Journal of Information Technology and Computer Science (INTECOMS)
Volume 8 Nomor 4, Tahun 2025
e-ISSN : 2614-1574
p-ISSN : 2621-3249

PROTOTYPE OF TEMPERATURE AND HUMIDITY MONITORING SYSTEM FOR AIR HANDLING UNIT (AHU) BASED ON BLYNK AT JUWATA TARAKAN AIRPORT

Salsabila Putri Supriyono[1], Kurniaty Atmia[2*], Sheilla Novita[3]
[1.2.3] Politeknik Penerbangan Makassar
Jalan Salodong No. 1, Untia Village, Biringkanaya District,
Makassar City, South Sulawesi, 90241
*Corresponding author: kurniaty.atmia@gmail.com

ABSTRACT

This research aims to design a prototype of an Internet of Things (IoT)-based temperature and humidity monitoring system. This tool is designed using the Blynk platform implemented in the Air Handling Unit (AHU) at Juwata Tarakan Airport. This system uses ESP32 as a microcontroller, DHT22 sensor, and OLED LCD and the Blynk application as monitoring media. In this research, I used the Research and Development (R&D) method with the stages of problem identification, design, testing, product revision, and conclusion. The test results show that the system can monitor temperature and humidity in real-time, provide automatic notifications when the temperature exceeds the threshold, and facilitate technicians in supervision without having to be physically present on site. This system can be applied not only at airports, but also in commercial buildings and other public facilities that require an efficient temperature and humidity monitoring system

Keywords: AHU, Temperature, Humidity, Blynk, ESP32, DHT22 Sensor, IoT

INTRODUCTION

As the primary means of air transportation, airports play a vital role in connecting regions and supporting public mobility. In this context, the availability of reliable and sustainable energy is crucial for maintaining smooth operations, security, and efficiency of airport services. Law of the Republic of Indonesia No. 1 of 2009 and Government Regulation No. 70 of 2001 concerning Airports emphasize that airports are not only landing points for aircraft, but also service centers encompassing various government and economic activities (Ashraf & Heavey, 2023). Activities taking place at airports related to passenger arrivals, departures, and transit are influenced by various factors such as surges in traffic during the holiday season, utilization of existing airport facilities and services, and route shifts and flight delays. Therefore, airport management and operational technicians need to be efficient in their work, as efficiency is one measure of airport performance (Solihah et al., 2024).

An Air Handling Unit (AHU) is a system used to regulate air quality within a building. AHUs regulate temperature, humidity, and air quality within a building (Bychkov et al., 2024). According to data from the Ministry of Civil Aviation website, the terminal area of Juwata Tarakan Airport is 1,250 m2. The author's direct observations indicate that there are three AHUs at Juwata Tarakan Airport. Each AHU handles one area, including the check-in area, waiting area, and passenger arrivals area (Barbiero et al., 2023).

One important aspect of capacity fulfillment is planning cooling capacity at airports. Temperature and humidity not only play a role in providing comfort but also affect passenger health (Dania et al., 2023). Therefore, the issue that will be discussed in this research is the modernization of the use of IoT technology to improve the efficiency and effectiveness of daily operational work at Juwata Tarakan Airport. IoT technology simplifies and increases the effectiveness of work by enabling instant data collection and analysis from various sources, such as sensors, equipment, and connected devices (Ceccarelli et al., 2024). With IoT technology, technicians can now monitor temperature or humidity remotely directly through sensor devices and internet connections. Considering that work that has been done manually and is quite draining both energy and time (Pang et al., 2025). The work in question is air conditioning temperature which is the standard level of service. This is important because many jobs are still done manually, which requires a lot of energy and time. The work in question is air temperature regulation that must meet the standard level of service. This is because airports are required to comply with standards and regulations set by the government in the aviation sector. The regulation in question is PM 41 of 2023 concerning Airport Services (Yu et al., 2023). Room temperature settings must comply with existing regulations, namely below 25°C, in the check-in area, departure lounge, and baggage claim area in accordance with PM No. 41 of 2023. Therefore, monitoring activities are needed to ensure the implementation of service standards for passengers that have been set by the government. Temperature monitoring is also carried out to determine temperature conditions during busy periods or when the number of passengers increases (Li et al., 2023; Maimun et al., 2025; Woodward et al., 2024).

