UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF CARBON MONOXIDE DETECTOR FOR VEHICLES WITH AUTO WINDOW ROLL DOWN AND SAFETY WARNING SYSTEM

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

By

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Sesi Pengajian: 2021

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I hereby, declared this report entitled Development of Carbon Monoxide Detector for Vehicles with Auto Window Roll Down and Safety Warning System 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 Electrical Engineering Technology (Industrial Power) With Honours. The member of the supervisory is as follow:

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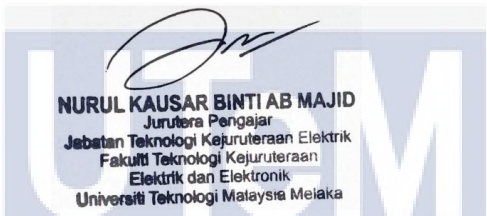

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ABSTRACT

Nowadays, the incidence of carbon monoxide (CO) gas leakage in vehicles has increased. The leaking of the vehicle exhaust system will lead to a high risk and harm to humans. Hazardous gas can affect human quality of life, such as the respiratory and blood systems, where it will harm driver and passenger brains due to a lack of oxygen in bloodstream. It primarily impacts the driver who has been driving and traveling on a long trip by way of a vehicle. The driver is supposed to have a rest and take a nap in their vehicle. Normally, the air conditioner (AC) is switched on during hot season, which ensures that the engine is often turned on which allows CO gas leakage to the vehicle. This project was created at reasonable cost to solve this issue by detecting CO gas using the MQ-7 sensor. To make this system more effective, Arduino UNO is used as a microcontroller to control both the process which are input and output. The LCD display is being used to display the concentration of CO gas in the vehicle at a ppm value. LEDs and buzzers operate as an alarm device. GSM and GPS technology are used to send a warning message with a real-time tracking device, where the location could be reported to an authorised person on longitude and latitude. In addition, this system is designed with a power window motor that automatically roll down the window when the concentration of CO gas is at danger. So, the concentration of CO gas in the vehicle can be controlled and this will avoid CO gas poisoning and death to the user.

DEDICATION

This was dedicated to my beloved father, Mr. Jasman Bin Ngisok, my beloved mother, Mrs. Saripah Binti Md. Sidek and my siblings, Mohd Shafiq, Nurul Syahirah, Mohd Syahmi and Mohd Syakirin. Praise be to Allah, S.W.T., that I am part of this supportive family. Thank you for your advice and best wishes.

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LIST OF ABBREVIATIONS

°C	Celsius
°F.	Fahrenheit
A	Ampere
AC	Air-Conditioner
ADC	Analog-to-Digital Converter
CO	Carbon Monoxide
COHb	Carboxyhaemoglobin
CPU	Central Processing Unit
DC	Direct Current
GUI	Graphical User Interface
GSM	Global System for Mobile Communication
GSM	General Packet Radio Service
GPS	Global Positioning System
Hb	Haemoglobin
I/O	Input/output
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LPG	Liquefied Petroleum Gas
MQ-7	Carbon Monoxide (CO) gas sensor
NTP	Normal Temperature and Pressure

PCB	Printed Circuit Board
PDP	Programmed Data Processor
PIC	Peripheral Interface Controller
PPM	Part Per Million
PWM	Pulse Width Modulation
RAM	Random Access Memory
ROM	Read-Only Memory
SnO2	Tin Oxide
V	Voltage

CHAPTER 1

INTRODUCTION

1.1 Background

Carbon monoxide (CO) gas is a colourless, odourless, completely tasteless, toxic gas that can never be detected without the use of advanced technology. Other than that, CO gas is released from organic matter by combustion due to lack of oxygen supply to allow the full of oxidation carbon dioxide (CO2) gas. Liquefied Petroleum Gas (LPG) injection system sometimes will result in irremediable effects for driver and passenger when the technical problem was happened at LPG system.

Sometimes this technical problem happens because of exhaust system is having a leakage or the exhaust systems is being blocked by any object that can cause CO gas to enter the car cabin. Passengers without being noticed will inhale the CO gas and this will cause fatality. The longer the time idling the more CO gas leak into the vehicle due to incomplete combustion of fuel.

It is nearly impossible for a victim to notice the symptoms of poisoning caused by the leakage of CO gas because CO gas is fast acting, especially when the victim is taking a nap. The leakage of vehicle exhaust system will contribute to a high risk and is harmful to human. The hazardous gaseous will affect the human health such as respiratory and blood system where it can damage our brain because of lack of oxygen in our blood stream.

In order to avoid excessive inhalation of CO gas inside the vehicle, a project entitled "Development of Carbon Monoxide Detector for Vehicles with Auto Window Roll Down and Safety Warning System" is proposed to deal with this issue by developing a safety alarm signal and requiring the vehicle's power window motor to roll down automatically when the concentration of CO gas in the vehicle reaches a dangerous level.

A major part of this project is Arduino UNO as a microcontroller which functions to monitor all inputs and outputs for this system. This project uses MQ-7 as a CO gas sensor that can be detect from 20 ppm to 2000 ppm and is particularly sensitive to CO gas. An LCD display is used to show the concentration of CO gas in ppm within the vehicle, whether at a normal or dangerous level.

LEDs and buzzers operate as a warning device. GSM and GPS systems are used to transmit a warning text via a real-time monitoring device, where the position can be reported to the authorized person in the state of longitude and latitude. In addition, this system is provided with a power window motor to automatically roll window down when the concentration of CO gas is at danger. It will reduce the concentration of CO gas in the vehicle to avoid CO gas toxicity inside the vehicle.

