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ANALYSIS AND DEVELOPMENT OF SMART GASES DETECTOR IN CABIN CAR

MUHAMMAD NAZREE BIN MOHAMAD
B091810335

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MUHAMMAD NAZREE BIN MOHAMAD

A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

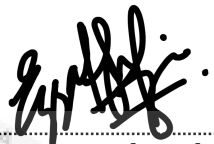
I Declare That This Thesis Entitled “Analysis And Development Of Smart Gases Detector In Cabin Car” Has Not Been Accepted For Any Degree And Is Not Concurrently Submitted In Candidature Of Any Other Degree Is The Results Of My Own Research Except As Cited In References.The Reasearch, Has Not Been Accepted For Any Degree And Is Not Concurrently Submitted In Candidature Of Any Other Degree.

Signature : 

Name : *Muhammad Nazree Bin Mohamad*
Date : *18 January 2022*

APPROVAL

I Hereby Declare That I Have Checked This Thesis And In My Opinion, This Thesis Is Adequate In Terms Of Scope And Quality For The Award Of The Bachelor Of Mechanical Engineering Technology (Automotive Technology) With Honours.

Signature : 

Supervisor Name : *Puan Ezzatul Farhain Binti Azmi*

Date : *28 January 2022*

DEDICATION

To my loving parents, Mohamad bin Ibrahim and Nik Fatimah binti Daud, my supportive family, and all of my good friends, whose unending support and prayers have been invaluable during my studies

ABSTRACT

Nowadays, many accidents happen as a result of drivers feeling drowsy or dizzy while driving. One of the reasons drivers and passengers may feel dizzy or drowsy is due to the high concentration of CO_2 in the car's cabin. Most of the CO_2 is produced by the human respiratory system. If the number of passengers increases, then the CO_2 concentration level in the car's cabin will also increase. The goal of this research is to build a new system capable of detecting various gases, such as carbon dioxide, carbon monoxide, and temperature, in the vehicle's cabin space. In addition, this analysis was conducted to determine whether the weather affects the concentration of carbon dioxide gas in the vehicle cabin in the morning and evening. This analysis also emphasizes the use of direct flow and closed flow air knobs because when gas from outside enters the vehicle's cabin space, such as carbon monoxide gas, and reacts with oxygen, it will produce carbon dioxide gas. In addition, this system is capable of detecting various sensors even though it is simple and can be installed in various vehicles. Arduino Wemos D1 R1, MQ-135 carbon dioxide sensor, MQ-9 carbon monoxide semiconductor sensor, and DHT humidity detector and temperature detector have been selected to create a new multifunctional system for detecting various gases and pollution in the cabin space of an injury. The Internet of Things module is used (IoT) and sensors in the main body that come with the WIFI unit. The data signal will be monitor and displayed on the LCD screen, while the data signal will be sent from the main body via the second WIFI unit and will be displayed on the screen of mobile phones that have been connected to internal applications (IoT) and processed and sent input to the module and the module analyzes the data and sends it to the transmitter to provide information to the user via the internet band directly to the user's telephone, when the circulation-air button is open (direct air) the average of CO_2 concentration is 1195 ppm and follow the ASHARE Standard which is 1200 ppm.SGD sensor can aware the passenger about dangerous our CO_2 and CO gas inside cabin car.

ABSTRAK

Pada masa kini, banyak kemalangan berlaku akibat pemandu yang merasa mengantuk atau pening semasa memandu. Salah satu sebab pemandu dan penumpang mungkin merasa pening atau mengantuk disebabkan oleh kepekatan CO_2 yang tinggi di dalam kabin kereta. Kebanyakan CO_2 terhasil dari sistem pernafasan manusia, jika bilangan penumpang meningkat maka tahap kepekatan CO_2 kabin kereta juga akan meningkat.Kajian ini bertujuan untuk mereka bentuk dan membina satu sistem baru yang mampu mengesan pelbagai gas iaitu karbon dioksida, karbon monoksida, dan suhu yang berada didalam ruang kabin kenderaan. Selain itu, kajian ini dilakukan untuk menentukan adakah cuaca memperngaruhi kepekatan gas karbon dioksida didalam kabin kenderaan diwaktu pagi dan petang. Kajian ini juga menitik berat pengguaan tombol udara pengaliran terus dan pengaliran tertutup kerana apabila gas dari luar masuk kedalam ruang cabin kenderaan seperti gas karbon monoksida bertindakbalas dengan oksigen akan menghasilkan gas karbon dioksida.Selain itu, sistem ini mampu mengesan pelbagai gas walaupun ringkas dan dapat dipasang dipelbagai kenderaan. Arduino Wemos D1 R1, alat pengesan MQ-135 karbon dioksida, MQ-9 karbon monoksida semikonduktor, dan DHT pengesan kelembapan dan pengesan suhu telah dipilih untuk mencipta satu sistem baru yang mempunyai pelbagai fungsi untuk mengesan pelbagai gas dan pencemaran yang berada diruang kabin kederaaan. Modul internet perkara digunakan (Internet of Things, IoT) dan pengesan dalam badan utama yang didatangi dengan unit WIFI, isyarat maklumat akan dikawal dan dipaparkan diskrin LCD, manakala isyarat maklumat akan dihantar dari badan utama melalu unit WIFI yang kedua akan dipaparkan pada skrin telefon mudah alih yang telah disambungkan kepada aplikasi interne perkara (IoT) dan diproses dan menghantar input ke module dan module menganalisi data dan hantar ke transmiter untuk memberi maklumat kepada pengguna melalui jalur internet terus ke telephone pengguna. Apabila mod pengaluran udara luar dibuka kadar kepekatan CO_2 ialah 1195 ppm iaitu di bawah nilai Piawaian ASHARE iaitu 1200 ppm. Secara keseluruhannya, SGD sensor dapat menyendari penumpang tentang bahayanya CO_2 dan CO dalam ruang cabin kenderaan.

