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IoT Usage in Multimedia Room and 3rd Floor Hallway Monitoring System in School of Applied Science Telkom University

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Abstract:.The concept of open space pertains to land without specific boundaries, while closed space refers to land that is confined by borders limiting its extent. A notable distinction exists in temperature between this spaces. This project aims to ascertain the temperature disparities between closed and open spaces using three primary components: the BME280, utilized for detecting temperature, humidity, and pressure; the ESP32 board, serving as the microcontroller device; and LEDs, which activate when temperature variances are sensed by the BME280. In enclosed rooms, the temperature remains relatively constant, ranging from 21.8°C to 23.88°C, humidity fluctuates between 61.17% and 65.15%, and pressure hovers between 937.05 hPa and 937.35 hPa. Conversely, findings from open spaces reveal temperature readings of 21.96°C to 24.92°C, humidity spanning 58.44% to 66.92%, and pressure ranging between 932.43 hPa and 936.16 hPa. Therefore, it shows that the occupancy monitoring system could be achieved

Keywords: *Monitoring system, Internet of Things (IoT), microcontroller, sensor, Favoriot.*

1.0 INTRODUCTION

Open space is a land concept that is not constrained by specific borders, whereas closed space refers to an area enclosed by borders. There is a significant temperature difference between closed and open spaces. An open space adjusts to the temperature of its surroundings, while a closed space traps temperature, leading to a constant temperature. Due to this temperature contrast, differences in humidity and pressure arise between the two types of spaces.

One method to measure temperature in these spaces utilizes the Internet of Things (IoT). Numerous projects have explored the application of IoT for monitoring temperature, humidity, and pressure. the research by Utomo et al. employs a Raspberry Pi controller, a DHT22 sensor, an Arduino board, and utilizes output platforms like the Telegram app and the cloud-based MongoDB network. This setup acquires and records temperature data from a server room using a temperature and humidity sensor connected to Raspberry Pi devices. The network connection allows for remote control of the air conditioner using Arduino. The outcomes demonstrate the system's effectiveness in dynamically monitoring and controlling commands via Telegram or web server applications.

the research by Yarnish, employs components such as NodeMCU ESP8266, the MQ-135 sensor, the BME280 sensor, ThingSpeak, and Visual Studio Code. This project monitors classroom occupancy levels by categorizing the number of occupants into occupancy levels using the k-NN classifier model based on environmental data collected by IoT devices.

Lastly, the research by Tigor employs IoT technology to measure temperature, humidity, and pressure. The project uses components such as the ESP32, BME280 sensor module, GP2Y1010AU dust sensor, MQ-136 gas sensor, MICS-6814 gas sensor module, and Winsen ZE03-SO2 gas sensor module. This system periodically monitors indoor air quality conditions and provides valuable insights into the environment.

This paper makes the following objectives:

1. To determine the temperature differences between a closed space and an open space
2. To adentify the relationship between temperature, humidity, and pressure.

2.0 METHODOLOGY

Figure 1 depicts the block diagram of the proposed proof-of-concept development for utilizing the Internet of Things (IoT) in monitoring temperature, humidity, and pressure. In this project, the input employs the BME280 sensor to measure temperature, humidity, and pressure. Specifically, it is capable of measuring temperatures ranging from -40 degrees Celsius to 85 degrees Celsius, humidity within the range of 0% to 100%, and pressure spanning from 300 hPa to 1100 hPa [4].

Data processing employs the ESP32 as the hardware component, with the program executed through uPyCraft. The ESP32 is a System on a Chip (SoC) featuring a dual-core microcontroller, along with a dual-mode Wi-Fi/Bluetooth radio and a variety of integrated peripherals. The microcontroller functions at frequencies up to 240 MHz, achieving a performance of 600 Dhrystone MIPS (Million Instructions per Second). Designed for mobile applications, wearable electronics, and more, the ESP32 is a low-power IoT SoC [5].

Output data is transmitted to the Favoriot cloud network. Additionally, the project incorporates a Light-Emitting Diode (LED), which blinks at specific intervals when the temperature falls within the predetermined range.

