Journal of Mechatronics and Artificial Intelligence

Homepage: https://ejournal-purwakarta.upi.edu/jmai/index

Design and Implementation of an IoT-Based Air Pressure Monitoring and Automatic Data Logging System for Industrial Compressors

Maudynar[1], Fikri Arif Wicaksana[1,*]

[1] *Electrical Engineering Department, Nusa Putra University, Sukabumi, Indonesia*
**Corresponding author email: fikriarifw@nusaputra.ac.id*

ARTICLE INFO

Article History:

Submitted/Received 06 June 2026
First Revised 04 July 2026
Accepted 27 Aug 2026
First available online 02 Nov 2026
Publication Date 15 Dec 2026

Keywords:
IoT,
ESP32,
Pressure Sensor,
Google Sheets,
Compressor Monitoring

ABSTRACT

Compressor systems play an important role in supporting industrial production processes because they provide compressed air for various pneumatic equipment. At PT Dahana, compressor pressure monitoring was still performed manually, making it difficult to obtain historical data for performance evaluation and preventive maintenance. This study aims to design an Internet of Things (IoT) based air pressure monitoring system equipped with automatic data recording. The proposed system utilizes an ESP32 microcontroller, SKU237545 pressure sensor, Wi-Fi communication, Google Apps Script, and Google Sheets as cloud-based data storage. The pressure sensor measures compressor air pressure and transmits data through the ESP32 to Google Sheets in real time. System testing was conducted on three compressors located in the workshop area, Elemented Factory, and Cartridge Emulsion Factory. The measured parameters include pressure values, differences between sensor readings and pressure gauge measurements, and percentage error. The results show that the developed system successfully performs real-time monitoring and automatic data logging. The pressure measurements obtained from the sensor show a relatively small error compared to the reference pressure gauge, indicating that the system can be utilized as a reliable monitoring solution. The implementation of this system supports preventive maintenance activities and improves operational efficiency in industrial compressor monitoring.

1. Introduction

Compressed air Compressed air systems are essential components in industrial operations because they supply pneumatic [1] energy for various production processes [2]. At PT Dahana, compressor pressure monitoring was conducted manually using pressure gauges, making it difficult to record historical data and evaluate compressor performance [3]. This study aims to design and implement an Internet of Things (IoT) [4] based air pressure monitoring system equipped with automatic data recording. The proposed system utilizes an ESP32 microcontroller, a pressure sensor, Wi-Fi communication, Google Apps Script, and Google Sheets as cloud-based data storage. The Research and Development (R&D) method was applied through several stages, including problem identification, system design, prototype development, testing, and evaluation [5], [6]. Testing was conducted on compressors located in the Compressor Workshop, Elemented Factory, and Emulsion Cartridge Factory. The collected data were compared with pressure gauge measurements to determine system accuracy. The results show that the monitoring system successfully measured compressor pressure in real time and automatically recorded operational data to Google Sheets [7], [8]. The developed system provides an efficient and reliable solution for compressor monitoring and supports preventive maintenance activities in industrial environments.

2. Methods

This study employed the Research and Development (R&D) method to design and develop an air pressure monitoring system for compressors. The R&D process consisted of problem identification, system design, prototype development, calibration, testing, and evaluation. The calibration process was carried out by comparing the sensor readings with a pressure gauge as a reference measuring instrument. The developed prototype was then tested under actual operating conditions to assess its performance, accuracy, and reliability. [9].

2.1. Data Collection Method

Data collection was carried out through field observation and direct measurement. Observations were conducted at the Compressor Workshop (WS), Elemented Factory, and Emulsion Cartridge Factory. Pressure gauge readings were used as reference values and compared with pressure sensor measurements to evaluate system accuracy.

2.2. System Design

The monitoring system consists of a pressure sensor, ESP32 microcontroller, Wi-Fi communication module, Google Apps Script, and Google Sheets database. The pressure sensor measures compressor

pressure and sends analog signals to the ESP32. The ESP32 processes the data and transmits the results to Google Sheets through an internet connection. The block diagram can be seen in figure 1 as follows.

