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Design of an Automated Deep Learning Recurrent Neural Networks System Integrated with IoT for Anomaly Detection in Residential Electric Vehicle Charging in Smart Cities

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Abstract : The paper focuses on the development of a system that combines Internet of Things (IoT) technologies and deep learning algorithms for anomaly detection in residential Electric Vehicle (EV) charging in smart cities. With the increasing number of EVs, ensuring efficient and reliable charging systems has become crucial. The aim of this research is to develop an integrated IoT and deep learning system for detecting anomalies in residential EV charging and enhancing EV load profiling and event detection in smart cities. This approach utilizes IoT devices equipped with infrared cameras to collect thermal images and household EV charging profiles from the database of Thailand utility, subsequently transmitting this data to a cloud database for comprehensive analysis. The methodology includes the use of advanced deep learning techniques such as Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) algorithms. IoT devices equipped with infrared cameras are used to collect thermal images and EV charging profiles. The data is transmitted to a cloud database for comprehensive analysis. The researchers also utilize feature-based Gaussian mixture models for EV load profiling and event detection. Moreover, the research findings demonstrate the effectiveness of the developed system in detecting anomalies and critical profiles in EV charging behavior. The system provides timely alarms to users regarding potential issues and categorizes the severity of detected problems based on a health index for each charging device. The system also outperforms existing models in event detection accuracy. This research contributes to the field by showcasing the potential of integrating IoT and deep learning techniques in managing residential EV charging in smart cities. The system ensures operational safety and efficiency while also promoting sustainable energy management. The data is collected using IoT devices equipped with infrared cameras and is stored in a cloud database for analysis. The collected data is then analyzed using RNN, LSTM, and feature-based Gaussian mixture models. The approach includes both EV load profiling and event detection, utilizing a feature-based Gaussian mixture model. This comprehensive method aids in identifying unique power consumption patterns among EV owners and outperforms existing models in event detection accuracy. In summary, the research concludes that integrating IoT and deep learning techniques can effectively detect anomalies in residential EV charging and enhance EV load profiling and event detection accuracy. The developed system ensures operational safety and efficiency, contributing to sustainable energy management in smart cities.

Keywords : cloud computing framework, recurrent neural networks, long short-term memory, Iot, EV charging, smart grids
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