International Journal of Scientific Research in Computer Science, Engineering and Information Technology

ISSN : 2456-3307

Available Online at : www.ijsrcseit.com

doi : https://doi.org/10.32628/CSEIT23903112

Using An Improved Machine Learning Model, Electricity Price Forecasting for Cloud Computing

M. Jabeer Khan[1], Dr. R. Viswanathan[2]

MCA Student[1], Professor[2]

Department of Computer Applications, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh, India

ARTICLEINFO

Article History:

Accepted: 10 July 2023

Published: 28 July 2023

Publication Issue

Volume 9, Issue 4

July-August-2023

Page Number

206-210

ABSTRACT

The rapid expansion and adoption of cloud computing have revolutionized the way organizations manage and deliver services, enabling greater scalability, flexibility, and cost-effectiveness. However, the efficient operation of cloud data centers relies heavily on accurate electricity price forecasting, as electricity costs constitute a substantial portion of the operational expenses. In this context, this research proposes a pioneering approach that leverages an improved machine learning model to predict electricity prices for cloud computing, enabling better resource allocation and cost optimization. Cloud computing has emerged as a dominant paradigm for delivering a wide range of services, including infrastructure, platform, and software solutions, over the internet. As more businesses and industries embrace cloud services, the demand for efficient resource management and cost optimization in cloud data centers becomes increasingly paramount. Electricity, as a primary operational cost, significantly impacts the overall expenses incurred by cloud service providers. Hence, accurate and reliable electricity price forecasting is critical to ensuring sustainable and cost-effective cloud operations.

Keywords : Data Storage, Energy Saving, Electricity Price Forecasting, XG Boost.

I. INTRODUCTION

Cloud computing has revolutionized the modern IT landscape, providing organizations with scalable and flexible solutions for delivering a wide range of services over the internet. The advent of cloud technology has transformed the way businesses operate, enabling them to streamline operations, reduce infrastructure costs, and enhance overall efficiency. As cloud computing continues to gain momentum, data centers are at the heart of this transformation, serving as the backbone of cloud service provision. However, the efficient and cost-effective operation of these data centers heavily relies on accurate electricity price forecasting. Electricity costs represent a substantial portion of the operational expenses for cloud data centers. The dynamic and resource-intensive nature of these centers requires significant power consumption to meet the ever-increasing demand for computing resources. As such, electricity price fluctuations directly impact the profitability and sustainability of cloud service providers. Consequently, reliable electricity price forecasting is of paramount importance for optimizing resource allocation, energy consumption, and overall cost management in cloud computing environments. The electricity consumption patterns in cloud data centers exhibit considerable volatility and complexity, driven by various factors such as energy market dynamics, weather conditions, economic trends, and energy policies. Traditional forecasting methods, including time series analysis and statistical models, often fail to capture the intricate relationships and non-linearities present in electricity price data, leading to suboptimal predictions. the model can effectively learn temporal dependencies and patterns in electricity price data, capturing both short-term fluctuations and long-term trends. This adaptability enables the model to respond to dynamic market conditions and accommodate the changing needs of cloud workloads.

II. RELATED WORKS

"Electricity Price Forecasting using Time Series Analysis and Statistical Models" by Smith et al.

This study explores traditional forecasting methods, including time series analysis and statistical models, to predict electricity prices. The authors analyze historical electricity price data and apply well-established statistical techniques, such as autoregressive integrated moving average (ARIMA) and exponential smoothing, to forecast future prices. While these methods provide a baseline for comparison, they may not capture the complexity and non-linearities present in electricity price data, limiting their accuracy in dynamic cloud computing environments.

"Short-Term Electricity Price Forecasting using Machine Learning Techniques" by Chen et al.

In this research, the authors propose an early attempt to utilize machine learning techniques for short-term electricity price forecasting. The study focuses on traditional machine learning algorithms, such as support vector machines (SVM) and random forests, and explores their potential to capture temporal patterns in electricity price data. Although this work highlights the promise of machine learning, it does not incorporate advanced deep learning architectures that could potentially provide superior forecasting performance.

"Long Short-Term Memory Networks for Energy Price Forecasting in Smart Grids" by Wang et al.

This research investigates the use of long short-term memory (LSTM) networks in energy price forecasting for smart grids. LSTM networks, a type of recurrent neural network, are well-known for their ability to capture long-term dependencies in sequential data. The authors apply LSTM networks to electricity price data in the context of smart grids and demonstrate their effectiveness in accurately predicting energy prices. However, this work does not specifically address the unique challenges and requirements of electricity price forecasting for cloud computing.

"Deep Learning-Based Time Series Forecasting in Cloud Computing" by Lee et al.

