DEVELOPMENT OF A REAL-TIME IoT BASED AIR POLLUTION MONITORING WITH NOTIFICATION SYSTEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Electronic Industry) with Honours.

By

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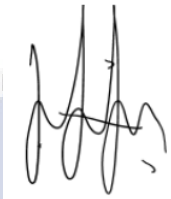
Signature : 

Supervisor : Dr Ida Syafiza Binti Md Isa

Date : 18/2/2021

ABSTRACT

Air pollution can cause long-term health effects to humans such as heart disease, lung cancers, and respiratory disease. There are many forms of contamination induced by smoke or gas emissions. These are triggered by fossil fuel burning due to motor transport. Furthermore, the manufacturing and construction operations also give an impact on the air quality. The economic growth of the region, which relies on manufacturing industries such as plastics, electronics, and rubber, has contributed to a rise in organic and inorganic carbon, plastics, and dust contaminations. Therefore, this project will develop an air pollution monitoring system using long-range (LoRa) communication technology. Several gas sensors such as MQ2, MQ7, and MQ135 are used to monitor the level of air pollution. The principal component of this project is Arduino Uno. The Arduino Uno will be used at the transmitter to monitor the air quality with the aid of several gas sensors connected to it and the data will be sent to the receiver using the LoRa communication module. Meanwhile, the data received at the receiver will be displayed at the LCD and stored in the cloud. Besides that, the data will be display on the Node-RED dashboard while the notification system will receive through the Telegram application.

ABSTRAK

Pencemaran udara merupakan satu permasalahan yang sering dihadapi oleh masyarakat. Pelbagai jenis punca pencemaran yang disebabkan oleh pembebasan asap atau gas diudara. Antaranya disebabkan oleh pembakaran bahan api fosil disebabkan oleh pengangkutan bermotor. Selain itu, aktiviti perindustrian dan pembangunan juga memberi impak terhadap pencemaran udara. Pembangunan ekonomi negara yang bergantung kepada industri pembuatan seperti bahan kimia, elektronik dan juga getah telah menyebabkan penambahan kepada berlakunya pencemaran gas organik dan bukan organik, bahan kimia dan habuk. Contoh pelepasan gas diudara adalah berasaskan nitrogen dan sulphur. Manakala, asap yang mengandungi sulphur dioksida dan hidrokarbon pula dilepaskan oleh kilang penapis minyak. Oleh hal yang demikian, projek ini dilaksanakan bertujuan menghasilkan sistem bagi memantau pencemaran udara dengan mengunakan (LoRa) dan beberapa penderia gas seperti MQ 2, MQ7 dan MQ135. Arduino Uno dia guna kan sebagai komponen utama dalam projek ini. Arduino Uno akan disambungkan dengan beberapa penderia gas dan juga LoRa pada bahagian pemancar. Pada bahagian penerima pula, Arduino Uno akan disambungkan dengan LCD,LoRa dan juga komputer. Data akan dihantar dengan menggunkan modul LoRa. Selain itu, data akan dipaparkan dalam Node-Red dan sistem notifikasi akan diterima melalui aplikasi Telegram.

DEDICATION

To my beloved parents Kamaruzaman Bin Yaakub and Mahnum Binti Yusoff, My great supervisor Dr Ida Syafiza Binti Md Isa and my lovely siblings. Thank you, everyone.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Global air contamination has gotten a significant issue that undermines our planet. It has a few unfriendly consequences for humanwellbeing and the living biological system in general. Air is one of the basic components of man's environment. The world's environment is brimming with air-carrying pollutants for example nitrogen, oxygen, carbon monoxide, and hints of some uncommon components. People required an environment of air that is liberated from pollution. This is significant for human life and wellbeing. Any adjustment in the common organization of air may make grave mischief to living things on earth. Air contamination is the nearness of at least one contaminant in the air can hurt people, creatures, and plant.

