DEVELOPMENT OF UNMANNED AERIAL VEHICLE (UAV) FOR AIR POLLUTION MEASUREMENT

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DECLARATION

I declare that this thesis entitled “DEVELOPMENT OF UNMANNED AERIAL VEHICLE (UAV) FOR AIR POLLUTION MEASUREMENT” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this report entitled "DEVELOPMENT OF UNMANNED AERIAL VEHICLE (UAV) FOR AIR POLLUTION MEASUREMENT" and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Mechatronics Engineering with Honours

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DEDICATIONS

To my beloved mother and father

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ABSTRACT

High potential and great quality in covering of collection and measuring of air quality data with high of precision in perceptual and secular of qualitative resolution that has been offered by unmanned aerial vehicles. The world today is heading towards industry 4.0 and technology is now also heading without human actions and mostly using robots. Today's technology network is very wide involving various networks such as cloud networking, internet of thinking, data base and cyber physical system. Industry 4.0 has been demonstrated through air pollution data collection models such as offline programming and adaptive control for complex welding, taking processes from product design through simulation to one place to complete the collection of air pollution data without moving according to today's world with covid disease - 19 which causes inhibition of human movement. There are also examples of companies implementing Industry
4.0 in the manufacture of robots to facilitate the process of retrieving air pollution data and various smart factories around the world. Industry 4.0 has been demonstrated through air pollution data collection models such as offline programming and adaptive control for complex welding, taking processes from product design through simulation to one place to complete the collection of air pollution data without moving according to today's world with covid disease -
19 which causes inhibition of human movement. There are also examples of companies implementing Industry 4.0 in the manufacture of robots to facilitate the process of retrieving air pollution data and various smart factories around the world. This study has 2 objectives which are develop a best unmanned aerial vehicle that really means to be capable platform to monitoring various types of air pollutants in real-time monitoring and design the easier types to manage air sensor to be mount in the unmanned aerial vehicle that will not make the connection to been a problem to solve. In that case, a design of the air sensor module that really needed to achieve the main objectives to manage the performances in taking the data of air pollution measurement with help of the new technology of unmanned aerial vehicle.

ABSTRAK

Potensi tinggi dan berkualiti tinggi dalam meliputi pengumpulan dan pengukuran data kualiti udara dengan ketepatan tinggi dalam spasial dan temporal resolusi kualitatif yang telah ditawarkan oleh kenderaan udara tanpa pemandu. Dunia hari ini menuju ke arah industri 4.0 dan teknologi kini juga menuju tanpa tindakan manusia dan kebanyakannya menggunakan robot. Rangkaian teknologi masa kini sangat luas melibatkan pelbagai rangkaian seperti rangkaian awan, internet pemikiran, pangkalan data dan sistem fizikal siber. Industri 4.0 telah ditunjukkan melalui model pengumpulan data pencemaran udara seperti pengaturcaraan luar talian dan kawalan adaptif untuk pengelasan kompleks, mengambil proses dari reka bentuk produk melalui simulasi ke satu tempat untuk menyelesaikan pengumpulan data pencemaran udara tanpa bergerak mengikut dunia hari ini dengan penyakit covid-19 yang menyebabkan penghambatan pergerakan manusia. Terdapat juga contoh syarikat yang melaksanakan Industri 4.0 dalam pembuatan robot untuk memudahkan proses pengambilan data pencemaran udara dan pelbagai kilang pintar di seluruh dunia. Industri 4.0 telah ditunjukkan melalui model pengumpulan data pencemaran udara seperti pengaturcaraan luar talian dan untuk pengelasan kompleks, mengambil proses dari reka bentuk produk melalui simulasi ke satu tempat untuk menyelesaikan pengumpulan data pencemaran udara tanpa bergerak mengikut dunia hari ini dengan penyakit covid-19 menyebabkan perencatan pergerakan manusia. Terdapat juga contoh syarikat yang melaksanakan Industri 4.0 dalam pembuatan robot untuk memudahkan proses pengambilan data pencemaran udara dan pelbagai kilang pintar di seluruh dunia. Kajian ini mempunyai 2 objektif iaitu mengembangkan kenderaan udara tanpa pemandu yang terbaik yang bermaksud platform yang mampu untuk memantau pelbagai jenis pencemaran udara dalam pemantauan masa nyata dan merancang jenis yang lebih mudah untuk mengurus sensor udara untuk dipasang di kenderaan udara tanpa pemandu yang tidak akan menjadikan masalah untuk diselesaikan. Dalam kes itu, reka bentuk modul sensor udara yang benar-benar diperlukan untuk mencapai objektif utama untuk menguruskan persembahan dalam mengambil data pengukuran pencemaran udara dengan bantuan teknologi baru kenderaan udara tanpa pemandu.