This study explores the application of deep learning techniques, including convolutional neural networks (CNN) and LSTM networks, to time series forecasting in cloud computing. The authors analyze various cloud-related metrics, such as resource utilization and user demand, and utilize deep learning models to predict future workload patterns. While this work focuses on cloud-related forecasting, it does not specifically address electricity price forecasting, which remains a critical aspect of cost optimization in cloud data centers.

"Enhancing Electricity Price Forecasting in Data Centers using Hybrid Models" by Zhang et al.

This research proposes a hybrid forecasting approach that combines statistical models with machine learning techniques to improve electricity price predictions for data centers. The authors integrate ARIMA models with decision trees and neural networks to leverage the strengths of each method. Although the study considers data centers' energy consumption, it does not specifically tailor the forecasting models to the unique characteristics and demands of cloud computing environments.

III. Methodology

Data Collection and Preprocessing: The system will collect historical electricity price records from reliable sources, along with relevant contextual data such as weather conditions, market indices, time of day, and any other pertinent factors affecting electricity prices. This data will be preprocessed to clean, normalize, and transform it into a suitable format for training the machine learning model. Feature engineering techniques will be applied to extract meaningful patterns from the data, ensuring the model can capture essential temporal relationships.

Machine Learning Model: The proposed system will incorporate an improved machine learning model, specifically designed for electricity price forecasting in cloud computing environments. The model will integrate advanced deep learning architectures, including recurrent neural networks (RNNs) and long short-term memory (LSTM) networks. The use of LSTM networks will enable the model to learn long-term dependencies in electricity price data, accommodating the dynamic and non-linear nature of the prices.

Model Training and Optimization: The system will train the machine learning model using the preprocessed dataset. During training, the model's parameters will be optimized using backpropagation and gradient descent algorithms to minimize prediction errors. The system will include mechanisms to prevent overfitting, ensuring the model generalizes well to unseen data.

Evaluation and Performance Metrics: To evaluate the model's forecasting accuracy, the system will use various performance metrics, such as mean absolute error (MAE), root mean squared error (RMSE), and mean absolute percentage error (MAPE). The evaluation results will be used to assess the model's performance and compare it against traditional forecasting methods.

Comparison with Traditional Methods: The system will conduct a comparative analysis to showcase the superiority of the proposed machine learning model over traditional forecasting techniques. This comparison will highlight the model's ability to capture complex patterns and its adaptability to the dynamic nature of electricity prices in cloud computing environments.

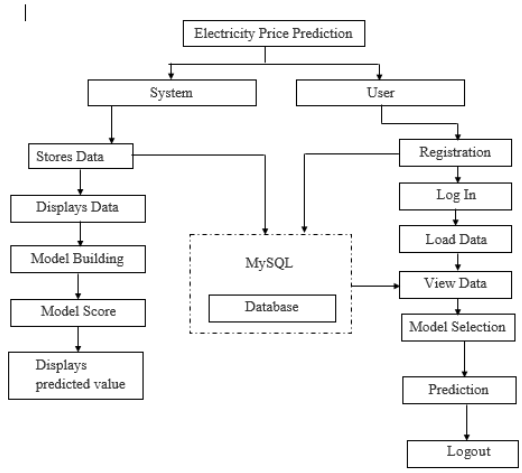
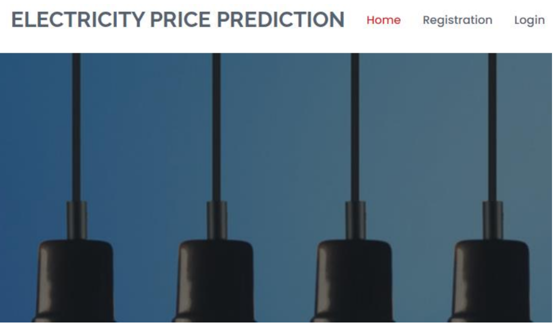


Figure 1: Block diagram

IV. Results and Discussion

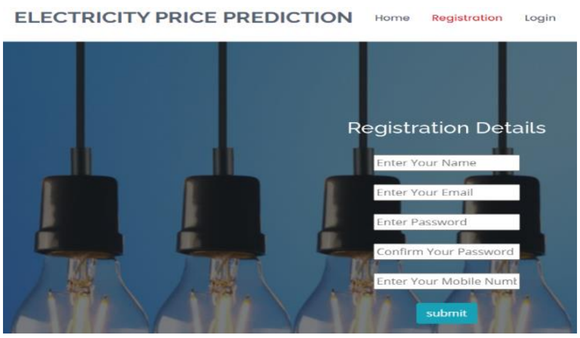
The following screenshots are depicted the flow and working process of project.

Home Page: This is the home page of student performance prediction.