This system is designed using the ESP32 microcontroller, which excels in power efficiency and WiFi network connectivity, and is capable of handling real-time data communications for the Internet of Things (IoT) (Fuchs & Lingnau, 2024; Labobar, 2024). The sensor used is the DHT22 due to its ability to read temperature and humidity with high accuracy and respond quickly to environmental changes, as has been effectively implemented in research by (Li et al., 2023; Theologou et al., 2024). The Blynk application is used as a real-time data monitoring medium that supports the digitalization of technical services at airports (Flamini et al., 2023; Maimun et al., 2025; Woodward et al., 2024). The use of the ESP32 as the processing center of this system enables energy efficiency and reliable network connectivity, and can be implemented in an automated monitoring environment in public facilities such as airports (Das et al., 2025; Muda, 2025). This research was developed using the Research and Development (R&D) method which involves the stages of problem identification, design, testing, revision, and conclusion to produce a system prototype that is ready for functional implementation (Retuerto & Andrade-Arenas, 2023).

Therefore, based on the above problems, the author chose the title "Prototype of Blynk-Based Air Handling Unit (AHU) Temperature and Humidity Monitoring System at Juwata Tarakan Airport." Ultimately, air temperature and humidity monitoring can be carried out automatically without interrupting customer comfort at the terminal and increasing the efficiency of existing work and workers (Rygał et al., 2025)(Das et al., 2025; Flamini et al., 2023; Muda, 2025).

METHODOLOGY

Method Of Collecting Data

The data collection method explains the procedures for collecting data. In this study, data were collected through observation and documentation. Observation is a data collection technique that involves direct observation of participants and the context involved in the research phenomenon. This was done in the field, namely in the Air Handling Unit (AHU) area at Juwata Tarakan Airport, North Kalimantan. Documentation was carried out by collecting research-related documents, such as real-time temperature and humidity data. This confirms that documentation is one of the main pillars in qualitative data collection (Popov et al., 2023; Retuerto & Andrade-Arenas, 2023; Rygał et al., 2025; Uchihira, 2022).

Data Processing

Data processing is the process of obtaining data from each research variable ready for analysis. Data processing describes how data is processed using a specific approach (qualitative/quantitative). Data obtained from testing will be processed quantitatively to calculate sensor accuracy and power consumption (Balaraju, 2020; Kadechkar, 2024; Naranjo, 2025; Novrinaldi, 2023; Pitoyo, 2024).

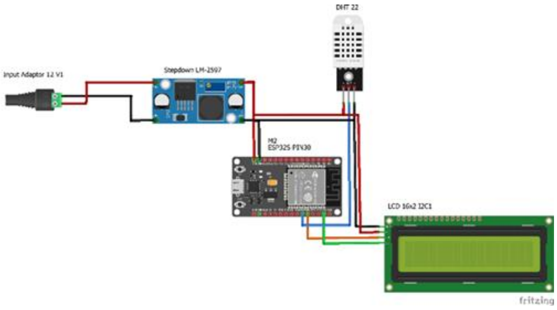
Data Analysis

Data analysis provides an explanation of the tools used. Data analysis according to Sugiyono (2019) is the process of systematically searching and compiling data obtained from observations, field notes, and documentation, by organizing data into categories, breaking them down into units, synthesizing them, arranging them into patterns, selecting what is important, and drawing conclusions so that they are easy to understand. The stages of data analysis include: Data Reduction, Data Display, and Conclusion Drawing/Verification (Fithri, 2025; Gopal, 2023; Ismagilov, 2021; Jiang, 2023; Lukmandono, 2020).

RESULTS AND DISCUSSION

Research Results

The result of this research is a prototype temperature and humidity monitoring system that can work in real-time by utilizing Blynk-based IoT technology. This system is specifically designed to monitor the performance of the Air Handling Unit (AHU) at Juwata Tarakan Airport. Based on direct observations in the field, temperature and humidity conditions in several areas such as the waiting room, check-in area, and passenger arrival area are the main focus in the implementation of this system. With the government- etermined temperature limit below 25°C, the designed system is able to accurately read environmental conditions and send the data to mobile devices via the Blynk platform.



