

Monitoring System for Applied Science Building in Telkom University

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Abstract: Close and open spaces have different temperatures, humidity, and pressures. Weather greatly affects the temperature and humidity in buildings. In an open room, breathing will feel more relaxed than in a closed room. Monitoring and controlling system for indoor air quality to keep an eye on the temperature. A room that is too humid will cause a lot of mold on any of the items made of wood. A room that has too many items will make the room feel full and suffocating to the human body. Users must connect sensors, boards, and clouds in a clear and consistent manner. The proof-of-concept performance evaluation for this project was put to the test in both closed and open spaces. The ESP32 microcontroller unit will process the command for detection. This tutorial demonstrates how to measure pressure, temperature, and humidity using a BME280 sensor module connected to an ESP32, and the sensor can be read on the Favoriot platform. The study presented here can be pursued by individuals who want to construct a structure and manage its size and user comfort levels. People who are undertaking activities inside or outside of a cozy environment will feel at home and won't be bothered by other people. It can also be used for people who have breathing difficulties.

Keywords: *Monitoring System, IoT, Microcontroller, BME280, Favoriot.*

1.0 INTRODUCTION

Weather parameters such as temperature, humidity, and air pressure are factors that greatly affect the survival of every living thing. The comfortable scope will affect the conditions in a room. Closed and open spaces have different temperatures, humidity, and pressures. Experiments were carried out in the classroom and outside the Telkom University Applied Sciences Building. Weather greatly affects the temperature and humidity in buildings, as shown in Fig. 1. In an open room, breathing will feel more relaxed than in a closed room.



Fig. 1. Weather in Bandung, Indonesia [1]

Engineers and architects find it [2] perplexing and highly challenging to track the measured data because it requires additional software. Monitoring and controlling system for indoor air quality that uses an exhaust fan to both keep an eye on the temperature and regulate it. While software instructions are built to produce permanent data, hardware components such as temperature and humidity sensors, an Arduino microcontroller card, a microSD card module, a solar panel, and a battery unit are employed. In a controlled climate chamber, a comparative study has been carried out to offer evidence on the effect of humidity on people's thermal comfort as well as their humidity adaptation.

The suggested system has outstanding performance [3] in managing indoor air quality in terms of pollutant concentration, Air Quality Index (AQI), and processing time to remove the pollutants, according to the results of the experiments. Using Sensing Fusion, Indoor Air Quality, an Extended Fractional Kalman Filter, and the Internet of Things, a practical method was proposed to increase the prediction accuracy of indoor air pollutant profiles while taking into account their nonlinear and stochastic nature.

Additionally, it included a novel indoor air quality index that took humidity into account. The purpose of this [4] project is to create a low-cost data logger powered by solar energy and to save the measured data on a microSD card as

an Excel file. While software instructions are built to produce permanent data, hardware components such as temperature and humidity sensors, an Arduino microcontroller card, a microSD card module, a solar panel, and a battery unit are employed. Over the course of four days, the constructed data logger is contrasted with the HOBO-U12 data logger. The findings indicate that a cost reduction of about 82% is possible for the data logger. In contrast, the data accuracy compared to the commercial data logger is 97% for temperature and 96% for relative humidity, respectively.

You can monitor the server room's temperature and humidity using the temperature monitoring system [5]. Most of the information regarding the heterogeneity of the relationship between various indoor environments and outdoor variability, as well as the relationship between indoor temperature and humidity conditions, is unclear. Homes in neighborhoods with higher socioeconomic levels are noticeably colder, and indoor temperatures are positively correlated with external temperatures throughout the warm season.

Researchers in [6] focused on the long-term monitoring of ambient vibration and environmental factors in order to evaluate the short- and long-term structural behavior of existing adobe constructions. The acquired results for natural frequencies are then connected with environmental variables, showing various timeframe effects on the modal characteristics resulting from daily and seasonal variations in the environmental conditions.

The work proposed in [7] manufactured highly accurate and low-cost radiosonde equipment that will serve as a model for the creation of observation instruments for the upper atmosphere, thereby lowering the cost of observation. The BME280 sensor's output value is compared to measurement values required by Badan Meteorologi, Klimatologi, dan Geofisika (BMKG). Pressure, temperature, and humidity are the calibrated parameters. The BME280 sensor has been used in radiosonde equipment built on the Arduino Pro Mini platform.

Therefore, this project differs from existing projects in that it focuses on the differences between closed and open spaces by monitoring temperature, humidity, and pressure. The objectives of this project are:

- i. To create a monitoring system for indoor and outdoor environments.
- ii. To test the monitoring system based on temperature, humidity, and pressure.

