The comparison of essential oil concentration to maximum air quality produced by diffuser based on Internet of Things (IoT) technology to create a healthy room

I Hikmah¹, A D Ramadhani² and F T Syifa²

¹Biomedical Engineering, FTTE, Telkom Purwokerto Institute of Technology, Banyumas, Central Java Indonesia
²Telecommunications Engineering, FTTE, Telkom Purwokerto Institute of Technology, Banyumas, Central Java Indonesia

E-mail: irmayatul@ittelkom-pwt.ac.id

Abstract. The efforts to maintain indoor air quality from dangerous viruses need to be improved. One way is by sterilizing the room using a disinfectant which has a weakness, namely that it is unsafe if the disinfectant is exposed to the body, especially, when entering the respiratory system, it will become dangerous toxins. Therefore, an innovation of a healthy room that is safe for the respiratory system is needed by applying essential oil as a natural antiseptic liquid which is converted into gas through a diffuser that is connected to a gas sensor equipped with the Internet of Things (IoT) technology. It can record air quality data and connect to an Internet server to monitor indoor air quality easily and practically. The research was conducted by making different variations in the concentrations of essential oil to obtain maximum air quality. From the results we obtained, the level of air quality is getting better when the oil concentration is increased because more gas particles can bind contaminant molecules in the air.

1. Introduction

A room with good air quality has a good effect on health, such as reducing the risk of respiratory disease and improving brain performance. Meanwhile, a room with unhealthy air quality will be polluted with invisible contaminants, facilitating the spread of viruses and bacteria to the people inside. The effect of indoor air contaminants on human health is ten times greater than those of outdoor air contaminants [1].

An innovative indoor air quality control system is one important way to deal with the COVID-19 pandemic and to prevent the spread of other dangerous viruses that may emerge in the future [2]. A spray of oil diffuser destroys free radicals that trigger the growth of dangerous bacteria. Sprayed air can also combat the threat of mold effectively [3]. Modified antiseptic oil in the form of gas in the air (diffused) can bind contaminant molecules in the air, which can control air quality in a room so that it remains good [4].

The simplicity and practicality of the air quality control system make it easy for people to apply this system. This requires an Internet of Things (IoT)-based innovation in a diffuser so that people can control their indoor air quality more practically and easily by simply connecting to the Internet on a PC or smartphone [2]. IoT refers to unique objects that can be virtually identified and represented in
the structure of the Internet. IoT aims to allow everything to be connected anytime, anywhere, with anything, and anyone who ideally uses any line/network/service [5].

Oxygen transfer is defined as the process of transferring oxygen from one phase to another, usually from liquid to gas phase (diffusion) [6]. One way to create good indoor air quality is to install electronic devices such as a diffuser. This device sprays steam into the air. The steam comes from the essential oils inside the device [4]. Cajuput oil is antimicrobial with molecules that can bind to the surrounding microbes so it is good to use as a diffuser filling [7]. However, the concentration of the cajuput oil solution needs to be considered to obtain maximum air quality output [8]. Thus, it is necessary to analyze the effect of essential oil concentration in a diffuser on indoor air quality.

To help raise awareness about the importance of good air quality and vigilance in the pollution caused by gases or other dangerous substances to human health. The implementation of the built system is expected to be useful to increase awareness of the importance of healthy air quality in the room because 90% of human activities are indoors [2]. This system can be used for buildings with closed rooms such as in houses, classrooms, offices, hospitals, hotels, etc. The air quality detector prototype describes an online air quality monitoring system that provides information on indoor and outdoor air quality via the Internet. The variable observed is the level of air quality [9]. The components connected to the IoT include an active gas sensor to detect gas. The gas sensor is connected to the Wemos board. The sensor detection results are sent to the Wemos microcontroller board and processed with the existing program. The Wemos board has a Wi-Fi module and sends the detection results to the cloud. The results are then sent to the IoT platform. Thingspeak is a platform that displays sensor detection results in real-time in graphical form. Data on Thingspeak can be accessed via computers and smartphones. Users can find out current changes in air quality in real-time by monitoring the air quality level through thingspeak.com [10].

2. Method
This experiment focused on comparing assorted essential oil and how to increase air quality. This method consists of four steps (analyze, detection, process, and conclusion).

![Figure 1. Methodology](image)

2.1 Design
In this step, MQ 135 sensor is connected to Wemos D1. At a certain point, MQ 135 pin A0 (analog data) is connected on port A0 Wemos D1. Then, this minimum system or microcontroller acts as a server. The device schema is as shown in Figure 2.

![Figure 2. Design Scheme](image)
On the other hand, Wemos D1 is connected to the network automatically to transmit sensor data. The parameter on MQ 135 is sent into Thingspeak platform. The next stage is sensing MQ 135 detection. The next criterion is about block diagram

![Block diagram](image)

**Figure 3.** Block diagram

2.2 **System Planning**
In this monitoring system, indoor air quality is measured. The data obtained is stored in the Thingspeak cloud by sending the data every 20 seconds. Figure 4 shows the flow of this research. The monitoring system works by reading the MQ135 sensor connected to the ESP8266. ESP8266 retrieves air quality data in ADC data and forwards it to the Thingspeak cloud using a Wi-Fi connection. In Thingspeak, data is processed into a graphic displayed on a PC monitor. Channels in Thingspeak are also created and configured as in Figure 5. Field 1 is used to store data sent by ESP8266.

