SIMATS ENGINEERING
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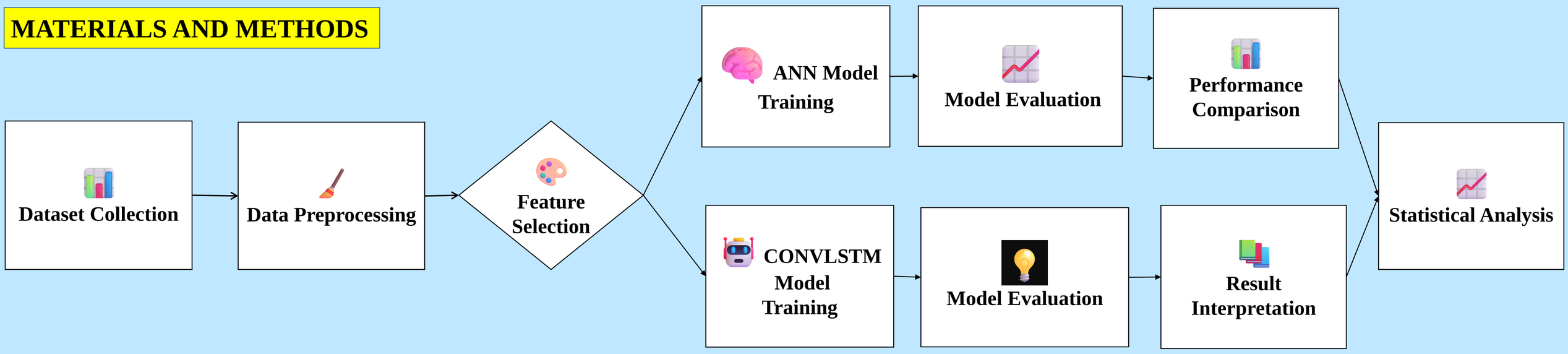
Increasing Energy Efficiency and Sustainability in Smart Buildings with Advanced Predictive Modelling: A Whole-System Approach Using the Convolutional Long Short-Term Memory (Conv LSTM) and Artificial Neural Networks (ANN) Algorithms

INTRODUCTION

- The importance of energy efficiency in smart buildings has been recognized globally due to the increasing demand for energy and the need to reduce carbon emissions. Smart buildings, equipped with advanced automation systems, can significantly reduce energy consumption and contribute to sustainability.
- The applications of smart buildings extend beyond energy efficiency. They also contribute to the health and well-being of the occupants by improving indoor air quality, lighting, and thermal comfort. Furthermore, they can enhance the operational efficiency of the building by facilitating predictive maintenance and reducing operational costs.
- While there are numerous studies on energy efficiency in smart buildings, there is a lack of research focusing on real-time load forecasting for Energy-efficient Management Systems using machine learning algorithms.
- This study aims to estimate and schedule energy consumption in Smart Buildings using real-time load forecasting for Energy-efficient Management Systems.
- This is crucial in smart grid technology, which attempts to reduce mutually reinforcing fluctuations in energy demand and cost using real-time load forecasting and scheduling.
- The application of this research is in energy management in smart buildings.

Fig. 1: Smart City Infrastructure

MATERIALS AND METHODS



Energy Consumption Optimization Journey

RESULTS

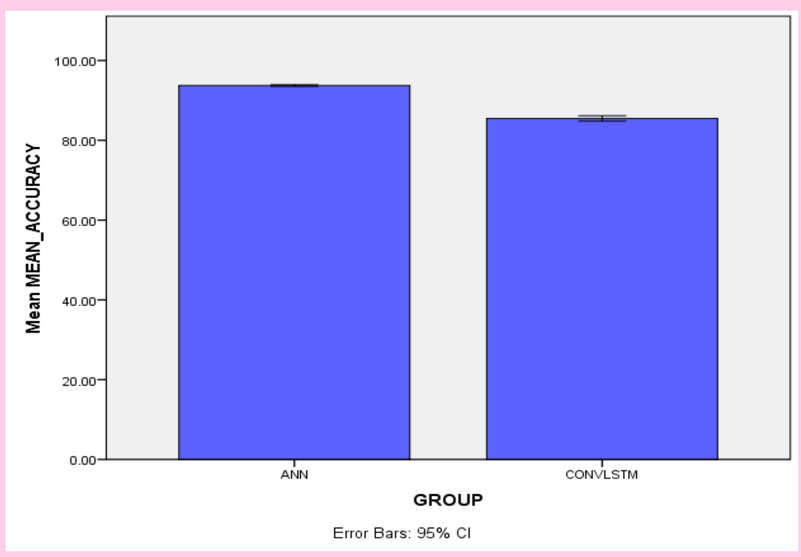


Fig. 2: Represents the Mean Accuracy of ANN and CONVLSTM

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	93.74	0.32042	0.10132
	CONVLSTM	5	85.48	0.91384	28898

Table 2: Independent Samples Test

	Mean Difference	Std. Error Difference	t	df	Sig. (2-tailed)
Equal variances assumed	8.26	0.306	26.973	18	0
Equal variances not assumed	8.26	0.306	26.973	11.18	0

- The Conv LSTM algorithm achieved an 84.82% accuracy rate, while the ANN algorithm attained a 93.58% accuracy rate in predicting energy consumption in SB.

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.
- Accuracy of the Artificial Neural Networks is (ANN) - 93.74 % and it is better than the other algorithm Convolutional Long Short-Term Memory (Conv LSTM) - 84.48%.
- Both Conv LSTM and ANN algorithms showed high accuracy rates, confirming their effectiveness in energy consumption prediction in Smart Buildings.
- The study successfully employs advanced predictive modeling, utilizing Convolutional Long Short-Term Memory and Artificial Neural Networks, to significantly enhance accuracy in predicting energy efficiency and sustainability measures within smart buildings.
- This acknowledgment highlights the need for robustness and generalizability in machine learning studies, especially in complex domains like energy prediction.
- The study was limited to a specific dataset and further research is needed to validate these findings across different datasets and conditions.

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