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Development and Adaptation of a LGBM Machine Learning Model, with a Suitable Concept Drift Detection and Adaptation Technique, for Barcelona Household Electric Load Forecasting During Covid-19 Pandemic Periods (Pre-Pandemic and Strict Lockdown)

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Abstract : While aggregated loads at a community level tend to be easier to predict, individual household load forecasting present more challenges with higher volatility and uncertainty. Furthermore, the drastic changes that our behavior patterns have suffered due to the COVID-19 pandemic have modified our daily electrical consumption curves and, therefore, further complicated the forecasting methods used to predict short-term electric load. Load forecasting is vital for the smooth and optimized planning and operation of our electric grids, but it also plays a crucial role for individual domestic consumers that rely on a HEMS (Home Energy Management Systems) to optimize their energy usage through self-generation, storage, or smart appliances management. An accurate forecasting leads to higher energy savings and overall energy efficiency of the household when paired with a proper HEMS. In order to study how COVID-19 has affected the accuracy of forecasting methods, an evaluation of the performance of a state-of-the-art LGBM (Light Gradient Boosting Model) will be conducted during the transition between pre-pandemic and lockdowns periods, considering day-ahead electric load forecasting. LGBM improves the capabilities of standard Decision Tree models in both speed and reduction of memory consumption, but it still offers a high accuracy. Even though LGBM has complex non-linear modelling capabilities, it has proven to be a competitive method under challenging forecasting scenarios such as short series, heterogeneous series, or data patterns with minimal prior knowledge. An adaptation of the LGBM model – called “resilient LGBM” – will be also tested, incorporating a concept drift detection technique for time series analysis, with the purpose to evaluate its capabilities to improve the model’s accuracy during extreme events such as COVID-19 lockdowns. The results for the LGBM and resilient LGBM will be compared using standard RMSE (Root Mean Squared Error) as the main performance metric. The models’ performance will be evaluated over a set of real households’ hourly electricity consumption data measured before and during the COVID-19 pandemic. All households are located in the city of Barcelona, Spain, and present different consumption profiles. This study is carried out under the ComMit-20 project, financed by AGAUR (Agència de Gestiód’AjutsUniversitaris), which aims to determine the short and long-term impacts of the COVID-19 pandemic on building energy consumption, incrementing the resilience of electrical systems through the use of tools such as HEMS and artificial intelligence.

Keywords : concept drift, forecasting, home energy management system (HEMS), light gradient boosting model (LGBM)
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