Chapter 16
Assessment of Electric Consumption Forecast Using Machine Learning and Deep Learning Models for the Industrial Sector

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ABSTRACT

Power demand forecasting is one of the fields which is gaining popularity for researchers. Although machine learning models are being used for prediction in various fields, they need to upgrade to increase accuracy and stability. With the rapid development of AI technology, deep learning (DL) is being recommended by many authors in their studies. The core objective of the chapter is to employ the smart meter's data for energy forecasting in the industrial sector. In this chapter, the author will be implementing popular power demand forecasting models from machine learning and compare the results of the best-fitted machine learning (ML) model with a deep learning model, long short-term memory based on RNN (LSTM-RNN). RNN model has vanishing gradient issue, which slows down the training in the early layers of the network. LSTM-RNN is the advanced model which take care of vanishing gradient problem. The performance evaluation metric to compare the superiority of the model will be R2, mean square error (MSE), root means square error (RMSE), and mean absolute error (MAE).

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INTRODUCTION

Machine Learning (ML) and its sub-fields like Deep Learning (DL) are contributing remarkably in the field of the energy sector. ML plays a significant role in predicting energy demand forecasting. The prediction of power load forecasting contributes to important factors, such as the energy capacity increase-decrease, distribution load for a specific time interval. An accurate demand forecasting of energy consumption helps energy providers to combat energy management and improves consumption efficiency during peak load hours efficiently. To forecast the energy demand, it is crucial to first estimate the current energy consumption. By the advent of Advanced Metering Infrastructure (AMI), it has become very easy to collect the usage data of each customer along with a detailed timestamp (Wang, Chen, Hong, & Kang, 2018). The data provided by AMI can be used for descriptive - current status; predictive-future aspects and prescriptive -solutions for energy management (Wang et al., 2018). Researchers are these days combining DL along with ML to forecast energy consumption with higher accuracy (Kong et al., 2017) (Yan, Li, Ji, Qi, & Du, 2019). These hybrid models are proving to be an efficient method to forecast the energy load.

Energy forecasting is basically divided into three ranges, namely; short term forecasting, medium-term forecasting, and long-term forecasting. There are various methods to forecast energy demand forecasting. The first method is physical methods. It predicts the result based on various weather conditions variables, like temp, humidity, wind speed, etc, along with electricity consumption. These values used as input to do the model and predict the output. These types of methods take a long time to collect the data and to process the result also. Secondly, statistical methods, predict the consumption based on the past consumption record of the energy along with the weather affecting variables. Some examples of the statistical method of predictions are Simple Moving Average (SMA), Auto-Regressive Integrated Moving Average (ARIMA). The third method is Machine Learning methods, which are becoming more popular these days. These methods give more accuracy on the prediction of the energy demand forecasting (Yang, Li, Gulliver, & Li, 2019). With the rapid development in the field of AI, hybrid algorithms are more in use.

There are many approaches to predict the consumption of energy by the customers. For accurate prediction, it is important to consider the consumption of the energy on an hourly, daily, weekly and monthly basis. A smart meter is one of the best ways to collect data concretely. It records the energy consumption after every 15 – 30 minutes timestamp (Wang et al., 2018). There are many classifiers and regressors used to predict consumption. In this paper, we will implement fundamental machine learning algorithms and a deep learning algorithm to compare the prediction accuracy. For energy prediction, the regression algorithm is being used as the data is of numerical type. One of the authors (Peng, Xu, Li, Xie, & Zhang, 2019) proposed a hybrid method with linear regression (LR) to improve the accuracy of the prediction in a real-time dataset with time-series. It gives a remarkably better accuracy as compared to the traditional method. Random Forest (RF) regression is another popular regressor used in electronic load forecasting. It evaluates the data with its iterative process of making various decision tress before giving a result. It traverses various time through training and testing data, before predicting the final results, hence gives better accuracy (Mukherjee, Mukherjee, Dey, De, & Panigrahi, 2020). Decision Tree Regression (DTR) is another traditional regressor which helps to decrease the problem of overfitting of the data (Bouktif, Fiaz, Ouni, & Serhani, 2018). After going through the literature for energy consumption forecasting, we decided to implement the traditional regressor such as Decision Tree Regression (DTR), Linear Regression (LR), and Random Forest Regressor (RF) and a deep learning model long