Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT BASED AIR POLLUTION MONITORING SYSTEM USING ARDUINO

NURUL AQILAH BINTI MAHMUDIN

Bachelor of Electrical Engineering Technology with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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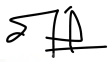
I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours. (please change the red text into black after edited)

Signature : 

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Date : 25 January 2023

Signature :

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Name (if any)

Date :

DEDICATION

To my beloved mother, Faridah binti Haji Yusak, and father, Mahmudin bin Haji Sulaiman,

and

To all my family members and friends.

ABSTRACT

Air pollution is the content of air in which there are foreign objects in concentrations that disturb or endanger humans, flora, fauna and property. This pollution occurs due to natural disasters, smoke from vehicle exhaust, open logging and burning. Accordingly, the human respiratory system will be disrupted as well as the earth's ozone layer of the air becomes thinner. Air quality management systems have been developed to regulate the concentration and quality of gases found in the atmosphere, such as carbon dioxide and oxygen to keep healthy. This project will utilize development of IoT based air pollution monitoring system to help consumer monitor the level of air pollution and air quality can be maintained and controlled. In addition, the purpose of this project is to alert the community regarding air pollution information by developing website ThingSpeak. It is because all air pollution information from multiple-ground based stations into one common area for effective and efficient monitoring and analysis of air pollution. This method of project allow users to check air quality data in an easy way like ThingSpeak that is connected to smartphones and computers anywhere and access the system data via Wi-Fi or Bluetooth by using Nodemcu V2. This method shows the data from ThingSpeak website. For next step, all the information can be access, monitor and check through smartphones and computer anywhere effectively and preciously. As results, the air pollution detected by MQ135 sensor meanwhile the readings data and status displayed in Serial monitor. Then, the data send to ThingSpeak to analysis purpose through a graph. For community, the status air pollution can be check in ThingView app. The impacts by doing this project is enhance the skills and gain experience in develop Internet of Things (IoT) air pollution monitoring system. It is also gain our knowledge about air quality and the importance to check the status for better life.

ABSTRAK

Pencemaran udara adalah persekitaran udara yang terdapat bendasing membahayakan manusia, flora, fauna dan harta benda. Pencemaran ini berlaku adalah disebabkan bencana alam, asap dari ekzos kenderaan, pembalakan dan pembakaran terbuka. Sistem pernafasan manusia akan terganggu serta lapisan ozon bumi udara menjadi makin nipis. Oleh itu, sistem kawalan kualiti udara diperkenalkan bagi tujuan untuk mengawal tahap kepekatan dan kualiti gas yang terdapat di udara seperti karbon dioksida, oksigen dan sebagainya untu kekal sihat. Projek IoT dalam sistem kawalan pencemaran udara dijalankan untuk membantu komuniti mengawal tahap kualiti udara. Tambahan lagi, salah satu objektif projek ini untuk memberi peringatan kepada pengguna dalam membangunkan suatu laman web ThingSpeak yang dapat mengumpul semua maklumat tentang tahap kualiti pencemaran udara. Hal ini kerana majoriti masyarakat telah maju dan moden dengan dapat mengakses ThingSpeak dengan mudah melalui penggunaan telefon pintar dan komputer. Projek ini memperkenalkan kaedah penggunaan telefon pintar yang dapat mengakses Wi-Fi atau Bluetooth melalui NodeMcu V2 untuk menyemak semua data tahap kualiti udara dalam aplikasi ThingView. Semua data akan dipaparkan di laman web ThingSpeak. Dengan ini, semua maklumat boleh diakses, kawal dan periksa melalui telefon pintar secara efektif di mana-mana sahaja. Hasilnya, tahap kualiti pencemaran udara dikesan oleh MQ135 dan pada masa yang sama, data bacaan dan status dipaparkan di serial monitor. Kemudian, data akan dihantar ke ThingSpeak untuk tujuan analisis dalam bentuk graf. Tahap pencemaran udara boleh diperiksa melalui aplikasi ThingView bagi pihak masyarakat. Implikasi dalam menjalankan projek ini adalah memperoleh kemahiran dan pengalaman dalam membangunkan sistem kawalan pencemara udara dalam menggunakan teknologi IoT.

