PROFILING LPG GAS SENSOR TO SOLVE INDUSTRY BASED PROBLEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

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DEDICATION

Dedicated to my beloved family, lecturers, supervisor and friends who have guided and inspired me through my journey in education. Thanks for their support and motivation.

ABSTRACT

Gas leakage detection and monitoring through internet of things (IoT) is considered to be more economical for industry. The main purpose of this project is to design a prototype and a system that can detect and monitor the Liquefied Petroleum Gas (LPG) leakage and alerts the safety management team through alarm on their mobile phone (by IoT application). This project also involve in IoT which all the data from the sensor will be sent to the cloud for monitoring and analysis by the safety management team. This system use Arduino based microcontroller and Wi-Fi shield module as a tool to collect data, process and sending the data to the IoT platform. The gas sensor use is MQ6 which is more sensitive to LPG.

ABSTRAK

Pengesanan kebocoran gas dan pemantauan melalui Internet of Things (IoT) adalah lebih ekonomi untuk industri. Tujuan utama projek ini adalah untuk mereka bentuk prototaip dan sistem yang boleh mengesan dan memantau kebocoran Gas Liquefied Petroleum (LPG) dan memberi amaran kepada pasukan pengurusan keselamatan melalui penggera di telefon bimbit mereka (melalui aplikasi IoT). Projek ini juga melibatkan dalam IoT di mana semua data dari sensor akan dihantar ke pengkalan data awan untuk pemantauan dan analisis oleh pasukan pengurusan keselamatan. Sistem ini menggunakan pengawal mikro berasaskan Arduino dan modul perisai Wi-Fi sebagai alat untuk mengumpulkan data, memproses dan menghantar data ke platform IoT. Penderia gas yang digunakan adalah MQ6 di mana ia lebih sensitif terhadap LPG.

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LIST OF SYMBOLS AND ABBREVIATIONS

LPG	:	Liquid Petroleum Gas
IoT	:	Internet of Things
SMS	:	Short Message Service
GMS	:	Global System for Mobile communication
LCD	:	Liquid Crystal Display
DC	:	Direct Current
PCB	:	Printed circuit board
PPM	:	Parts Per Million
GND	:	Ground
TX	:	Transmitter
RX	:	Receiver
COM	:	Communication

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter describe the background of the LPG gas, Internet of Things (IoT) and its potential for sustainability. The aim/objective of the research, problem statement, scope, contribution and organization of the thesis is presented in this chapter.

1.1 Background of the project

The Liquid Petroleum Gas (LPG) leakage detection and monitoring system using IoT application is proposed for industrial safety [1][2]. LPG which based on propane or butane, are highly flammable mixture of hydrocarbon gases used as fuel in heating appliances, cooking equipment and vehicles [3]–[7]. LPG was first identified as a significant component of petroleum product in 1910 [1]. Commercially available LPG is currently drive mainly from fossil fuels [1]. Burning of LPG releases carbon dioxide (a greenhouse gas) and carbon monoxide [4], [8]–[10]. LPG is an odorless gas and

hence the addition of Ethane thiol (C_2H_6S) which allows it to exhibit odor during leakage [5], [11]–[14]. Alternatively, an ideal gas sensor can be used to sense the leakage of an LPG from vehicles, industrial, home and other residential areas [4], [11], [15]. If there is a leakage of LPG, we can easily identify by its concentration through the gas sensor.

The incident of gas leakage that happened on 5th April 2016 in Mid Valley Megamall (Kuala Lumpur) which causes 8 injuries during reinstatement work on liquefied petroleum gas (LPG) system [16]. The LPG cylinder was exploded [3], [4], [16]. The incident happened during the reinstatement work on liquefied petroleum gas (LPG) system after maintenance works [16]. This leakage detection and monitoring system detect the gas leakage with an alarm and alert the safety team through their mobile phone (IoT application) [8], [17]–[21].

1.2 Objective of the project

The main objective for this project is to design and develop a system and prototype that can detect and monitor the leakage of LPG or any such petroleum based gaseous substance that can be detected using Industrial Standard gas sensor. Next, to perform gas profiling and placement for application in LPG refurbishment factory. Lastly, to monitor the leakage of LPG gas over internet and mobile application.

1.3 Problem Statement

The operation from decanting gas from the cylinder will cause environment concerns discomforts nearby residents. Gas leakage leads to various accidents resulting into both financial loss as well as human injuries [11], [22]. The risk of fires, explosion, suffocation, all are based on their physical properties such flammability, toxicity etc.[5], [15], [23]. The number of deaths due to the explosion of gas cylinders

has been increasing in recent years [11], [19], [23]. The reason for such explosion is due to sub-standard cylinders, old valves, worn out regulators and lack of awareness using gas cylinders add to risks [1], [22], [24]. The present work aims at designing a system that detects gas leakage and alerts the subscriber through an alarm by buzzing the buzzer and send the data to the IoT platform and mobile application [1], [4], [8], [15], [25]. Therefore, the proposed of this project is to study the sensor profiling, calibration and placement of the sensor [9], [23], [26]. After that, the data will be analyzed in the form of graph.

