Data Transmission Reduction in IoT Wireless Sensor Networks

Amina Salifu†,Arouna Ndam †

†African Institute of Mathematical Sciences,†

Abstract

A Wireless Sensor Network (WSN) is a collection of spatially separated and specialized sensors that work together to monitor, record, and transmit information about the physical state of the environment to an internet-based location. In order to improve WSN power consumption, this work proposes a classification technique where K nearest neighborhood was applied in those clusters to select the best nodes. The purpose of the classification technique is to divide the network into various node-groupings. We calculated the correlation matrix for one node in each group and cluster, and we also applied the RNN model to get a better prediction within each node in each cluster, so only one node of data will be sent from each cluster to the base station.Furthermore, the experimental results reveals that, based on a suitable choice of nodes, our proposed model perform accurate predictions, with minimum error measured using the Root Mean Squared Error (RMSE) as compared to related work.The radio-energy transmission model used in this work also show that our proposed model is able to save two times more energy, than most of the existing data transmission models.

Introduction

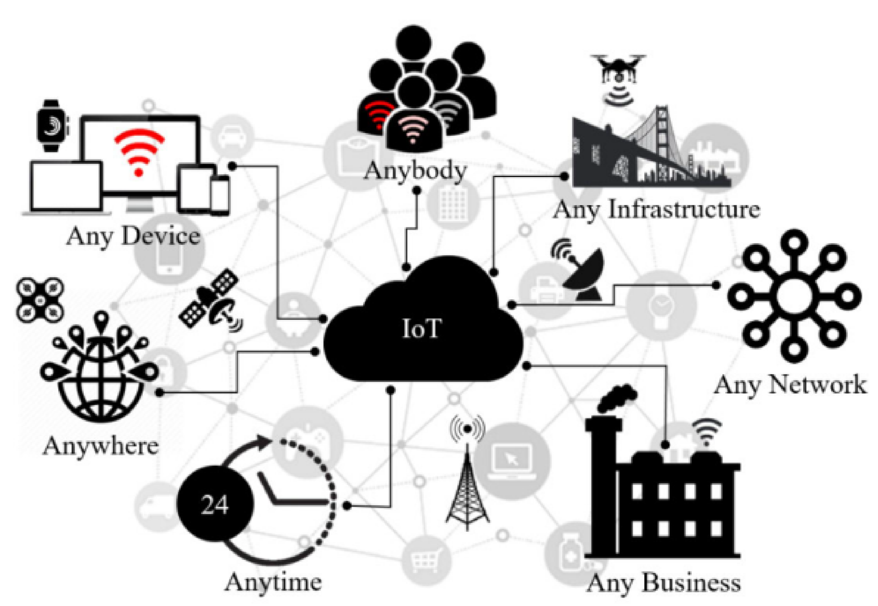


Fig. 1: IoT concept

Observed Dataset

The dataset has about 2.3 million readings collected from the 54 sensors installed in the lab.

- IoT dataset collected from Intel Berkery lab
- The columns included are date:yyyy-mm-dd, time:hh:mm:ss.xxx, epoch, moteid, temperature, humidity, light, voltage.

