

RINGKASAN

PERANCANGAN DAN ANALISIS SISTEM KENDALI KANDANG AYAM CLOSED HOUSE BERBASIS HMI HAIWELL CLOUD SCADA DENGAN PENDEKATAN FSM DAN HYSTERESIS

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Kandang ayam broiler tipe *closed house* memerlukan sistem kendali mikroklimat yang stabil dan adaptif untuk menjaga kondisi lingkungan sesuai kebutuhan ternak. Namun, sistem kendali yang masih banyak digunakan di lapangan umumnya berbasis logika *timer* atau *boolean* sederhana sehingga kurang responsif terhadap perubahan kondisi lingkungan yang dinamis dan berpotensi menimbulkan fluktuasi suhu serta *rapid switching* pada aktuator. Penelitian ini bertujuan merancang dan menganalisis sistem kendali mikroklimat kandang ayam *closed house* berbasis algoritma *Finite State Machine* (FSM) yang dikombinasikan dengan logika *hysteresis*. Sistem dikembangkan menggunakan HMI Haiwell sebagai pusat komputasi yang tidak hanya berfungsi sebagai antarmuka visual, tetapi juga menjalankan algoritma kendali, pengelolaan mode operasi, pencatatan data (*data logging*), serta integrasi dengan platform SCADA berbasis *cloud*. Metode penelitian yang digunakan adalah metode rekayasa yang meliputi studi literatur, perancangan perangkat keras dan perangkat lunak, implementasi algoritma kendali, serta pengujian dan analisis sistem pada lingkungan operasional kandang.

Hasil penelitian menunjukkan bahwa sistem yang dirancang mampu beroperasi secara stabil dan terintegrasi antara sensor, HMI, PLC, aktuator, serta platform SCADA berbasis *cloud*. Analisis performa kendali suhu dilakukan dengan membandingkan nilai suhu aktual terhadap *setpoint*. Berdasarkan data operasional selama satu periode pemeliharaan, diperoleh nilai MAE sebesar 0,76 °C, persentase error rata-rata 2,75%, dan RMSE sebesar 1,05 °C, yang menunjukkan bahwa variasi suhu masih berada dalam batas toleransi mikroklimat ayam broiler. Selain itu, penerapan logika *hysteresis* terbukti mampu mencegah fenomena *rapid switching* pada aktuator dengan tingkat efektivitas mencapai 100%. Hasil ini menunjukkan bahwa pendekatan kendali FSM–Hysteresis mampu meningkatkan stabilitas pengendalian suhu sekaligus menyediakan sistem monitoring kandang yang terintegrasi berbasis IoT.

Kata kunci: kandang ayam closed house, Finite State Machine, Hysteresis, HMI Haiwell, SCADA, sistem kendali

SUMMARY

DESIGN AND ANALYSIS OF A POULTRY CLOSED HOUSE CONTROL SYSTEM BASED ON HAIWELL HMI CLOUD SCADA USING FINITE STATE MACHINE AND HYSTERESIS APPROACHES

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Closed-house broiler chicken farms require a stable and adaptive microclimate control system to maintain environmental conditions that meet the physiological needs of the livestock. However, many control systems currently implemented in the field still rely on simple timer-based or boolean logic, which are often unable to respond effectively to dynamic environmental changes and may lead to temperature fluctuations and rapid actuator switching. This study aims to design and analyze a microclimate control system for a closed-house broiler farm based on a Finite State Machine (FSM) algorithm combined with hysteresis logic. The system is implemented using a Haiwell HMI as the main computational unit, which functions not only as a visualization interface but also executes the control algorithm, manages operating modes, performs data logging, and integrates with a cloud-based SCADA platform. The research methodology follows an engineering approach, including literature review, hardware and software design, implementation of the control algorithm, and system testing and analysis under actual operational conditions.

The results show that the proposed system operates stably and integrates sensors, HMI, PLC, actuators, and a cloud-based SCADA platform. The control performance was evaluated by comparing the actual temperature with the predefined setpoint. Based on operational data collected during one broiler production cycle, the system achieved a Mean Absolute Error (MAE) of 0.76 °C, an average percentage error of 2.75%, and a Root Mean Square Error (RMSE) of 1.05 °C, indicating that temperature variations remain within the acceptable microclimate tolerance for broiler chickens. Furthermore, the implementation of the hysteresis mechanism successfully prevented the occurrence of rapid switching in the actuators, achieving 100% effectiveness in suppressing unwanted switching events. These results demonstrate that the FSM–Hysteresis control approach improves temperature control stability while providing a reliable IoT-based integrated monitoring system for closed house broiler farms.

Keywords: closed-house poultry, Finite State Machine, hysteresis, Haiwell HMI, SCADA, control system.