

Telkom University Situ Tekno Environmental Monitoring System

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Abstract: Heat waves could be fatal without a proper cooling system. Lakes could be a natural and environmentally friendly choice for cooling down outdoor areas. Due to the slow temperature fluctuations on large bodies of water, it cools down the surrounding areas during summer or during a heat wave. This study is conducted to develop a low-cost monitoring system to determine the effects of a lake on its surrounding areas. It also analyzes the difference between an area with a lake and another without, while testing the performance of the BME280 sensor in the process. The results show that due to evaporation, the temperature of location A (near the lake) is lower compared to location B, (Tokong Nanas Building). The Humidity of location B is higher than location A due to its more enclosed properties compared to location B. Lastly, the pressure of location B is lower than location A because of the higher humidity in location B.

Keywords: *Monitoring System, Internet of Things, Microcontroller, BME280 Sensor, Favoriot*

1.0 INTRODUCTION

A heat wave is a period of very hot weather, especially in countries that lie in the tropical region. Although there are several definitions for heat waves, it is typically defined as an extended period of extremely hot weather relative to the normal conditions of the area at that time of year. Small urban water bodies, like ponds and canals, play a vital role to cool down the surrounding environment during the heat wave periods, it is due to the fact that water temperature increases and decreases slower as compared to the land. Therefore, in the summer season, the coastal regions remain cooler, and warmer in the winter season as compared to landlocked regions. The presence of a large body of water may affect the temperature, humidity, and pressure of the surrounding environment. A landlocked area might be hotter and less humid[1].

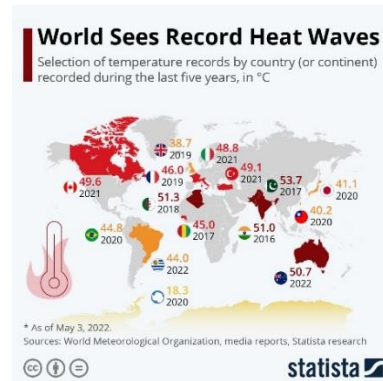


Fig. 1. World Sees Record Heat Waves [2]

There have been numerous studies on environmental monitoring systems. In [3] authors analyzed an IoT-based real-time environmental monitoring system utilizing an Arduino UNO board, a DHT11 sensor, and an ESP8266. In [4] authors effectively monitored and dynamically controlled the indoor environment monitoring using telegram. On the other hand, in [5] authors developed an autonomous robot system to monitor environmental parameters like temperature, humidity, and air quality.

Authors in [6] developed a prototype of a temperature, humidity, and pressure monitoring system for ulcer wounds utilizing BME280. Authors in [7] developed a system to

monitor the cooling properties of a lake using remote sensing technology.

Previous studies primarily focused on the general monitoring of the environment and ulcer wounds. Moreover, they utilized expensive remote-sensing systems to monitor the cooling properties of a lake. In this research, we introduced an inexpensive BME280 sensor to analyze the effects of a lake in terms of temperature, humidity, and pressure on the surrounding environment. Therefore this paper focuses on:

1. To test the performance of the BME280 sensor in measuring temperature, humidity, and pressure of an environment with and without a lake
2. To analyze the difference between the monitored data on a location with and without a lake.

2.0 METHODOLOGY

Figure 2 depicts the proposed Telkom University Situ Tekno environmental monitoring system. The system uses a BME280 that is interfaced with the ESP32 microcontroller via a jumper cable. The ESP32 in turn is interfaced with a Wi-Fi network that enables it to send the data to the Favoriot IoT platform, which produces real-time graphs to analyze.