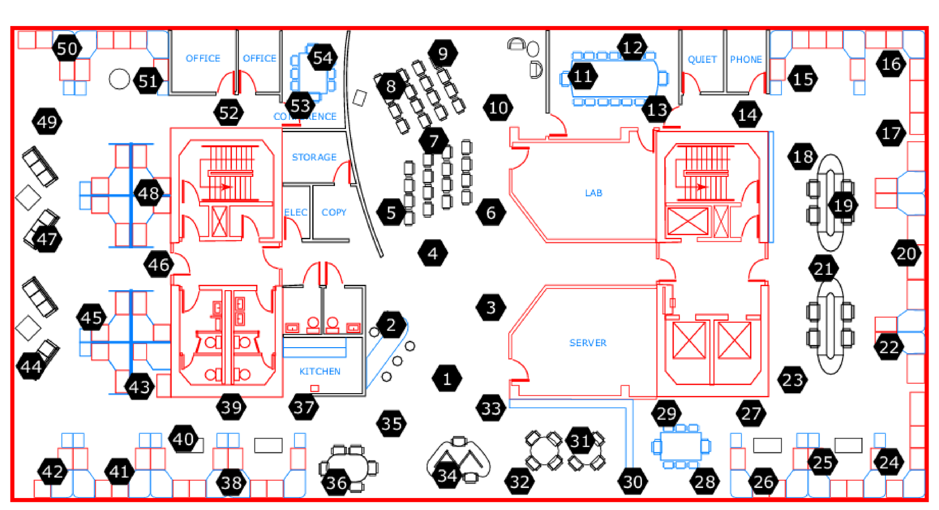
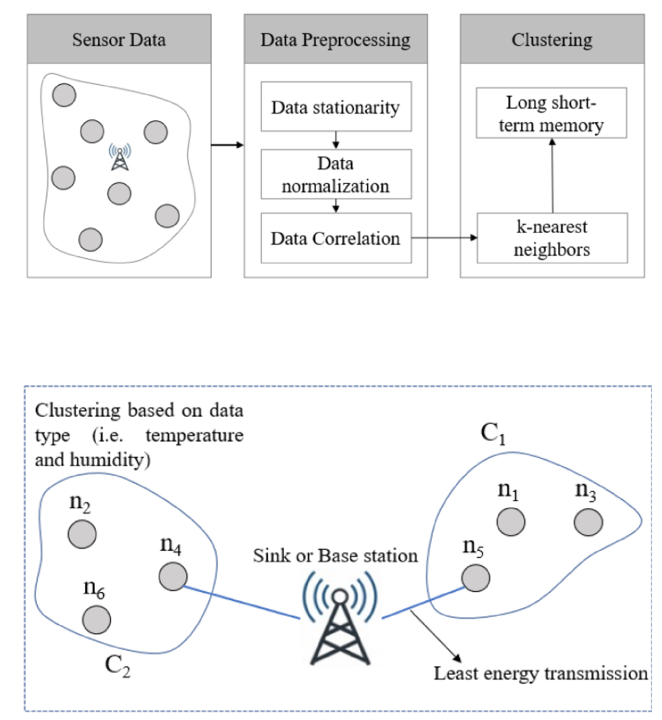


Fig. 2: Intel Indoor Sensor Nodes

- Used nodes $2, 4, 6$
- Studied correlation
- Performed Clustering

Proposed Method



Evaluation Metrics

Energy in each cluster C_k

$$E(C_k) = min\{E_{n_1}, E_{n_2}, ..., E_{n_m}\} \quad (1)$$

$E_{n_{1\leq i\leq m}}$is the energy required by node i for transmission.

Lifetime of cluster C_k

$$lifetime(C_k) \propto \frac{1}{E}. \quad (2)$$

Network lifetime

$$\sum_{k=1}^{K} lifetime(C_k). \quad (3)$$

Nodes organization

$$S = \{n_i\}_{0\leq i\leq N} \;\; where \;\; (n_i = node\, i) \quad (4)$$

Where
S is the set of sensor nodes
N is the number of nodes.

Results

The graphs and tables below shows the results obtained after training the models, K Nearest Neighbor(KNN), Clusters,LSTM with the sample dataset and entire dataset.

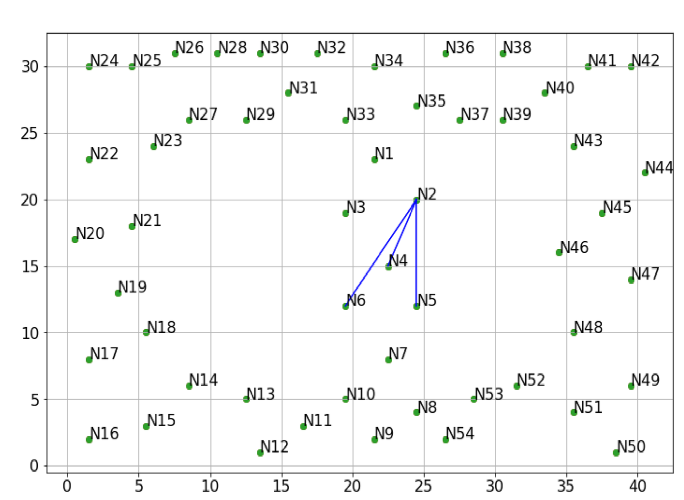


Fig. 5: clustering of node base on temperature,humidity on correlation

Correlation	Temperature2	Temperature4	Temperatu
Temperature2	1.00	-0.71	+0.87
Temperature4	-0.71	1.00	-0.55
Temperature6	+0.87	-0.55	1.00

Fig. 6: correlation matrix of sensor node (4,2,6)