Picture 1. AHU Monitoring System Wiring Diagram

The monitoring process is carried out using a DHT22 sensor that reads temperature and humidity, then sends it via an ESP32 microcontroller connected to a WiFi network. The data is then displayed on an I2C OLED LCD screen and sent simultaneously to the Blynk application on a smartphone. Based on the trials conducted, the system is able to provide stable and consistent measurement results, and can be accessed remotely by technicians or airport facility managers. The advantages of this system lie in the simplicity of installation, operational efficiency, and its ability to present environmental data quickly and accurately without repeated manual intervention. Presentation of Trial Data.

Trial Data Testing

TestingESP32 microcontroller

The ESP32 is used as a control center, collecting data from sensors and sending it to Blynk. Test results show that the ESP32 is capable of:

• It lights up steadily with a 5V supply via USB cable.

• Connects to a 2.4GHz WiFi network within 3–5 seconds.

• Run the program with a 5 second delay for temperature and humidity readings.

• Display data in Blynk app with <1 second latency.

This microcontroller was chosen because it has good processing speed and stable connectivity capabilities, two things that are very important for a real-time monitoring system.

DHT22 Sensor Testing

The DHT22 sensor was chosen due to its superior accuracy compared to the DHT11. This sensor can read temperatures ranging from -40°C to 80°C and humidity up to 100%. Testing was conducted in a mock-up AHU.

Table 1. DHT22 Sensor Testing

Time	Temperature (°C)	Humidity (%)	Status
Morning	23.1	59	Stable
Afternoon	26.2	67	Active Notification
Afternoon	24.5	61	Stable
Evening	22.7	56	Stable

The results showed that the sensor was able to provide consistent readings, and the system was able to trigger notifications at pre-set temperature thresholds.

OLED Display Testing

An I2C OLED display is used as a local display showing the current temperature and humidity. Tests show that the data is updated every 5 seconds, and the text is clearly readable from a distance of approximately 1 meter. The OLED display allows technicians directly near the device to view conditions without opening the app.

Picture 2. OLED Display Testing

Data Analysis Results

After conducting various tests on the Blynk-based AHU temperature and humidity monitoring system, data analysis showed that this device has stable and responsive performance. The DHT22 sensor can read temperature with an accuracy of ±0.5°C and humidity with an accuracy of ±2%, which is very important for maintaining the AHU cooling system operating in optimal conditions. Tests conducted showed that the device is able to detect quite small temperature changes and provide early warning if the temperature condition exceeds the predetermined threshold.

Product Revision

During testing, several technical issues were identified that affected the accuracy and performance of the instrument. Based on the evaluation and testing results, several product revisions were required to improve system performance and ensure optimal functionality under field conditions.

1. Notification Settings Changes

During the initial testing phase of the system, device notifications were set to appear every second. However, after evaluation, this setting proved to produce excessive and spammy notifications, disrupting user experience. Therefore, the system was revised by changing the notification interval to every minute.

2. Temperature Threshold Adjustment on Notifications

The temperature threshold for notifications in the Blynk app was initially set at 26°C. Based on testing, 25°C was found to be a more appropriate threshold for indicating potential issues in the AHU cooling system. Therefore, the temperature threshold was changed to 25°C.

Discussion of Research Results

The IoT-based temperature and humidity monitoring system developed in this study aims to facilitate monitoring of Air Handling Unit (AHU) performance at Juwata Tarakan Airport. Testing results show that the system functions well and meets expectations. Data from the DHT22 sensor can be sent in real time to the Blynk smartphone application via the ESP32 device. Furthermore, temperature and humidity information is displayed directly on the OLED screen, allowing technicians to perform checks without accessing additional software. The use of the OLED screen has proven effective, as it can display data clearly even from a distance of about one meter.

