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Investigating Time-Series Energy Forecasting in Smart Buildings: A Comprehensive Comparison between ANN and RNN-based Models for Improved Accuracy and Efficiency

INTRODUCTION

- The importance of energy forecasting in smart buildings has grown significantly due to the increasing need for energy efficiency and sustainability. Applications range from optimizing energy usage to reducing carbon footprint.
- While many studies have explored energy forecasting using traditional statistical methods, there is a lack of research comparing the performance of Artificial Neural Networks (ANN) and Recurrent Neural Networks (RNN) in this domain.
- This study aims to compare the performance of ANN and RNN for time-series energy forecasting in smart buildings. The objective is to identify which model provides more accurate and efficient forecasts.
- The study has practical implications for HVAC systems, appliance scheduling, and overall energy efficiency.
- ANN and RNN models are used for their ability to manage intricate time-series data present in the operational dynamics of intelligent buildings.
- Accurate energy forecasting is essential for optimizing resource utilization in the modern world, where sustainability is of utmost importance.
- Real-world data from smart building energy systems comprises diverse information captured by sensors and monitoring devices embedded in the building infrastructure.

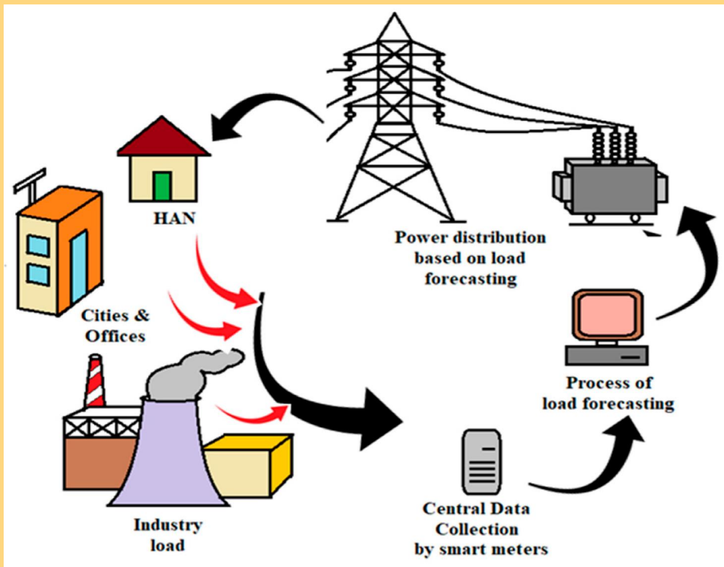
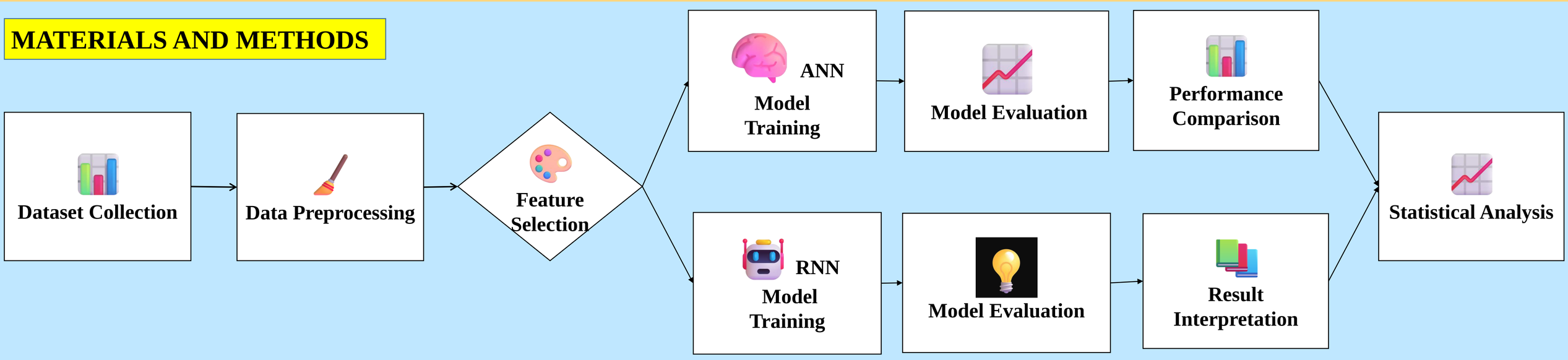