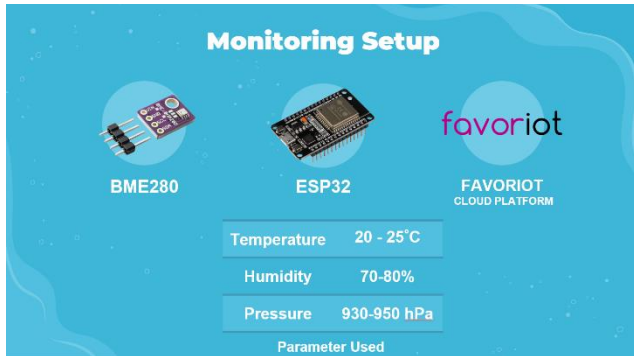


Fig 2. The block diagram of Situ Tekno Environmental Monitoring System

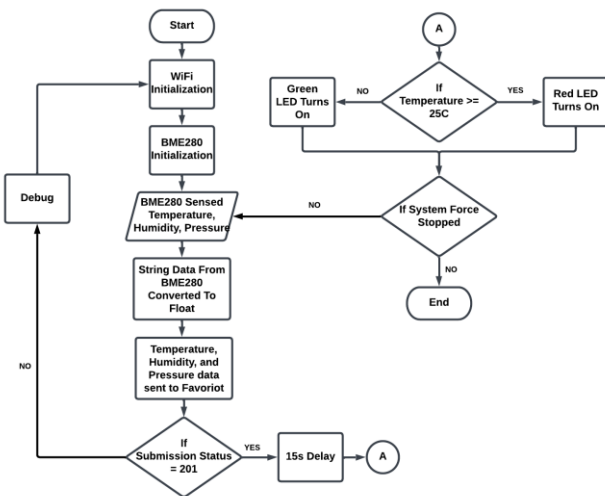


Fig.3. The flowchart of Situ Tekno Environmental Monitoring System

The performance evaluation of the Situ Tekno (Tekno Lake) Monitoring System was conducted in two different locations, namely A and B. To analyze the difference in temperature, humidity, and pressure of both locations.



Fig. 4. Locations A and B on Google Earth

Table 1. Latitude and longitude of location A and B

Location	Latitude	Longitude
Location A	6°58'24.07"S	107°37'54.86"E
Location B	6°58'22.65"S	107°37'45.61"E

According to the system operational flowchart shown in Figure 3, the monitoring system starts with the initialization of the Wi-Fi module (note that ESP32 Wi-Fi only connects with 2.4 GHz bands), followed by the initialization of the BME280 module. The sensor measures the temperature, humidity, and pressure of both locations. Which then forward it to the ESP32 board.

The data received from the sensors are in string format because the sensor transfers not only the numerical data but also the unit of the data (°C, %, and hPa), thus turning the output format into a string. The data sent to the Favoriot server should be in integer or float format, so it can be displayed in a graph. This means the string data from the BME280 should be converted to the float format with the indexing method. Then the data is sent to the Favoriot server using the HTTP protocol every 15 seconds. For the indicator, the ESP32 board will turn the LED on according to the temperature measured. The data will be analyzed, based on the data of temperature, humidity, and pressure that have been captured using the Situ Tekno Monitoring System.

3.0 RESULTS & DISCUSSION

This system was developed to monitor the condition of the Telkom University's Situ Tekno, i.e., the temperature, humidity, and, pressure through the Favoriot IoT platform. The developed project prototype is shown in Figure 5.

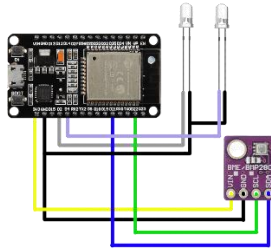


Fig.5. The circuit diagram of Situ Tekno Environmental Monitoring System

The performance evaluation was conducted in Situ Tekno Lake at Telkom University. The proof of the concept was tested within 1 hour to observe the temperature, humidity, and pressure. Figure 6 shows the actual proof of concept circuit developed in this project. To start the system evaluation, the respective micro-python file codes were downloaded and run on the ESP32 microcontroller via uPyCraft IDE. The BME280 sensor is placed to capture the data.