Overall, this system makes it easy for technicians to monitor temperature and humidity quickly, accurately, and efficiently. Furthermore, the system automatically notifies any temperature deviations, allowing for immediate corrective action without having to wait for scheduled manual checks. The results of this development also demonstrate that the system has significant potential for application not only in airports but also in other environments such as hospitals, shopping malls, and office buildings that require strict temperature and humidity control.

Research Implications

Research on the Internet of Things (IoT)-based temperature and humidity monitoring system in the Air Handling Unit (AHU) at Juwata Tarakan Airport provides several important implications, particularly in the context of airport technician operations:

1. Practical Solutions for Technicians at Airports

This system provides a real solution for technicians Monitoring AHU conditions without the need for manual on-site inspections. With real-time temperature and humidity monitoring through the Blynk app, technicians can monitor environmental conditions anytime, anywhere, and take faster and more appropriate action when abnormal temperature and humidity changes occur.

2. Reducing Workload and Risk of Human Error

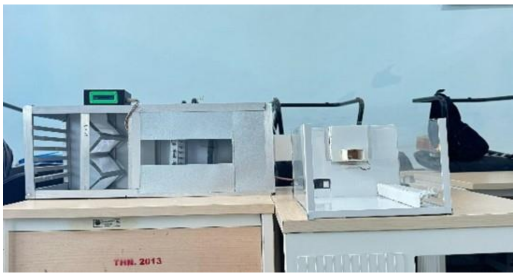
This automated system significantly reduces the technician's workload. Routine inspections can now be minimized because the system automatically alerts if temperature or humidity exceeds thresholds. This also reduces the risk of delays in handling and human error in recording environmental data.

3. Operational Efficiency and Time Savings

With a more controlled notification system (after revising the notification frequency), technicians are no longer distracted by repeated, short-term information and receive only critical notifications. This improves work efficiency, as technicians can focus more on corrective actions rather than repetitive monitoring.

4. Adaptation Potential in Other Areas

The successful implementation of this system in the AHU opens up opportunities for its application in various other airport facilities, such as control rooms, server rooms, or storage areas that require stable temperature and humidity. This demonstrates the system's flexibility and potential for adaptation to airport infrastructure management more broadly.



Picture 3. Mock Up Air Handling Unit (AHU)

CONCLUSION

The research entitled "Prototype of Blynk-Based Air Handling Unit (AHU) Temperature and Humidity Monitoring System at Juwata Tarakan Airport" has successfully designed and developed an Internet of Things (IoT)-based monitoring system using ESP32, DHT22 sensor, OLED display, and Blynk application. This system is capable of displaying temperature and humidity data in real-time and sending automatic notifications if the temperature exceeds a predetermined threshold. During testing, the system demonstrated stable performance and consistent sensor readings.

During the development process, the notification frequency was revised from one second to one minute to avoid disturbing users, and the temperature threshold was adjusted from 26°C to 25°C to be more responsive to temperature changes. With a simple yet functional design, this system is not only suitable for use in airport environments, but also has the potential to be applied in other places such as offices, hospitals, and shopping centers. Overall, the research objective of creating a prototype temperature and humidity monitoring system that is practical, easy to use, and works in real-time has been achieved, and provides a real contribution to supporting technician work efficiency and air environmental comfort.

Although the developed prototype system has performed well, there is still room for improvement. The use of sensors with higher accuracy and resilience to extreme environmental conditions should be considered to improve system performance. Long-term testing is also recommended to measure device durability and data validity under various conditions. Furthermore, the integration of cloud-based data storage can support long-term analysis and reporting. In the future, developing a more intelligent system through the integration of technologies such as AI and machine learning could be a further step so that the system is not only reactive but also able to predict disruptions early.

