SISTEM PREDIKSI JENIS JALAN DENGAN METODE *MACHINE LEARNING* BERDASARKAN DATA TEGANGAN DAN ARUS MOTOR DC KEMUDI

SKRIPSI

Diajukan untuk memenuhi sebagian syarat untuk memenuhi gelar Sarjana Teknik pada Program Studi Mekatronika dan Kecerdasan Buatan

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ABSTRAK

Deteksi kondisi permukaan jalan yang akurat sangat penting untuk menjaga keselamatan berkendara serta adaptabilitas kendaraan. Metode konvensional berbasis sensor visual maupun inersial sering kali mengalami kesulitan, khususnya ketika digunakan pada kondisi pencahayaan yang buruk atau lingkungan yang tidak stabil. Untuk mengatasi hal tersebut, penelitian ini mengusulkan pendekatan klasifikasi non-visual dengan memanfaatkan data tegangan dan arus dari motor DC kemudi sebagai data utama untuk prediksi jenis permukaan jalan. Data dikumpulkan secara *real time* menggunakan kendaraan *Micro Electric Vehicle* (MEVi), kemudian diproses melalui ekstraksi fitur statistik. Dua jenis *dataset* digunakan berdasarkan skema pelabelan berbeda: pertama untuk klasifikasi jenis permukaan jalan, dan kedua untuk gabungan arah pergerakan kemudi dan jenis jalan. Tiga algoritma *supervised learning*, yaitu *Support Vector Machine* (SVM), *K-Nearest Neighbors* (KNN), dan *Gradient Boosted Decision Tree* (GBDT), dilatih serta di validasi dengan data baru. Hasil pengujian menunjukkan bahwa KNN dan GBDT keduanya mencapai rata-rata F1-score sebesar 1.00 pada data baru, menunjukkan hasil prediksi yang baik. Sebaliknya, SVM menunjukkan *overfitting* dengan penurunan kinerja signifikan pada data yang belum pernah dilihat. Kondisi tersebut dapat dipengaruhi oleh sifat SVM yang sensitif terhadap pemilihan parameter, sehingga pada pengaturan yang tidak optimal sering menghasilkan batas klasifikasi yang terlalu kompleks.Temuan ini mengindikasikan bahwa data tegangan dan arus dari sistem kemudi dapat dijadikan indikator dalam klasifikasi permukaan jalan. Pendekatan ini tidak hanya lebih hemat biaya dan tahan terhadap kondisi cuaca dibandingkan metode visual, tetapi juga memiliki potensi untuk diintegrasikan pada sistem *Advanced Driver Assistance Systems* (ADAS) maupun sistem kendaraan otonom.

Kata Kunci: Prediksi Jenis Jalan, *Supervised Learning*, Motor DC Kemudi, *Support Vector Machine, K-Nearest Neighbors, Gradient Boosting Decision Tree*

ROAD TYPE PREDICTION SYSTEM USING MACHINE LEARNING METHOD BASED ON VOLTAGE AND CURRENT DATA OF STEERING DC MOTOR

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ABSTRACT

Accurate detection of road surface conditions is crucial for driving safety and vehicle adaptability. Conventional visual or inertial sensor-based methods often struggle under poor lighting or unstable environmental conditions. This study proposes a non-visual classification approach using voltage and current data from a DC steering motor to predict road surface types. Data were collected in real time from an autonomous micro electric vehicle (MEVi) and processed through statistical feature extraction. Two datasets were created based on different labeling schemes: one for road type and another combining steering direction and road type. Three supervised learning algorithms Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and Gradient Boosted Decision Tree (GBDT) were trained and evaluated using K-Fold cross-validation and new data validation. Results show that KNN and GBDT achieved consistently high performance, with both models reaching an average F1-score of 1.00 on new data, indicating excellent generalization. In contrast, SVM exhibited signs of overfitting, with significantly lower performance on unseen data. This may be due to SVM's sensitivity to parameter tuning and its tendency to create overly complex decision boundaries when using non-optimized settings. KNN and GBDT, on the other hand, are better suited for tabular statistical data and can model non-linear relationships effectively. The findings suggest that electrical signals from steering systems can serve as reliable indicators for road surface classification. This method offers a low-cost, weather-resilient alternative to visual approaches and holds practical potential for integration into Advanced Driver Assistance Systems (ADAS) or autonomous vehicle platforms.

Keywords*: Road type prediction, Supervised Learning, Steering DC Motor, Support Vector Machine, K-Nearest Neighbors, Gradient Boosting Decision Tree*

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