Results

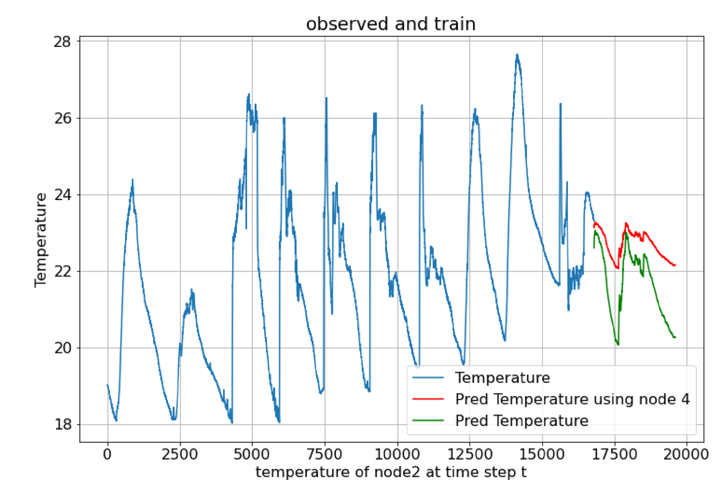


Fig. 7: node 4 used in predicting node node2 and compared to the previous predicted node2

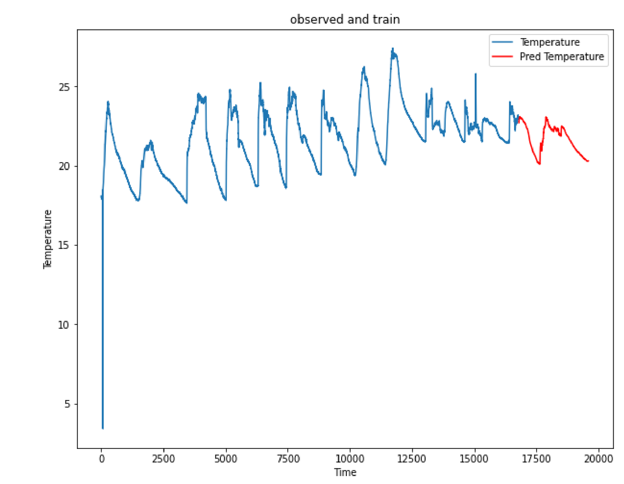


Fig. 8: predicted temperature value for node 2 aided by node 4 and node 6

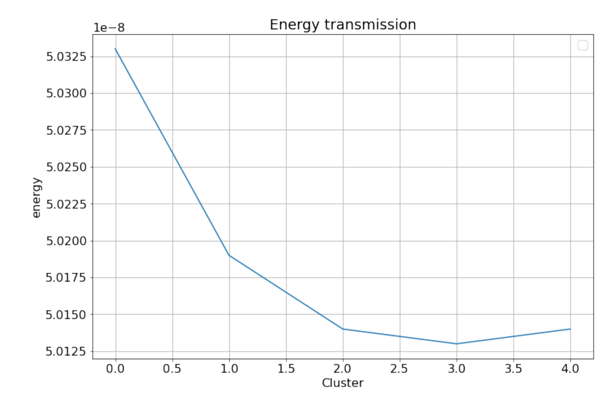


Fig. 9: Shows the minimum Energy of the entire network base on their clusters.

Conclusion

Conclusively, from the models used in the analysis ,comparing the evaluation metrics of the various models used,

- The spatial and temporal characteristics of the sensing data can be captured by the KNN model.
- The proposed architecture is ultimately capable of conserving more energy than the model architectures currently in use.

.

Acknowledgements

My deepest appreciation goes to AIMS Senegal for the academic support and my supervisor Dr.Arouna Ndam for his contributions to this project. Also thank you to IndabaX Ghana for giving me the platform to showcase my work.

References

- G. Yang, Q. Zhang and Y. -C. Liang, "Cooperative Ambient Backscatter Communications for Green Internet-of-Things," in IEEE Internet of Things Journal, vol. 5, no. 2, pp. 1116-1130, April 2018, doi: 10.1109/JIOT.2018.2799848.
- Li, Shancang, Li Da Xu, and Shanshan Zhao. "The internet of things: a survey." Information systems frontiers 17 (2015): 243-259.
- M. Dixit, J. Kumar and R. Kumar, "Internet of things and its challenges," 2015 International Conference on Green Computing and Internet of Things (ICGCIoT), Greater Noida, India, 2015, pp. 810-814, doi: 10.1109/ICGCIoT.2015.7380574.