2.0 METHODOLOGY

Figure 2 shows the block diagram of the proposed proof of concept development of the suggested evolution of the idea of monitoring temperature, humidity, and pressure. The BME280 sensor will be able to find them. To stop the system

from picking up any other commands for the given command, users must connect sensors, boards, and clouds in a clear and consistent manner. The linked sensor will identify the conditions in a space needed for detection.

The ESP32 microcontroller unit will process the command for detection. The input detection command is checked by the microcontroller. The following action will be taken by the program if the command matches the instruction entered in the programming set. To examine the output and graphs of the results of temperature, humidity, and pressure detection, the device is connected to the platform, namely Favoriot.

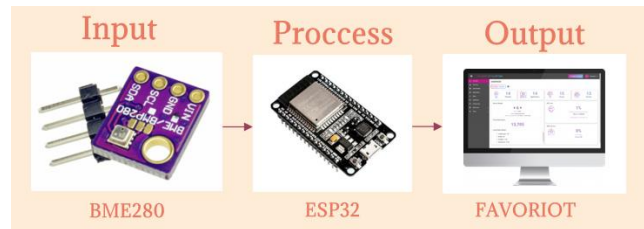


Fig 2. The block diagram of the Monitoring System for Building

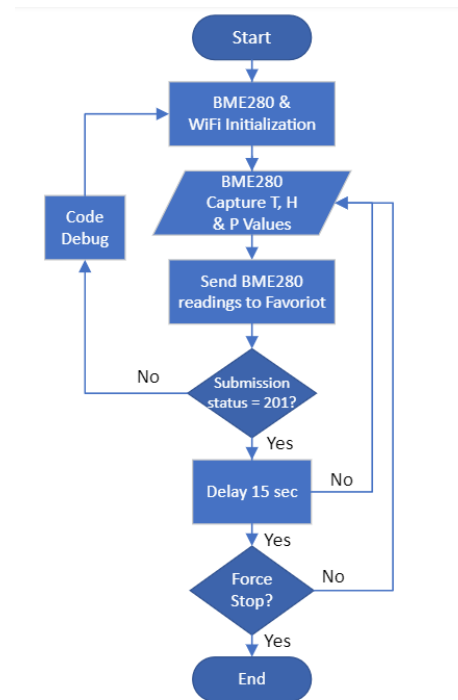


Fig.3. The flowchart of the Monitoring System for Building

According to the system operational flowchart in Figure 3, the system starts with the initialization of the Wi-Fi module, and the initialization of the BME280 sensor is one of the first two steps in the system, as shown by the operational flowchart in Figure 2. Following that, the sensor records the values for pressure, humidity, and temperature. The pre-connected Favoriot platform is where the readings for temperature, humidity, and pressure values are located. In order to establish a successful connection between the user

device and the microcontroller device, the proposed system uses the internet to send a signal to the Favoriot platform.

The number 201 will show up as confirmation that the program has connected to the platform successfully if it has been successfully executed. The program will issue a debug code if it doesn't work before starting the WiFi module initialization and sensor initialization again. The room's temperature, humidity, and pressure will be detected by sensors that are attached to the microcontroller board and platform. Once data is collected, the sensor will continue to measure or verify the room's state for 15 seconds.

Figure 4 depicts the suggested circuit diagram as a circuit that can be constructed by connecting a number of connections between the sensor pins and the esp32. The sensor's first pin, VCC, is linked to pin 3v3, the sensor's second pin, GND, is connected to pin 22 on the ESP32, the sensor's third pin, SDA, is attached to pin 21, and the sensor's fourth pin, pin SCL, is connected to pin 21. Sending data from sensors to the ESP32 requires connecting these pins. This tutorial demonstrates how to measure pressure, temperature, humidity, and altitude using the Arduino IDE and the BME280 sensor module connected to an ESP32. To share data with a microcontroller, the BME280 sensor uses the I2C or SPI communication protocol. With the BME280 sensor module, we'll communicate via I2C.

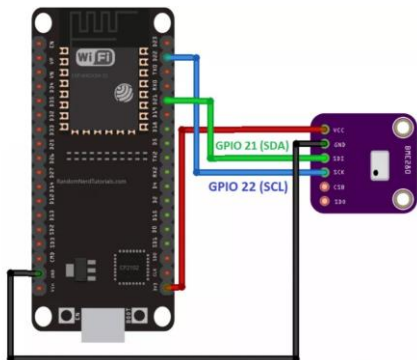


Fig. 4. Circuit diagram of the proposed system

3.0 RESULTS & DISCUSSION

The result of this project is to monitor the temperature, humidity, and pressure in both open and enclosed portions of a structure. A performance comparison between several rooms was made. The proof-of-concept performance evaluation for this project was put to the test in both closed and open spaces.

Figure 5 shows the location that has been examined: the room is closed, there is no fan or air conditioner, there is just window ventilation, and the room is also vacant and only slightly open. Because there were multiple fans present at the time, Figure 6 depicts an open space with plenty of ventilation and airflow. Some people choose to conduct their activities while remaining silent.

