A PORTABLE EMBEDDED GAS LEAKAGE DETECTION DEVICE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

by

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• DECLARATION

I hereby, declared this report entitled “A portable embedded gas leakage detection device” is the results of my own research except as cited in references.

Signature : ..............................
Name : ..............................
Date : ..............................
This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial Electronics) (Hons.). The member of the supervisory is as follow:

……………………………….

(Project Supervisor)
Gas leakage are the major concerns in a wide range of industries because the serious hazardous condition can lead to health risks and property damage. The purpose of this project is to develop portable gas leakage detection system for process plant industries. The MQ 9 gas sensor was used in this project in order to detect carbon monoxide (CO) and combustible gases. The gas sensor will detect the concentration of the gas according the voltage output of the sensor. Other than that, the output system also includes LED indicator and alarm system. The RGB LEDs was used to display different level of gas concentration or leakage exposure limits. The alarm system uses buzzer to notify the users about any gas leakage occurs. The buzzer will be activated immediately when the detected gas concentration was exceed the threshold level. The PIC18F4550 was used as the microcontroller for this project. Furthermore, the gas monitoring system will capable to display the gas concentration on the personal computer of the control room through serial communication by UART. A graphical representation was created using visual basics for monitoring purpose. The project implementation will undergoes two stages such as software and hardware implementation. Finally the implementation of the project would be done after troubleshooting and debugging.
ABSTRAK

• DEDICATIONS

To my beloved parents

Chin Chien Keong and Yong Siew Ling

Siblings,

Chin Fong Kee, Chin Sin Teng and Chin Sin Hui

Dedicated in thankful appreciation for your supporting, encouragement and best wishes.
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Moreover, I would like to pay thankfulness to my family. With the aid and supporting of my family toward my education, I was motivated and being supported throughout all my time in UTeM as students and spur on to greater achievement in future.
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LIST OF SYMBOLS AND ABBREVIATIONS

LED = Light emitting diode
GPS = Global positioning system
CO = Carbon monoxide
GSM = Global system for mobile
LPG = Liquefied petroleum gas
LCD = liquid crystal display
UK = United Kingdom
WSN = wireless sensor network
G = Giga
Hz = Hertz
MEMS = Micro Electro Mechanical System
ED = energy decay
TDOA = time delay of arrival
ML = maximum like hood
LS = least square
AWGN = additive white Gaussian noise
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>OSHA</td>
<td>occupational safety and health administration</td>
</tr>
<tr>
<td>PPM</td>
<td>part per million</td>
</tr>
<tr>
<td>SnO₂</td>
<td>tin dioxide</td>
</tr>
<tr>
<td>V</td>
<td>Voltage</td>
</tr>
<tr>
<td>USB</td>
<td>universal serial bus</td>
</tr>
<tr>
<td>ISA</td>
<td>Instruction Set Architecture</td>
</tr>
<tr>
<td>IO</td>
<td>input output</td>
</tr>
<tr>
<td>EEPROM</td>
<td>Electrically Erasable and Programmable Read Only Memory</td>
</tr>
<tr>
<td>RAM</td>
<td>random access memory</td>
</tr>
<tr>
<td>CCP</td>
<td>Capture/Compare/PWM</td>
</tr>
<tr>
<td>A/D</td>
<td>analog to digital</td>
</tr>
<tr>
<td>RF</td>
<td>radio frequency</td>
</tr>
<tr>
<td>NMEA</td>
<td>National Marine Electronics Association</td>
</tr>
<tr>
<td>UART</td>
<td>universal asynchronous receiver /transmitter</td>
</tr>
<tr>
<td>BASIC</td>
<td>Beginner's All-purpose Symbolic Instruction Code</td>
</tr>
<tr>
<td>RAD</td>
<td>rapid application development</td>
</tr>
<tr>
<td>API</td>
<td>application programming interface</td>
</tr>
<tr>
<td>GUI</td>
<td>graphical user interface</td>
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**INTRODUCTION**

- **Introduction**

  Gas leakage detector devices is getting important with the rises of more and more industrial being developed. Therefore it is getting vital for correct devices to be installed
to provide a safe working environment for the workers. This chapter will summarise the background, research objective, work scope and problem statement.

