

ABSTRAK

Perkembangan teknologi *Internet of Things* (IoT) dan *Machine Learning* memberikan peluang untuk meningkatkan efisiensi sistem monitoring hidroponik melalui pemanfaatan data sensor secara otomatis. Pada sistem hidroponik, pemantauan kondisi larutan nutrisi umumnya hanya menampilkan nilai pH dan suhu sehingga pengguna masih harus melakukan interpretasi secara manual untuk menentukan kondisi larutan nutrisi. Penelitian ini bertujuan membangun model klasifikasi kondisi larutan nutrisi hidroponik menggunakan algoritma *Logistic Regression* dan *Support Vector Machine* serta membandingkan performa kedua algoritma tersebut. Dataset yang digunakan merupakan hasil pembacaan sensor pH dan suhu sebanyak 2.227 data. Karena dataset belum memiliki label kelas, dilakukan proses *rule-based labeling* berdasarkan standar budidaya selada, yaitu pH 5,5–6,5 dan suhu 24–30°C sehingga diperoleh 2.099 data Normal dan 128 data Tidak Normal. Untuk mengatasi ketidakseimbangan data diterapkan metode *Synthetic Minority Over-sampling Technique* (SMOTE), kemudian data dinormalisasi menggunakan *StandardScaler* sebelum proses pelatihan model. Evaluasi model dilakukan menggunakan metrik *Accuracy*, *Precision*, *Recall*, *F1-Score*, dan *Confusion Matrix*. Hasil penelitian menunjukkan bahwa algoritma *Logistic Regression* memperoleh nilai akurasi sebesar 97,98%, sedangkan algoritma *Support Vector Machine* memperoleh nilai akurasi sebesar 98,65%. Selain itu, *Support Vector Machine* menghasilkan nilai *precision* sebesar 81%, *recall* sebesar 100%, dan *F1-score* sebesar 90%, lebih baik dibandingkan *Logistic Regression* yang memperoleh *precision* sebesar 74%, *recall* sebesar 100%, dan *F1-score* sebesar 85%. Berdasarkan hasil tersebut dapat disimpulkan bahwa algoritma *Support Vector Machine* memiliki performa terbaik dalam mengklasifikasikan kondisi larutan nutrisi hidroponik berdasarkan parameter pH dan suhu sehingga berpotensi diterapkan sebagai pendukung sistem monitoring hidroponik berbasis IoT.

Kata kunci: *Machine Learning*, *Logistic Regression*, *Support Vector Machine*, Hidroponik, Klasifikasi, *Internet of Things* (IoT).

ABSTRACT

The development of Internet of Things (IoT) and Machine Learning technologies has created opportunities to improve the efficiency of hydroponic monitoring systems through the automatic utilization of sensor data. In hydroponic systems, nutrient solution monitoring generally only displays pH and temperature values, requiring users to manually interpret the data to determine the condition of the nutrient solution. This study aims to develop a classification model for hydroponic nutrient solution conditions using the Logistic Regression and Support Vector Machine algorithms and to compare the performance of both algorithms. The dataset used consisted of 2,227 pH and temperature sensor readings. Since the dataset did not contain class labels, a rule-based labeling process was applied based on the optimal growth standards for lettuce, namely a pH range of 5.5–6.5 and a nutrient solution temperature of 24–30°C, resulting in 2,099 Normal data instances and 128 Abnormal data instances. To address the class imbalance problem, the Synthetic Minority Over-sampling Technique (SMOTE) was applied, followed by data normalization using Standard Scaler before the model training process. Model performance was evaluated using Accuracy, Precision, Recall, F1-Score, and the Confusion Matrix. The experimental results showed that the Logistic Regression algorithm achieved an accuracy of 97.98%, while the Support Vector Machine algorithm achieved an accuracy of 98.65%. Furthermore, Support Vector Machine obtained a precision of 81%, a recall of 100%, and an F1-score of 90%, outperforming Logistic Regression, which achieved a precision of 74%, a recall of 100%, and an F1-score of 85%. Based on these results, it can be concluded that the Support Vector Machine algorithm provides superior performance in classifying hydroponic nutrient solution conditions based on pH and temperature parameters, making it a promising approach for supporting IoT-based hydroponic monitoring systems.

Keywords: Machine Learning, Logistic Regression, Support Vector Machine, Hydroponics, Classification, Internet of Things (IoT).