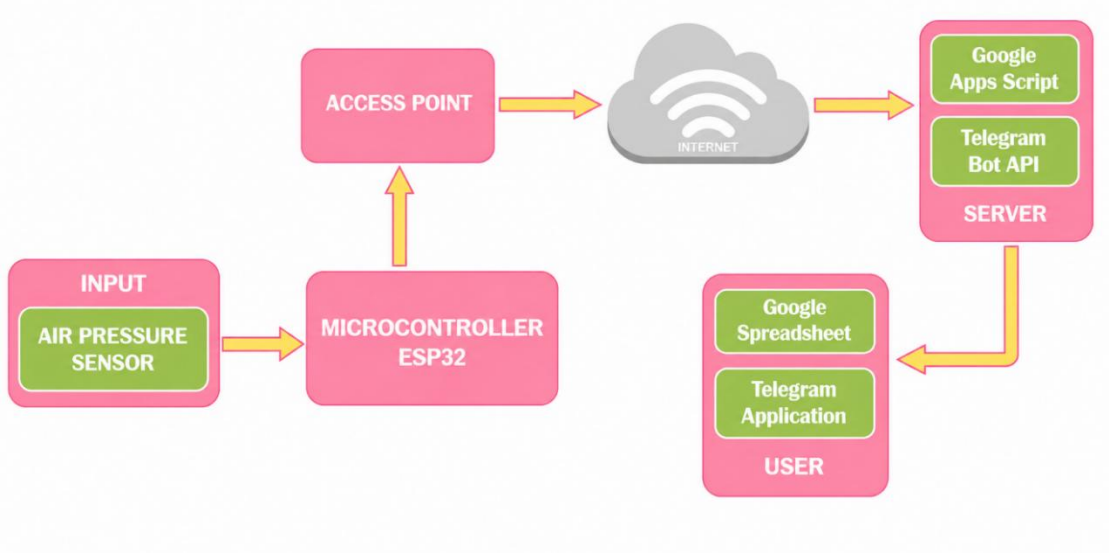


Figure 1: Diagram block of the system.

The hardware used in this study was selected to support pressure measurement, data processing, and wireless communication functions. These components were integrated to form an IoT-based compressor pressure monitoring system capable of recording and transmitting data automatically. The hardware components used are listed in Table 1.

Table 1: Hardware Components

No	Component	Function
1	ESP32	Main controller and Wi-Fi communication
2	Pressure Sensor SKU237545	Pressure measurement
3	Step Down Converter	Voltage regulation
4	Lithium Battery	Power supply
5	Google Sheets	Data storage
6	Google Apps Script	Data transmission

2.3. System Flowchart

The system starts by reading pressure values from the sensor. The measured data are processed by the ESP32 and converted into pressure units (bar) [10]. The results are then transmitted through Wi-Fi and stored automatically in Google Sheets. If the pressure exceeds the predetermined threshold, the system can provide monitoring information for further action. The flowchart can be seen in figure 2 as follows.

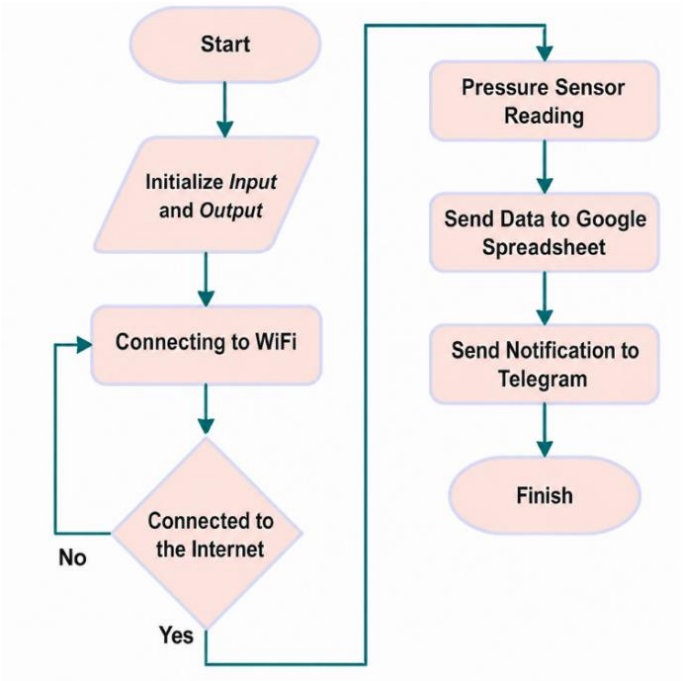


Figure 2: Flowchart system.

3. Results and Discussion

3.1. System Implementation

The developed prototype was installed on compressor units at PT Dahana. The pressure sensor was connected to the compressor airline, while the ESP32 handled data acquisition and transmission. The monitoring results were displayed and recorded automatically in Google Sheets. The prototype can be seen in figure 3 as follows.