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LIST OF SYMBOLS AND ABBREVIATIONS

ESC	-	Electronic Speed Controller
UAV	-	Unmanned Aerial Vehicle
DOE	-	Department of Environment
CO	-	Carbon Monoxide
PWM		Pulse Width Modulation
NO	-	Nitric Oxide
RC	-	Remote Control
PNC	-	Preferred Noise Criteria
PM	-	Preventive Maintenance
OMNET	-	Objective Modular Network Testbed
EPA	-	Effective Projected Area
FYP	-	Final Year Project
USB	-	Universal Serial Bus
GPS	-	Global Positioning System
TTL	-	Transistor Logic
RF	-	Radio Frequency

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CHAPTER 1

INTRODUCTION

1.1 Overview

Introduction segment describes the motivation then follow the problem statement, goals and nature based on the project analysis. It explains the inspiration for the planned investigation for a current challenge in real life and a new disease environment called covid-19. The goals of the project are to manage and solve the issue and the scope based on the research been part of the study field of the test, the constraint and the purpose based on the project.

1.2 Motivation

Nowadays, the global unmanned aerial vehicle industry is keep increasing due to high demand which world now moved forward to achieve the industry 4.0. The World itself releases an established level of contaminants by environment from the outcome of numerous. Ecosystem occurrence even so actions contribute to this contamination by introducing increasingly harmful of bioaerosols and gasoline in the atmosphere of the world by human. [1]. Air pollution from electricity pollution production and use is a global and local problem. It leads to global warming and human health destruction, health of the ecosystem and sustainable local and global growth. [2].

A wide range of models for air emissions are used to start with computational moisture energetic approximate imitation on a small scale, such as a street canyon and a period geographical dimensions to metropolitan including hemispheric simulations of contaminants with enough existence in the atmosphere. [3] Besides that, precise examine a bit of feathers emitted by combustion sources such as vehicles, gas locomotives, ships and dredgers, industrial chimneys and even domestic chimneys requires an effective placement of the sensor for air on board the UAV. Moreover, the use of UAVs to quantify air

quality, especially at slow speeds or stationary flights, can only be successful if the location of the air sensor intake is calibrated, so that the sampling of gaseous and particulate matter contaminants is carried out before the UAV mix propellers or the plumule is dispersed. The air is deflected by the action of the UAV propellers in motion when the lift is made, and this is called the down washing and up washing effect. The transport of gas to the gas sensors is a crucial operation, and reliable sampling is dependent on the estimation of the contribution of the rotor disruption to this process.

The first study designed that identify the best location for air sensor intake onboard a quadcopter and how to bring the air to the sensor. Meanwhile, the study also investigated the design of air quality sensor that will mount on quadcopter using a designing software simulation and finding out that at the perimeters be the maximum air speed and at the center of the UAV was be the minimum air speed[4].Another study will be taken is the performance that between or air sensor module and the quadcopter system it can work completely or will have another error just because of type of the unmanned aerial vehicle. This designed will be implement in this project since the air sensor of the unmanned aerial vehicle will be use during air pollution measurement.

1.3 Problem Statement

Collection of air quality data closer emission sources is It was exceedingly difficult emission sources to collect the air quality data in this moment, besides where been complicated to many sites and places, having barrier or are themselves difficult to move and counter from a place to another place due to the covid 19 that make movement control order been created that not only in Malaysia, but it was around the world at the moment. Unmanned Aerial Vehicles that categorized by the drone deliver new approaches to air emissions and atmospheric research. However, there are a range of important design decisions that need to be taken to allow for representative data collection, in particular the positioning of the air sampler or the intake of the air sensor. A suitable detection strategy must be developed to address these issues.

