

INTISARI

RANCANG BANGUN SISTEM *ADAPTIVE TRAFFIC LIGHT* BERBASIS AWS *SERVERLESS* DAN INTEGRASI IOT

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Pengaturan lampu lalu lintas berbasis waktu tetap kurang responsif terhadap perubahan kepadatan, sedangkan sensor lapangan memerlukan biaya dan pemeliharaan tinggi. Penelitian ini membangun prototipe *adaptive traffic light* tanpa sensor fisik dengan memanfaatkan data Google Maps. Data jarak dan waktu tempuh dari Google Distance Matrix API dikumpulkan untuk 4 fase simpang, disimpan di Amazon S3, lalu dibersihkan otomatis melalui AWS Lambda terjadwal. *Dataset* hasil *cleaning* digunakan untuk melatih model prediksi kecepatan (*speed_kmh*) per fase menggunakan Regresi Linear sebagai model utama, serta *Random Forest* sebagai pembanding. Prediksi kecepatan dikonversi menjadi rekomendasi durasi *green time* berbasis aturan dengan batas *gmin*, *gmax*, dan *intergreen*, kemudian dipublikasikan melalui AWS IoT Core menggunakan MQTT dan diterapkan pada miniatur APILL berbasis ESP32. Hasil evaluasi Regresi Linear pada *test* set menunjukkan R^2 71,05%–88,39% dengan rata-rata 81,54%, MAE rata-rata 0,815 km/jam, dan RMSE rata-rata 1,276 km/jam. Evaluasi sistem mencatat *delay* komputasi *cloud* rata-rata 2,82 s, *delay* pemrosesan perangkat 1,606 ms, dan *latency end-to-end* 837,9 ms.

Kata kunci : *adaptive traffic light*, Google Distance Matrix API, AWS *serverless*, regresi linier, AWS IoT Core, MQTT, ESP32.

ABSTRACT

DESIGN AND IMPLEMENTATION OF AN ADAPTIVE TRAFFIC LIGHT SYSTEM USING AWS SERVERLESS AND IOT INTEGRATION

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Fixed-time traffic lights are less responsive to changing congestion, while roadside sensors require high cost and maintenance. This study develops an adaptive traffic light prototype without physical sensors using Google Maps data. Travel distance and duration from the Google Distance Matrix API are collected for a four-phase intersection, stored in Amazon S3, and automatically cleaned via scheduled AWS Lambda. The cleaned dataset is used to train per-phase speed prediction models (speed_kmh) using Linear Regression as the main model and Random Forest as a benchmark. Predicted speeds are converted into recommended green times using constraint-based rules involving gmin, gmax, and intergreen, then published through AWS IoT Core using MQTT and applied to an ESP32-based traffic-light miniature. On the test set, Linear Regression achieves R^2 ranging from 71,05% to 88,39% with an average of 81,54%, MAE of 0,815 km/h (average), and RMSE of 1,276 km/h (average). System measurements report an average cloud computation delay of 2,82 s, device processing delay of 1,606 ms, and end-to-end latency of 837,9 ms.

Keyword: adaptive traffic light, Google Distance Matrix API, AWS serverless, linear regression, AWS IoT Core, MQTT, ESP32.