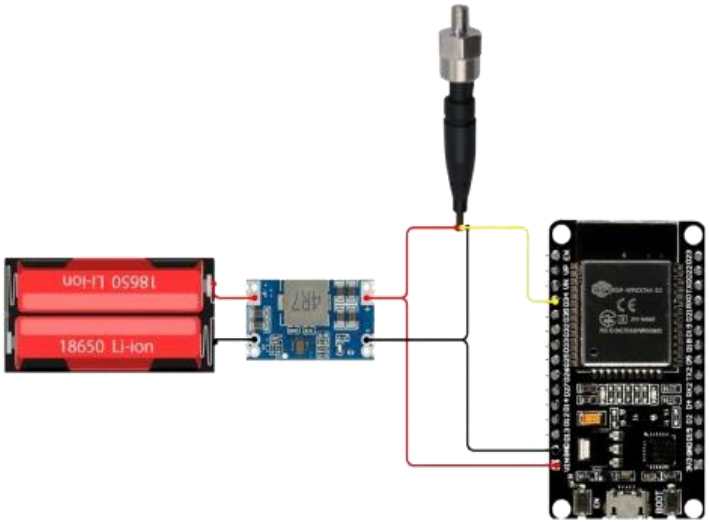


Figure 3: Wiring of the system.

3.2. Compressor Pressure Testing

System testing was conducted by comparing pressure sensor readings with pressure gauge measurements.

3.2.1. Workshop Compressor Testing

The following table of measurement results on the compressor workshop, can be seen in table 2 as follows.

Table 2: Compressor measurement results workshop.

Gauge (Bar)	Sensor (Bar)	Difference	Error (%)
8.00	7.90	0.10	1.25%
4.00	3.95	0.05	1.25%
6.00	5.43	0.57	9.50%
8.00	7.91	0.09	1.13%
8.00	8.05	0.05	0.63%

3.2.2. Elemented Compressor Testing

The following table of measurement results on the compressor, can be seen in table 3 as follows.

Table 3: Compressor measurement results.

Gauge (Bar)	Sensor (Bar)	Difference	Error (%)
8.50	8.13	0.37	4%
9.00	8.40	0.60	7%
9.00	8.40	0.60	7%
8.50	8.20	0.30	4%
9.00	8.40	0.60	7%

3.2.3. Cartridge Compressor Testing

The following table of measurement results on the compressor, can be seen in table 4 as follows.

Table 4: Compressor measurement results cartridge.

Pressure Gauge (Bar)	Sensor (Bar)	Differences	Error
8.40	7.99	0.41	5%
8.00	7.64	0,36	5%
8.30	7.94	0.36	4%
8.50	8.13	0.37	4%
8.20	7.76	0,44	5%

3.2.4. Error Calculating

The percentage error was calculated using:

$$Error(\%) = \frac{|\ Pgauge - Psensor\ |}{Pgauge} \times 100\% \quad (1)$$

Where :

- $Pgauge$ = pressure gauge reading
- $Psensor$ = pressure sensor reading

3.2.5. Test result documentation

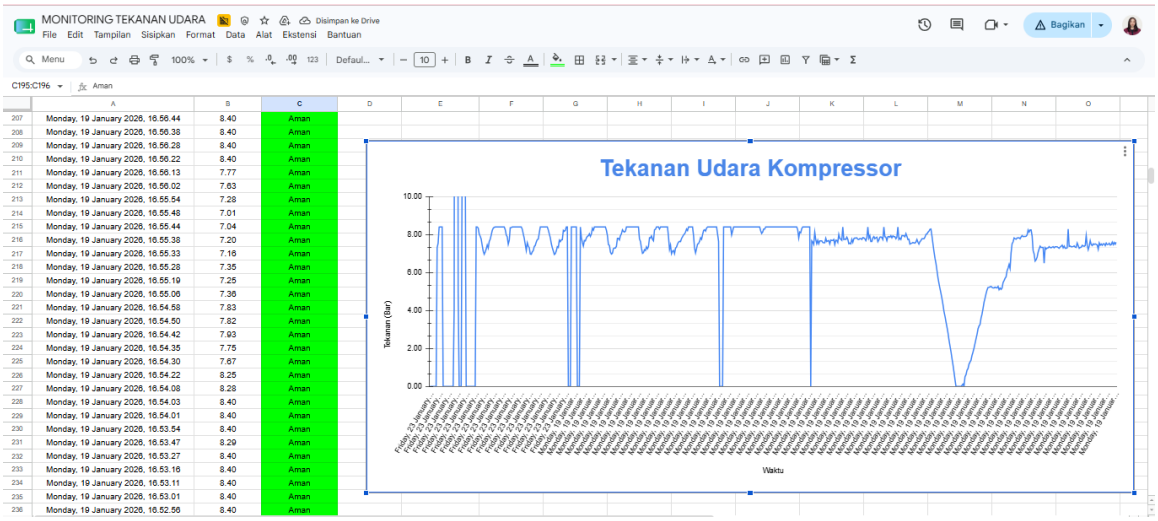


Figure 4: Data results of air pressure measurement on compressor in spreadsheet.



