WIRELESS AIR QUALITY MONITORING SYSTEM FOR INDOOR ENVIRONMENT

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JUDUL: WIRELESS AIR QUALITY MONITORING SYSTEM FOR INDOOR ENVIRONMENT

SESI PENGAJIAN: SESI 2016/2017

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WIRELESS AIR QUALITY MONITORING SYSTEM FOR INDOOR ENVIRONMENT

LOW CHEN HAU

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This report is submitted in partial fulfilment of the requirements for the Bachelor of Computer Science (Computer Networking)

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2017

DECLARATION

I hereby declare that this project report entitled

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is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date : 21/8/2017

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I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Computer Networking) With Honours.

SUPERVISOR: _____ Date : 21/8/2017

(DR.NURUL AZMA BINTI ZAKARIA)

DEDICATION

To my beloved parents, supervisor and friend.

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ACKNOWLEDGEMENTS

First at all, I would like to take this opportunity to express my highest gratitude to my dearest supervisor, Doctor Nurul Azma binti Zakaria. Dr Azma, thank to your valuable guidance and advices throughout the whole process of this final year project. Furthermore, your patience and understanding had helped me through all problems that I faced during the progress of doing this project.

Next, I would like to thank to the evaluator for this project, Dr Zaheera Zainal Abidin, for your opinions towards the weaknesses in my project and guidance for me to improve my project.

Last, I would like to thank to my parents and friends for their understanding and give fully support for me to complete the final year report.

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ABSTRACT

Most people nowadays pay attention about the health, for example the food they eat are healthy and especially the air they breathe. In Malaysia, every end of the year, the haze pollution occurs cause by the open burning in Indonesia. However, the dangerous particle in the outside air produce a harmful condition inside the house which polluted the indoor air environment through windows or doors. Therefore, a wireless indoor air quality monitoring system is developed to monitor the air quality in the indoor environment. The contribution of this project is to develop a prototype using low-cost air quality control unit sensor, temperature and humidity sensor, solar power supply and Raspberry Pi. Next, the system provides able air quality monitoring reading and display the data in webpage using the cloud storage. Furthermore, the system also able to store record in cloud storage for further data analysis and able to send the notification when in unhealthy condition. The healthy limit is set in 100ppm which means about the healthy limit, the system send the email notification to user and in the same time the red LED bulb lighted up and the green LED bulb lighted up again when the air quality below the healthy limit. Besides that, the system is a low-cost system and using solar power as the power supply to reduce the harm to the planet and create positive conditions for the environment. Next, the setup of the project is easily which is just interact with the Raspberry Pi and sensor technology which can found easily in the market with low-cost price. The impact of this study produce a better indoor environment monitoring to the user.

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ABSTRAK

Kebanyakan orang pada masa kini memberi perhatian terhadap kesihatan, contohnya makanan yang mereka makan sihat dan terutama udara yang mereka nafas. Di Malaysia, setiap akhir tahun, pencemaran jerebu berlaku disebabkan oleh pembakaran terbuka di Indonesia. Walau bagaimanapun, zarah berbahaya di udara luar menghasilkan keadaan yang berbahaya di dalam rumah yang mencemarkan persekitaran udara dalaman melalui tingkap atau pintu. Oleh itu, sistem pemantauan kualiti udara dalaman tanpa wayar dibangunkan untuk memantau kualiti udara di persekitaran tertutup. Sumbangan projek ini adalah untuk membangun prototaip menggunakan sensor unit kawalan kualiti udara kos rendah, sensor suhu dan kelembapan, bekalan kuasa solar dan Raspberry Pi. Seterusnya, sistem ini menyediakan bacaan pemantauan kualiti udara yang mampu dan memaparkan data dalam laman web menggunakan storan awan. Selain itu, sistem juga dapat menyimpan rekod dalam storan awan untuk analisis data lanjut dan dapat menghantar pemberitahuan apabila dalam keadaan tidak sihat. Had yang sihat ditetapkan pada 100ppm yang bermaksud tentang had yang sihat, sistem menghantar pemberitahuan e-mel kepada pengguna dan pada masa yang sama mentol LED merah menyala dan mentol LED hijau menyala semula apabila kualiti udara di bawah had yang sihat. Di samping itu, sistem ini adalah sistem kos rendah dan menggunakan tenaga suria sebagai bekalan kuasa untuk mengurangkan bahaya kepada planet ini dan mewujudkan keadaan positif bagi alam sekitar. Seterusnya, persediaan projek mudah sahaja yang hanya berinteraksi dengan Raspberry Pi dan teknologi sensor yang dapat dijumpai dengan mudah di pasaran dengan harga murah. Impak kajian ini menghasilkan pemantauan persekitaran dalaman yang lebih baik kepada pengguna.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Most people nowadays concern about health, they concern about whether the food they eat or water they drink are healthy for their life but most of them pay a little attention to environment around them especially the air quality that surround them.

