ABSTRACT

Public charging stations for electric vehicles often implement battery swap systems to minimize charging times. However, these systems primarily display the State of Charge (SoC) of batteries, without providing information on the State of Health (SoH). This limitation poses a significant risk, as users may inadvertently receive degraded battery packs with an SoH of 70%–80%, increasing susceptibility to overheating and potential safety hazards, such as fires. Mitigating these risks, this study evaluates the performance of three machine learning algorithms—Random Forest (RF), Neural Network (NN), Gradient Boosting (GB), K-Nearest Neighbor (KNN), and Decision Tree (DT)—for predicting the State of Health (SoH) of batteries. The prediction is based on key parameters such as battery cycles, voltage, current, and State of Charge (SoC), with Depth of Discharge (DoD) derived from charging and discharging cycles serving as a critical feature for accurate estimation. Experimental results indicate that the KNN algorithm achieves the lowest Mean Absolute Error (MAE) of 2.0748%, outperforming the other methods. The slope of the battery degradation is found to be 0.02484 and the R^2 score is 0.99895 which is the same as the value from the machine learning method. Consequently, the KNN method is recommended to be integrated to the public charging station. It is also successfully integrating the KNN method to the public charging system.

Keywords: Battery swap systems, Public charging stations, State of Charge, State of Health, Machine learning, Depth of Discharge.