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I would also like to extend my deepest gratitude to all those who have directly and indirectly guided me in writing this thesis. My appreciation and thanks are also dedicated to all of my friends for their helpful insights, cooperation, and stimulating comments. I would also like to express my apology for any mistakes or shortcomings in carrying out this task. To end with, I am truly delighted, as this research would benefit others.

Thank you.

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LIST OF ABBREVIATIONS

ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
DHT11	-	Humidity and Temperature Sensor
IDE	-	Integrated Development Environment
IIC	-	Interface Module
IoT	-	Internet of Things
LCD	-	Liquid Crystal Display
MQ-9	-	Carbon Monoxide Combustible Gas Sensor
MQ-135	-	Air Quality Sensor
NIOSH	-	National Institute of Occupational Safety and Health
OSHA	-	Occupational Safety and Health Administration.
O_2	-	Oxygen
PPM	-	Parameter per Million
SO	-	Sulfur Dioxide
WHO	-	World Health Organization
WiFi	-	Wireless Fidelity

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, there are many tools that facilitate the work of human beings and society. Here, a carbon dioxide detector was built to reduce the death rate in vehicle cabins due to the inhalation of toxic gases. This tool facilitates and helps the community to take care of the dangers of these carbon dioxide effects. In addition, with this detector, the public can know if there is a problem with gas leakage in the car or increased carbon dioxide concentration and can also detect sudden temperature changes.

This tracking tool was developed using Internet of Things (IoT) applications, which are capable of sending data to users who are anywhere. This is beneficial to users who use this tool in their vehicles. The longer you are in the vehicle, the higher the carbon dioxide concentration, which is due to the increase in the passengers themselves and also in the external environment (Daluwathu, 2020). The quality of the air is determined by the quantity of pollution and the present weather conditions. The air quality in villages and countryside is better than in cities and industry regions (Stitnimankarn, et al., 2020).

The carbon dioxide ($CO2_)$ levels in the cabin are supposed to be the same as the CO_2 levels in the outside air, which differ depending on location (Global Monitoring Laboratory, National Oceanic and Atmospheric, 2020). As in most experiences, discomfort of unpleasant smells is one of the main concerns of pollutants in the vehicle's cab. However, the adverse health effects that result from it are even more serious. The most dangerous thing is fatigue. Driver fatigue is one of the main concerns in the fight to reduce the number of road fatalities. Fatigue is often linked to symptoms of drowsiness or drowsiness, as well as a lack of focus, loss of concentration and slow reactions. In addition, lack of sleep and fatigue symptoms can lead to hand-eye coordination, which can lead to headaches, nausea, dizziness due to exhaust

pollutants such as Carbon Monoxide (CO), Nitrogen Oxide (Nox), and increase the likelihood of collision (E. L. Anderson and R. E. Albert, 2018). Passengers are exposed to pollutant air that flows into the vehicle cabin. In previous studies, it has been found human daily activity can be a cause of human health problems because of exposing themselves to CO_2. However, they are produced by human respiratory process and the environment (Daluwathu, 2020). CO_2 is a colourless gas produced by human exhalation.

In the modern world today, the number of cars is increasing with the technologies. For the closed environment that are closed and when a ventilation system fails, such as inside a car cabin, CO_2 concentrations rise dramatically in proportion to the number of passengers. If concentration is higher than Oxygen (O_2), it will have negative health effects for passengers and drivers, as well as fatigue, drowsiness, and slow reaction times to attack passengers and drivers in the cabin. This research is carry out to determine the amount of CO_2 produced in the cabin car, as well as to develop Smart Gases Detector in the Cabin Car under various conditions, including static car, moving car with direct and closed air recirculation on the air conditioning system.The Smart Gases Detector (SGD) monitors CO_2 to measure the concentration of carbon dioxide and temperature produced in the car cabin.