When talking about the air pollution, especially every end of the year, Malaysia always faced the haze pollution due to the open burning of the forest in Indonesia. The open burning released harmful gases and one of the example is Nitrogen Oxide (NO_x) which is the main component of formation of acid rain. Those kinds of harmful gases affect our health and can cause lung cancer or chronic heart disease even though in indoor environment. This is because the outdoor air pollution come in to indoor through windows. Therefore, a system is proposed which can detect the air pollution in indoor environment so that the people manage to keep away those harmful gases which affect their health.

In order to remove those harmful gas, the air sensor was used. Nowadays the sensor technology has been improving as compared to the previous technology. There are many air quality sensor products selling in market, which used high technology and knowledge to develop this kind of air quality monitoring system. Therefore, those existing products are costly. Besides that, some of them do not provide the notification

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alert and store the data for further analysis. Therefore, this project proposes a solution to overcome the problems by develop a wireless network and low-cost system that can monitor the quality of the air and the system can able to record the data reading and sending notification when the air quality beyond the limit.

The hardware use in this system are Raspberry Pi, an air sensor to sense those harmful gases and a temperature and humidity sensor to detect the temperature and humidity. A web page was created to display and analysis the data for air quality. When the air quality is in unhealthy environment, a notification is sent to the user through email. There is also a wireless network connection in this system so that the data can send to the cloud storage and sending the email notification to the user when the air quality is in unhealthy condition. In the end of the project, this system helped the user to monitor the air quality in their living environment.

1.2 Problem Statement (PS)

Today a lot of air pollution monitoring system found in the market but the use high-technology to develop and costly. Other than that, the air pollution monitoring system in the market mostly shows the reading of the air quality, but they did not provide any notification and they also did not store those air quality reading on cloud storage and even in local storage. The people or user cannot access the previous air quality reading and do analysis when the system does not provide storage to store the reading. Therefore, this system is proposed to solve those problems.

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Table 1.1 Summary of Problem Statement

PS	Problem Statement
PS 1	The existing air quality monitoring device in the market are costly.
PS 2	The air quality monitoring system show only the reading and did not provide the notification and reading storage.

1.3 Problem Question (PQ)

Problem question is use to distinguish each problem that being stated in table 1.1. The table 1.2 below show the project question's summary based on the problem statement above.

Table 1.2 Summary of Project Question

PS	PQ	Project Question
PS 1	**PQ 1**	What type of low cost tool that suitable to used to monitor the air quality?
PS 2	**PQ 2**	How to alert the user and keep record when air in unhealty level?

1.4 Project Objective (PO)

Project objective used to defines the things that need to achieve. The problem statement and also the project question of this project that stated in the previous subsection must be considered to achieve the project objectives.

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There are three objective, which need to be achived in this project and those objective are shown as below:

Table 1.3 Summary of Project Objectives

PS	PQ	PO	Project Objective
PS 1	PQ1	PO1	To develop a wireless network and low-cost system that can monitor the quality of air which can affect the human's health.
PS2	PQ2	PO2	To integrate the monitoring system with the webpage so that the information can be viewed online.
		PO3	To daily record air quality's data and generate notification email when the air quality is in unhealthy condition.