The main target of this study is to develop an air-polluting monitoring system to monitor the air quality by using low range (LoRa) communication protocol. This is because alerting people to any risky circumstance is important as prevention is better than cure. It can reduce harm and the cost for health treatment as the proposed air pollution monitoring system using LoRa can monitor air pollution in a wide area network to give an alert to people in that area for precaution.

1.2 Background of study

Air pollution can give a big impact on our life that poses many challenges to the planet's ecosystem and environment. Exceptionally obvious in the dire need to control the air quality, inferable from extended industrial activities over the past years. People

ought to understand the impact of the air pollution ecosystem. For those who work in a factory are to be even more at risk of inhaling hazardous substances and pollutants because of their sustained exposure to pollution. Because of that awareness and safety precaution should be taken before any risky circumstance happen. This work focused on the development of the air pollution monitoring system to monitor the air quality by using LoRa technology. Besides that, several types of gas sensors are used in the developed system to monitor the level of the air quality.

LoRa (Long Range) is a secured electronic remote designed by Cycleo of Grenoble, France that is used in the Internet of Things (IoT) development. It was picked up by Semtech in 2012, which holds the IP for the LoRa transmission structure. LoRa transmits over permit free sub-gigahertz radio repeat bunches. The transmissions range of more than 10 km in rural regions are enabled by LoRa since a long time ago with low force utilization.

1.3 Problem Statement

Malaysia should be stressed on the importance of having an air pollution system as there are many health cases related to air pollution due to the industry's chemical substance. For instance, in March 2019 thousands of people were hospitalized because of the disposing of a toxic incident in Sungai Kim Kim in Pasir Gudang which resulted in air pollution. Also, due to this, many educational institutions in the nearby area had to shut down their operation for three months as many people in that institution had been affected due to the air pollution. Therefore, developing an air pollution monitoring system would make industry players progressively mindful in dealing with consistent practices at the plants.

1.4 Objective

The objective for this project are:

I) To develop an air pollution monitoring system to monitor the air quality by using long-range (LoRa) communication technology.

II) To develop a data logging system to record real-time gas data for monitoring.

III) To analyses the reliability of the developed system considering different types of gas sensors.

1.5 Scope of research

The scope of this project is to focus on the development of air pollution monitoring systems to monitor air quality by using LoRa communication module. Several gas sensors such as MQ2, MQ7, and MQ135 to detect several types of gas such as smoke, carbon monoxide, ammonia, benzene, and alcohol respectively are used to determine the status of air quality. Besides, the performance of the system is evaluated in terms of a data logging system and reliability to send a notification to people in case of an emergency in real-time.

1.6 Organization

This project focus on developing an air pollution monitoring system to monitor the air quality by using LoRa as the communication method (LoRa) between the transmitter and receiver. The thesis comprises of the five chapters. Chapter 1 present the introduction related to the air pollution system, objective, problem statement, background of the project, scope of the research, and the expected results. Chapter 2 presents the literature review related to the current air pollution monitoring system using different communication technology and working system. In chapter 3, the methodology and components used in this thesis are presented. Also, the workflow of this project such as

the Gantt chart is included. In chapter 4 presents the outcomes that have been recorded and explored from the examination. Lastly, chapter 5 presents the conclusion of this thesis.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents the literature review related to the development of the air monitoring system. Air pollution is harmful to living things and the environment. Air pollution happened due to the release of toxic or harmful pollutants into the air. Air emissions that contain contamination (i.e., carbon monoxide, sulphur dioxide, nitrous oxides, methane, and chlorofluorocarbons), particulate matter (i.e. both organic and inorganic), and biological molecules can cause diseases, asthma, and even death to the living human. Air Pollutant Index (API) in Malaysia is partitioned into five classes which are good, moderate, unhealthy, very unhealthy, and serious.