![Research flow](image)

**Figure 4.** Research flow

![Healthy room monitoring channel setting](image)

**Figure 5.** Healthy room monitoring channel setting
At the initial configuration, the WEMOS board is set to connect to Wi-Fi. After the Wi-Fi connection is successfully connected, the sensor will read the air quality in the room, and the data will be sent to the Thingspeak cloud to update the data on the server. The data received will be graphed and displayed on the PC monitor. Figure 6 shows the algorithm used in air quality data collection. The data are then analyzed and categorized according to the air quality indicators in the study [10]. Table 1 shows the air quality level categories using MQ135 sensor.

### Algorithm: Healthy Room Monitoring

1. **Initialization:** SSID, API KEY, password, sensorValue. Channel ID
2. **Check Wi-Fi connection**
3. **Input:** sensorValue
4. **Update to Thingspeak server**
5. **Output:** Air Quality

**Figure 6.** Algorithm of healthy room monitoring

**Table 1.** Air quality indicator [10]

| Air quality level | Category       |
|-------------------|----------------|
| > 800             | High pollutant |
| 400-800           | Low pollutant  |
| < 400             | Normal (Good)  |

The data of the monitoring system was collected using 2 scenarios by obtaining the mean of each experiment. We had also measured air quality without a diffuser. The first scenario is measuring air quality by changing the distance between the sensor and the diffuser with the ratio of water concentration and cajuput oil of 195:5 ml. The capacity of the diffuser is 300 ml. We observed air quality at 5, 10, 15, 20, and 35 cm. Scenario 1 is shown in Figure 7. Then, the data was processed to obtain the ideal distance used in the test in scenario 2. Scenario 2 is measuring the indoor air quality with a fixed distance between the sensor and the diffuser but different liquid concentration [11]. Table 2 shows the changes in the concentration of the liquid tested.

**Figure 7.** Test scenario 1
Table 2. Test scenario 2

| No | Water (ml) | Cajuput oil (ml) | Distance (cm) |
|----|------------|-----------------|---------------|
| 1  | 195        | 0               | 15            |
| 2  | 195        | 5               | 15            |
| 3  | 185        | 15              | 15            |
| 4  | 185        | 20              | 15            |
| 5  | 185        | 25              | 15            |

3. Results and discussion

Before we collect the data according to Figure 7, a test was performed by reading the air quality on the serial monitor to prove that the data on the server was the same as the reading on the serial monitor. The results in the serial monitor were also updated via the Thingspeak cloud. Next, the air quality test data under normal conditions without a diffuser were collected for 30 minutes resulting in a mean of 138.65. Air quality under normal conditions was still in the good category according to Table 1. Figure 9 shows the graph of testing under normal conditions.

Another test was conducted based on the first scenario in Figure 7. The mean of each experiment over each distance was taken. At 5 cm, the mean of air quality is 121.8. At 10 cm and 15 cm, the value tends to be stable, but there is an increase compared to the mean at 5 cm. At 10 cm and 15 cm, the mean is 127. At 20 cm, the mean increases to 133. At 35 cm, it becomes 135. When the distance between the diffuser and the sensor is further away, the value of the air quality indicator increases. However, the value shown is still in a good category. The first scenario test graph is shown in Figure 10. If we compare to normal conditions without a diffuser, the air quality figure decreases when the diffuser is turned on.

Figure 8. Reading of data via serial monitor in thingspeak.com
Figure 9. Graph of air quality in normal condition from thingspeak.com

Figure 10. Comparison of air quality to distance

In the second-scenario data collection, the test was conducted according to Table 2. The experimental results are shown in accordance with Table 3. In the first experiment, the researcher only used water and obtained the value of the air quality of 113.49. Compared with normal conditions, the value of the air quality is below normal conditions. Furthermore, 5 ml of oil was added, and it was found that the value of the air quality increased to 127.83. However, when it was added with 185 ml of water, the value was 79.64. Then, the oil concentration with a fixed volume of water of 185 ml was added. When adding 20 ml and 25 ml of oil, the value of the air quality decreased. This indicates that the level of air quality is getting better when the oil concentration is increased.

| No | Mixture                        | Distance (cm) | Air Quality |
|----|--------------------------------|---------------|-------------|
| 1  | water: 195 ml and oil: 0 ml    | 15            | 113.49      |
| 2  | water: 195 ml and oil: 5 ml    | 15            | 127.83      |
| 3  | water: 185 ml and oil: 15 ml   | 15            | 79.64       |
| 4  | water: 185 ml and oil: 20 ml   | 15            | 61.63       |
| 5  | water: 185 ml and oil: 25 ml   | 15            | 60.47       |
4. Conclusion
From the two scenarios of the test, it is concluded that the ideal distance between the gas sensor and the diffuser is 15 cm with average air quality of 127. At this distance, variations in the concentration of the solution were given where each additional 5ml of cajuput oil resulted in better air quality up to 60.47. The increase in the volume of cajuput oil enables more gas particles to bind contaminant molecules in the air.

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