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First and foremost, I would like to express my gratitude to my supervisor, Ts. Dr. Ahmad Zubir bin Jamil for his precious guidance, words of wisdom and patient throughout this project.

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PM	-	Fine Particulate Matter
	-	
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LIST OF ABBREVIATIONS

PPM	-	Parts per Million
GPS	-	Global Positioning System
GPRS	-	Generate Packet Radio Services
GSM	-	Global System for Mobile Communication
IoT	-	Internet of Things
LED	-	Light Emitting Diode
LCD	-	Liquid Crystal Display
LTE	-	Long Term Evolution
SOC	-	System of Chip
TCP/ IP	-	Transmission Control Protocol/ Internet Protocol
WHO	-	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

In today's world, pollutants is one of the major human health concern. An air pollution is any mechanical, physical, or biological element that alters the natural features of the atmosphere, whether indoors or outside. Household combustion devices, motor vehicles, industrial operations, and forest fires are all common sources of air pollution. The World Health Organization (WHO) stated the data that almost all of the worlwide population breathe air that exceeds PM2.5 and PM10 contains high amounts of contaminants, with the poorest and middle-income countries being the most affected. An air pollution cause respiratory and other diseases and it is important source of morbidity and mortaility.

Air quality has long been a topic of discussion, dating back to the Roman era. Authorities eventually took action following a succession of significant pollution episodes, beginning with the reduction of emissions. Donora, Pennsylvania was engulfed in a deadly haze in October 1948. Over the course of five days, about half of the town's 14,000 residents suffered from serious respiratory or cardiovascular problems. It was difficult to take a breath. The death toll has grown to more than 40. The streets of Donora are enveloped in a thick coating of grey cloud in these terrifying images. High above the city, a warm air pocket had passed, trapping colder air and pollution below.

Donora was no new to pollution. Steel and zinc smelters have long fouled the town's air. The air pocket, on the other hand, prevented pollutants from escaping. As they simmered on the streets, residents inhaled them in lethal proportions. Donora's illness was

severe, but it was part of a bigger pattern. Air pollution has become a terrible consequence of industrial progress across the country and around the world. Crisis like Donora was widely publicized. People noticed and began to act.

Since it happened, the link between air pollution and health has been studied by experts. The state has begun to enact legislation to decrease pollution in the air. And in 1970, a milestone year, The Clean Air Act was amended by Congress, which sets national air quality standards.

Throughout the years, the evolution of technology keep advanced in worldwide. Recently, Internet of Things (IoT) is one of the popular system or the internet-connected network of physical items (or "things") equipped with sensors, software, and other technologies for the purpose of networking and sharing data with other devices and systems.

An IoT ecosystem is made up of web-enabled smart devices that acquire, send, and act on data from their surroundings using embedded systems such as CPUs, sensors, and communication gear. IoT devices can exchange sensor data with an IoT gateway or other edge device, which can then be sent to the cloud for analysis or examined locally. On occasion, these devices may communicate with one another and act on the data they receive. Individuals may engage with the devices to set them up, provide instructions, or obtain data, but the devices conduct the majority of the work.

For example, air pollution can be observe, collect all information and check air quality level (K. Kumar Sai *et al*., 2019). Air sensors, such as the MQ135 Gas Sensor, are used to detect various dangerous chemicals in the air, such as CO2, and are connected to the Arduino Uno, a microcontroller that is utilised in the system and constantly transmits data to the application via the Wi-Fi module.

To control the data information, the best microcontroller need to be choose for the monitoring system is Arduino. Because of its simple structure and wide variety of

working conditions, it is one of the best microcontrollers. Arduino microcontroller are essentially a controller for electronics. They can utilise their inbuilt CPU to transform inputs like light on a sensor or an item near a sensor to outputs like driving a motor, ringing an alarm, turning on an LED, displaying information on an LCD, and so on. Furthermore, Arduino also may be tuned using relatively simple design criteria and is straightforward to build using analogue or digital components. Thus, the interface connection of the monitoring system is connecting internet with IoT devices to provide all data.