PO1: To develop a wireless network and low-cost system that can monitor the quality of air which can affect the human's health.

Based on this system, the Raspberry Pi microcomputer and some air sensor was used to product a low-cost system. The Raspberry pi is a microcomputer that low in cost and using operating system "Raspian" which form by interacting the Raspberry Pi with the Debian operating system. In addition, Raspberry Pi can support the wireless connection, thus this system use a wireless network connection to send the reading of the air quality to the cloud storage.

PO2: To integrate the monitoring system with the webpage so that the information can be viewed online.

The system integrated with the webpage to display the reading of the air quality. The owner can view the information or the reading of the air quality online.

PO3: To daily record air quality's data and generate notification email when the air quality is in unhealthy condition.

For the database, the air quality reading is recorded and stored in the online cloud storage. If the air quality are in unhealthy condition, a notification is generated by sending a warning email using email server.

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1.5 Project Scope

The scope of this project are going to be handled as follow:

- Raspberry Pi microcomputer is used as a device that interact to other hardwares
- MQ135 Air Quality sensor is used to detect air quality in indoor environment.
- DHT22 Temperature and Humidity sensor is used to detect the temperature and humidity in indoor environment.
- Notification message is sent to the user by using an email.

1.6 Project Contribution (PC)

Project contribution defines the expected from this project and significant contribution of this project. This project uses low-cost Raspberry Pi and air quality sensor to monitor the air quality.The air quality reading is transffered to the cloud server through wireless network connection. The webpage has the funtion to show the record of the air quality reading. The reading of air quality is also recorded in cloud storage. One of the contribution of this project is to send an email notification to the uses when the air quality is in unhealthy condition.

Table 1.4 Summary of Project Contribution

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	Understand the functionality of low-cost Raspberry Pi and the air quality sensor and humidity sensor in wireless network.
PS2	PQ2	PO2	PC2	Monitor the air quality reading and display in webpage through internet.
		PO3	PC3	Manage record data in cloud storage for further data analysis and send notification when in unhealthy condition.

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1.7 Report Organization

Chapter I: Introduction

This chapter mainly focus of the introduction of project which include the introduction and the background of the project. It also briefs explained the problem statement, project objective, scope of the project, the expected outcome and conclusion to make sure the project can be understood easily.

Chapter II: Literature Review

This chapter focuses on the explanation of the reading material and publish thesis. Hence, this chapter described some related publish thesis and journal articles on air quality monitoring. Those publish thesis and articles is analysed especially about the main tools that used in this project. For example, Raspberry Pi and air quality sensor.

Chapter III: Project Methodology

In this chapter focus on the project method which explain each stage of the selected methodology like waterfall methodology. The chapter also describe the milestone of this project.

Chapter IV: Analysis and Design

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In this chapter focus about the problem analysis, analysis requirement and the project design. For the problem analysis, all the problem statement that stated in chapter I discussed in here whereas the analysis requirement of the project focus on two side, which are hardware requirement and software requirement. For the design of the project, the logical design of the project and the flow of the project also attached in this chapter.

Chapter V: Implementation

In this chapter focus on how the project is implemented. This project used the Raspberry Pi and air quality sensor. The step by step of how to wiring and configuration the Raspberry Pi with the air sensor also stated in this chapter.

Chapter VI: Testing

This chapter focuses about the project test plan, test design and test results and analysis of the project. The testing plan is done consist of the test organization, test environment and test schedule. Next, the test design is descripted in the testing data. The test result is analysed in order to conclude in testing phase.

Chapter VII: Conclusion

This chapter discusses about the summary of the project. The conclusion includes the observation on weaknesses and strengths, proposition for improvement which are future work, project contribution and the limitation of the project.

1.8 Conclusion

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Last but not least, this project is aiming to achieve all the objective and to overcome the problem statement in this project. This assists the understanding of the reader about the project including the project background, objective and problem statement. In the next chapter, the literature review is discussed, which describes about the related works.