- **Background**

  Gas leakage is a major concern with process plant industries because it can cause serious incidents resulting in both human injuries and financial losses. The air quality was reduced due to the environmental pollution in our surrounding area. Air pollution is one of serious aspects because the polluted air is odourless and colourless. Further accumulation of the certain type hazardous gases will lead to ignition easily. Employers should increase the safety awareness and responsibility in the workplace environment because they are easily exposed to the threat towards their health and wellbeing. Furthermore, safety plays an important role on this situation and it is necessary that good safety systems are to be implemented in working area. Hence, there is a growing demand for the gas monitoring system. However, the performance of present systems are limited to identify the hazardous gas leaks potentially. Gas leakage detection system is required to monitor the gas concentration and inform the safety situation continuously in the industrial area. The proper measures would be adopt such as the LED indication and the buzzer will be turn on immediately when the gas concentration detected was exceed the set point. Gas leakage detection and leakage location identification are the most important tasks in the process plant industry. Therefore, the gas leakage detection device integrated with GPS module will develop for rapidly identify and locate the source of hazardous gas leakage so that the repair work can be perform easily. The GPS module will send the location signal to control room after the gas leakage was detected. Besides that, the present invention of gas leak detection devices were bulky, costly and limited in portability for inspection. Thus this project intention is to develop a gas leakage detection system which is portable and increase the mobility for the users in the confined place. The project also provide a portable gas leakage detector which is highly sensitive to the CO and those combustible gases with the selected gas sensor. Moreover, the proposed
system also introduced the graphical representation for human machine interface using visual basic. In addition, this project will also develop the gas leakage detector system by using wireless network. Hence, the gas monitoring system will capable to display the gas concentration and the actual location data in the personal computer of the control room through the internet network. The authorized person can be monitor the gas concentration in the control room. Personal gas leakage detector cannot detect the build-up of combustible gases in a non-occupied area. Thus it is necessary to implement fixed gas leakage detector that connect to controllers which equipped with audible or visible indicators.

- **Research Objective**
  
  - To implement good safety system in potential risk area in order to avoid accidents and protect life.
  - To design microcontroller based gas leakage detection system for process plant industry.
  - To develop cost effective alarm system for gas leakage detection device.
  - To implement a gas monitoring system which is human machine interface using visual basic.
  - To install gas leakage detection unit at vulnerable places of process plant industry.

- **Project Work Scope**
To develop a portable embedded gas leakage detection device which allows the user to detect combustible gas quickly and easily in working area.

To design the gas monitoring system for the detection of a gas leakage with human machine interface using visual basic.

The system comprises a monitoring station called central room with programmed computer.

To develop a gas leakage detection system for the data transfer by using UART.

Problem Statement

There are many types of gas leak detector that is currently available to user. However some existing gas leakage detector system does not achieved safety standards and application requirement for process plant industries. One of the disadvantages of those gas leakage detectors are bulky or limited in portability and mobility at confined place where contaminated with hazardous gas. The inability of gas leakage detection system to locate the affected area in short time can causes catastrophe damage to worker, facility and environment. It is important to identify the gas leakage location rapidly so that to facilitate repair of gas leaks and perform maintenance. Furthermore, the standard gas leakage detector which used by process plant industries were both time and energy consuming. Therefore, the prototype of the portable gas leakage detection device with GPS module in this research project is to overcome the shortcoming of the existing safety system. Furthermore, the gas leakage detection device with wireless system will be develop in order to solve the problem. The workers can be monitor the situation and receive the information in the control room without personal checking at vulnerable places.
• Outline

There are five chapters in this project which are introduction, literature review, methodology, result and discussion and the last chapter is conclusion and reference. Each chapter will discuss its own parts in detail related to the project. Chapter one is the introduction of the project. Problem statement, objective and scope of the project have been discussed in this chapter. Next, chapter two will be discusses more on the theory and literature reviews that has been done before by other person or group. Besides that, this chapter also discusses the type of microcontroller used, selected sensor and the system software which involve in programming. While chapter 3 focuses on the methodology and elaboration of process flow on the project. Chapter 3 also includes the software implementation and hardware development of the project. Results and discussion are briefly explained in chapter four. Lastly, chapter five is the conclusion for the whole project. Some future suggestions and recommendation such as a functional addition and hardware improvement of project are also mentioned.
LITERATURE REVIEW

Introduction

This chapter will discuss in details on the components and equipment used for this project in general. Besides that, there are several past research project or journal that is related to this project. The existing system only can detect the gas leakage at vulnerable locations. This is due to the inability of existing gas leakage detector system to identify the gas leakage location with low potential risk. In addition, the signal is send through wireless to the control room after the hazardous gas leakage was detected. For instances, the defect case like the discontinuity in cables will lead to loosing of vital information related to safety of process plant industries. Increase in the complexity of process plant industry leads to increase in the number of equipment to detect gas leakage. This increases the number of cables that connect from industrial sensors to the control room which leads to cluttered wiring. This will increases the cable cost. Furthermore, messy wiring caused difficulty to troubleshoot the reduced insulation and identifying the individual cable along the duct is very troublesome and time consuming. Currently, the location of the workers in the site is uncertain. In case of an emergency event, the officers inside control room have to personally check the positions of the workers in the particular sites. This calls for more effort and time.