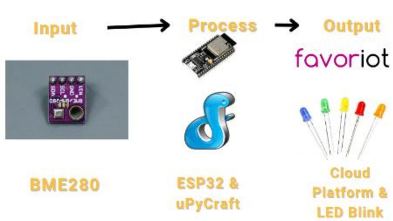

Fig 1. The block diagram of IoT Temperature, Humidity, and Pressure Monitoring Device

According to the system operational flowchart in Figure 2, the system starts with the initialization of the BME280 sensor and Wi-Fi module. This includes downloading the data from Micropython using uPyCraft platform to ensure the device has connected to the Favoriot cloud platform. Then, the sensor obtains the data on temperature (T), humidity (H), and pressure (P). In addition, the obtained data will be sent to the cloud platform. In the next step, the data has to be submitted as submission status 201. If this condition cannot be accomplished, the code needs to be debugged, then reinitialize BME280 sensor and the Wi-Fi. Else, the process moves on to the next step. In this step, there will be two conditions that require LED. First, if T is lower than 25 degrees Celcius, the LED will blink every 0.05 seconds. Otherwise, the LED will blink every 1 second. After one of the conditions is fulfilled, the process is delayed every 8 seconds before the sensor is ready to collect another data. Then, after the delay, there will be another condition, where the process keeps running if there is no forced stop, for example, the program is forced closed, an error in the system, and so on. On the contrary, when there is a force closed, the process comes to an end.

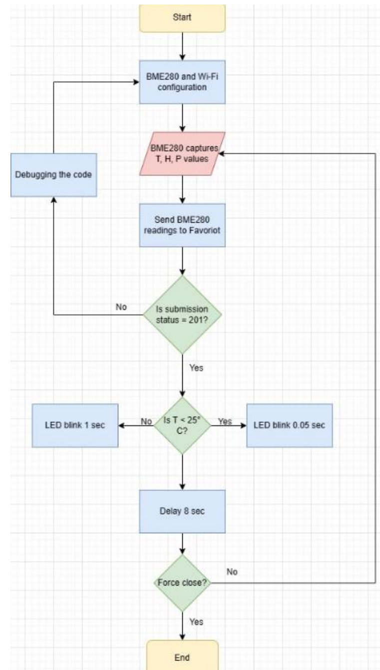

Fig.2 The flowchart of IoT Temperature, Humidity, and Pressure Monitoring Device

The circuit diagram of the proposed IoT device is shown in Figure 3. The circuit is designed to create a monitoring device with a sensor input, while the output is the LED light. This circuit diagram is made of electronic components such as BME280 sensor, ESP32 board, and LED light.

BME280 is used in this circuit as the sensor for T, H, and P. ESP32 board as the SoC microcontroller device. Lastly, LED is used as the trigger when the BME280 detects the T.

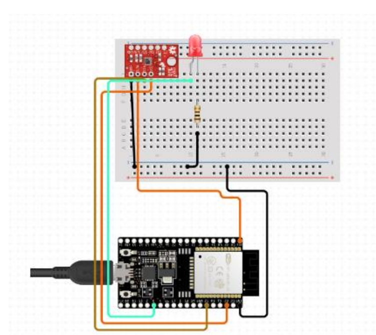

Fig. 3 Circuit diagram of the proposed system

3.0 RESULTS & DISCUSSION

This project was developed to discern temperature, humidity, and pressure disparities between enclosed and open spaces within the Multimedia Room and the 3rd-floor hallway of the School of Applied Science (SAS) building at Telkom University.

In this project, the performance evaluation of the established proof of concept was conducted within both the Multimedia Room and the 3rd-floor hallway of the SAS building at Telkom University. The assessment occurred over a 15-minute duration for each location. Figure 4 presents the conditions within the Multimedia Room. This room, defined by its enclosed walls, serves as a pertinent example of a closed space.

Fig.4 Multimedia Room in SAS building Telkom University

The 3rd-floor hallway in the SAS building at Telkom University serves as the representative of an open space. This unoccupied corridor seamlessly connects with the 3rd-floor balcony, avoiding any physical barriers that might restrict the surroundings. The state of the 3rd-floor hallway is illustrated in Figure 5

Fig.5 3rd Floor Hallway in SAS building Telkom University

the Figures 6, 7, and 8 sequentially portray the outcomes of the temperature, humidity, and pressure measurements within the Multimedia Room, as derived from the data sent to Favoriot. In Figure 6, the room's temperature exhibits relative constancy over 8-second intervals, ranging from 21.8 degrees Celsius as the lowest to 23.88 degrees Celsius as the highest, with an average of 22.04 degrees Celsius. Notably, an initial larger fluctuation is observed, followed by sustained stability.

Figure 7 reveals that the humidity graph within the Multimedia Room demonstrates fluctuations, albeit with relatively modest numerical gaps between readings. The humidity spans from 61.17% as the lowest to 65.15% as the highest.

Similarly, Figure 8 illustrates the pressure graph, which identifies intermittent pressure variations. Despite these fluctuations, the differences between pressure points remain relatively minor, ranging from 937.05 hPa to 937.35 hPa..

