the system is constructed.
5. Deployment: after the system has been constructed/developed, the system is distributed to user, afterward user evaluates and give feedback towards the application that has been made. Feedback is directly given and used for the next application development or iteration onward.

2.1 Conceptual Framework

Based on the Prototyping Theory stated above, the conceptual framework design will be shown in the following Figure 2.

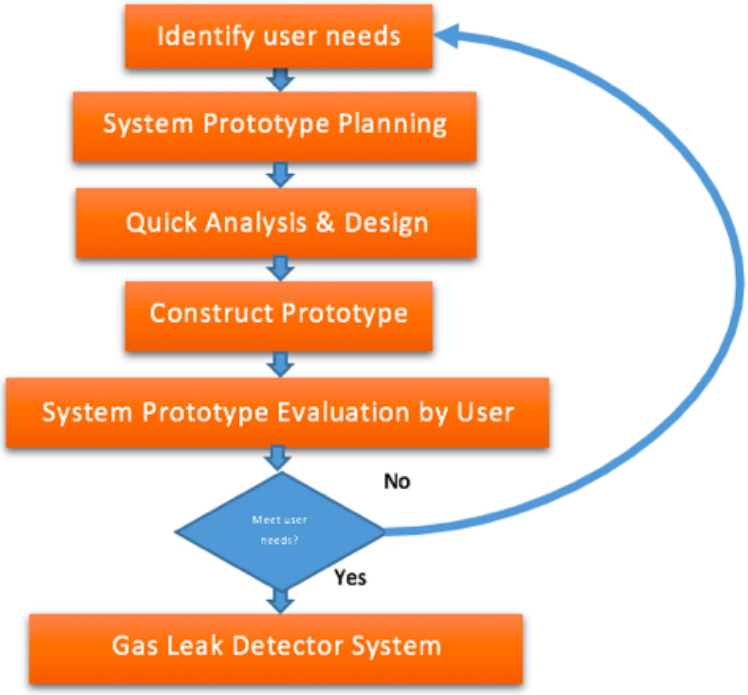

Figure 2 Conceptual Framework

2.2 System Architecture Design

The workflow process architecture of the system is shown in the following Figure 3.

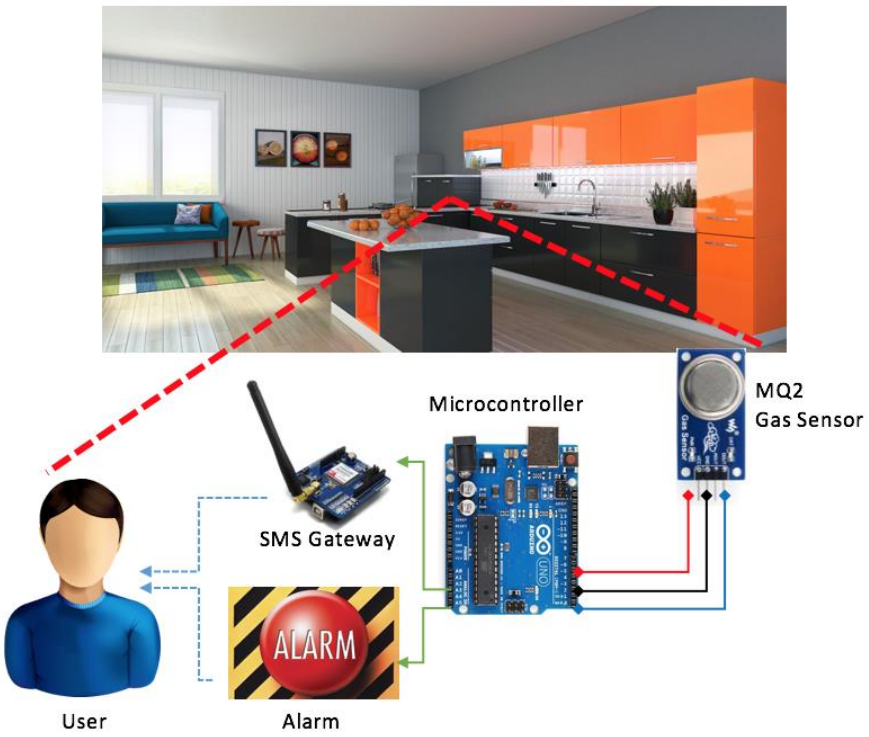

Figure 3 System Architecture Design

The MQ2 sensor is used for sensing the gas in the air whenever there is a gas leak, this will be done by reading the part per million (ppm) gas ratio parameter in air, this is referred as raw data. The MQ2 sensor then convert the raw data into digital signal which contain HIGH or LOW. The converted parameter is then sent to the Arduino Uno R3 (Microcontroller) to be processed. Afterward, the system in Microcontroller evaluates whether the input gas parameter is LOW, that means the gas leak is occurred. The system then sent the information to the user via Sim900 SMS Gateway and directly set the alarm notification to On. The Alarm will remain on until it exceeds 180,000 milliseconds or equivalent to 3 minutes.

2.3 Hardware Implementation

There are three modules included in this system. First is the sensor module, which contains of three MQ2 sensors. Second is Processing module, where the Arduino Uno R3 Microcontroller are chosen. Third is the SMS Gateway module, where the Sim900 GSM is chosen. And the last is the Alarm module. For the hardware schema description is shown in following Figure 4.

