UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A GAS ALERT SYSTEM BY USING ARDUINO

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer Systems) (Hons).

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Engineering Technology (Computer Systems) (Hons.). The member of the supervisory is as follow:

…………………………………

Dr. Abdul Kadir

ABSTRAK

Dalam kehidupan seharian manusia, alam sekitar merupaka isu serius yang berkait dengan kesihatan manusia. Oleh itu, isu persekitan dia tempat kerja telah diperbinacangkan dengan serius bagi meningkatkan kesedaran and sebagai tanggungjawab terhadap kesihatan orang ramai and pekerja mengenai pencemaran alam sekitar. Antara gas yang berbahaya ialah karbon dioksida , gas penyejuk dan gas cecair petroleum (LPG) yang mana terhasil dari proses pembakaran yang tidak sempurna. Di dapur restoran, berlakunya kebocoran gas dapur dan terdapat juga gas -gas yang mudah terbakar hasil dari proses mencuci dan memasak. Gas- gas ini boleh menyebabkan letupan atau kebaran dan ia berbahaya kepada pelanggan, pekerja mahupun pemilik restoran. Keadah tradisional dengan menggunakan sabun untuk mengesan kebocoran gas pada gas memasak merupakan kaedah yang sering digunakan oleh kebanyakkan pengguna. Ia juga merupakan kaedah yang tidak effektif jika terdapat kejadian kebocoran gas diwaktu restoran ditutup. " A Gas Alert System" merupakan jalan penyelesaian bgi kes ini, yang mana ia akan menghantar amaran kepada pemilik restoran sekiranya ia mengesan kehadiran gas yang tidak normal dengan menggunakan alat pengesan gas MQ 2. Amaran akan dihantar dengan menggunakan teknologi GSM(Global System for Mobile). Melalui kaedah pengesanan ini, ia merupakan cara yang efektif bagi mengesan kehadiran gas yang mudah terbakar mahupun kebocoran gas. Hal ini kerana, keupayaan manusia untuk mengesan kehadiran gas yang tidak normal ini adalah terbatas.

ABSTRACT

In human's daily life, environment gives the most significant issues which is related to human health. Therefore, environment and workplace air quality issues are seriously discussed to increase the awareness and responsibility regarding the threat on the environment towards public and workers health. Most of the dangerous gas such as carbon monoxide (CO), refrigerant gas and liquefied petroleum gas (LPG) is the compounds that are produced by incomplete combustion. In kitchen restaurant, the LPG leakage and the presence of combustible gas which are produced from cleaning and cooking process. These will cause explosion or fire and may harm the restaurant worker or even customer. The traditional method use for most people to detect cooking gas leakage by using soap water are not effective if the leakage occur when the restaurant are closed where no one there. A Gas Alert System is the best solution in this case as it will send an alert to the owner of the restaurant if it detect the presence of abnormal gas condition in the restaurant. This system also provide a precaution step by activating kitchen exhaust fan if the concentration of gas in warning stage and activating alarm at the dangerous level. A Gas Alert system will able to detect LPG leakage and the presence of combustible gas by using MQ-2 sensor. By using Global System for Mobile technology, an alert can be sent to the phone. This detecting provides efficient way to detect leakage and presence of combustible gas because human had limitation in order to detect the presence of those compounds.

DELICATION

To my beloved

parents

Ismail bin Arshad and Norain binti Mahmud

siblings,

Muhammad Shafiq bin Ismail, Nurul Farhana binti Ismail and Muhammad Taufiq

Adzha bin Ismail

course mates,

BETC KOHORT 1

Dedicated in thankful appreciation for your supporting, encouragement and best

wishes.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CO   -   Carbon Monoxide

CO_2 -   Carbon Dioxide

CH_4 -   Methane

EDA   -   Environmental Protection Agency

GSM   -   Global System for Mobile

LED   -   Light Emitting Diode

LPG   -   Liquefied Petroleum Gas

I   -   Current In The Circuit(A)

NiO_x -   Nitric Oxide

PPM   -   Parts Per Million

O_2 -   Oxygen

R   -   Resistance (Ohm)

TiO_x -   Titanium Dioxide

V   -   Voltage Value (Volt)

V_0 -   Output Voltage (Volt)

CHAPTER 1

INTRODUCTION

1.1   Introduction to Gas

The increase in the development of the technology and the human race, people failed to take care about the surroundings in which they live in. Thus, most people polluted the environment and thereby reducing the quality of the place which can be harmful to them. Even though, there are several aspects of pollutions such as soil, air and water pollution can detect visually and by tasted. For air pollution that caused by certain gas, it cannot detect as its odorless, tasteless and colorless. Some of the gases are useful in our daily life. It makes our daily life become easier and save time.