1.2 Problem Statement

One of the growing public concerns is regarding human health, safety and comfort. There are so many form of pollution that degrades the atmosphere, causes biodiversity loss, stratospheric ozone depletion, damaging acid rain, and global warming, climate change and land degradation. Particularly fast urbanization in growing nations has become a common phenomenon. Air pollution must be controlled in order to ensure the healthy and clean climate.

The emission of combustion fossil fuel vehicles is one of the main causes of air pollution in Malaysia. Other human innovations and activities, in addition to industry, contribute to air pollution. Air quality based on pollutants level which has the parameters like carbon dioxide, nitrogen dioxide, sulfur dioxide etc. As a result of these factors, there is an increasing need for an air pollution management and monitoring system.

It is necessary to impose regulations governing the rigorous monitoring of air pollution. All air pollution and information from multiple ground-based stations, ground-based and aerial mobile sensors, remote sensing and atmospheric models, and social media into one common area for effective and efficient monitoring and analysis of air pollution in

the urban environment. Thus, lung cancer asthma, coronary artery disease including chronic pulmonary diseases, coughing and other diseases can be reduced.

1.3 Project Objective

The project is being carried out with the following goals in mind:-

a. To use ThingSpeak to monitor air quality and maintain it under control for a brighter future and cleaner environment.
b. To monitor the level of pollution using collected data shown on the ThingSpeak website at any time and from any location using your computer or mobile device.
c. To develop website specifically to alert community regarding on air pollution infomation.

1.4 Scope of Project

a) This project to create an equipment that allowing for easy integration into any other sort of internet-based architecture (IoT) that permits the use of sensors capable of collecting information on sensors connected to smart city environment measurements, with the goal of giving data on environmental pollution-related data.
b) With rapid growth in infrastructure and industrial modules, environmental issues have fueled a significant need for smart monitoring systems. The Internet of Things (IoT) has become an alternative nowadays because to its cost effectiveness, high performance, and other factors.
c) The Internet of Things (IoT) allows computers and mobile devices to connect with one another.
d) To minimise any doubt about the project's feasibility owing to limits and restraints, the scope of the project is described as follows: Arduino Uno, NodeMcu V2

ESP8266 Wi-Fi Module, MQ135 Gas Sensor, LED, Trimmer Potentiometer, and Buzzer.

e) ThingSpeak software will be use to collect and display the data include analysis for prediction based on data readings. As an example, quality of air is good or not. All data is saved at http://thingspeak.com, which is a programme that allows users to upload and store sensor data to the cloud.

f) The environment data obtained can be monitored from anywhere. Wi-Fi Modules are used as network connectors in this system. These gadgets, however, must be placed near the Wi-Fi hotspot. Furthermore, this method only shows the data from the ThingSpeak website.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the reviews of researchersworks or project carried out by previous related to the project topic. This chapter will also include fundamental knowledge with respect to the topics, mostly on area of air pollution, what is the types of microcontroller that use in device and how IoT works on and help in monitoring system. All the data is simplified based on the title, abstract, introduction, conclusion, and full text. All the information that is focused on the same or different objective can be used as a comparison, which can make the outcome project better.

2.2 History of Air Pollution

In October 1948, the town of Donora, Pennsylvania, was shrouded in a fatal haze. Over the course of five days, about half of the town's 14,000 residents suffered from serious respiratory or cardiovascular problems (E. Jacobs *et al.*, 2018). It was difficult to take a breath. The death toll has grown to more than 40. The streets of Donora are covered in a thick coating of grey cloud in these terrifying images. Warm air had passed high above the city, trapping cooler air and pollution below.

Donora was no acquainted to pollution. The town's air has long been polluted by steel and zinc blast furnaces. The air pocket, on the other hand, prevented pollutants from escaping. As they simmered on the streets, residents inhaled them in dangerous proportions. Donora's illness was severe, but it was part of a bigger pattern. Air pollution has become a terrible consequence of industrial progress across the country and around the world.