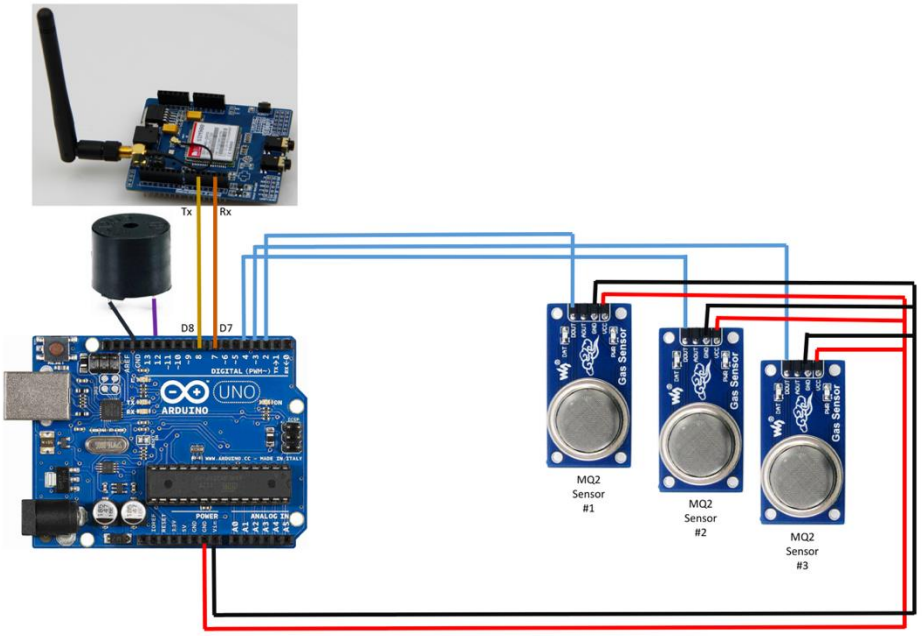

Figure 4 Hardware Schema

3. TESTING AND EVALUATION RESULT

The Figures below describe the result of the development of the gas leak detector system. The Figure 5 shows the sensors component. The sensors component shown in Figure 5 contain the MQ2 Semiconductor sensor for combustible Gas. MQ2 gas sensor use the SnO_2 sensitive material which with lower conductivity in clean air. The sensor's conductivity is higher along with the gas concentration rising whenever the target combustible gas exists. MQ2 gas sensor is suitable for sensing gas such as LPG, Propane, and Hydrogen, and also Methane and other combustible steam, and it is with low cost and suitable for different application.

Figure 6 and Figure 7 show the inside of the gas leak detector system module which contains Arduino Uno R2 Microcontroller, SIM900 SMS Gateway, and Arduino Shield. Arduino Uno uses the ATmega328. It has 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator, an ICSP header, a reset input, a power jack, and a USB connection, and

it contains everything needed to support the microcontroller. The SIM900 is a complete Quad-band GSM/GPRS solution that can be used in any applications. SIM900 perform GSM/GPRS 850/900/1800/1900MHz for voice, SMS, Data, and Fax in a small form factor and with low power consumption. And for the Arduino Shield is a board that can be plugged on top of the Arduino PCB extending its capabilities.

Figure 8, Figure 9 and Figure 10 show the buzzer (alarm) and the Sim900's Antenna component. Figure 11 shows the message notification on smartphone device.

The Gas leak detector system has been completely developed and has been evaluated by user, and for the result can be seen in Table 1.

Figure 5 Sensor Component

Figure 6 Inside Module and power adapter

Figure 7 Arduino Microcontroller and shield

Figure 8 Outside Appearance of gas leak detector system module

Figure 9 Buzzer (alarm) component

Figure 10 Sim900 Antenna

Figure 11 Message notification sent to recipient 6285288877755

Table 1 Evaluation Result

No	Evaluation Task	Data & Tools	Expected Output	Actual Output
1	Detect Gas Leak	Gas Lighter, LPG	Gas Leak Detected	Gas Leak Detected
2	Buzzer/Alarm Alert (within duration of 180,000 ms	Buzzer	Alarm is running for 180,000 ms	Alarm is running for 180,000 ms
3	Send message	Recipient number: 6285288877766, Sim900, Samsung s7 Edge	Message sent to recipient	Message sent to recipient

The evaluation result in Table 1 shows that the expected output and the actual output from evaluation task number 1 to evaluation task number 3 exists no differences and this indicates that the gas leak detector system is running successfully.

5. CONCLUSION

This gas leak detector system contains two features, this includes the SMS Gateway feature for only sending warning information regarding the gas leak to user, and the Alarm for the warning alert. There is some improvement which can be applied for the future work, such as regarding the SMS Gateway, it need to enhance with feature such as notifying the user whenever the remaining credit balance is insufficient. Another thing which can be enhanced is regarding the sensor, the sensors in this module do not include somewhat notification for notifying the user whenever the sensor not working properly or not connected to the microcontroller for some cases, therefore, it is recommended to add this kind of features in the future work for better refinement.

REFERENCES

[1] Tombeng, M. T. (2015). Smarthome for Home Safety and Monitoring System Using Smartphone Application and Zigbee Wireless Communication. Konferensi Nasional Sistem dan Informatika. ISSN: 2460-8378, p. 402. Bali: STIKOM

[2] Pressman, R. S. (2005). *Software Engineering: A Practitioner's Approach.* McGraw-Hill Higher Education.

[3] Kassar, R. A., & Tembhurnikar, N. P. (2013). WSN Based Air Pollution Monitoring System. *International Journal of Science and Engineering Application*, pp. 55-59.

[4] Mukherjee, A. (2016). *Project Hub*. Retrieved August 08, 2016, from Arduino: https://create.arduino.cc/projecthub/Aritro/smoke-detection-using-mq-2-gas-sensor-79c54a