GAS LEAKAGE ETECTION SYSTEM BASED ON EFFECTIVE SENSORS PLACEMENT IN FACTORY SETTING USING IOT

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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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I hereby, declared this report entitled GAS LEAKAGE ETECTION SYSTEM BASED ON EFFECTIVE SENSORS PLACEMENT IN FACTORY SETTING USING IOT is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

Signature: …….

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ABSTRAK

Kebocoran gas berbahaya berpotensi tinggi untuk memudaratkan kesihatan dan alam sekitar. Bahkan kebocoran kecil di ruang terpencil secara perlahan-lahan akan meningkat sehingga kepekatan gas tinggi mampu meletup atau akan membunuh orang. Enam pekerja pembersih lelaki di kilang kumbahan mengalami masalah pernafasan setelah tersedut gas merbahaya dan 3 daripadanya meninggal dalam operasi tersebut. (MalayMail, Friday, 25 Dec 2020). *Kebocoran gas mungkin berasal dari saluran paip atau bekas yang bocor yang menyimpan gas berbahaya. System pengesanan kebocoran gas adalah system IoT yang dirancang untuk mengesan gas yang bocor dan segera menghantar penggera. System ini mengunakan Arduino Uno, ATMega328P, dan ESP8266-01 – Modul Wi-Fi. Sensor yang telibat adalah sensor gas MQ-4, MQ-6, MQ-8 dan MQ-135. Projek ini dirancang untuk persekitaran industry. Julat pengesanan sensor adalah focus kepada penempatan yang betul dan bilangan optimum adalah parameter yang menentukan keberkesanan pengesanan kebocoran gas. Aplikasi mudah alih dibangunkan mengunakan Blynk. Aplikasi ini segera mematikan penggera dan memaparkan lokasi kebocoran. Susun atur penempatan sensor gas dan masa diambil untu memberitahu bahawa kebosoran ditunjukkan.*

ABSTRACT

Gas leakage is potentially dangerous to health and the environment. Even a small leak into a confined space will slowly build up to fatal gas concentration or deadly gas explosion. Gas leakage may originate from a leaking pipeline or container which store hazardous gases. Gas Leakage Detection System is an IoT system designed to detect leaked gas and immediately set off the alarm. The system uses Arduino Uno, ATMega328P, and ESP8266-01 - Wi-Fi Module. The sensors involved are MQ-4, MQ-6, MQ-8 and MQ-135 gas sensor. This project is planned for an industrial setting. The sensors' detection range is the focus of this project. The proper placement and optimum number are the parameters that determine the effectiveness of the gas leakage detection. A mobile application is developed using Blynk. The application immediately sets off an alarm and displays the location of the leakage. The layout of the gas sensors placement and time is taken to notify the leakage are presented.

DEDICATION

To the memory of my mother Letchumy a/p Ponnusamy and my father Muniandy a/l Perumal.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ppm	Particle Per Million
GLDS	Gas Leakage Detection System
IoT	Internet of Things
LED	Light Emitting Diode
MCU	Micro-Controller Unit
LCD	Liquid Crystal Display
GSM	Global System for Mobile Communication
GUI	Graphical User Interface
IDE	Integrated Development Environment
LPG	Liquified Petroleum Gas
ADC	Analog to Digital Converter
RX	Receiver
TX	Transmitter
GND	Ground
PWM	Pulse Width Modulation
AP	Access Point
STA	Station
PCB	Printed Circuit Board
CH4	Methane
H2	Hydrogen
NH3	Ammonia

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter outlines the background of this project, the project's problem statement, and the motivation behind it. The objectives are stated which must be focused on this project. The project scope is briefly explained and finalized in this chapter.

1.2 Problem Statement

Poisoned and explosive gas are the main hazard which can affect human health and safety caused by gas leakage in an industrial environment. The hazardous gas builds up to a certain concentration in a confined place can be severe and deadly.

This thesis describes the development of a system is able to monitor and detect various type of gas leakage. This study investigates the location of the sensors in factory settings. Sensor’s placement in a factory environment is the important considering the sensitivity and detection range of the sensors.

1.3 Objectives

From the problem statement, three objectives need to be achieved to realize the project.

I. To design a gas leakage and detection system in a factory setting.

II. To develop a prototype of the system with a mobile monitoring system.

III. To analyse the effectiveness of sensor placing based on parameters in factory settings.

1.4 Scope of Work

The gas leakage detection system uses Arduino Uno to control all the components involved in detecting gas and monitoring system. The gas sensor chosen is MQ- type variations which are MQ-4, MQ- 6, MQ-8, and MQ-135. The gas sensors have various detectability based on the datasheet provided. The sensors are able to detect the gas level in terms of ppm which is particle per million. The sensors are tested in indoor settings with different parameters for more accuracy with a different range of gas sources. The sensors are connected at analog input of the Arduino Uno . Additionally, the ESP8266-01 - Wi-Fi Module is used to making communication between the microcontroller and mobile application developed, through the cloud server. The use of the Blynk App is to develop a mobile application. The app is made to show the sensor location that detected the gas leakage. The mobile application also keeps a log for reference purposes of the incidents. The log can be viewed in form of a live graph or uploaded in a CSV type file as an excel sheet for detailed view.