Liquefied Petroleum Gas (LPG) is one of the common alternative fuels used in the world today. It is a mainstay for heating and cooking in Malaysia. LPG gas is a fossil fuel, like oil and natural gas. It can be refined from oil and natural gas the same way gasoline is refined from crude oil (Grabianowski, 2005). Two main types of LPG are butane and propane. They are only used in their pure form for test purposes, and are supplied as commercial butane or commercial propane, which are mixtures of gas with the other gases added to improve the working characteristics (Treloar, 2010). The advantages of LPG gas are most of propane comes from domestic sources, less expensive than gasoline and potentially lower toxic, carbon dioxide (CO_2), carbon monoxide (CO), and non methane hydrocarbon (NMHC) emissions.

1

Combustion gas involves a chemical reaction. It will produce heat as the gas reaction changes into a new compound. A compound is a substance with more than one kind of atom (Senese, 2010). Combustion byproducts enter buildings and homes directly from the use of unvented kerosene and gas space heaters, gas fireplaces, gas stoves, indoor use of charcoal or gas grills. They also can enter and accumulate as a result of poorly ventilated appliances (U.S. Consumer Product Safety Commission, 1993). Examples of combustion gas are Carbon Monoxide and Nitrogen oxide. These two will cause headaches, dizziness, weakness, nausea, confusion, and disorientation, to fatigue in healthy people and episodes of increased chest pain in people with chronic heart disease.

Gas detector is a gas detecting device. It can only detect if there is any abnormal presence of gas concentrations. The detecting system use to alert an authorized person through GSM (Global System for Mobile) network. Therefore, the gas alert system gives advantages to users as they can be alert from the system as there are any leaking or absence of hazardous gas an allowed them to take an action.

1.2   Problem Statements

There are so many accidents may occur at the kitchen restaurant related to dangerous gas. Thus the abnormal condition of the atmosphere of the kitchen restaurant should be regularly alert as most of the dangerous gas such as carbon monoxide (CO), refrigerant gas and liquefied petroleum gas (LPG) are colourless and odourless compound that are produced by incomplete combustion. Therefore, all the activities in the kitchen like cooking and cleaning process will cause combustion gas produce. This combustion gas occurs when the chemical reaction involve to produce compounds which is flammable.

Due to some difficulties to monitor the atmosphere of the kitchen restaurant all the time and the lack of skill to detect a gas leak by the owner or the worker of the restaurant, the abnormal condition of Liquefied Petroleum Gas (LPG).

The presence of combustion gas should be detected by an automatic system. In this case, a gas alert system must have ability to alert the owner of the restaurant.

1.3 Objectives of Project

The objectives of this project are:

i. to utilize a device that able to detect the LPG leakage and the presence of abnormal conditions of other combustion gas by using gas sensor.

ii. to develop a gas detecting system that will use the GSM communication system to send alerts after detecting a gas leak.

iii. to integrate a subsystem that can sent alerts to the user and at the same time provide a precaution step by activating the kitchen exhaust fan after the detection.

1.4 Scope of Project

This project is divided into software programming and hardware. For the hardware, it can be categorized into four systems:

i. The sensing system

ii. Arduino UNO board

iii. Output system

iv. GSM module

Arduino UNO is a device that acts similar to a microcontroller unit. It is an open-source electronic prototype platform based on flexible, easy-to-use hardware and software with high performance and special features. In the sensing circuit system, there is MQ-2 which uses to detect two types of gas, which is Liquefied Petroleum Gas (LPG) and combustion gas. The outputs of the system are, LEDs, buzzer and exhaust fan. Global System for Mobile technology (GSM) will use as a communication system to sent alerts to the authorized person.

