



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**PORTABLE AIR QUALITY MONITORING 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 Automation & Robotics) with Honours.

اونيورسي تيكنيكل مليسيا ملاك by

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**PAVINRAJ A/L SELVARAJU**

**B071610760**

**950607-05-5163**

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Cop Rasmi Penyelia

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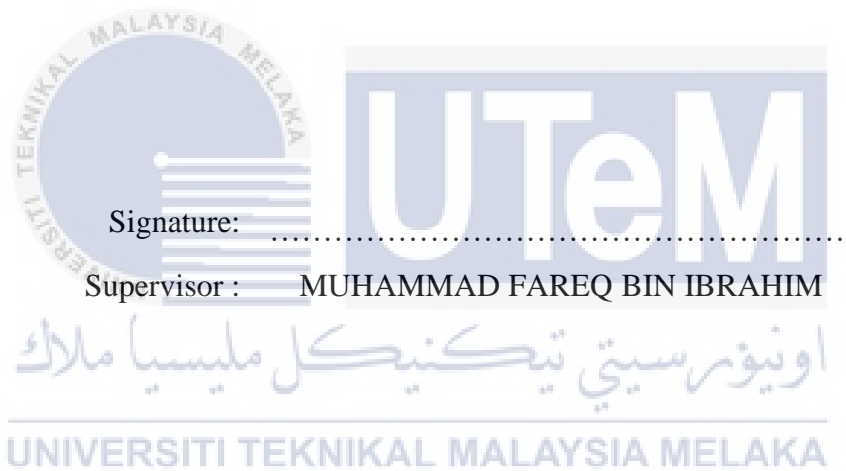
Author : PAVINRAJ A/L SELVARAJU

Date:



## APPROVAL

This report is submitted to the Faculty of Electric 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 Automation & Robotics) with Honours. The member of the supervisory is as follow:



## ABSTRAK

Menurut beberapa kajian, kematian yang dikaitkan dengan peningkatan pencemaran udara meningkat tahun demi tahun dan ada berjuta-juta kematian berkaitan pencemaran udara di dunia dalam tempoh setahun. Tetapi kebanyakan orang tidak mempunyai platform yang sesuai yang boleh menilai dan memberi amaran jika terdapat bahan pencemar udara yang berbahaya di atmosfera. Matlamat projek ini, adalah untuk mereka bentuk Sistem Pemantauan Kualiti Udara mudah alih sebagai sistem amaran, untuk menangani masalah-rata orang. Sistem Pemantauan Kualiti udara mudah alih ini direka untuk terus mengesan standard kualiti udara dan memastikan bahawa kualiti udara adalah selamat pada keadaan semasa. Sistem ini boleh memberi amaran kepada pengguna jika alam sekitar dikesan dengan bahan pencemar udara dalam kadar yang tinggi. Peranti ini juga boleh merakam ukuran kualiti udara dengan setem masa dan tempat koordinat. Ukuran yang dikumpul boleh digunakan untuk menghasilkan laporan atau mengubah ke dalam graf untuk memberi gambaran menyeluruh terhadap maklumat yang dikumpul, supaya pengguna biasa lebih memahami status kualiti udara di sekeliling mereka di samping membantu mereka untuk memantau corak kualiti udara dari masa ke masa sebagai langkah berjaga-jaga.

## ABSTRACT

Deaths linked to air pollution increase year after year and there are millions of air pollution-related deaths in the world within a year alone, according to some studies. But most people in the average do not have an appropriate platform that can assess and warn if there are hazardous air pollutants in the atmosphere. The aim of this initiative, the design of the Portable Air Quality Monitoring System as an Alert System, is to address the average person's problem. The Portable Air Quality Monitoring System is designed to continually track air quality standards and ensure that air quality is safe in actual moment. The system can alert users if the environment is sensed with a heavy rate of air pollutants. The device can also record air quality measurements with time stamps and position and place coordinates. The measurements collected can be used to produce reports or transform into graphs to give a thorough insight into the information collected, so that the ordinary users can better understand their air quality status around them while also helping them to monitor air quality patterns over time.