Fig. 6. Prototype of Situ Tekno Monitoring System

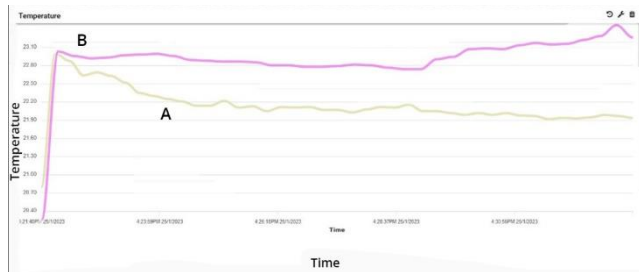


Fig. 7. Temperature over time result of Situ Tekno Monitoring System on a graph

Figure 7 shows the results of the temperature reading of the BME280 sensor over time presented in a graph. According to the result, the temperature range of location A is between 21.90 – 22.90°C, and in location B is between 22.80 – 23.40°C, which confirms that the temperature of location A is lower than the first due to the effect of the lake.

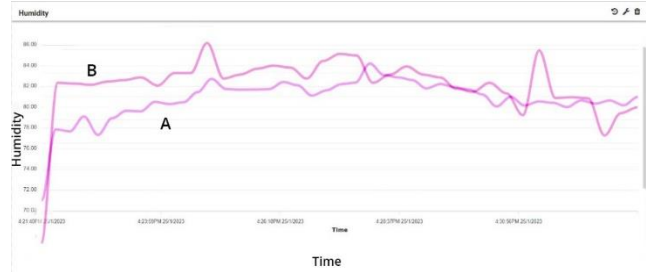


Fig. 8. Humidity over time result of Situ Tekno Monitoring System on a graph

The humidity for both locations is relatively similar to each other. The humidity range for location A is between 73 – 75%, while the range for location B is between 78 – 84%. According to the results, the humidity of location B is higher than location A due to the shade of a building and the lack of airflow of the respective location.

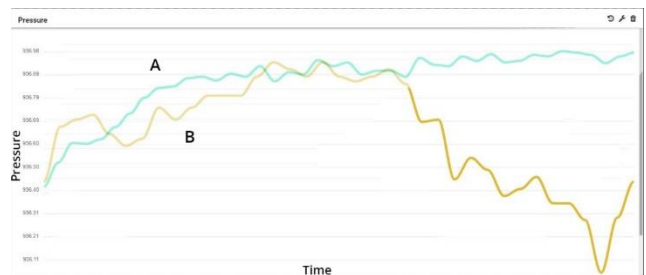


Fig. 9. Pressure over time result of Situ Tekno Monitoring System on a graph

As shown in figure 9 the pressure of location B decreases drastically in the last half of the reading. This is due to the inverse relation property of the pressure and humidity. The pressure will decrease when the humidity increases. This can be seen in Figure 10.

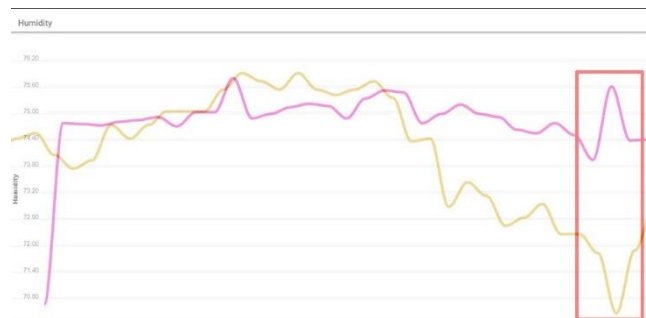


Fig. 10. Comparison between the humidity and pressure at location B

4.0 CONCLUSION

According to the successful reading of the BME280 sensor, lakes do influence the temperature, humidity, and pressure of the surrounding areas. Due to evaporation, the temperature of location A (near the lake) is lower compared to B, (Tokong Nanas Building). The Humidity of location B

is higher than location A due to its more enclosed properties compared to location A. Lastly, the pressure of location B is lower than location A because of having higher humidity at location B.

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