WIRELESS GAS LEAKING DETECTOR

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ABSTRACT

This project is about designing a wireless gas leaking detector using microcontroller system, sensor, RF module and several other devices. The detector is based on the commercial gas sensor from Figaro Company, buzzer and LCD alphanumeric display. This system uses Microchip microcontroller as a tool to collect input data, process and release output data. The significant of this project is to briefly show how to connect a microcontroller system with input and output devices consists of LCD display and buzzer. This project will be a reference material to the future student or consumer in order to understand usage of a microcontroller and make use of its features. Reprogramming function of the microcontroller is enabled in order to allow user to explore and experience how to program a microcontroller. Output and input device are presented in such interactive way to actually show how microcontroller does the controlling part of the project.

ABSTRAK

Projek ini berkenaan tentang merekabentuk sebuah pengesan kebocoran gas tanpa wayar menggunakan sistem mikropengawal, penderia, modul RF dan beberapa alat lain. Pengesan gas ini berdasarkan penderia gas dari Figaro, buzzer dan paparan LCD. Sistem ini menggunakan mikropengawal sebagai sebuah alat untuk mengumpul data masukan, memproses dan membebaskan data keluaran seperti paparan pada LCD dan system amaran. Kepentingan projek ini adalah untuk menunjukkan secara ringkas bagaimana untuk menghubungkan sebuah sistem mikropengawal dengan peranti masukan dan keluaran seperti paparan LCD dan buzer. Projek ini akan menjadi bahan rujukan untuk pelajar masa depan atau pengguna bagi memahami penggunaan sebuah mikropengawal dan mempergunakan ciri-cirinya. Fungsi memprogram semula pada mikropengawal dibolehkan bagi membenarkan pengguna untuk meneroka dan mengalami sendiri bagaimana untuk memprogram sebuah mikropengawal. Peranti masukan dan keluaran dipersembahkan dalam cara yang interaktif untuk menunjukkan bagaimana mikropengawal melaksanakan bahagian pengawalan projek.

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LPG	-	Liquefied petroleum gas
RAM	-	Random Access Memory
ROM	-	Read Only Memory
PIC	-	Peripheral Interface Controller
LCD	-	Liquid Crystal Display
LEL	-	Lower Explosion Limit
PPM	-	Part Per Million
ADC	-	Analog to Digital Converter
PCB	-	Printed Circuit Board
RF	-	Radio Frequency
RH	-	Relative Humidity

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CHAPTER I

INTRODUCTION

1.1 Background of Project

Gas sensors are employed in a wide range of applications in the fields of safety, health, and instrumentation. Common examples are domestic or commercial alarms for explosive and toxic gases or in automotive application as gas leakage detectors for LPG powered cars and exhausts detectors inside any fuel powered truck or car. Such sensors, nowadays, are found also in applications involving air quality control systems and pollution monitoring.

Today sensors have featuring a high sensitivity to a wide gases variety, are very compact in size and have significantly reduced their power consumption to better adapt to portable solutions. Building a system with a gas sensor is not as easy as it could appear. Despite the sensor could be treated, basically, as a variable resistor which value depends on gas concentration in air the practical implementation in a project should be done considering some design rules, especially if the final circuit is a device to be used in a field where reliability is strongly required. As an example the internal elements of a sensor such as heater and gas sensitive resistors have to be constantly kept under control to avoid failures leading to a wrong alarm indication. Furthermore, if the application

needs to achieve good measurement accuracy, factors like environment temperature, sensor life have to be taken into account.

Flammable gas detectors can make a valuable contribution to the safety of these processes. The detector can be used to trigger alarms if a specified concentration of the gas or vapour is exceeded. This can provide an early warning of a problem and help to ensure people's safety. However, a detector does not prevent leaks occurring or indicate what action should be taken. It is not a substitute for safe working practices and maintenance.

The application of microcontroller in such an instrument will reduce cost. Primarily, the microcontroller is capable of storing and a programming. The microcontroller contains a CPU (central processing unit), RAM (random-access memory), ROM (read only memory), IO (input/output), serial and parallel ports, timers, and sometimes other built-in peripherals such as A/D (analog-to-digital) and D/A (digital-to-analog) converters.

There is a large variety of microcontroller on the market today. We will focus on a few versatile microcontroller chips called programmable interface controller PIC chips from Microchip Technology[1]. Microchip uses PIC to describe its series of PIC micro controllers.

In this project the programs are written in an assembly and basic languages respectively. Basic is a user-friendly language, it is easier to learn and master than either assembly language or C language. The multiple-detector-system was developed using components such as gas sensor (TGS2611), PIC16F876A and LCD alphanumeric display.

1.2 Objectives of Project

Objective of this project is design the circuit that can detect leaking gas of natural gas and toxic gas. Circuit will have display to show the concentration of gas and alarm as a warning system if the concentration exceeds safe concentration.