1.4 Objectives

The main objectives of this research are to:

1. To design, fabricated and analyze modular air monitoring sensor printed circuit board for used on unmanned aerial vehicle (UAV) platform.
2. To perform and analyze air monitoring sensor capability test on fixed wing or quadcopter unmanned aerial vehicle (UAV).

1.5 Scope

The scope of the research are as follows:

For Objective 1:

1. Design and investigate performance free fabricated printed circuit boardsensor without any wiring that connect electrical or electric components using conductive tracks using EasyEDA software.
2. The use of Blynk apps as the application that show the output of the printed circuit board air quality sensor module.

For Objective 2:

3. The project will be focused on the reading of data Air Quality Module that are humidity, temperature and air quality using Blynk Apps.
4. Position of printed circuit board air quality on unmanned aerial vehicle in detecting the air pollutants will be used the measurement in UAV system.

The analyze mainly focusses on the selecting the modular unmanned aerial vehicle (UAV) and designing of the fabricated printed circuit board air quality sensor module.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The segment shall be undertaken on basis from the credible resources, such as papers, conference proceedings and publications pertaining to the proposed project. Overview topics on Unmanned Aerial Vehicle type, system architecture, controller platform is examined and compared. The assessment of each part, process and comparison shall be provided in the following pages.

2.2 Overview Air Pollution in Malaysia

In the early days of abundant resources and limited pressure on growth, little attention was paid to rising environmental issues in Malaysia. Haze episodes in Southeast Asia began between 1983 and 1997 and challenged Malaysia's environmental governance and increased environmental awareness. As a result, the Government has developed the Malaysian Air Quality Standards, the Air Pollution Index, and the Haze Action Plan to enhance air quality. Land transport, among them, contributes most to air pollution. The Malaysian Air Quality Index (MAQI) was established in 1993 by the DOE which was the first national air quality index system and have brought significant role in informing both the governing parties and general public about the air quality status based on the air pollution index (API) status in table 2-1 [5].

Table 2-1: Air pollution index (API) status [5]

API	DESCRIPTOR
0-50	Good
51-100	Moderate
101-200	Unhealthy
201-300	Very unhealthy
>300	Hazardous
>500	Emergency

2.3 Theoretical Background

In this subchapter, there will be theory of Unmanned Aerial Vehicle (UAV) to measure the air pollution to get the data fusion. On top of that, the use of UAVs to measure air quality, especially at slow speeds or stationary flights, can only be successful if the position of the air sensor intake is optimized in such a way that the sampling of gaseous and particulate contaminants is carried out prior to the UAV propulsion. Unmanned Aerial Vehicles (UAVs), carrying on-board sensors, may be used for reliable measurement of shipping pollutants, outflow by the factory stacks or land vehicles where it is too difficult or risky to use all manned aircraft. [5] and lower-level ground stations [6].

Quadcopter UAVs have higher payload capability and higher in-flight stability and survival compared to quadruples, making them ideal for UAV and air quality studies where the ability to carry various sensors and sustain an in-flight fixed position is necessary [7]. However, a systematic analysis has not yet been carried out on the position of the sensor on such platforms. The system built and tested in this research shall consist of a UAV multirotor, CO_2,CO, NO_2 and NO gas sensors, a DISC mini, thermal energy and gas sensor as well as an easier time visualization interface. All the sensors are combined with the Arduino NANO microcontroller panel [7].

2.4 System Architecture

Figure 2-1 shows an overview of the system, the payload gas sensing and the PNC monitor, while the UAV system architecture, DISC mini and gas sensors, the Arduino board, the telemetry and the RC receiver, and (b) the ground control

components, including the RC transmitter. The UAV pilot or the UAV ground station operator (GSO) can communicate wirelessly with the UAV.[8]

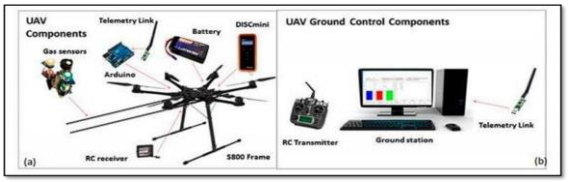

Figure 2-1: Components in UAV system [8]