Power Disaggregation for Enhanced Energy Efficiency

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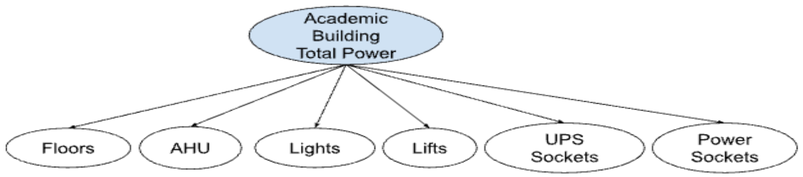
Research Question

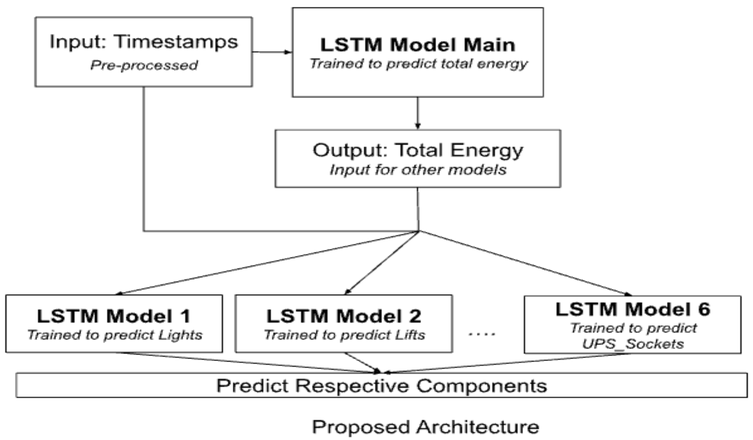
This study focuses on developing a robust deep learning algorithm, to accurately forecast non-intrusive load monitoring (NILM).
It enables the extraction of behavioural insights, monitoring of appliance health, and forecasting future energy consumption, thereby promoting sustainable and efficient energy utilization.

Data and Method



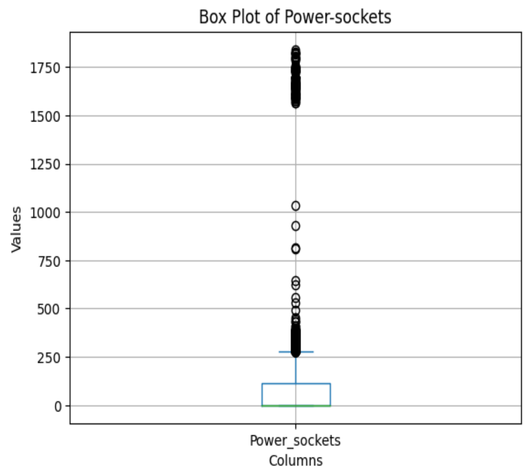
Structure of the COMBED Dataset (IIIT Delhi)

- **Long Short-Term Memory (LSTM**) models are used for their capacity to capture long-term dependencies and intricate temporal patterns.
- **R-squared error** helps in assessing goodness of fit, serving as a robust metric for forecasting model assessment.



Proposed Architecture

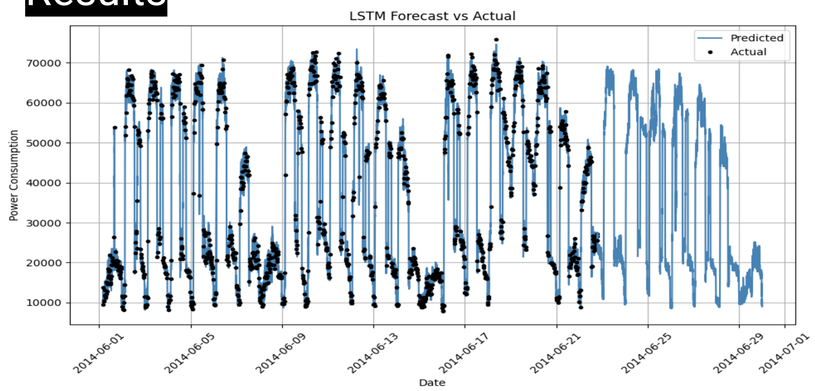
Challenges



No of outliers
Power Sockets: 1459
UPS Sockets: 16312
Lifts: 2444

It's probable that not all elements adhere to uniform usage patterns, and there could be notable deviations from the norm.
In our case, **Power_sockets, Lifts, and UPS-sockets** represent **0.1%, 1.8%, and 5.1%** of the total consumption, respectively. That is why the overall pattern in the power consumption is not affected.

Results



Model	0.5 second	1 second
LSTM	0.9953	0.9947
Prophet	0.7683	0.7302

Performance of Models for Total Power
on Different sampling of data (0.5 second and 1 second)

Component	Window size	LSTM Layers	Dropout Layers	R Squarred
Power_sockets	7	2	0.4	0.231
UPS-Sockets	10	1	0.2	0.576
Lifts	7	2	0.4	0.315
Floors	5	1	0.4	0.986
AHU	10	1	0.2	0.981
Lights	5	2	0.4	0.732

Performance of LSTM Models for components

Conclusion

- Long Short-Term Memory (LSTM) models effectively capture trends for most components, but sudden peaks, which occur more frequently, are crucial to capture.
- However, gathering additional data throughout the year is essential due to seasonal variations in building usage patterns.
- The subsequent phase involves exploring sudden spikes and developing an informed model.

References

1. *Batra, N., Parson, O., Berges, M., Singh, A. and Rogers, A., 2014. A comparison of non-intrusive load monitoring methods for commercial and residential buildings. arXiv preprint arXiv:1408.6595.*
2. *Hwang, H. and Kang, S., 2022. Nonintrusive load monitoring using an LSTM with feedback structure. IEEE Transactions on Instrumentation and Measurement, 71, pp.1-11.*

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