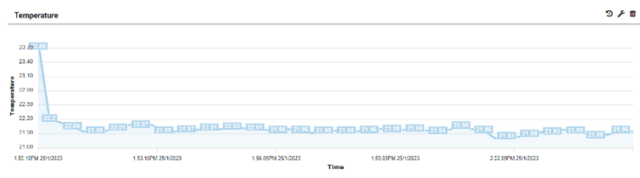

Fig.6 Result of temperature per time in Multimedia Room

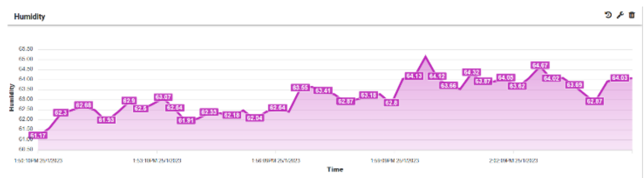

Fig.7 Result of humidity per time in Multimedia Room

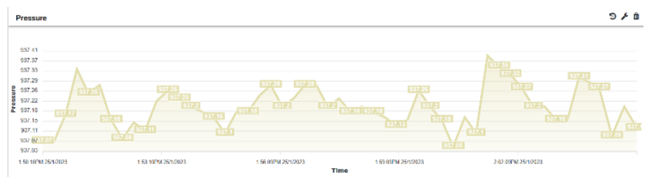

Fig.8 Result of pressure per time in Multimedia Room

Conversely, the measurements taken in the 3rd-floor hallway reveal distinct outcomes. Figure 9 illustrates a gradual temperature increase occurring in 8-second intervals. Recorded temperature spans from the lowest of 21.96 degrees Celsius to the highest of 24.92 degrees Celsius, with an average of 23.92 degrees Celsius..

Figure 10 showcases the humidity graph for the 3rd-floor hallway, depicting a descending trend. Humidity readings oscillate between the lowest value of 58.44% and the highest of 66.92%.

Similarly, Figure 11 portrays the pressure graph, evidencing decreasing pressure values. The pressure range extends from the lowest measurement of 932.43 hPa to the highest at 936.16 hPa

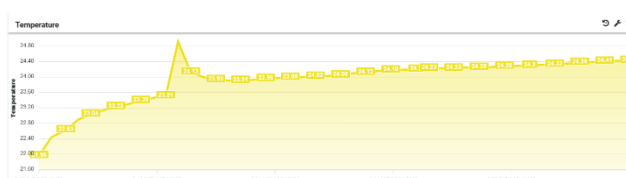

Fig.9 Result of temperature per time on the 3rd floor hallway

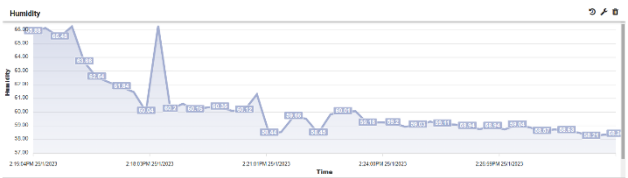

Fig.10 Result of humidity per time on the 3rd floor hallway

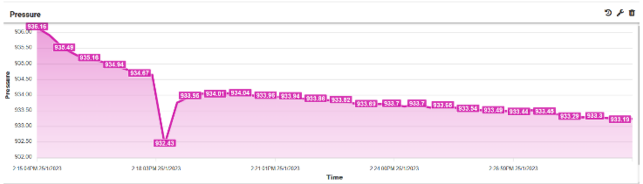

Fig.11 Result of pressure per time on the 3rd floor hallway

4.0 CONCLUSION & RECOMMENDATION

Based on the conducted experiment, it can be concluded that a obseavable temperature distinction exists between open and closed spaces. In an open space, like the 3rd-floor hallway in this case, the temperature gradually rises, influenced by the ambient conditions. Conversely, within an enclosed space, exemplified by the Multimedia Room, the temperature remains relatively constant due to the confinement of air, causing minimal temperature fluctuations. The collected data from the previous section reveals that the space with the lowest average temperature, namely the Multimedia Room, also exhibits the highest average levels of humidity and pressure. Lower temperatures correspond to elevated humidity and pressure levels. Conversely, higher temperatures correlate with reduced humidity and pressure levels.

This monitoring device holds potential utility for various stakeholders. Air conditioning manufacturers could employ it as a benchmark for monitoring their products. Constructors might utilize it to gauge temperature, humidity, and pressure for forthcoming building projects. Additionally, climate scientists could employ it to track the average temperature within specific regions for research purposes.

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