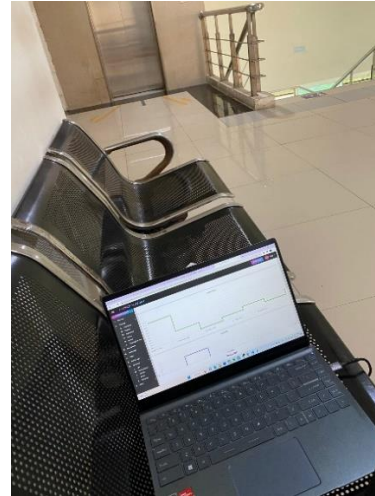


Fig. 5. Monitoring environment at Closed Space

Figure 7 shows the concepts developed in this research with actual evidence. Each micropython code file is downloaded to begin the system evaluation, and the ESP32 microcontroller is then used along with the uPyCraft IDE to run the programs. On the user's project board, a BME280 sensor is mounted.



Fig. 6. Monitoring environment in Open Space

Figure 8 demonstrates that the open room's temperature is lower than the one in the enclosed room. This is due to the fact that greater window ventilation directly affects how hot the open room is, and the fan in the open space is powerful enough to lower the temperature in the space. The temperature is higher in a closed space, despite the absence of sound or other people passing through it. A closed room can only be ventilated through a window that is no larger than one in an open space.

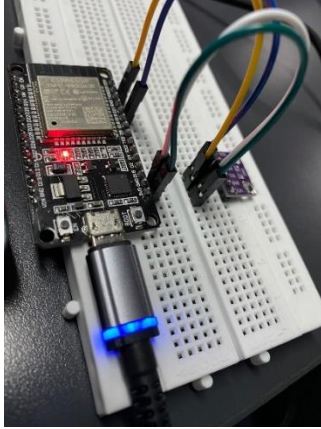


Fig. 7. Beardboard

Figure 9 displays the humidity results for the two rooms. Because there are more people in the open room at that time than in the closed room, the humidity in the open room is higher than in the latter. Also, Figure 9 illustrates this point, showing how there are more people and objects present at that time, increasing the pressure in an open area. In contrast, a closed room is completely empty and has few objects in it.

According to Figures 8 to 10, the precise calculation outcomes are displayed. The initial explanation is that the temperature in the open space starts at 23.33°C and rises to 23.52°C after 8 minutes of analysis. It rises from 23.44°C to 23.63°C in a closed space at a rate of 8 minutes. The second explanation is humidity, which ranges from 73.2% in open space to 75.60%. Additionally, from 73.21% to 75.92%, more rooms are now closed than before. The final justification is related to the pressure that exists in both open and closed spaces. In an open space, the pressure rises from 930.88 hPa to 931.25 hPa, but in a closed space, the pressure very slightly rises from 930.50 hPa to 930.96 hPa.

Table 1. Measurement data recorded from all data.

	Open Space	Closed Space
Temperature (°C)	23.33-23.52	23.44-23.63
Humidity (%)	73.21-75.60	73.21-75.92
Pressure (hPa)	930.88-931.25	930.50-930.96

4.0 CONCLUSION & RECOMMENDATION

A comparison of indoor and outdoor surroundings' temperatures, hygrometer readings, and pressure is made. Low temperatures, a fair amount of humidity, and a lot of pressure are all present in open space. In a closed environment, the temperature is higher, the humidity is a little lower, and the pressure is lower. For individuals who desire to construct a structure and manage its size and user comfort levels, the study presented here can be pursued. It

is advantageous to both builders and the neighborhood. As a result, when someone wants to construct a building, they can design it accurately, correctly, and comfortably. It can also be used for people who have breathing difficulties. People who are undertaking activities inside or outside of a cozy environment will feel at home and won't be bothered by other people.