2.1.1 A Smart Air Pollution Monitoring System [1]

Every year, there are half a million children below five years old died from respiratory infections due to indoor/outdoor pollution and second-hand smoke. Therefore, this study is conducted to monitor and evaluate the air quality by updating the real-time monitored data to a central server over the Internet. The air pollutant monitoring system is developed using Arduino Uno, Wi-Fi module 8266, and a gas sensor which is MQ135, and a liquid crystal display (LCD). The block diagram of the developed system is as shown in Figure 2.1.

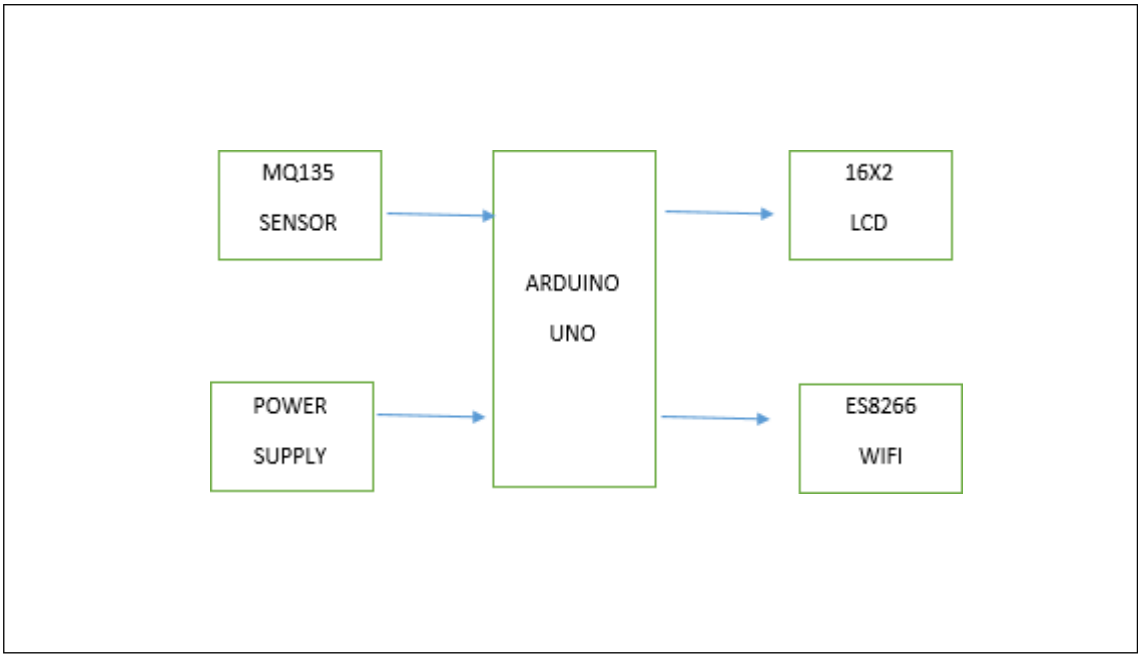

Figure 2.1: The Proposed air pollution measuring system block diagram [1]

In this work, the Arduino library was mounted, and a request was sent to the LCD. Data of the air quality are obtained through MQ135. The optimized sensor made the analog output voltage equal to the Parts per Million (PPM) concentration of the polluting gases. In this work, Microsoft Excel is used to analyze the air quality measurement that had been taken based on the Parts per Million (PPM). The monitored data are displayed on the LCD panel before being transmitted to the server through the Wi-Fi network. In the work, a web application "Thing Speak" is used to share the information with the people. The authors conclude that the proposed air pollution monitoring system using the "Thing Speak" application helps to raise the consciousness about the air quality to the people.[1]

2.1.2 Air Pollution Monitoring System based on Geosensor Network [2]

The work in [2] proposed a Geosensor-based air quality control system. The goal of the developed system is to identify the status of the air in the existing and near-future

pollutants sector. The developed system can be used for several applications such as tracking the seabird environment, microclimate chaparral transects, building comfort, and detecting instruction. The target of this project is to reduce costs and severe damage that might happen.