1.4 Scope of the project

The wireless monitoring system for LPG leakage is proposed for industrial factory [3]–[6], [17]. The system is detecting the leakage of LPG gas and alert the employee in the factory about the leakage. Whenever the system detects the increase in the concentration of the LPG it immediately alerts by activating a buzzer and it will send the data over the internet [8], [27]–[30]. In this project, the amount of LPG will display on the LCD [26], [29], [31], [32]. In the program code the value of threshold is set in order to activate the buzzer. WiFi hardware module is used to send the data to the IoT platform [17], [27], [33], [34]. Besides that, the management team can also monitor the reading of the LPG by using their smart phone via the IoT mobile application (Virtuino). All the data will be analyzed and presented in the form of graph. Type of gas sensor used also were chosen to make sure it is suitable for the industry. The hardware and circuit of the project will be implemented in the model that is suitable for the industry. After that, the programming will be uploaded into the hardware.

1.5 Contribution of the project

This project may benefit many industries especially for the oil and gas. This project can also be used as alcohol detector and can detect the presence of smoke [35]. This project also can be implemented at home for safety. This system helps us to upgrade our safety standards, comply statutory requirements on environmental commitments and most important and basic function being prevent accidents and protect life and property from disaster [5], [6], [9]. In the long run, the maintenance cost is very less compared to the previous project. This project able to prevent the fire due to LPG gas leakage [3]–[5], [17]. This project also able to prevent the employee in the industry from having a serious health problem due to LPG leakage in industry.

1.6 Organization of the project

Chapter 2 of this thesis report will discuss literature review on LPG related projects such as "Economical and optimal gas leakage detection and alert system" [14], "Embedding real-time multilevel gas leakage" [9], "LPG detection using GSM module" [5] and etc. Some general information on LPG, effects of LPG leakage and its consequences will also be covered in this chapter.

Chapter 3 contains the method that were used for this project. In this chapter the flow of implementation of this project and the block diagram is explained. List different kinds of IoT platforms, sensor devices and research methods which are commonly used at present and analyze all the given methods and devices. Then appropriate devices and methods will be selected and the reason why choose them are also explained.

Chapter 4 mainly describes how to design the system and achieve all the functions. This chapter will demonstrate the operating principle of the selected sensors work,

how to integrate these sensors onto IoT platform and how to make the integrated system output proper sensed data. The programming code and simulation of this project are also explained.

Chapter 5 summarizes the contributions of the thesis work and sums up all the realized functions by the designed system. This chapter also illustrates what kind of future work can be done related to the thesis work.

CHAPTER 2

BACKGROUND STUDY

This chapter will discuss about the previous project that is related to this project. In this chapter the general information about the LPG is explained and the effects of the LPG to human health and environment are also explained.

2.1 Related Work

Several research papers have been published regarding the problem related with LPG leakage. One such method is detect the gas leakage by using MQ-6 sensor and the sensitivity control circuit based on IC555 [1], [15], [36] [14]. IC 555 timer is one of the most versatile IC and is used as a monostable and astable multivibrators, dc-dc converters and toxic gas alarm and many others [14]. The proposed project is tested and the results are verified by producing an early warning signal under less severe condition and activate a high pitched alarm during the leakage of LPG and provide a safeguard to the user [3]–[5], [17].

The design by using Arduino Uno and ZigBee has also been presented [28], [35], [37]–[39] [9], [15], [18], [26], [30], [34], [38], [40], [41]. This project sends data read from the gas sensor and monitor the system. This proposed project used Global System for Mobile communication (GSM) module to send the message/SMS to the user's smartphone [6], [13], [15], [30], [34]. This project automatic shutdown the gas flow of a single user pipeline on a multilevel based system [6], [11], [12], [27].

The design of gas leakage detection and automatic gas shut off system is proposed for kitchen [22]. The aim of this project is designing a system that detects gas leakage and alerts the subscriber through alarm and display the status [4], [14], [24], [42]. Besides that, this project also able to turn off the gas supply valve. This project was implemented by using microcontroller PIC16F876A [3].

In [4], relay DC motor is used to control the stove knob. Along with the safety measure, this system has additional advantage of automatic rebooking of cylinder when the level of gas goes below the normal weight of the cylinder [1]. This project implemented by using ATmega328P microcontroller [3], [4], [26], [31], [38].

A new technology approach have been proposed by using IoT application [19]–[21]. It provides real time information available on the internet for faster accessing with a gas sensor that can detect various other hazardous gases. The advantage of this proposed project is that it offers quickest response time possible and accurate detection of an emergency situation and in turn helps in faster diffusion of the critical situation [27].

2.2 General Information on LPG

LPG was first produced in 1910 by Dr. Walter Snelling as a mixture of Propane and Butane having saturated as well as unsaturated hydrocarbons [1]. LPG also referred to as simply propane or butane, are flammable mixtures of hydrocarbon gases used as fuel in heating appliances, cooking equipment, and vehicles [1], [3], [5]. LPG processing involves separation and collection of the gas from its petroleum base. LPG is isolated from the petrochemical mixtures in one of two ways by separation from natural gas or by the refining of crude oil [3], [4], [43]–[45]. Both processes begin by drilling oil wells.

2.3 General Information on Internet of Things (IoT)

The Internet of Things (IoT) and Industry 4.0 are names for related concepts [46], [47]. Industry 4.0 revolution is the most comprehensively focusing towards cyber-physical architecture by which achieving, components like sensors should be provide feature to sense behavior like Self-Aware and Self-Predictive which leads to degradation monitoring and provide life prediction, which should lead us to production efficiency [46], [48].

The IoT is inter communication of embedded devices using networking technologies [18], [27]. IoT can be identified in the three major dimensions from it orientation things, internet and schematic. Things are sensors which sense and brings information to the system and schematic or knowledge helps to do manipulation. The IoT will be one of the important trends in the future, can affect the networking, business and communication [49], [50]. In the future, every device will be connected to the web directly with the users expecting it to be responsive to their needs.