ABSTRAK

Prediksi Perpindahan Sumber *Daya Automatic Transfer Switch* PLTS-PLN Menggunakan Model Dua tahap GRU-MLP Berbasis IoT Pada Inkubator Telur Ayam

(2026 : xvii + 128 Halaman + 78 Gambar + 21 Tabel + Daftar Pustaka + Lampiran)

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Automatic Transfer Switch (ATS) *hybrid* PLTS–PLN pada inkubator telur berperan penting dalam menjaga kontinuitas suplai daya, namun sistem konvensional bersifat reaktif dan hanya bereaksi ketika kondisi kritis telah terjadi. Penelitian ini mengembangkan sistem prediktif berbasis model dua tahap *Gated Recurrent Unit* (GRU) dan *Multilayer Perceptron* (MLP) untuk memproyeksikan mode sumber daya aktif 30 menit ke depan. Sistem *monitoring* berbasis IoT diimplementasikan dengan platform *Blynk* sebagai *dashboard real-time* dan *Google Sheets* sebagai *data logging* historis yang mengakuisisi 6.048 baris dataset selama 21 hari, mencakup parameter tegangan panel surya, tegangan baterai, *State of Charge*, dan daya beban. Pada tahap pertama, GRU dilatih untuk memproyeksikan empat parameter sensor berdasarkan enam *timestep* riwayat pengamatan, kemudian hasil proyeksi menjadi input tahap kedua yaitu MLP untuk klasifikasi biner mode *Battery*/PLN. Hasil evaluasi pada *testing set* menunjukkan model GRU mencapai *overall* R^2 sebesar 0,9384 dengan seluruh parameter mencapai R^2 di atas 0,90, sedangkan model MLP mencapai *Accuracy* 0,9636, *F1 Macro* 0,9475, dan *AUC-ROC* 0,9946. Evaluasi *pipeline end-to-end* menunjukkan peningkatan *AUC-ROC* menjadi 0,9986 dan *Precision* PLN sebesar +3,09%, mengonfirmasi kualitas proyeksi GRU sebagai input MLP. Pengujian pada data lapangan 24 jam menghasilkan *Accuracy* 0,8881, *F1 Macro* 0,8779, dan *AUC-ROC* 0,9927 dengan *Precision* PLN mencapai 0,9765, yang menegaskan model sangat jarang memberikan sinyal PLN palsu sehingga mencegah *false switching relay*. Sistem terbukti layak diimplementasikan sebagai solusi ATS prediktif berbasis IoT untuk mendukung otomasi peralihan sumber daya pada inkubator telur.

Kata Kunci : *Automatic Transfer Switch*, PLTS–PLN, *Two-Stage Model* GRU-MLP, IoT, Inkubator Telur.

ABSTRACT

Prediction of Resource Transfer via the Automatic Transfer Switch between the Solar Power Plant and the National Grid Using a Two-Stage IoT-Based GRU-MLP Model in an Egg Incubator

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An Automatic Transfer Switch (ATS) hybrid PLTS–PLN system in egg incubators plays a crucial role in maintaining power supply continuity; however, conventional systems are reactive and respond only after critical conditions have occurred. This research develops a predictive system based on a two-stage Gated Recurrent Unit (GRU) and Multilayer Perceptron (MLP) model to project the active power source mode 30 minutes ahead. An IoT-based monitoring system was implemented using the Blynk platform as a real-time dashboard and Google Sheets as historical data logging, acquiring 6,048 rows of data over 21 days, covering solar panel voltage, battery voltage, State of Charge, and load power parameters. In the first stage, GRU was trained to project four sensor parameters based on six timesteps of historical observations, and the projection results served as input to the second stage, namely MLP, for binary classification of Battery/PLN mode. Evaluation results on the testing set demonstrated that the GRU model achieved an overall R^2 of 0.9384, with all parameters reaching R^2 above 0.90, while the MLP model achieved an Accuracy of 0.9636, F1 Macro of 0.9475, and AUC-ROC of 0.9946. End-to-end pipeline evaluation showed an increase in AUC-ROC to 0.9986 and PLN Precision of +3.09%, confirming the quality of GRU projections as input to MLP. Testing on 24-hour field data yielded an Accuracy of 0.8881, F1 Macro of 0.8779, and AUC-ROC of 0.9927, with PLN Precision reaching 0.9765, confirming that the model rarely produces false PLN signals and thus prevents false switching relays. The system is proven feasible to be implemented as an IoT-based predictive ATS solution to support power source transition automation in egg incubators.

Keyword : *Automatic Transfer Switch, PLTS–PLN, Two-Stage Model GRU-MLP, IoT, Egg Incubator.*