ML Papers

Technical Words

Time Series Analysis : Time series analysis is a statistical technique used to analyze data points collected or recorded at specific time intervals. It aims to identify patterns, trends, cycles, and other characteristics in the data over time, helping to make forecasts or understand the underlying structure of the time-dependent data.

Anomaly activity detection : Anomaly activity detection refers to the process of identifying unusual or unexpected behaviors or patterns in a system that deviate from the norm.

Time Series Analysis for Energy Consumption Forecasting in Smart Homes

Link: https://www.sciencedirect.com/science/article/abs/pii/S073658532200140X

Key Points from the abstract

> - In our research we compare SVR, LSTM, GRU, CNN-LSTM, CNN-GRU models for predictive energy consumption data of smart residential homes
> - Empirical results indicate that with increase in the amount of data the performance of machine learning SVR degraded significantly more as compared to Deep Learning Techniques, which provides conclusive evidence that machine learning techniques are not suitable for the task.
> - The Energy Consumption is also negatively related to Carbon Footprint and has a positive correlation with Ecological Footprint
> - Helmers and Marx (2012) suggested that electric cars hold a sustainable future in mobility, they showed that during the e-conversion of an electric car the CO2 emission can be reduced by more than 80 %
> - In this sense, we resampled the original data from minutes to days, and for the second dataset we resampled the original data from minutes to hours and predicted the consumption for next hour using the historical energy consumption data from the previous one hour and current hour environmental features.
> - Unlike past researchers we focus upon using environmental features for our predictions, the major advantage being they are easy to collect for a region rather than collecting data for every single home which could make data collection part of the problem solving pipeline expensive.
> - We observed that a machine learning model's performance is heavily dependent on the granularity of training data whereas for deep learning and hybrid models the dependence on granularity of data is comparatively smaller.

Conclusions

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The study used a variety of models to find reliable models for predicting
electric energy consumption at two different granularities of data.For days
granularity, the proposed CNN-GRU architecture performed best, while for hours
granularity, LSTM performed best. In terms of MAE, LSTM outperformed the proposed
CNN-GRU architecture by 0.4 %, while when granularity was measured in days, CNN-
GRU outperformed LSTM by 17.4 %. When compared to other models, the SVR model
performed worse
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Anomaly Detection in Smart Homes: A Survey

Link: https://link.springer.com/chapter/10.1007/978-3-319-21671-3_9

Key Points from the abstract

> This chapter reviews smart home's dense sensing approaches, an extensive review from sensors, data, analysis, algorithms, prompting reminder system, to the recent development of anomaly activity detection.

Energy consumption prediction by using machine learning for smart building: Case study in Malaysia

Link: https://www.sciencedirect.com/science/article/pii/S266616592030034X

Key Points from the abstract

> - Thus, this research aims to address the problems by developing a predictive model for energy consumption in Microsoft Azure cloud-based machine learning platform.
> - Three methodologies which are Support Vector Machine, Artificial Neural Network, and k-Nearest Neighbour are proposed for the algorithm of the predictive model.
> - The data collected is analysed and pre-processed before it is used for model training and testing.
> - The performance of each of the methods is compared based on RMSE, NRMSE, and MAPE metrics.
> - The experimentation shows that each tenant's energy consumption has different distribution characteristics.
> - In our previous study, only k-NN was proposed as the method to predict energy consumption. It is difficult to know whether the method proposed was the best since there is no comparison had been made. Hence, another two methods from machine learning are added in this study.

- Moreover, the traditional development of a predictive model is usually based on the trend of maximum demand (kW) consumption only, which is known as a time series method.

Real-time detection of anomalous power consumption

Link: https://www.sciencedirect.com/science/article/abs/pii/S1364032114001142

Key Points from the abstract

- This method identifies anomalies in two stages: consumption prediction and anomaly detection
- Daily real-time consumption is predicted by using a hybrid neural net ARIMA (auto-regressive integrated moving average) model of daily consumption. Anomalies are then identified by differences between real and predicted consumption by applying the two-sigma rule.

OPTIMIZING ENERGY CONSUMPTION IN SMART HOMES USING MACHINE LEARNING TECHNIQUES

Link:https://www.e3s-conferences.org/articles/e3sconf/pdf/2023/24/e3sconf_icseret2023_02002.pdf

Key Points from the abstract

This review paper explores the merits and demerits of using machine learning techniques for energy optimization in smart homes
This paper presents machine learning techniques that have been used to optimize energy utilization in smart homes. In this paper proposed the using Stochastic Gradient Descent (SGD) algorithm for optimizing energy utilization in smart homes.