In this work, two systems which are air contamination tracking system and sensor network management system are used to control the geosensor network. The control system helps to adjust the sampling interval and verify the network status. The air quality control program promotes the integration of the sensor data and mitigation models for air emissions to consider the extent and region of emission.

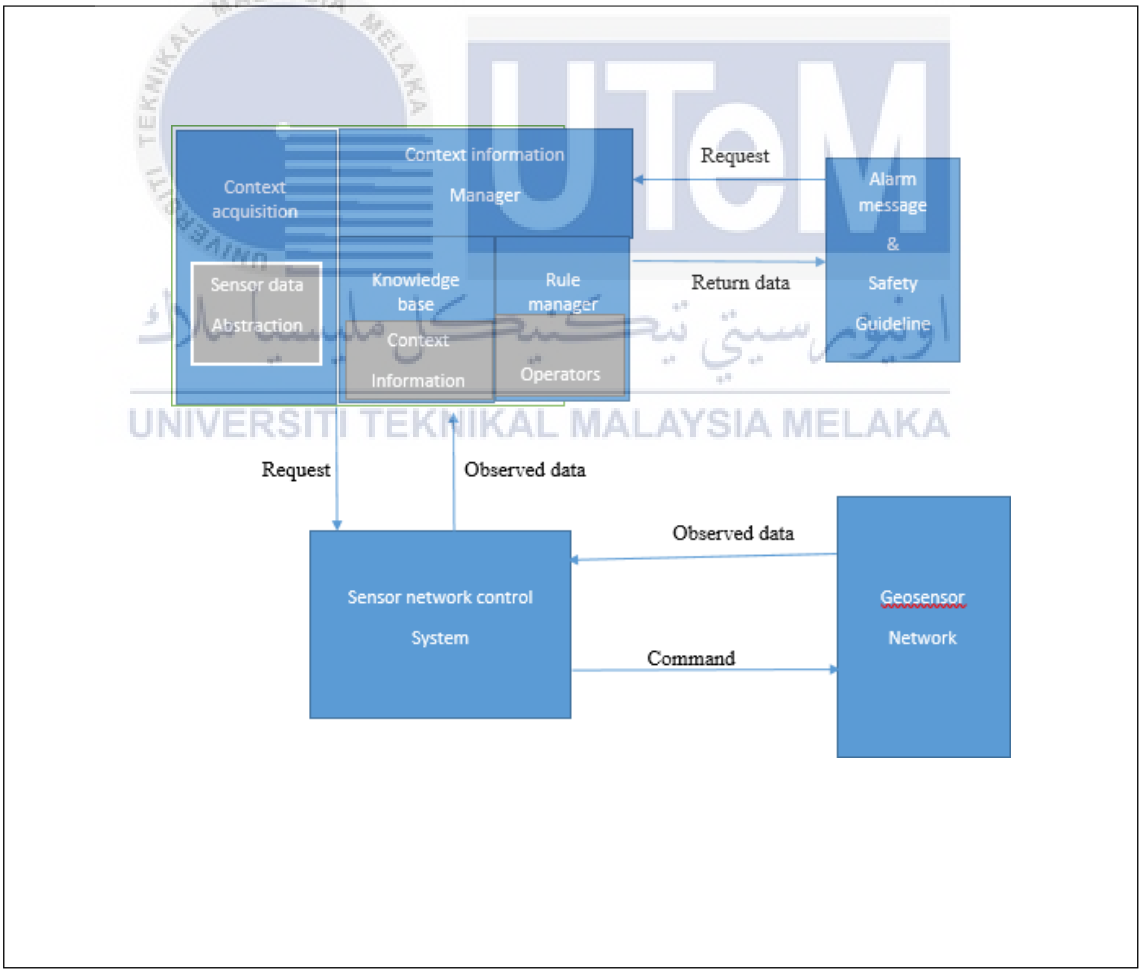

Figure 2.2: The architecture of the air pollution monitoring system [2]