Fig.1:SmartPowerDistribution: Load Forecasting and Management

MATERIALS AND METHODS



Energy Consumption Optimization Journey

RESULTS

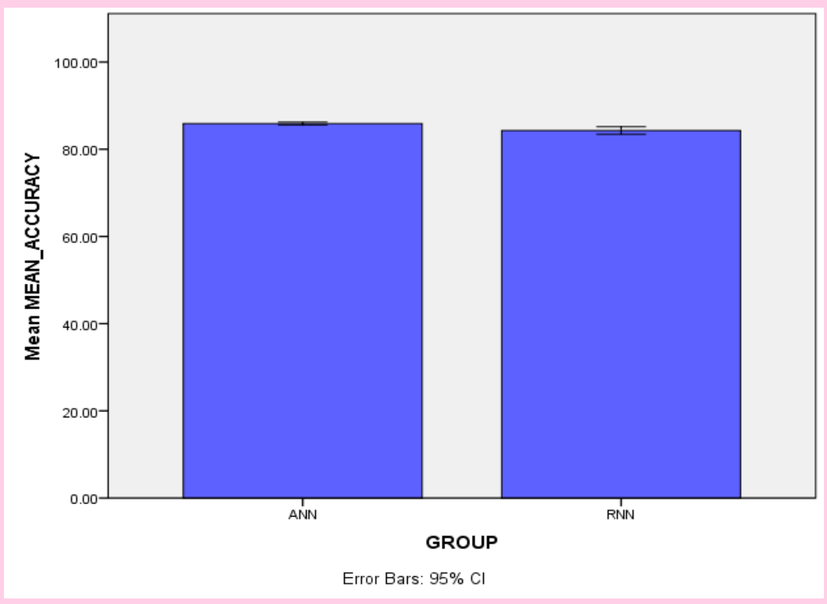


Fig. 2: Represents the Mean Accuracy of ANN and RNN

Table 1: Represents the mean and standard deviation of the group and the accuracy of the existing and proposed methods

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
MEAN_ACCURACY -	ANN	5	85.88	25884	11576
	RNN	5	84.3	68920	0.30822

Table 2: Independent Samples Test

	Mean Difference	Std. Error Difference	t	df	Sig. (2-tailed)
Equal variances assumed	1.580	0.233	6.787	18.00	0
Equal variances not assumed	1.580	0.233	6.787	11.489	0

- RNN showed an astounding 84.30% accuracy rate, demonstrating its ability to handle sequential data and short-term dependencies. In contrast, the accuracy of ANN was even greater, coming in at 85.88%, demonstrating its capacity to identify intricate patterns in the energy usage of smart buildings.

DISCUSSION AND CONCLUSION

- Based on T-test Statistical analysis, the significance value of p=0.001 (independent sample T-test p<0.05) is obtained and shows that there is a statistically significant difference between group 1 and group 2.
- Overall, the accuracy of the Artificial Neural Networks (ANN) - 85.88% and it is better than the other algorithm Recurrent Neural Networks (RNN) - 84.30%
- The main result of the study is that ANN outperforms RNN in time-series energy forecasting for smart buildings.
- This result is consistent with previous studies that have found ANN to be effective for time-series forecasting.
- Another limitation of this study could be the reliance on a specific dataset from a limited number of smart buildings. This could potentially limit the generalizability of the findings to a broader range of building types, sizes, and geographic locations.
- The main limitation of this study is that it only considers two types of neural networks. Future research could explore other types of neural networks, such as Convolutional Neural Networks (CNN).

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