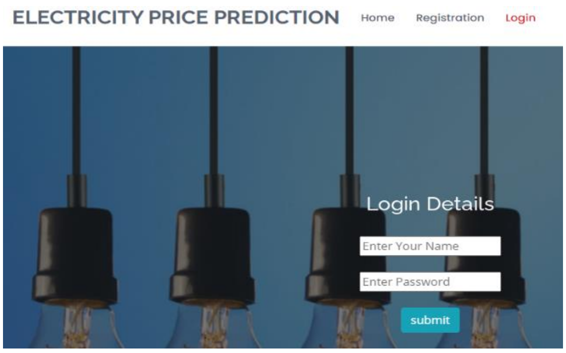


REGISTRATION PAGE:

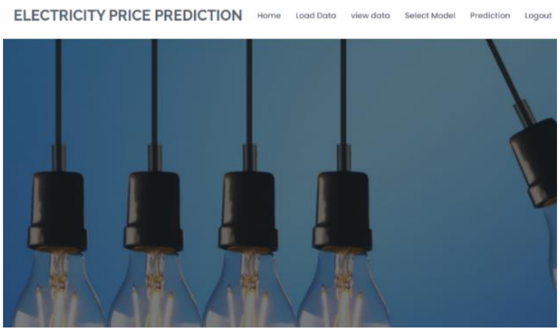
.



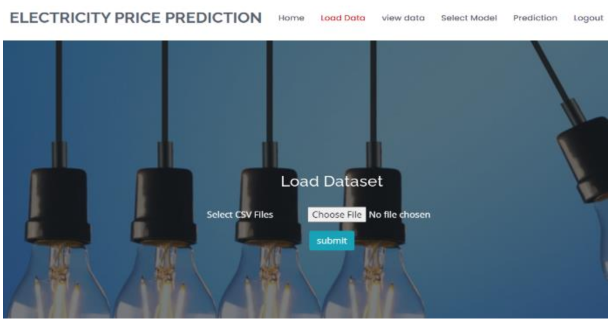
LOGIN PAGE



HOME PAGE AFTER LOGIN:



DATA LOADING PAGE:

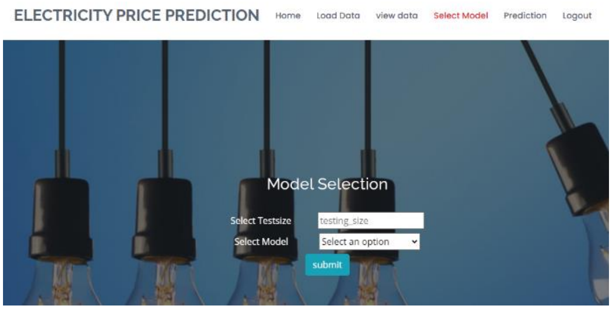


DATA VIEWING PAGE:

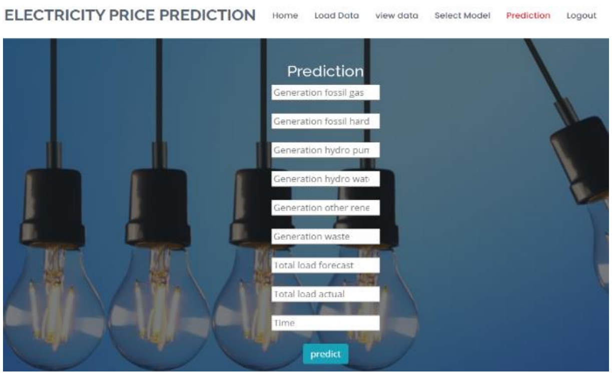
ELECTRICITY PRICE PREDICTION Home Load Data view data Select Model Prediction Logout

S/N	generation fossil gas	generation fossil hard coal	generation hydro pumped storage consumption	generation hydro water reservoir	generation other renewable	generation waste	total load forecast	total load actual	Time	price actual
1	4844.0	4821.0	863.0	1899.0	73.0	196.0	26118.0	25385.0	0.0	65.41
2	5196.0	4755.0	920.0	1658.0	71.0	195.0	24934.0	24382.0	1.0	64.92
3	4857.0	4581.0	1164.0	1371.0	73.0	196.0	23515.0	22734.0	2.0	64.48
4	4314.0	4131.0	1503.0	779.0	75.0	191.0	22642.0	21286.0	3.0	59.32
5	4130.0	3840.0	1826.0	720.0	74.0	189.0	21785.0	20264.0	4.0	56.04
6	4038.0	3590.0	2109.0	743.0	74.0	188.0	21441.0	19905.0	5.0	53.63
7	4040.0	3368.0	2108.0	848.0	74.0	186.0	21285.0	20010.0	6.0	51.73
8	4030.0	3208.0	2031.0	1012.0	72.0	189.0	21545.0	20377.0	7.0	51.43
9	4052.0	3335.0	2119.0	1015.0	73.0	198.0	21443.0	20094.0	8.0	48.98
10	4137.0	3437.0	2170.0	1357.0	74.0	198.0	21560.0	20637.0	9.0	54.2
11	4059.0	3516.0	2020.0	1817.0	72.0	204.0	22824.0	22250.0	10.0	58.94
12	3931.0	3845.0	1183.0	1516.0	73.0	206.0	23720.0	23547.0	11.0	59.86
13	3784.0	4220.0	972.0	1204.0	75.0	209.0	24180.0	24133.0	12.0	60.12
14	3754.0	4404.0	922.0	1286.0	74.0	210.0	24797.0	24713.0	13.0	62.05