1.2 Problem Statement

Car drivers who have a long drive and tend to take a nap in their car for refreshment may not be aware of the existence of carbon monoxide within the vehicle because carbon monoxide (CO) is odourless, colourless and completely tasteless. When a vehicle is idle with its engine running, the exhaust fumes which contains CO gas could flow into the vehicle through the leakage of exhaust piping system. Liquefied Petroleum Gas (LPG) injection system sometimes will result in irremediable effects for driver and passenger when the technical problem happened at LPG system. High concentration of CO gas inside the vehicle without opening the windows can affect the human health such as respiratory and blood system where it can damage the driver's and passenger's brain because of lack of oxygen in human blood stream. This may bring some symptoms to them like dizziness, headaches, and death. Therefore, a project entitled "Development of Carbon Monoxide Detection for Vehicle with Auto Window Roll Down and Safety Alert System" is important to be designed to detect the concentration of CO gas, and to roll down vehicle's window automatically when the CO gas level is at danger state. GSM and GPS technologies are used to send an alert message with a real-time tracking system where the location will be informed in state of longitude and latitude to the authorized person.

1.3 Objective

The goals of this project are as follows:

1. To design and develop a Carbon Monoxide (CO) gas detection system for vehicle with automatic roll down window using Arduino microcontroller
2. To develop an alert and monitoring system for the Carbon Monoxide (CO) gas detection and using GSM and GPS to send a warning message and location.

1.4 Scope of Project

This project is a combination between hardware and software. To achieve 1st objective, components such as Arduino UNO as microcontroller, MQ-7 Carbon Monoxide (CO) gas sensor, buzzer, LCD display, LED and power window motor have been used for the hardware component. The purpose of Arduino UNO is to monitor the overall detector system from the CO gas detection to the safety alert system. The MQ-7 sensor is being used to detect the existence of CO gas while the buzzer triggers a safety alert when the CO concentration is at a dangerous level. LED indicators are used to alert the consumer of the level of CO gas concentration. The LCD display shows the measurement of the concentrations of CO gas in ppm value and the power window motor has been used to automatically demonstrate the roll-down of the vehicle window that Arduino UNO regulates when the concentration of CO gas exceeds a dangerous level. Arduino Integrated Development Environment (IDE) will be used for the software program section of the application.

To achieve the 2nd objective, GSM and GPS systems are used to send a warning message via a real-time monitoring device, where the position can be reported to the authorized person in the state of longitude and latitude.

1.5 Thesis Outline

This report covers five chapters. All these chapters are covered on the implementation of this project operation, which deals with “Development of Carbon Monoxide Detection for Vehicle with Auto Window Roll down and Safety Alert System”.

Chapter 1 presents an explanation of this project scope, including background, problem statement, goal, project scope and project outline.

Chapter 2 consists of a literature review. In this section, it is about discussing related previous journal or article that other researchers have conducted to develop the project. Details on a variety of materials, devices that have been used and technologies will be covered in technical detail in this chapter.

Chapter 3 is the methodology used to implement this project. The method and technique as a reference and apparatus shall be developed with a consistent flow of this study. A block diagram will display the complete purpose of this project scope. The flow chart will be used as well as the method for this project will be explained throughout this chapter.

Chapter 4 focuses on the conclusions of the outcomes of this project. In addition, the analysis discussion focused on the outcome of the project and the findings are explicitly summarized throughout this chapter.

Finally, for the last chapter which is chapter 5 consists of the conclusions and recommendations are discussed in this chapter, with understanding for the whole of research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter would highlight in general the concept of carbon monoxide (CO) gas, the effectiveness of CO gas along the human body and the source of CO gas from the vehicle. This chapter also explains the overview of existing devices, microcontrollers in general and CO gas sensor technologies. In comparison, a variety of previous related works, articles and journals linked to this project will also be discussed.

2.1.1 Impact of Carbon Monoxide (CO) Gas on The Human Body System.

Carbon monoxide (CO) gas has been harmful to the human body system. CO gas is odourless, colourless, and completely tasteless where it is impossible to identify human beings. CO gas is released from organic matter by combustion due to lack of oxygen supply to allow the full of oxidation with carbon dioxide (CO2) gas. In addition, CO gas becomes significantly lighter in the air. Table 2.1 summarizes some of the effects of long-term exposure to various concentrations of CO gas in ppm. (Agarwal, A., & Kumar, R., 2016).

Table 2.1 Concentration of CO gas and symptoms after inhalation

Concentration of CO gas	Time of exposed	Symptoms
0 ppm	-	Fresh air.
9 ppm	-	Maximum indoor air quality level.
10-35 ppm	8 hours	Headache, dizziness and nausea.
100 ppm	2-3 hours	Slight headache.
200 ppm	2-3 hours	Mild headache, dizziness, fatigue and nausea.
400 ppm	1-2 hours	Loss of judgement, serious headache, sweating.
800 ppm	45 minutes	Unconscious within 2 hours. Dizziness, nausea and convulsions. Death within 2-3 hours.
1,600 ppm	20 minutes	Headache, tachycardia, dizziness and nausea. Death within 1 hour.
3,200 ppm	5-10 minutes	Headache, dizziness and nausea. Death within 30 minutes.
6,400 ppm	1-2 minutes	Headache, dizziness and nausea. Death less than 20 minutes.
12,800 ppm	1-3 minutes	Unconsciousness. Death within 3 minutes.

Once CO gas has been inhaled by the human respiratory system, it interacts with oxygen that carries blood haemoglobin and forms carboxyhaemoglobin (CO-Hb). Haemoglobin is no longer available for transferring blood when CO gas is mixed with haemoglobin. Exposure of CO gas to humans will cause serious brain and heart complications with excess than 20% of carboxyhaemoglobin (CO-Hb) (Bailey Regina, 2020).