1.5 Conclusion

This project focuses on the development of an IoT-based gas leakage detection system that focuses on sensor placement. This chapter presented the statement of the problem, the objectives, and the scope of the project. This chapter is critical for defining essential requirements that need to be concentrated on project growth. The next chapter will discuss the literature review focusing entirely on the collection and analysis of published research papers.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section's central theme describes several designs and chronologically ordered the development of the gas detection system as of 2016. Most of the methods discussed are for use in commercial settings. A review of related literature studies and research throughout the whole section was done to gain a better understanding of the implementation of the study and to give basic ideas on how it might help the current project develop. In this chapter, this approach is used to trace the theme improvement over time.

2.2 Related Previous Works

2.2.1 The Design of the Combustible gas detector based on NAP-100AC

The gas sensor NAP-100AC is used as the main component in this project. The AVR MCU of ATmega8 was used in this project as the ATmega6 package has 8 analog to digital converter channels. The monitoring of the system happens as the concentration of the flammable gas is displayed in an LED display. The RS485 is used to communicate with the connect bell and valve devices. the standard infrared analyser is used to measure the concentration of the leaked gas in the atmosphere. The supply voltage of the sensor NAP-100AC is 0.16v-2.3v. The sensor is calibrated as zero (Tan and Lei, 2016)

2.2.2 Human security from death-defying gases using an intelligent sensor system

The sensor is a transducer which supposed to detect any events of change in an environment and produce an electrical signal as the output. MQ-7 and MQ-2 are used to detect carbon monoxide and flammable gases, respectively. The integer values of the sensor are received and converted to a digital signal in Arduino Uno so that the user can monitor the concentration of the gases from LCD. The communication mode used in this project is GSM. The microcontroller is connected to the GSM module and then transmits data as a message alert to the user. The MQ-7 sensor uses 100 ppm of Carbon Monoxide as a known reference value and the MQ-2 sensor uses 1000 ppm of hydrogen as a known reference value. Both sensors have different calibration values to obtain the accuracy of the readings. The calibration of the sensor plays a big role in the accuracy of the detection of gas leakage (Visvam Devadoss Ambeth, 2016)

2.2.3 Prototype of Gas Leak Detector System Using Microcontroller and SMS Gateway

In this article, several processes such as planning, modeling, construction, and deployment steps are discussed. The sensor used is MQ-2 and the microcontroller used was Arduino Uno . The MQ-2 sensor senses the concentration of the leaked combustible gas using ppm gas ratio parameter in the air. The microcontroller then converts this analog data into a digital signal which indicates high or low. When the Arduino Uno processed the data then the Sim900 SMS Gateway comes into action as the GSM Module. the GSM is connected to Arduino Board to communicate to the user. The communication between

the system and the user is sent by Sim900 SMS Gateway and triggers the alarm ON. The alarm will set to ON for 3 minutes (Tombeng, 2017)

2.2.4 Embedded Hardware Prototype for Gas Detection and Monitoring System in Android Mobile Platform

Implementation of IoT happens as Bluetooth module HC-05 is used as a data transfer medium to the mobile device. The LPG sensor MQ-6 and ATmega16 microcontroller also are used in this gas detection and monitoring system. the ATmega16 has 16KB of flash memory for store program. when the flammable gas is detected, the user gets an alert, and the exhaust fan is turned on while the user is connected to Bluetooth. The mobile application is developed to monitor the concentration of the gas leaked. It is a GUI based application that provides a simple and easy to use interface. The app is designed in JAVA using Atmel Studio 6.0 as the IDE tool. It can be connected to multiple LPG detectors at once. But when the smartphone is away from the Bluetooth source the connection is disconnected. For monitoring purposes, the user must connect the smartphone to Bluetooth every time (Kurzekar, Arora and Shrestha, 2018)

2.2.5 A Microcontroller Based Gas Leakage Detection and Evacuation System

MQ-2 and PIC16F628A microcontroller are used as the main components in this project. The microcontroller was loaded with a CSS-C compiler coded program using MP-Lab software. The Proteus IDE software was used to test the code before compiled and loaded into the real physical microcontroller. When the gas leak is detected the

microcontroller receives a signal from the sensor. Then the microcontroller sends SMS to the user and a buzzer is turned on. The alert is sent to mobile through a SIM800L GSM Module. Then the solenoid valve stops the gas flow and switches on the evacuator fans which blows away leaked gas. When the leaked gas concentration has dropped the buzzer is turned off (Adekitan, Matthews and Olasunkanmi, 2018)

2.2.6 Microcontroller Based Low-Cost Gas Leakage Detector with SMS Alert

This article is about developing a device for detecting gas leakage that can automatically detect gas leakage and prevent leakage that can be permeated or penetrated in place. The system uses a gas sensor MQ-5 to detect LPG (Liquified Petroleum Gas). To alert the user about gas leakage via SMS the GSM module is used. If the flammable gas concentration is high the buzzer and LED switches on to warn the user. To power the machine, Arduino Uno Programming is used to fed software to the PIC16f877 microcontroller. The exhaust fan will be turned on if the device senses a certain flammable gas concentration in its surroundings and sends text messages to a predefined telephone number (Banik, Aich and Ghosh, 2018)

2.2.7 LPG gas sensor detection using IoT

Managing and monitoring the use of data across a complex computerized system is called real-time data monitoring system. This is the prototype design of a system to detect and monitor LPG remotely in real-time. This system uses Arduino based microcontroller, Wi-Fi shield module as a communication tool. The circuit was constructed using proteus IDE and produce a printed circuit board for the hardware