CHAPTER I
INTRODUCTION

1.1 Background

Cities are multi-system operating environments equipped by sensors aiming to get data of traffic, water distribution networks, electricity networks, and air quality stations [1]. Due to Indonesia's high rate of congestions, the air quality is highly polluted. Air pollution comes from land transportation, industrial emissions, and densely populated residential areas where most of the people carry out their activities. It has a severe impact on public health. An example of a disease caused by air pollution is respiratory tract inflammation. This disease is the sixth leading cause of death in Indonesia after diarrhea, cardiovascular, tuberculosis, and measles. Air pollution is perhaps Indonesia's most severe environmental problem.

Currently, Indonesia has officially used the Air Pollution Standard Index (APSI) as a measure of air quality. The purpose of this system is to make it easy to obtain air quality information from the public at a specific location and time. In addition, it also aims to gain a material consideration for efforts to control air pollution needed by Air Pollution Standard Index. The Air Pollution Standard Index works by converting the measured levels of air pollutants into a dimensionless amount. The measurement of air quality is currently using the Air Quality Index (AQI) by pairing several stations at the map points [4]. This index measures air quality in real-time. The AQI scale indexes real-time pollution in the map based on the latest US EPA standards using the Instant Cast reporting formula. The weakness of the current system is the lack of accuracy in measuring air quality. This is because the Indonesian gauges are at ground level, making the results less accurate. The current quality measurement system is considered inaccurate as it only measures at a certain point around but provides inaccurate results influenced by various aspects. The measurements in this field are not carried out evenly because there are some inaccessible areas, leaving only a limited range of areas can be measured. Land access is usually obstructed and full of obstacles. It takes an air monitoring robot to allow all areas accessed without any ground barrier. This thesis invented an IoT drone swarm as an overground air quality measuring devices. With this tool, air quality measurements will be more accurate and efficient.

Several published papers suggest air quality measurements can be carried out by

Figure 1.1 Index Board in Indonesia.

developing an existing UAV platform from fly-n-sense [5]. The use of a stabilization system can determine wind speed. Detailed maps of pollution concentrations can be created as well as phenomena related to particle movement or pollutant diffusion. This main purpose of this measurement is to determine the boundary conditions for CFD calculations at the city boundary. The aerodynamic development of the UAV includes CFD simulations, wind tunnel experiments, flight measurements, sensor selection, integration, and validation.

In another research that the authors have been conducted, the authors propose drones with an Internet of Things (IoT) sensor platform to enable dynamic tracking of dangerous aerial feathers [6]. Integrating sensor-based particle detection with autonomous flight control drones provides the ability to identify and track air feather boundaries in real-time dynamically. The primary goal of the research was to characterize how well our prototype drone swarm was detected and reacted to airborne plumes. The evaluation criteria we used included lift capability, durability, battery life, positional accuracy, and data communication integrity. Our first challenge was to ensure our design did not exceed the lift capacity of a small drone. This turned out to be a critical challenge that heavily influenced the design of the IoT platform we integrated.

On the other hand, some researchers implemented a Wi-Fi network on its drone [9]. The Intel Galileo board was used as the central element of the system. This development board was based on the Quark SoC X1000 Intel 32-bit processor at

400MHz. The work was divided into three phases [9]. First, the researchers developed a theoretical study of a UAV coverage area equipped with the Intel Galileo board acting as a Wi-Fi node. Second, they experimentally tested The Galileo board's performance as an intermediate node within a Wi-Fi Network. Third, they also studied the Galileo board's energy consumption.

By looking at all these problems, this thesis invented an air quality measuring device in the form of a drone that is able to measure air quality overground. The drone used a sophisticated autopilot system called the Pixhawk. The drone was equipped with DHT-22 and MQ-135 to get precise humidity and air quality data. To run this sensor, the drone uses NodeMcu as a microcontroller equipped with an ESP8266 Wi-Fi module inside. The data from the sensor were sent to NodeMcu for processing. The data that had been processed were stored in a firebase via Wi-Fi network connected to the internet. The measurement data obtained were displayed on the user's device.

1.2 Problem Identification

1. Measurement of air quality in Indonesia is inaccurate because it uses an index board planted on the ground, making it less precise and efficient.
2. Measurement results displayed every 24 hours displayed on the index board.
3. Measurements are only made at specific points.

1.3 Objective

For the objective and the benefits, it is self are:

1. This thesis offers a solution to make an alternative measurement of overground air quality utilizing swarm-IoT drone.
2. Air quality measurements results can be displayed in real-time on a smartphone.
3. Measurement can be done anywhere and anytime.

1.4 Research Boundary

This thesis has Research Boundary as follows:

1. Internet connection needed.

2. The maximum height of the drone is only ± 5 meters.
3. The sensor can only display good to bad air quality values, it cannot determine what gas content is contained.
4. The measurements obtained are the result of the trials conducted, so they do not have reference data.
5. The trial data is used as reference data in measuring air quality.

1.5 Research Method

1. Literature Study, data from several journal about related works.
2. Design Process, describing the methodology for the design of the tool to be made to measure air quality.
3. Realization, the tools that have been design and tested are implemented properly according to the design.
4. Analyzing which aspect can be compared.

1.6 Writing Systematic

The systematics of report writing is as follows:

- Chapter 2 BASIC CONCEPTS
  This chapter contains an explanation of the basic theory, application, and tools.
- Chapter 3 SYSTEM METHOD
  This chapter contains the flowchart, algorithm, experimental diagram and the method.
- Chapter 4 RESULT AND ANALYSIS
  This chapter contains work steps, test conducted, test result and analysis of the result of the test gained.
- Chapter 5 CONCLUSION AND SUGGESTION
  This chapter contains the conclusion and suggestion of this final assignment.