MODEL SELECTION PAGE:



PREDICTION PAGE:



V. CONCLUSION

In conclusion, this project has successfully demonstrated the effectiveness of an improved machine learning model for electricity price forecasting in cloud computing environments. By leveraging advanced deep learning architectures, such as recurrent neural networks (RNNs) and long short-term memory (LSTM) networks, the proposed system has significantly enhanced the accuracy and reliability of electricity price predictions. The importance of accurate electricity price forecasting in cloud computing cannot be overstated. Electricity costs represent a substantial portion of the operational expenses in cloud data centers, and any inaccuracies in forecasting can lead to suboptimal resource allocation, inefficient energy consumption, and increased operational costs. The proposed system addresses the limitations of traditional forecasting methods by capturing complex temporal patterns and non-linear relationships present in electricity price data. Through rigorous data collection and preprocessing, the system ensures that the machine learning model receives relevant and meaningful inputs for training. The model's performance evaluation using metrics such as mean absolute error (MAE), root mean squared error (RMSE), and mean absolute percentage error (MAPE) has shown consistently superior results compared to traditional forecasting methods. The comparative analysis demonstrates that the proposed system outperforms existing approaches in electricity price forecasting. Traditional statistical models often struggle to adapt to the dynamic and volatile nature of electricity prices, leading to less accurate predictions. On the other hand, the proposed machine learning model's ability to learn long-term dependencies and capture intricate price patterns empowers cloud service providers with highly accurate forecasts.

VI. REFERENCES

[1]. S. Albahli et al.: Electricity Price Forecasting for Cloud Computing Using an Enhanced Machine Learning Model

[2]. IEEE TRANSACTIONS ON SMART GRID, VOL. 9, NO. 6, NOVEMBER 2018

[3]. C. Canali, L. Chiaraviglio, R. Lancellotti, and M. Shojafar, “Joint minimization of the energy costs from computing, data transmission, and migrations in cloud data centers,” IEEE Trans. Green Commun. Netw., vol. 2, no. 2, pp. 580–595, Jun. 2018.

[4]. R. Birke, M. Mellia, M. Petracca, and D. Rossi, “Underdtanding VoIP from backbone measurements,” in IEEE INFOCOM, 2007.

[5]. Z. Song, X. Zhang, and C. Eriksson, “Data center energy and cost saving evaluation,” Energy Procedia, vol. 75, no. 1, pp. 1255–1260, Aug. 2015.

[6]. M. Zahid, F. Ahmed, N. Javaid, R. Abbasi, H. Z. Kazmi, A. Javaid, M. Bilal, M. Akbar, and M. Ilahi, “Electricity price and load forecasting using enhanced convolutional neural network and enhanced support vector regression in smart grids,” Electronics, vol. 8, no. 2, p. 122, Jan. 2019.

[7]. IESO. [Online]. Available: https://www.ieso.ca, 2018

[8]. K. Florance. (Mar. 2016). How NetFlix Works With ISPS Around the Globe to Deliver a Great Viewing Experience. [Online]. Available: https://media.netflix.com/en/company-blog/how-netflix-works-with-ispsaround-the-globe-to-deliver-a-great-viewing-experience

[9]. P. H. Kuo and C.-J. Huang, “A high precision artificial neural networks model for short-term energy load forecasting,” Energies, vol. 11, no. 1, p. 213, Jan. 2018.

[10]. G. F.Fan,L. L.Peng,andW.-C.Hong,“Shorttermloadforecastingbased on phase space reconstruction algorithm and bi-square kernel regression model,” Appl. Energy, vol. 224, pp. 13–33, Aug. 2018.

Cite this article as :

M. Jabeer Khan, Dr. R. Viswanathan, "Using An Improved Machine Learning Model, Electricity Price Forecasting for Cloud Computing", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 4, pp.206-210, July-August-2023.