IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, May 2025
Impact Factor: 7.67

AI-Enhanced Digital Twins For Battery Management With Explainable Predictions

Dr. D. Vijaya Lakshmi[1], Ganji Sai Deepak Reddy[2], Thara Kapuganti[3]
[1]Professor & HOD, Mahatma Gandhi Institute of Technology, Hyderabad, India
[2,3]UG Student, Mahatma Gandhi Institute of Technology, Hyderabad, India

Abstract: *With the automotive industry speedily moving towards electric vehicles (EVs), precise prediction of battery states is crucial for performance optimization, safety, and durability. This work presents a new method employing Explainable Data-Driven Digital Twins for the prediction of battery states in EVs. Sophisticated machine learning models, such as Deep Neural Networks (DNN), Long Short-Term Memory (LSTM) networks, Convolutional Neural Networks (CNN), Support Vector Regression (SVR), Support Vector Machines (SVM), Feedforward Neural Networks (FNN), Radial Basis Function networks (RBF), Random Forests (RF), and Extreme Gradient Boosting (XGBoost), are combined to create a holistic and trustworthy model. The main objective of this research is to improve the predictability of the most important battery parameters, e.g., state of charge (SOC) and state of health (SOH), for different operating conditions. Utilizing different algorithms, the digital twin model is highly accurate and resilient in its forecasts. Further, explainable AI (XAI) methods are used to translate and understand the hidden drivers that govern battery performance so that the outputs of the model are transparent and trustworthy. Preliminary results indicate that the proposed approach dramatically surpasses conventional techniques in prediction precision and consistency. This study helps to promote the development of intelligent and adaptive battery management systems, which are crucial to the sustainable electric mobility future.*

Keywords: Electric vehicles, battery prediction, Digital Twins, machine learning, DNN, LSTM, XGBoost, SOC, SOH, Explainable AI, adaptive battery management

DOI: 10.48175/568