For software programming, it will categorize into two which is:

    i. Arduino programming

    ii. GSM programming

Arduino software is used to write the programming for the Arduino board microcontroller. While, GSM programming will use certain library in order to allow the system send the alert to mobile phone.
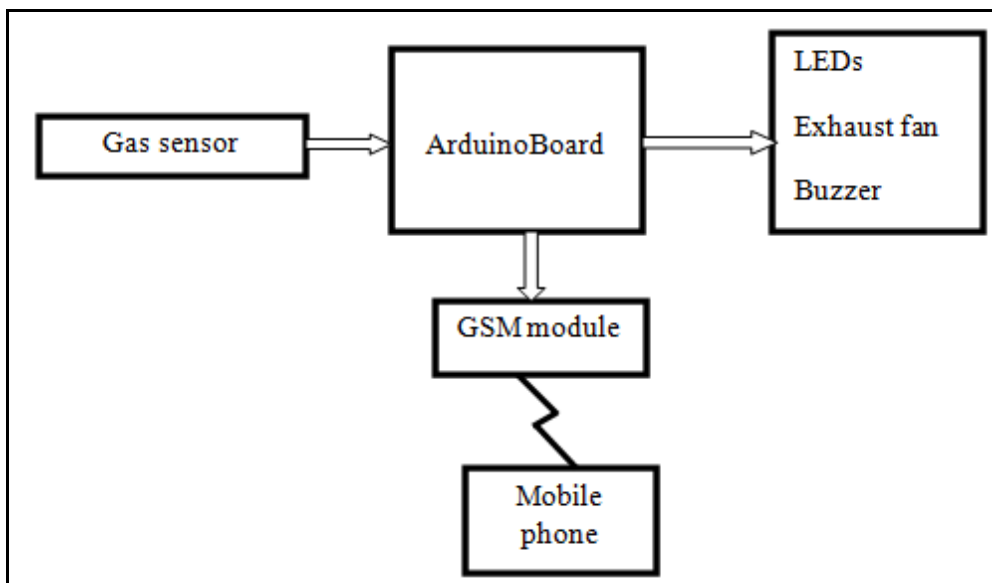

Figure 1.1: Overall view of project

1.5   Project Significant

A gas alert system is suitable used in the kitchen restaurant. This system can cover a small area and most of the people in there are busy with their cooking and cleaning process in the kitchen. The restaurant owner, the worker and the customer will get the benefits, as this system able to alert people after detecting an abnormal gaseous condition. Therefore, it helps to monitor gas condition while the restaurant is closed as most of restaurant in Malaysia are not twenty four hours opened. Finally, a gas alert system also able to activating a kitchen exhaust fan as a precaution step to avoid explosion or get burned.

1.6   Summary

In the kitchen's restaurant, there are some gaseous that are poisonous will release from the cooking and cleaning process. Due to the human limitation to detect the presence of those gaseous, a gas alert system is the solution to detect the abnormal gas condition and sent alert to user through GSM. This system is able to detect LPG leakage and presence of combustible gas in the kitchen restaurant. There are three level of concentration of gaseous which is green LED is for normal, yellow is for warning while red is for dangerous gas condition. As the precaution step, exhaust fan will activated at warning state while, buzzer will activate as the gas condition enter the dangerous state.

CHAPTER 2
LITERATURE REVIEW

2.1   Related Project Works

This chapter will discuss in details on the components and instruments used for this project in general. Besides that, there are some of past related projects or paperwork that is related to this project.

A related project of detecting of poisonous gas paper is build to monitor the absent of abnormal gas condition by using Zigbee which was used to send sensor data from Arduino port to computer in a wireless connection. For the sensing circuit, there were Liquefied Petroleum Gas (LPG) sensor, MQ 6 and alcohol gas sensor, MQ 3. The output system consists of LEDs, buzzer and exhaust fan. Based on Figure 2.1, there was the overview of the "Wireless Gas Monitoring System of Gas Detector" (Hamdon, 2012).
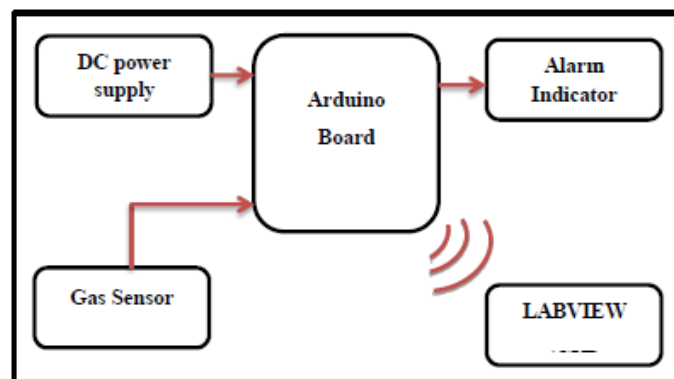

Figure 2.1: The overview of the "Wireless Gas Monitoring System of Gas Detector"

6

Arduino software was used to write the programming for the Arduino board microcontroller. Furthermore, X-CTU was used to program Zigbee in order to transfer the data and LABVIEW Graphical User Interface (GUI) was used to monitor the level gas concentration.