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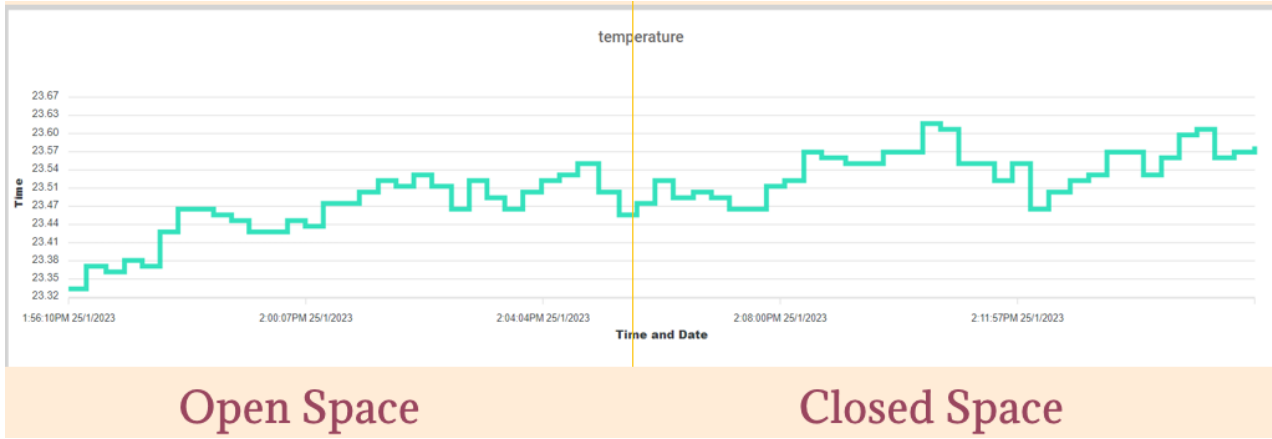


Fig. 8. Your output display on Favoriot when temperature conditions happened

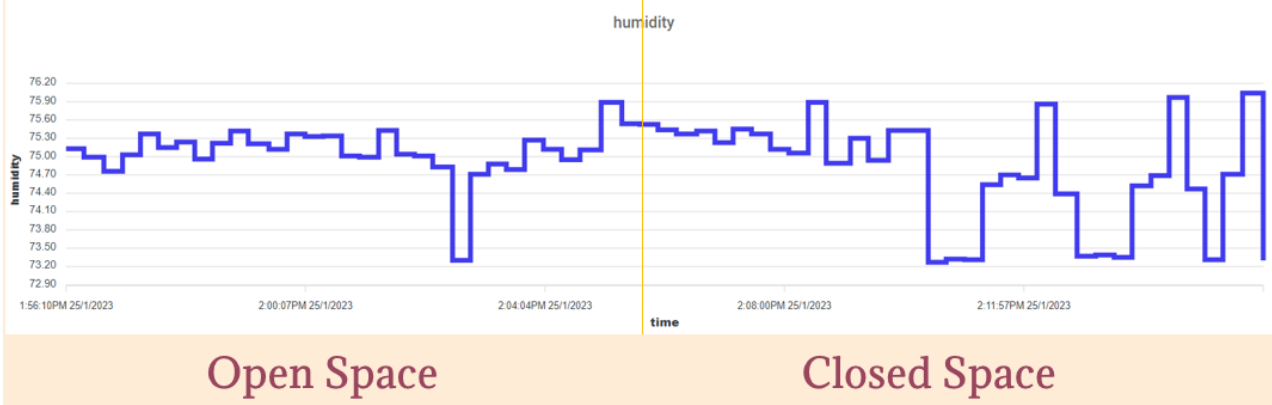


Fig.9. Your output display on Favoriot when humidity conditions happened.

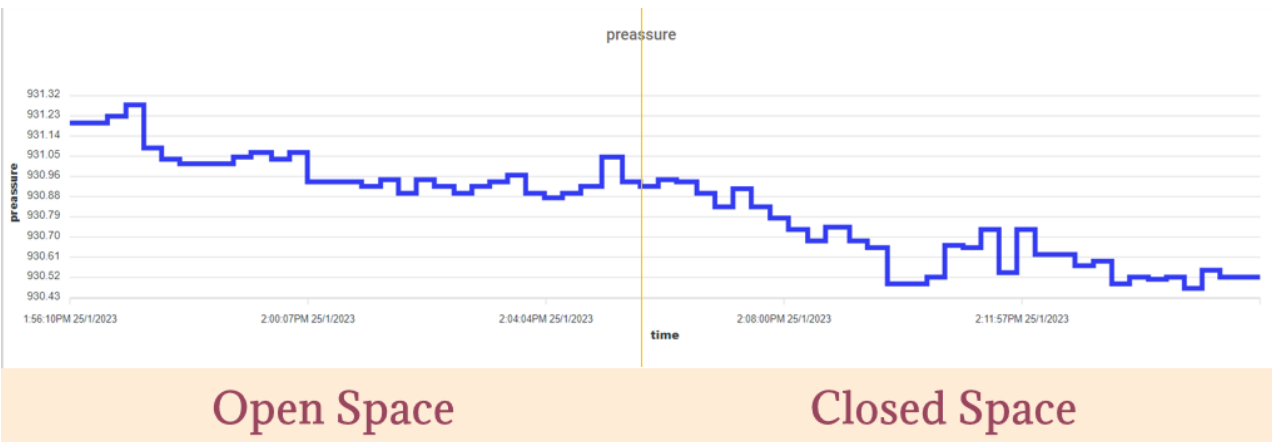


Fig. 10. Your output displays on Favoriot when pressure conditions happened