1.3 Scopes of Project

1. The circuit is basically on the gas sensor and the PIC. The sensor could be treated, basically as a variable resistor which value depends on gas concentration in air and high sensitivity.

2. PIC16F876A has chosen to makes the detector much simpler. The programming also controls the concentration of gas and the air humidity.

3. This project also applied the wireless concept for transfer the data from sensor to PIC. Wireless gas detection is designed for continuous monitoring of toxic and combustible gases in air. No complicated system configuration is needed. Simply assign a unique address to the remote sensor and you are done. The gas monitor will collect all the necessary data information from the sensor including the target gas type. 2 main devices in wireless system are transmitter and receiver.

4. The output of this project is buzzer and a LCD display. The buzzer acted as alarm if gas concentration exceeds the safe concentration of that gas. The LCD display should display the gas concentration and the air humidity.

5. All simulations are constructing and performed using Protues 7.1, PICC and MPLAB.

1.4 Outline of Thesis

This thesis consists of five chapters. The first chapter discuss about background, objective and scope of this project. Chapter two discuss more on theory and include literature reviews that have been done. It also will discuss on components of the hardware and software used in this project. Chapter three discuss on the methodology hardware and software development of this project. Chapter four will discuss about project's testing and results. Finally in chapter five it will discuss about conclusion and future work proposal for the project.

CHAPTER II

LITERATURE REVIEW

2.1 Literature Review Overview

This chapter discuss about reviews of existing project created to get an idea about the project design, conception and any information that related to improve the project. With different concept and design, there are other creations and innovations of projects done by other people. Researches related to this project also covered in this chapter.

2.2 General Information on Natural Gases

Natural gas is obtained principally from conventional crude oil and non associated gas reservoirs and secondarily from coal beds, tight sandstones and Devonian shale. Some is also produced from minor sources such as landfills. In the future, it may also be obtained from natural gas hydrate deposits located beneath the sea floor in deep water on the continental shelves or associated with thick subsurface permafrost zones in the Arctic.

Natural gas is a mixture of low molecular-weight aliphatic (straight chain) hydrocarbon compounds that are gases at surface pressure and temperature conditions. At the pressure and temperature conditions of the source reservoir, it may occur as free gas (bubbles) or be dissolved in either crude oil or brine. While the primary constituent of natural gas is methane (CH_4), it may contain smaller amounts of other hydrocarbons, such as ethane (C_2H_6) and various 4 2 6 isomers of propane (C_3H_8), butane (C_4H_{10}), and the pentanes (C_5H_{12}), as well as trace amounts of heavier 3 8 4 10 5 12 hydrocarbons. [3]

2.3 Potential Health Effects

Methane is not toxic below the lower explosive limit of 5% (50000 ppm). However, when methane is present at high concentrations, it acts as an asphyxiant. Asphyxiants displace oxygen in the air and can cause symptoms of oxygen deprivation (asphyxiation). The available oxygen should be a minimum of 18% or harmful effects will result.(3,11) Methane displaces oxygen to 18% in air when present at 14% (140000 ppm).

Effects of oxygen deficiency at 12-16% is breathing and pulse rate are increased, with slight muscular incoordination at 10-14% is emotional upsets, abnormal fatigue from exertion, disturbed respiration at 6-10% is nausea and vomiting, inability to move freely, collapse, possible lack of consciousness and below 6% is convulsive movements, gasping, possible respiratory collapse and death.

Methane gas is not a skin irritant. Contact with the refrigerated liquefied gas or compressed gas escaping from its cylinder may cause cold burns or frostbite. Symptoms of mild frostbite include numbness, prickling and itching in the affected area. Symptoms of more severe frostbite include a burning sensation and stiffness of the affected area. The skin may become waxy white or yellow. Blistering, tissue death and gangrene may also develop in severe cases.

Methane gas does not irritate the eyes. Contact with the refrigerated liquefied gas or compressed gas escaping from its cylinder may cause cold burns or freezing of the eye. Permanent eye damage or blindness could result. [4]

2.4 Natural Gas Leak Detection Techniques

Table 2.1 Comparison of Different Natural Gas Leak Detection Techniques

Technique	Feature	Advantages	Disadvantages
Acoustic sensor	Detect gas based on acoustic emission	Portable Location identified Continuous monitor	High cost Prone to false alarm Not suitable for small leak
Gas sampling	Flame ionization detector used to detect natural gas	No false alarm Very sensitive	Time consuming Expensive
Soul monitoring	Detects tracer chemicals added to gas pipe line	Very sensitive No false alarm Portable	Need chemicals and therefore expensive Time consuming
Dynamic modeling	Monitored flow parameters modeled	Portable Continuous monitoring	
Flow monitoring	Monitor either pressure change mass flow	Low cost Continuous monitor Well developed	Prone to false alarm Unable to pinpoint leaks
Diode laser absorption	Absorption of a parallel laser monitored in the infrared	Remote monitoring Long range Portable	Prone to false alarm Expensive sources Short system life time