

POLITEKNIK MELAKA

**DEVELOPMENT GAS CLEARANCE SPOTTER
TO ALERT CAR USER BY USING ESP 32**

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ABSTRACT

A device to ensure safety when working in areas exposed to dangerous gases. Especially for vehicle users and industrial or construction workers. The Gas Clearance Spotter monitors the level of dangerous gases such as carbon monoxide, toxic gases or methane which can endanger the health and safety of certain people. The role of devices such as gas clearance spotter is also to provide danger awareness to users when gas levels have exceeded the out-of-control limit, which is the safe limit. This device was created to make it easy for users to carry anywhere and to provide real-time monitoring of areas that are likely to be exposed to dangerous gas leaks. This device is designed using a gas sensor, namely the MQ7 sensor, a digital display using I2C LCD 16x2, and emergency alarms such as buzzer that gives a sound or vibration to detect dangerous gas leaks in industrial areas or public vehicles. This device has successfully function and the gas value will be displayed on the LCD. If the gas level reaches the danger level, then the buzzer and LED will turn ON, and notification is sent to the family member to alert them.

ABSTRAK

Peranti untuk memastikan keselamatan semasa bekerja di kawasan yang terdedah kepada gas berbahaya. Terutama untuk pengguna kenderaan dan pekerja industri atau binaan. Gas Clearance Spotter memantau tahap gas berbahaya seperti karbon monoksida, gas toksik atau metana yang boleh membahayakan kesihatan dan keselamatan orang tertentu. Peranan peranti seperti pengesanan pelepasan gas juga adalah untuk memberikan kesedaran bahaya kepada pengguna apabila paras gas telah melebihi had di luar kawalan, iaitu had selamat. Peranti ini dicipta untuk memudahkan pengguna membawa ke mana-mana dan menyediakan pemantauan masa nyata kawasan yang mungkin terdedah kepada kebocoran gas berbahaya. Peranti ini direka menggunakan penderia gas, iaitu penderia MQ7, paparan digital menggunakan I2C LCD 16x2 , dan penggera kecemasan seperti buzzer yang memberikan bunyi atau getaran untuk mengesan kebocoran gas berbahaya di kawasan industri atau kenderaan awam. Bacaan akan dipaparkan pada LCD dalam masa 2 saat. Peranti ini telah berjaya berfungsi dan nilai gas akan dipaparkan pada LCD. Jika paras gas mencapai paras bahaya, maka buzzer dan LED akan dihidupkan dan pemberitahuan dihantar kepada ahli keluarga untuk memaklumkan mereka.

TABLE OF CONTENTS

CONFIRMATION OF THE PROJECT	ii
DECLARATION OF ORIGINALITY AND OWNERSHIP	iv
ACKNOWLEDGEMENTS	v
ABSTRACT	vi
ABSTRAK	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
CHAPTER 1	1
INTRODUCTION	1
1.1 Introduction	1
1.2 Background Research	2
1.3 Problem Statement	4
1.4 Research Objectives	5
1.5 Scope of Research	5
1.6 Project Significance	6
1.7 Chapter Summary	6
CHAPTER 2	7
LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Challenges in Gas Clearance Spotter	7
2.2.1 Previous Research	8
2.2.2 Overview of Hazardous Gas Detection	8
2.2.3 Portable Gas Detection Systems	9
2.2.4 IoT-Enabled Gas Detection	10
2.2.5 Emergency Alarm Integration	11
2.2.6 Multi-Gas Detection Capabilities	12
CHAPTER 3	18
RESEARCH METHODOLOGY	18
3.1 Introduction	18
3.2 Project Design and Overview.	18
3.2.1 Block Diagram of the Project	20
3.2.2 Flowchart of the Project 2	21
3.2.3 Project Description	22
3.3 Project Hardware	22
3.3.1 Schematic Circuit	23
3.3.2.2 ESP 32	23
CHAPTER 4	29
RESULTS AND DISCUSSION	29
4.1 Introduction	29
4.2 Results and Analysis	29
4.3 Discussion	32
4.4 Chapter Summary	32
CHAPTER 5	33

CONCLUSION AND RECOMMENDATIONS	33
4.5 Introduction	33
4.6 Conclusion	33
4.7 Suggestion for Future Work	33
4.8 Chapter Summary	34
CHAPTER 6	35
PROJECT MANAGEMENT AND COSTING	35
4.9 Introduction	35
4.10 Gant Chart and Activities of the Project	35
4.11 Milestone	37
4.12 Cost and Budgeting	38
4.13 Chapter Summary	39
REFERENCES	40
APPENDICES	41
APPENDIX A- DATA SHEET	41
APPENDIX B- PROGRAMMING	42
APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE	49