## DEDICATION

To my beloved parents, Mr. Selvaraju and Mrs. Parvathy thanks for their support and pray. A full appreciation to my supervisor Muhammad Fareq Ibrahim and friends at Universiti Teknikal Malaysia Melaka for advising and helping through this project.





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## LIST OF ABBREVIATIONS

|                         |  |
|-------------------------|--|
| <b>AQI</b>              | Air Quality Index                          |
| <b>PPM</b>              | Parts Per Million                          |
| <b>µg/m<sup>3</sup></b> | One micro gram per cubic meter of air      |
| <b>UI</b>               | User Interface                             |
| <b>API</b>              | Air Pollution Index                        |
| <b>CO</b>               | Carbon Monoxide                            |
| <b>NO<sub>2</sub></b>   | Nitrogen Oxide                             |
| <b>SO<sub>2</sub></b>   | Sulphur Dioxide                            |
| <b>O<sub>3</sub></b>    | Ozone                                      |
| <b>CO<sub>2</sub></b>   | Carbon Dioxide                             |
| <b>PM<sub>10</sub></b>  | Particulate matter with size of 10 micron  |
| <b>PM<sub>2.5</sub></b> | Particulate matter with size of 2.5 micron |
| <b>RAD</b>              | Rapid Application Development              |
| <b>IDE</b>              | Integrated Development Environment         |
| <b>XML</b>              | Extensible Markup Language                 |
| <b>DB</b>               | Database                                   |

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Prolonged exposure to bad air quality environments in developing nations is a significant government health problem. The pollutants accountable for bad air quality are projected to cause approximately 2.5 million early deaths annually. Of these fatalities, approximately 1.5 million are caused by polluted indoor air, and bad indoor air quality is proposed to present a important health threat to more than half of the world's inhabitants. Because of its connection with industrialization, social hygiene issues connected with bad air quality have a disproportionate impact on advanced and developing countries. After detection of airborne pollutants, remedial intervention to enhance air quality is often simple to introduce. Several climate scientists have created designs for tracking many of the pollution gasses such as sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO), etc. This project focuses on designing and implementing a portable monitoring system for air pollutants. It describes how to monitor the amount of air pollutants using a gas detector, a dust detector, an Arduino microcontroller and a Bluetooth module. The important thing about this report is to develop a portable air pollution monitoring system that can track, analyze and determine the position of atmosphere quality at its present place using this mobile air quality tracking system. Users can make preventive steps in advance based on the air quality information that can lead to a good life and create a safer atmosphere to live according to their regular activity plan.

## 1.1 Background

Air is a most fundamental segment that make up earth's structure and it assist for the continues biological life forms. The atmosphere is loaded with air which contains gases such as nitrogen, oxygen, carbon dioxide and has small amounts other gases and dust or particulate matter. Air pollution happens when there is expansive number of harmful particles presence in the air atmosphere.

Those harmful particles will change the world's ordinary air synthesis and this irregularity in earth's climatic creation will make negative outcomes the encompassing condition. Natural occasion and human exercises are the sole specialists that contributing towards air pollution. Volcanic ejection is one of the cases of natural occasion that reason serious air pollution in certain area (IPCC, 2007). Day by day human exercises from non-renewable energy source consuming, industrialization to slice and consume is the fundamental contributing element of air contamination all around whenever compared with natural occasion.