Figure 5: (a) Component photo, (b) Cartridge Emulsion test documentation, (c) Testing documentation in Elemented, (d) Testing documentation in the Workshop.

3.3. Discussion

The test results indicate that the developed monitoring system can measure compressor pressure with acceptable accuracy. The observed differences between sensor readings and pressure gauge measurements are mainly caused by sensor tolerance, analog signal conversion, and compressor pressure fluctuations during operation. The integration of ESP32, Google Apps Script, and Google Sheets successfully enabled automatic data recording and real-time monitoring. This capability allows historical pressure data to be stored and analyzed for preventive maintenance purposes.

4. Conclusion

An IoT-based air pressure monitoring system for compressors has been successfully designed and implemented at PT Dahana. The system utilizes a pressure sensor, ESP32 microcontroller, and cloud-based data storage through Google Sheets. The developed system is capable of monitoring compressor pressure in real time and automatically recording operational data. The testing results show that the system provides acceptable measurement accuracy and can support preventive maintenance activities by providing historical pressure records. Future work may include integrating alarm notifications and predictive maintenance features to further improve system reliability and operational efficiency.

Acknowledgement

The author would like to express sincere gratitude to PT Dahana for providing internship opportunities and research facilities. The author also thanks the Electrical Engineering Study Program of Nusa Putra University and all supervisors for their guidance and support throughout this study.

References

[1] D. Gryboś and J. Leszczyński, "Exergy analysis of pressure reduction, back pressure and intermittent air supply configuration of utilization/expansion stage in compressed air systems," *Energy*, vol. 285, p. 129419, 2023, doi: https://doi.org/10.1016/j.energy.2023.129419.

[2] I. K. Priyanto, M. E. R. Ramadhan, F. P. L. Gojandra, and N. Kurniadi, *POMPA DAN KOMPRESOR*. Alungcipta, 2025.

[3] S. N. Swamy and S. R. Kota, "An empirical study on system level aspects of Internet of Things (IoT)," *IEEe Access*, vol. 8, pp. 188082–188134, 2020.

[4] A. Rahayu, "Metode penelitian dan pengembangan (R&D): Pengertian, jenis dan tahapan," *DIAJAR: Jurnal Pendidikan Dan Pembelajaran*, vol. 4, no. 3, pp. 459–470, 2025.

[5] M. Waruwu, "Metode penelitian dan pengembangan (R&D): konsep, jenis, tahapan dan kelebihan," *Jurnal Ilmiah Profesi Pendidikan*, vol. 9, no. 2, pp. 1220–1230, 2024.

[6] M. I. Amin and A. Wisaksono, "Google Sheet Based Air Dryer Compressor Monitoring System: Sistem Pemantauan Kompresor Pengering Udara Berbasis Google Sheets," *Indonesian Journal of Innovation Studies*, vol. 26, no. 3, pp. 10–21070, 2025.

[7] H. Alfarizi and R. Z. Abidin, "Sistem Monitoring Suhu Berbasis IoT dengan Sensor Thermocouple dan Pelaporan Otomatis Menggunakan Google Sheets pada Ruang Cold Storage," *JATI (Jurnal Mahasiswa Teknik Informatika)*, vol. 9, no. 6, pp. 9212–9218, 2025.

[8] D. S. Serra, A. J. C. Ribeiro, T. A. dos Santos, F. S. Á. Cavalcante, and M. L. M. de Oliveira, "Prototype for measuring air flow in pipes using ultrasonic sensors for exhaust gas velocities," *Sens. Actuators A Phys.*, vol. 393, p. 116829, 2025, doi: https://doi.org/10.1016/j.sna.2025.116829.

[9] B. Aryani and M. R. Tsani, “Pengembangan Sistem Pendeteksi Tekanan Ban Berbasis Internet of Things untuk Otomatisasi Inspeksi Kendaraan,” *Infotekmesin*, vol. 16, no. 2, pp. 417–424, 2025.

[10] N. A. U, S. Pujiyati, T. Hestirianoto, A. Rahmat, J. Santosa, and K. N. Nadya, “The Journal of Academic Science Design of Gas Pressure and pH Pressure Monitoring and Control System using ESP32 on IoT-Based Biogas Digester,” vol. 2, no. 5, pp. 5–10, 2025.