LIST OF TABLES

TABLE	TITLE	PAGE
	Table 3. 2: MQ7 sensor activation and CO gas level based on LCD display.....	19
	Table 3. 3 :Sequence of Finger Model Blinking.....	22
	Table 4.10: Gant Chart and activities of the Project... ..	33-34
	Table 4.11: Milestone of project... ..	35
	Table 4.12: Cost and Budgeting of Gas Clearance Spotter... ..	36

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 3.2:	Block Diagram of the Project.....	20
Figure 3. 2.1:	Flow chart of the project.....	21
Figure 3. 3:	Circuit Diagram of Gas Clearance Spotter	23
Figure 3.4:	Flowchart of the system.....	25
Figure 3.5:	Prototype Development... ..	26
Figure 3.6:	Mechanical Design/Product Layout... ..	26

LIST OF ABBREVIATIONS

IoT	Internet of Things
ESP32	Espressif Systems Processor
LED	Light Emitting Diode
CO	Carbon Monoxide
CO ₂	Carbon Dioxide

CHAPTER 1

INTRODUCTION

1.1 Introduction

Gas leaks in industry and automobiles can be just as dangerous as household gas leaks, although the causes, risks, and prevention methods may differ. In industrial settings, gas leaks typically occur in factories, manufacturing plants, chemical plants, or any facility that uses or stores gases such as natural gas, propane, or industrial chemicals. Such leaks may be caused by faulty equipment, worn-out pipes, or poorly handled gas, or by human error. In industry, the consequences of a gas leak can be severe, resulting in fires, explosions, and exposure to toxic chemicals that can be dangerous to workers and the environment. Industries install gas detectors, regulate equipment, and train workers on safety precautions to prevent gas leaks. Additionally, automatic shut-off systems are used in many facilities to reduce the effects of leaks. In addition, carbon monoxide (CO) is a colorless, odorless, and tasteless gas that is formed during the incomplete combustion of fuels, such as in car engines, in industrial processes, or in equipment such as furnaces. The problem is particularly dangerous because plastics can accumulate in small, enclosed spaces, undetected. Exposure to high concentrations of carbon monoxide can cause poisoning and symptoms include headaches, dizziness, nausea, confusion and death. The risk is particularly high in cars with faulty exhaust systems or in industrial areas without proper ventilation. CO leaks need to be dealt with immediately to avoid serious health hazards.

A device to ensure safety when working in areas exposed to dangerous gases. Especially for vehicle users and industrial or construction workers. The Gas Clearance Spotter monitors the level of dangerous gases such as carbon monoxide, toxic gases or methane which can endanger the health and safety of certain people. The role of devices such as gas clearance spotter is also to provide danger awareness to users when gas levels have exceeded the out-of-control limit, which is the safe limit. This device was created to make it easy for users to carry anywhere and to provide real-time monitoring of areas that are likely to be exposed to dangerous gas leaks.

1.2 Background Research

Some of these gases are carbon monoxide (CO), methane (CH₄), hydrogen sulfide (H₂S) and ammonia (NH₃). Gases such as these pose a threat to the general population's health including respiratory issues, poisoning, or in an unfortunate sequence of events, death. These gases can be found in a number of different settings such as industries, chemical factories, waste treatment plants, and even in houses. However, due to the invisibility and odorless nature of these gases, it is challenging for people to detect their presence in the environment, making gas detection a crucial aspect of safety management (Seo, 2023).

Portable gas detection systems play a critical role in ensuring safety in workplaces where employees may be exposed to toxic gases. These devices are often employed in enclosed spaces like tunnels, underground mines, and industrial storage tanks, where the risk of gas contamination is significant and ventilation is limited. Automation with the capability to detect gas significantly eases the task of gas detection within a space or location with hazardous potential (Al-Okby et al., 2021).

The Internet of Things (IoT) has revolutionized gas detection technology by integrating smart sensors with wireless communication and cloud-based data processing. IoT-based gas monitoring systems enable remote and real-time surveying of gas concentrations, meaning hazardous gases can be observed from any location (Waghmare *et al.*, 2024). These systems are particularly beneficial in industrial facilities where large-scale monitoring is required, such as oil refineries, chemical plants, and underground mining operations (Waghmare *et al.*, 2024).

Gas detection systems are often integrated with emergency alarm mechanisms to provide immediate warnings in the event of a hazardous gas leak. These alarm systems are incredibly important in reducing any risk by warning personnel before the gas concentration escalates to a dangerous level. Traditional alarm mostly integrated light and sound indicators, while the newer IoT-based alarms have the ability to notify relevant parties on digital devices, ensuring response teams are informed in real-time (Maltezos *et al.*, 2022).

