Sistem Monitoring Suhu dan Kelembapan Ruang Server dengan Evaluasi Otomatis terhadap ASHRAE TC 9.9
dan Rate of Change Alarm
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

INTISARI

SISTEM *MONITORING* SUHU DAN KELEMBAPAN RUANG *SERVER* DENGAN EVALUASI OTOMATIS TERHADAP ASHRAE TC 9.9 DAN *RATE OF CHANGE ALARM*

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Infrastruktur *server* merupakan aset vital bagi PT Hino Motors Manufacturing Indonesia (HMMI) yang kinerjanya sangat dipengaruhi oleh stabilitas suhu dan kelembapan. Selama ini, *monitoring* kondisi lingkungan pada ruang *server* masih dilakukan secara manual dan konvensional, sehingga risiko kegagalan perangkat akibat anomali suhu sering kali terlambat terdeteksi. Penelitian ini bertujuan untuk merancang dan mengimplementasikan sistem *monitoring* terpusat berbasis *Internet of Things* (IoT) dengan integrasi standar ASHRAE TC 9.9 dan algoritma *Rate of Change* (RoC) *Alarm* guna mengatasi kendala *monitoring* manual serta meminimalisir potensi kerusakan perangkat keras. Sistem dibangun menggunakan mikrokontroler ESP32 dan ESP8266 sebagai *node* sensor, protokol MQTT untuk transmisi data, serta *web dashboard* berbasis Next.js yang interaktif. Implementasi *frontend* mencakup visualisasi data *real-time* via *WebSocket* dan denah lokasi sensor dinamis. Hasil pengujian akurasi suhu menunjukkan nilai *Mean Absolute Error* (MAE) yang sangat rendah sebesar 0,22. Pengujian *Quality of Service* (QoS) menggunakan Wireshark membuktikan reliabilitas jaringan dengan nilai rata-rata *latency* sebesar 20,19 ms pada ESP32 dan 50,85 ms pada ESP8266, rasio *packet loss* 0%, dan penggunaan *bandwidth* yang efisien di kisaran 200-450 *bytes*/*sec*. Sistem telah berhasil di-*deploy* secara *on-premise* pada *server* lokal HMMI, memberikan solusi *monitoring* yang responsif terhadap anomali lingkungan serta meningkatkan efisiensi operasional tim IT melalui fitur pelaporan data historis yang sistematis.

Kata Kunci: ASHRAE TC 9.9, Aplikasi *Web* , IoT, *Monitoring* Ruang *Server*, *Rate of Change*

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ABSTRACT

SERVER ROOM TEMPERATURE AND HUMIDITY MONITORING SYSTEM WITH AUTOMATIC EVALUATION AGAINST ASHRAE TC 9.9 AND RATE OF CHANGE ALARM

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Server infrastructure is a vital asset for PT Hino Motors Manufacturing Indonesia (HMMI), whose performance is significantly influenced by the stability of temperature and humidity. Previously, environmental monitoring in the server room was still conducted manually and conventionally, leading to risks where hardware failures due to temperature anomalies were often detected too late. This research aims to design and implement a centralized Internet of Things (IoT) based monitoring system with the integration of ASHRAE TC 9.9 standards and the Rate of Change (RoC) Alarm algorithm to overcome manual supervision constraints and minimize the potential for hardware damage. The system is built using ESP32 and ESP8266 microcontrollers as sensor nodes, the MQTT protocol for data transmission, and an interactive Next.js-based web dashboard. Frontend implementation includes real-time data visualization via WebSocket and dynamic sensor location maps. Temperature accuracy testing results show a very low Mean Absolute Error (MAE) of 0.22. Quality of Service (QoS) testing using Wireshark proves the high reliability of the communication channel, yielding an average latency of 20.19 ms for the ESP32 and 50.85 ms for the ESP8266, packet loss ratio of 0%, and efficient bandwidth usage ranging from 200-450 bytes/sec. The system has been successfully deployed on-premise at HMMI's local server, providing a responsive monitoring solution for environmental anomalies and enhancing the IT team's operational efficiency through systematic historical data reporting features.

Keywords: *ASHRAE TC 9.9, IoT, Rate of Change, Server Room Monitoring, Web Application*