Living organisms such as humans, animals, food crops and natural environment need an atmosphere of air that is free from pollution. Any change in the natural composition of air may cause grave harm to life forms on earth. According to a study published in Environmental Research Letters, air pollution kills more than 2 million people each year. The effects of air pollution on human health may vary widely depending on the level of pollutants. Short-term exposure to toxic pollutants can cause serious health problems such as respiratory problems, irritation of the eye, nose and throat, and lung-related diseases such as asthma (Kampa and Castanas, 2008). In the

meantime, long-term exposure to other sites can lead to serious life-threatening diseases such as cancer, immune, neurological and respiratory damage. For example, after inhaling toxic fumes 15 types of chemicals in air samples taken from areas surrounding Sungai Kim Kim, including hydrogen cyanide, which emitted from chemical waste dumped into Sungai Kim Kim on March 7, a total of 951 people were warded and 25 ended up in the Intensive Care Unit (ICU).

Aside from causing medical problems among people, air pollution additionally adversely influences surrounding area and causes indirect impact on human health through climate change such as acid rain, haze, ozone depletion, drought and global climate change.

## 1.2 Problem Statement

Many types of devices are available on the market to assist any individual to maintain their healthy lifestyle. But devices that are capable of monitoring air quality are not abundantly accessible at the market and the current devices is excessively expensive and massive. Individuals who are concerned about the air quality of their surrounding environment find out that it hard to get the correct device or framework that has the ability for generating readings of air quality and warn them if the air quality is in poor condition.

For reading the Air Quality Index (AQI), most people need to rely on meteorological stations. In addition, these readings will only be broadcasted on television or posted later on websites. The delayed reading of AQI is not accurate since each time climatic change rapidly (Wong et al., 2012). Besides that, to generate the AQI readings, meteorological stations use heavy, costly complex set of tools and framework. It's not

feasible to acquire these devices as a personal air quality monitoring system and it is not necessary for individual use to generate exact AQI reading. Other than that, meteorological stations are static at certain places and not portable. Therefore, meteorological stations only can generate AQI reading for a specific district and people living in the spots without meteorological stations will find it hard for get to know the air quality level of their surrounding region.

AQI is the combination of different Parts per Million (PPM) gases or one micro gram per cubic meter of air readings ( $\mu\text{g} / \text{m}^3$ ) specifically published by the meteorological department to determine the general overall level of air quality. The process of taking different gas levels of PPM or  $\mu\text{g} / \text{m}^3$  requires different time lengths and combining all these different gasses in order to produce a single reading that is more precise than other methods known as AQI. However, the long process of generating AQI reading is becoming the main issue when a single gas level is dangerously high, but the meteorological department has to wait for PPM or  $\mu\text{g} / \text{m}^3$  reading of other gasses to calculate the AQI readings. The meteorological stations should always broadcast an early warning in the process of calculating AQI reading for noticing the public since sensing a high amount of reading of a single gas.

A simple detection of air pollution and early warning system is therefore considered necessary for individual use to determine the level of safety in air quality. This can be accomplished by using simple and cheap electronic gas sensors that are available on the market to build an air quality monitoring device. Compared to the expensive devices used within meteorological stations, these sensors are not accurate in generating air quality reading, yet they can detect air quality level without delay and give much faster

advanced warning than meteorological stations. Simple air quality monitoring system must capable of producing PPM or  $\mu\text{g} / \text{m}^3$  air quality readings and its corresponding percentage value based on the AQI calculation method.

### 1.3 Objective

Two main objectives of this project are:

- I. To design and develop a portable monitoring device for air quality that can detect and measure harmful air pollutants.
- II. To analyse a portable monitoring device for air quality that can detect and measure harmful air pollutants.

### 1.4 Project Scope

The Air Quality Monitoring Device is fabricated to be inexpensive, portable and user-friendly. An Android application will be developed and embedded as a single operating system unit with the assembled device. The system is aimed to general health-conscious users who are concerned about the level of air quality in their surrounding environment, which could adversely affect their health. The proposed system is not taken into account to be a latest invention as similar products or systems were already on the market. But, in order to fulfil the stated objective, the proposed system is integrated with extra functionality. In addition, this system is developed for indoor and outdoor use as well as users can easily to obtain the system's real-time air quality level.