Another related project was focus on wireless remote monitoring system which based on SMS through GSM. From the overall architecture of the system, the hardware and software architecture of the system is designed. The monitoring centre of this system consists of a computer and connected with RS232 to TC35 communication module for GSM. Therefore, there were also use MSP430F149 MCU as shown in Figure 2.2, a display unit, sensors, and data gathering and processing unit. The software for monitoring centre and remote monitoring station were designed using VB (Peijiang & Xuehua, 2008).

Figure 2.2 MSP430F149 MCU

2.2   Gas

All substances are made up of tiny particles called molecules. In solid state, each molecule is strongly attracted to its nearby molecule known as cohesion and there is little space between each molecule for movement. In liquid states, cohesion exists but it has more kinetic energy and move more vigorously, giving the materials its fluids properties. In molecules of a gas, there is no cohesion and free from adjoining molecules and can move in any direction.

2.2.1 Hazardous Gas in Kitchen

Gas kitchen ranges releasing invented combustion products into the kitchen are common in many restaurants. The main pollutants are carbon monoxide, carbon dioxide, nitrogen dioxide and water vapor. Carbon monoxide is a deadly toxin. In one study, 51 percent of kitchen ranges tested raised CO concentrations in the room above the EPA standard of 9 parts per million. Five percent had carbon monoxide levels above 200 parts per million. Nitrogen in the air combines with oxygen in the burner produce Nitrogen Oxide which can cause respiratory irritant. Therefore carbon dioxide is non toxic gas produced during incomplete combustion. Higher concentration of CO_2 can cause drowsiness and headache. Excess of water vapor can lead to problems with mold, wood rot, and peeling paint (Greiner, 2002). Figure 2.3 shows the section through the earth`s Strata showing natural gas traps (Treloar, 2010).
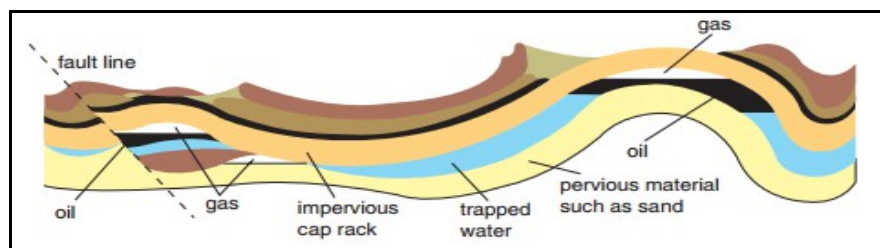

Figure 2.3: Earth Strata showing natural gas traps (Treloar, 2010)

There are two main types of LPG which is butane and propane. The key different between LPG and natural gas is when modest pressure is applied to the LPG it becomes a liquid. This makes it possible to store large quantities of the fuel in specially constructed containers. The characteristics and properties of gases (typical values) are shown in Table 2.1 (Treloar, 2010).

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Table 2.1: Physical characteristics and properties of gases (Treloar, 2010)

Quality/unit	Natural methane	LPG propane	LPG butane
Chemical formula	CH_4	C_3H_8	C_4H_{10}
Boiling point	−162°C	−42°C	−2°C
Specific gravity of liquid fuel	–	0.5	0.57
Specific gravity of gas vapour	0.58	1.78	2.0
Gross calorific value	38.5 MJ/m³	95 MJ/m³	121.5 MJ/m³
Gas family	2nd	3rd	3rd
Flammability limits	5–15%	2.3–9.5%	1.9–8.5%
Air/gas ratio	9.81:1	23.8:1	30.9:1
Oxygen/gas ratio	2:1	5:1	6.5:1
Flame speed	0.36 m/s	0.46 m/s	0.38 m/s
Ignition temperature	704°C	530°C	500°C
Max. flame temperature	1000°C	1980°C	1996°C
System operating pressure	21 ± 2 mbar	37 ± 5 mbar	28 ± 5 mbar
Liquid storage vapour pressure	–	6–7 bar	1.5–2 bar

2.2.2 Combustion Process

The combustion process involves a chemical reaction that produces heat as the fuels changes into a new compound. A compound is a substance with more than one kind of atom. The complete combustion will produce CO_2 and water vapour. Based on Figure 2.4, it shows the example of the complete combustion process (Treloar, 2010).

9