REFERENCES

Ashraf, M., & Heavey, C. (2023). A prototype of supply chain traceability using Solana as blockchain and IoT. *Procedia Computer Science*. https://www.sciencedirect.com/science/article/pii/S1877050922023705

Balaraju, J. (2020). Prediction and Assessment of LHD Machine Breakdowns Using Failure Mode Effect Analysis (FMEA). In *Lecture Notes in Mechanical Engineering* (pp. 833–850). https://doi.org/10.1007/978-981-13-9008-1_70

Barbiero, G., Berto, R., Senes, G., & Fumagalli, N. (2023). Wilderness is the prototype of nature regardless of the individual's connection to nature. An empirical verification of the solastalgia effect. In *International Journal of …*. mdpi.com. https://www.mdpi.com/1660-4601/20/14/6354

Bychkov, M. L., Shlepova, O. V, Shulepko, M. A., & ... (2024). Human epithelial protein SLURP-2 as a prototype of drugs for wound healing. *Russian Journal of …*. https://doi.org/10.1134/S1068162024030014

Ceccarelli, M., Sanz, S., Díaz, V., & Russo, M. (2024). Design and construction of a prototype of an assisting device for arm exercise. In *Machines*. mdpi.com. https://www.mdpi.com/2075-1702/12/2/145

Dania, T., Chladkova, H., Duda, J., Kožíšek, R., & ... (2023). The motivation of generation Z: A prototype of the Mendel University student. ... *International Journal of …*. https://www.sciencedirect.com/science/article/pii/S1472811723001295

Das, D., Teixeira, E. S., & Morales, J. A. (2025). Recurrent Neural Network/Machine Learning Predictions of Reactive Channels in H+ + C2H4 at ELab = 30 eV: A Prototype of Ion Cancer Therapy Reactions. *Journal of Computational …*. https://doi.org/10.1002/jcc.70033

Fithri, P. (2025). A case study on risk analysis of machine breakdown using the FMEA method. In *E3s Web of*

Conferences (Vol. 604). https://doi.org/10.1051/e3sconf/202560412001

Flamini, A., Ciurluini, L., Loggia, R., & ... (2023). A prototype of low-cost home automation system for energy savings and living comfort. *IEEE Transactions* …. https://ieeexplore.ieee.org/abstract/document/10113199/

Fuchs, F., & Lingnau, V. (2024). The homo economicus as a prototype of a psychopath? A conceptual analysis and implications for business research and teaching. In *Journal of business ethics*. Springer. https://doi.org/10.1007/s10551-024-05638-7

Gopal, N. (2023). Risk Analysis of Cheese Packaging Machine Using FMEA and FCODAS Approach. In *Industrial Reliability and Safety Engineering Applications and Practices* (pp. 91–104). https://doi.org/10.1201/9781003140092-7

Ismagilov, F. R. (2021). Fmea application in the design and manufacture of modern and advanced electrical machines. *International Review of Aerospace Engineering*, *14*(3), 147–158. https://doi.org/10.15866/irease.v14i3.19644

Jiang, S. (2023). A dynamic failure mode and effect analysis (FMEA) method for CNC machine tool in service. In *Journal of Physics Conference Series* (Vol. 2483, Issue 1). https://doi.org/10.1088/1742-6596/2483/1/012047

Kadechkar, A. (2024). FMEA 2.0: Machine Learning Applications in Smart Microgrid Risk Assessment. In *12th International Conference on Smart Grid Icsmartgrid 2024* (pp. 629–635). https://doi.org/10.1109/icSmartGrid61824.2024.10578271

Labobar, K. (2024). Damai model as a prototype of religious moderation. In *Evangelikal: Jurnal Teologi Injili Dan Pembinaan* …. core.ac.uk. https://core.ac.uk/download/pdf/598964198.pdf

Li, J., Zhang, Q., Xu, C., Zhang, Y., Lu, Y., Ai, M., & Tan, X. (2023). Differences in clinical characteristics and liver injury between patients diagnosed with the Omicron subvariant BA. 5.2 and the prototype of SARS-CoV-2: a …. In *BMC gastroenterology*. Springer. https://doi.org/10.1186/s12876-023-02907-z

Lukmandono. (2020). Analysis of Total Productive Maintenance (TPM) and Failure Mode and Effect Analysis (FMEA) to improve machine effectiveness: A study on Indonesia’s sugar mills. In *Iop Conference Series Materials Science and Engineering* (Vol. 885, Issue 1). https://doi.org/10.1088/1757-899X/885/1/012063

