International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET

Electricity Consumption Prediction Using Machine Learning

D. Karthik*[1], K. Suprathik[2], K. Dhanush Vardhan[3], N. Vara Prasad[4], Mr. G. Sreenivasulu[5]
[1]B.Tech. Student, [2]B.Tech. Student, [3]B.Tech. Student, [4]B.Tech. Student, [5]Associate Professor, HOD CSE
CSE Department, JB Institute of Engineering and Technology, Hyderabad, India

ARTICLEINFO

Article History:

Accepted: 05 April 2023
Published: 20 April 2023

Publication Issue
Volume 10, Issue 2
March-April-2023

Page Number
560-563

ABSTRACT

Electricity consumption has increased exponentially during the past few decades. This increase is heavily burdening the electricity distributors. Therefore, predicting the future demand for electricity consumption will provide an upper hand to the electricity distributor. Predicting electricity consumption requires many parameters. The paper presents two approaches with one using a Recurrent Neural Network (RNN) and another one using a Long Short Term Memory (LSTM) network, which only considers the previous electricity consumption to predict the future electricity consumption. These models were tested on the publicly available London smart meter dataset. To assess the applicability of the RNN and the LSTM network to predict the electricity consumption, they were tested to predict for an individual house and a block of houses for a given time period. The predictions were done for daily, trimester and 13 months, which covers short term, mid-term and long term prediction. Both the RNN and the LSTM network have achieved an average Root Mean Square error of 0.1

Keywords : LSTM, RNN, AMI, ARIMA

I. INTRODUCTION

The rapid increase in electricity consumption requires an accurate forecasting of electricity consumption distribution. In order to accurately forecast the electricity usage, the electricity consumption needed to be tracked. Therefore, Advanced Metering Infrastructure (AMI), was introduced. AMI leads to a large amount of electricity consumption data. AMI data is used for electricity consumption forecasting. Forecasting helps make decisions on power distribution from the national grid. An accurate forecast on the electricity consumption can prevent unplanned electricity distribution disruptions. AMI provides the background to utilize data for descriptive, predictive and prescriptive analytics. The demand for energy is based on various factors such as weather, occupancy, types of machines and appliances used. The dependency on high number of factors have made forecasting techniques much complex. Accurate predictions of the electricity consumption is important for efficient distribution. However, applying all the variables that effect electricity consumption can create a complex forecasting model which is unstable and unpredictable. Therefore, data-driven solutions to predict electricity consumption focuses on time-series solution.

II. LITERATURE SURVEY

The energy consumption data that is available may also contain blocks of missing data, making time-series predictions difficult. Thus, the main objectives of this paper are: (a) Develop and optimize novel deep recurrent neural network (RNN) models aimed at medium to long term electric load prediction at one-hour resolution; (b) Analyze the relative performance of the model for different types of electricity consumption patterns; and (c) Use the deep NN to perform imputation on an electricity consumption dataset containing segments of missing values. The proposed models were used to predict hourly electricity consumption for the Public Safety Building in Salt Lake City, Utah, and for aggregated hourly electricity consumption in residential buildings in Austin, Texas. For predicting the commercial building's load profiles, the proposed RNN sequence-to-sequence models generally correspond to lower relative error when compared with the conventional multi-layered perceptron neural network. For predicting aggregate electricity consumption in residential buildings, the proposed model generally does not provide gains in accuracy compared to the multi-layered perceptron model.

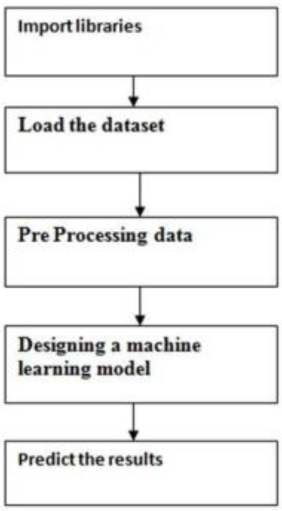
EXISTING SYSTEM

ARIMA is one of the most common technique used for time series forecasting. ARIMA models applied to forecast household consumption and predict demand for office buildings . Furthermore, ARIMA was used for short-term forecasting for half-hourly consumption in Malaysia. The results of models have shown high performances for short term predictions. ARIMA models have been identified as a high performing solution for short term predictions. SVM has also been used for forecasting electricity consumption . However, the non-linear models have shown to achieve better results for short term prediction. A comparison with ANN, Multiple Regression (MR), Genetic Programming (GP), DNN and SVM, the results showed higher performance for ANN. The experiment results showed that despite that the amount of data was limited, the DNN has produced comparable results with other techniques tested in the research.

PROPOSED SYSTEM

Deep learning is capable of learning from hidden patterns with no feature selection and outperform most of the machine learning and statistical methods to achieve various tasks . Time series data holds a sequential pattern, in which the data holds co-relationships between parallel data instances (xt depends on $xt-1$ and xt effects $xt+1$). Sequential data is handled by Recurrent Neural Networks (RNN), Long Short-Term Memory Networks (LSTM) and memory networks due to the capability of memory to hold past information.