1.2 Problem Statement

Most car accidents happen because the driver feels sleepy when driving (Rehaman, 2021). Besides that, passengers will experience nausea and dizziness when they ride in the car for an extended period of time. It is widely assumed that a concentration of less than 1000 parts per million (ppm) is natural. Drowsiness parameters occur at levels ranging from 1000 ppm to 2500 ppm. Nausea and headaches are common side effects of levels between 2500 ppm and 5000 ppm. Exposure to levels above 5000ppm is extremely unhealthy, and it should not be prolonged (D A Krawczyk1, 2019). The increase in cases of children dying because parents left their child inside a cabin car for a long time (Ferrara, 2013). The main reason for this problem is the increasing level of CO_2, temperature and decreasing level of O_2 in the car cabin. The time taken for a car reaches the dangerous level of CO_2 until it causes the side effects of CO_2 on passengers such as shortness of breath, headache, feeling sleepy and more.

Every day, more people die in automobile cabins from drowning and suffocation. Many experts say it stems from a leak of carbon monoxide gas from the exhaust manifold. Here we can see, apart from the leakage of carbon monoxide gas, the concentration of carbon dioxide also contributes to cases of death. In one study, the author said that closed ventilation is the main cause of death due to suffocation from inhaling carbon dioxide gas (Daluwathu, 2020). Here, we can see that carbon dioxide gas is a non -toxic gas but can cause shortness of breath. The Figure 1.1 shows some newspaper clippings of the incident caused by falling asleep in the car's cabin while the engine was being started.

Figure 1.1 Newspaper clippings of the incident caused by falling asleep in the car's

The problem that arises here is that the community does aware about the dangers concentration of carbon dioxide in the car's cabin. Figure 1.2 depicts a father forgetting and dying in the car with his son until he dies from shortness of breath and suffocation.This is due to the increased concentration of CO_2 causing the CO_2 to invade the blood vessels and cause the victim to have blood pressure (Bord, 2007).

Figure 1.2 Newspaper clippings of the incident caused by a father forgetting and dying in the car with his son

While the engine is open and the car is in an idle state, in the long run, CO gas leaks from the exhaust and can enter the passenger's cabin. CO kills in two ways whether it is absorbed into the blood along with oxygen or it pumped throughout the body and damaging the organs. Then the remaining oxygen will be reduced and the addition of CO_2 gas will cause poisoning. The Figure 1.3 shows four students sleep in the car and two died due to inhaling gas CO.

Figure 1.3 Four students sleep in the car and two died due to inhaling gas CO

1.3 Objective

The objectives of this project have been identified and should be achieved to produce a successful smart gases detector. Specifically, the objectives are as follows:

(i) To develop a smart gas detector with carbon dioxide sensor in cabin car.

(ii) To determine the concentration of CO_2 in different recirculation mode (direct air & close air), different number of passenger, different time (morning & evening), and different vehicle movement (static & moving) in air conditioning systems for compact and sedan cars.

(iii) To analyse the relationship between concentration of CO_2, temperature using thinkspeak application generated by Internet of Things (IoT).

1.4 Scope of Research

The scope of this research is as follows:

This project's scope of study has been limited to the Perodua Axia (compact car) and Proton Saga (sedan car) in car cabin only.Furthermore, this experiment determines the different amounts of CO_2 in a cabin car during the morning and evening, for close and direct air. Then, this experiment focuses on the number of passengers involved during the experiment, which are two, three, and four people, and the data will be automatically collected by application thinkspeak in accordance with the scope described above.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The nature of the surrounding environment is increasingly affecting the comfort of the vehicle's occupants. As a result, the relationship between pollutant and comfort may affect a person and public safety. Sustainable transportation policies are inextricably related to the sector's ability to reduce carbon dioxide (CO_2) emissions. Comfort is no comprehensive set derived from architecture, engineering, social sciences, or the arts from the standpoint of sustainable growth in the automotive industry (Natalini & Bravo, 2014).

Automotive manufacturers' concern for indoor and outdoor air quality must combine and satisfy both comfort-related and road safety-related issues, without ignoring any element of energy efficiency. Furthermore, the new engines have a good performance in reducing energy, but this energy was used to heat the cabin during the winter (Doru Constantin *, 2016).

2.2 Carbon Dioxide

From article Airthings Tavis Davis state CO_2 is a greenhouse gas that is naturally occurring and innocuous in small quantities, but when levels grow, it may affect productivity and sleep. CO_2 levels concentrate inside with less ventilation since it is most typically created by the air we breathe. Indoor CO_2 concentrations are influenced by a mixture of outside CO_2, indoor breathing, and the building's ventilation rate. We have less fresh air as buildings and dwellings grow more energy-efficient and airtight. The Figure 2.4 shows the effects of CO_2.