Advanced multi-gas detectors can simultaneously measure gases like ammonia (NH₃), chlorine (Cl₂), carbon monoxide (CO), and hydrogen sulfide (H₂S), providing

comprehensive safety coverage. These detectors enable setting custom alarms and logging data, providing users with the ability to track exposure levels and alerting them to take preventive measures if necessary (Tahir *et al.*, 2023). The ability to detect multiple gases at once improves the safety of employees at workplaces and reduces expenditure incurred in the installation of diverse detection systems (Tahir *et al.*, 2023).

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1.3 Problem Statement

Problem statement regarding ensuring safety in environments at risk of hazardous gas exposure. The main problem may be the use of poor quality, inaccurate or outdated gas monitoring equipment in providing early warning of hazardous gases. The user may not know or face difficulties in detecting hazardous gas leaks through the existing system. Gas clearance spotters who have a current system may use a gas detector that is capable of identifying certain gases in the exposed environment. This is so, there are several shortcomings or weaknesses in the existing system, namely in terms of speed and accuracy of readings, lack in detecting various gases. From the problem statement and study of the current system, many things can be modified to be implemented such as improving speed and being able to provide more accurate readings. Not only that, the ability to detect various types of gas leaks.

The modification that needs to be made to the existing system is to further improve the ability to detect gas, which is to further improve the technology that is capable of detecting more types of dangerous gas leaks at the same time such as carbon dioxide (CO₂), hydrogen sulfide, ammonia compared to the gases that are always detected, namely methane and carbon monoxide (CO). In addition, improvements in the speed and accuracy of readings, which makes this innovated system easier to detect little by little exposure to gas levels and provide warnings and signals quickly to users. In addition, adding an IoT system in the implementation of new devices. It is a network system of physical devices that are connected to the internet and can communicate with each other. These devices are equipped with sensors, software and other technologies that allow them to collect data without human intervention. The last is to install an emergency alarm which can signal through a loud sound to alert or wake up users, especially vehicle users when they are asleep and not aware of the presence of hazardous gas.

Vehicle Users: Can avoid and ensure their safety when passing through situations where there are dangerous gases such as industrial areas or places with poor ventilation. The user will receive a signal in their vehicle via an emergency alarm and send information or signals to their immediate family via the IoT system if the user falls asleep in their vehicle.

1.4 Research Objectives

The main objective of this project is to create a gas clearance spotter that detects carbon monoxide (CO) levels in the environment using the MQ7 gas sensor. The sensor detects and then gives a warning signal and sounds an alarm if the CO level exceeds the safe level.

More specifically the principal objective of this research is:

1. To design a circuit diagram for a Gas Clearance Spotter and perform simulations using SimuIIIDE.
2. To build an electrical circuit for the Gas Clearance Spotter based on the designed circuit diagram, using an ESP32 for testing.
3. To analyze gas density using a precise gas sensor and display the readings on an LCD.
4. To enhance signal transmission to contacts through the IoT system.

1.5 Scope of Research

1. Detecting carbon monoxide using MQ7 gas sensor.
2. The carbon monoxide level will be exposed on the 16x2 i2c lcd.
3. The red LED and buzzer will light up and sound if the carbon monoxide level exceeds the safe limit.
4. This IoT system uses a Telegram Bot to let users monitor and control the device online through their smartphones. All data and commands are sent automatically via Telegram in real time.

Components:

- a) I2c Lcd 16x2
- b) Buzzer
- c) Led
- d) MQ7 sensor
- e) Resistors and Jumper Wires
- f) Power Supply (5v Power bank)

1.6 Project Significance

The Gas Clearance Spotter project focuses on the early detection of carbon dioxide (CO₂) gas leaks in vehicles. Increased CO₂ concentrations in the cabin of a vehicle, especially in closed or commercial vehicles, can cause respiratory distress, dizziness, loss of concentration, and in extreme cases, fainting. The system is designed to detect CO₂ levels in real time and provide a warning if they exceed safe levels. As such, the project contributes to improving driver and passenger safety and reducing the risk of accidents due to excessive CO₂ exposure. It also supports initiatives towards safer and healthier vehicles to use.

1.7 Chapter Summary

In this chapter, we focus on introducing the product we want to create, the project objectives, scope and importance of this project to the user. It shows that this product has been innovated to be superior. In making this product, there are important inputs, namely the MQ7 gas sensor and outputs which is red LED, Buzzer, I2C LCD 16x2 that is output plays an important role in overcoming CO₂ leakage.