Block diagram



III. IMPLEMENTATION

Step 1 : Data collection and preprocessing: Collecting relevant data on electricity consumption and associated factors, cleaning and preprocessing the data to prepare it for analysis.

Step 2: Feature selection: Identifying and selecting the most relevant features or variables that influence electricity consumption.

Step 3 : Model selection: Choosing the appropriate machine learning algorithm based on the type of problem, data characteristics, and performance metrics.

Step 4 : Training and validation: Splitting the data into training and validation sets, training the machine learning model on the training set, and validating the model on the validation set.

Step 5 : Hyperparameter tuning: Optimizing the model by adjusting hyperparameters using cross-validation techniques.

Step 6 : Evaluation and deployment: Evaluating the performance of the final model using appropriate metrics, deploying the model in a production environment, and monitoring its performance over time.

SOFTWARE TOOLS

Operating system: windows 10
Coding language: Python3
Jupyter notebook
Modules: Tensorflow, Keras, sci-kit learn
The software for the development has been selected based on several factors such as Support

- ➢ Cost Effectiveness
- ➢ Development Speed
- ➢ Stability
- ➢ Accuracy

FUNCTIONAL REQUIREMENTS

Data collection and storage: The system should be able to collect and store relevant data on electricity consumption and associated factors.

Data preprocessing: The system should be able to preprocess the data, including cleaning, normalization, and feature extraction.
Training and validation: The system should be able to train machine learning models using historical data and validate the models using appropriate techniques.

NON-FUNCTIONAL REQUIREMENTS

Performance: The system should be able to process large amounts of data efficiently and provide accurate predictions and forecasts within a reasonable time frame.
Scalability: The system should be able to handle an increasing amount of data and users without compromising its performance.
Reliability: The system should be reliable and available, with minimal downtime and errors.
Maintainability: The system should be maintainable, with easy-to-understand code and documentation, and support for version control.
Usability: The system should be user-friendly and easy to use, with clear and intuitive interfaces.
Testability: The application is tested for validation, and works fine.

ADVANTAGES

Better energy management: Accurate predictions of electricity consumption can help energy providers and consumers better manage their energy use, leading to reduced costs and improved sustainability.

Real-time monitoring and control: Machine learning algorithms can enable real-time monitoring and control of energy consumption, allowing for more efficient use of resources and quicker response to changes in demand

Increased efficiency: Accurate predictions of electricity consumption can help energy providers optimize their operations and reduce waste, resulting in increased efficiency and cost savings.

Better planning and decision-making: Machine learning algorithms can provide insights and recommendations for energy providers and consumers, enabling better planning and decision-making.

DISADVANTAGES

Data quality : The accuracy of machine learning models depends heavily on the quality of the input data. If the data is incomplete, inconsistent, or biased, it may result in inaccurate predictions.

High initial costs

APPLICATIONS

- Energy management: Energy providers can optimize opearions and reduce costs
- consumers are incentivized to reduce their energy consumption during peak periods.
- Accurate predictions of electricity consumption can be used to forecast energy demand and prices, enabling energy providers and consumers to make informed decisions.

IV. CONCLUSION

This project compares ARIMA, ANN, DNN, RNN, and LSTM models for predicting electricity consumption for individual and block of houses in short, mid, and long terms. ARIMA performs well for short term predictions, but is outperformed by RNN and LSTM for mid and long term forecasts. RNN and LSTM show high accuracy in predicting electricity consumption for all three terms.

Future Aspects:

Future aspects of electricity consumption prediction using machine learning include integration with IOT devices, Energy storage optimization, Energy trading, energy-efficient city planning.

V. REFERENCES

[1]. Rahman, A., Srikumar, V., Smith, A.D.: Predicting electricity consumption for commercial and residential buildings using deep recurrent neural networks. Applied energy. 212, 372-385 (2018)

[2]. Wang, Y., Chen, Q., Hong, T., Kang, C.: Review of smart meter data analytics: Applications, methodologies, and challenges. IEEE Transactions on Smart Grid. (2018).

[3]. Deb, C., Zhang, F., Yang, J., Lee, S.E., Shah, K.W.: A review on time series forecasting techniques for building energy consumption. Renewable and Sustainable Energy Reviews. 74, 902-924 (2017).

[4]. Amber, K., Ahmad, R., Aslam, M., Kousar, A., Usman, M., Khan, M.: Intelligent techniques for forecasting electricity consumption of buildings. Energy. 157, 886-893 (2018).

[5]. Cai, H., Shen, S., Lin, Q., Li, X., Xiao, H.: Predicting the energy consumption of residential buildings for regional electricity supply-side and demand-side management. IEEE Access.(2019).

Cite this article as :

Sh D. Karthik, K. Suprathik, K. Dhanush Vardhan, N. Vara Prasad, Mr. G. Sreenivasulu, "Electricity Consumption Prediction Using Machine Learning", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 10 Issue 2, pp. 560-563, March-April 2023.
Journal URL : https://ijsrset.com/IJSRSET2310296