Maimun, M., Hamdani, H., Listiana, H., & ... (2025). Pesantren as a Prototype of Education with a Deep Learning Approach. *Jurnal Pendidikan* …. https://ejournal.uiidalwa.ac.id/index.php/jpi/article/view/2373

Muda, N. R. S. (2025). PROTOTYPE OF SHEPAT DRONE BASED ON BOMB FIXEDWING. *International Journal of Social Science*. https://bajangjournal.com/index.php/IJSS/article/view/9904

Naranjo, J. E. (2025). Enhancing Institutional Sustainability Through Process Optimization: A Hybrid Approach Using FMEA and Machine Learning. *Sustainability Switzerland*, *17*(4). https://doi.org/10.3390/su17041357

Novrinaldi. (2023). Risks potency analysis of flakes machine in banana flakes production process using failure modes and effects analysis (FMEA). *Agricultural Engineering International Cigr Journal*, *25*(2), 66–76. https://www.scopus.com/inward/record.uri?partnerID=HzOxMe3b&scp=85164182491&origin=inward

Pang, B., Wen, L., Zheng, L., Wei, J., Xu, T., & ... (2025). Neutrophil Extracellular Traps: Emerging Biomarker and Prototype of Functional Materials. *Advanced Functional* …. https://doi.org/10.1002/adfm.202425035

Pitoyo, D. (2024). Optimizing Operations: Evaluating Overall Equipment Effectiveness (OEE) And Failure Mode Effect Analysis (FMEA) For Muratec Qpro Ex Winding Machines at PT XYZ. In *Journal of Physics Conference Series* (Vol. 2928, Issue 1). https://doi.org/10.1088/1742-6596/2928/1/012013

Popov, S. V, Maslov, L. N., Mukhomedzyanov, A. V, & ... (2023). Apelin is a prototype of novel drugs for the treatment of acute myocardial infarction and adverse myocardial remodeling. In *Pharmaceutics*. mdpi.com. https://www.mdpi.com/1999-4923/15/3/1029

Retuerto, M. G., & Andrade-Arenas, L. (2023). Prototype of a mobile application for teaching the first grade letter course. *Advances in Mobile Learning* …. https://www.syncsci.com/journal/AMLER/article/view/AMLER.2023.02.003

Rygał, J., Rygał, R., & Zurek, S. (2025). Technological Challenges for a 60 m Long Prototype of Switched Reluctance Linear Electromagnetic Actuator. In *Actuators*. mdpi.com. https://www.mdpi.com/2076-0825/14/8/380

Solihah, P. A., Kaniawati, I., Samsudin, A., & ... (2024). Prototype of greenhouse effect for improving problem-solving skills in science, technology, engineering, and mathematics (STEM)-education for sustainable …. In *Indonesian Journal of* …. ejournal.kjpupi.id. https://ejournal.kjpupi.id/index.php/ijost/article/view/352

Theologou, K., Johnson, M., Tombrink, J., & ... (2024). CHESTER: Experimental prototype of a compressed heat energy storage and management system for energy from renewable sources. In *Energy Conversion and* …. Elsevier. https://www.sciencedirect.com/science/article/pii/S0196890424004606

Uchihira, N. (2022). Project FMEA for Recognizing Difficulties in Machine Learning Application System Development. In *Picmet 2022 Portland International Conference on Management of Engineering and Technology Technology Management and Leadership in Digital Transformation Looking Ahead to Post Covid Era Proceedings*. https://doi.org/10.23919/PICMET53225.2022.9882797

Woodward, M., Dixon-Woods, M., Randall, W., & ... (2024). How to co-design a prototype of a clinical practice tool: a framework with practical guidance and a case study. *BMJ Quality &* …. https://qualitysafety.bmj.com/content/33/4/258.abstract

Yu, T., Li, H., Liu, Y., Li, J., Tian, J., Liu, Z., Rao, Y., Guo, S., & ... (2023). A prototype of dual-ion conductor for all-solid-state lithium batteries. *Science* …. https://doi.org/10.1126/sciadv.adj8171