IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-6, Issue-7, July 2018 E-ISSN: 2347-2693

Predicting Energy Consumption of a House using Neural Network

N. Saranya[1], B.S.E.Zoraida[2]

[1] Department of Computer Science, Bharathidasan University, Tiruchirappalli, India
[2] Department of Computer Science, Bharathidasan University, Tiruchirappalli, India

[*]*Corresponding Author: sasisaran4794@gmail.com, Tel.: +91-86829-51879*

Available online at: www.ijcseonline.org

Accepted: 19/July/2018, Published: 31/July/2018

Abstract— Due to lack of Electricity generation, managing customer demand for energy in India is a difficult task. In order to satisfy the customer demand, Renewable Energy can be introduced for each house to meet out the demand. This paper tries to predict the energy consumption of a house by considering 10 years of data. The Back Propagation neural network prediction method is used widely for this purpose because of its high plasticity and simple structure. The proposed work uses Feed-Forward BackPropagation and Elman BackPropagation Network to predict the demand for electricity consumption. In both two networks are computed were correlation coefficient values and Sum of Square Errors. The result obtained shows FeedForward BackPropagation Network gives better predicts of energy demand.

Keywords— Energy Prediction, Energy, Electricity Consumption, Neural Network.

I. INTRODUCTION

Electricity is used by every homes and industries. Almost the entire appliances at homes, businesses and industries are running because of electricity. The electricity consumption in India has been increasing continuously over the last decade because of the significant improvement in electrification of villages. Still India is far behind when compared to rest of the world.

This paper predicts electricity consumption using Artificial Neural Network (ANN) methods are nonlinear in nature. They are biologically inspired models that typically consist of simple computing units connected in a certain manner. Connection/Structures between units and the calculation that a unit performs vary in different neural model.

In this paper, Artificial Neural Network topologies FeedForward and Feedback are considered**.** FeedForward ANN the information flow is unidirectional. A unit sends information to other unit from which it does not receive any information. There are no feedback loops. They are used in pattern generation/recognition/classification. They have fixed inputs and outputs. However it has beenFeedBack ANN feedback loops are allowed. They are used in content addressable memories.

In this paper, FeedForward BackPropagation network applied to predicts electricity consumption for a home using historical data. The performance of FeedForward BackPropagation network is compare with Elman BackPropagation network. In both the above methods Sum of Square Errors(SSE) were computed. The errors of FeedForward BackPropagation Neural Network is lesser than Elman BackPropagation.

Rest of the paper is organized as follows, Section I contains the introduction of Predicting energy consumption and Neural Network, Section II contain the related work of prediction, Section III described problem formulation, Section IV the computational result, section V gives the conclusion and scope for further research.

II. RELATED WORK

Ma et al., [1] integrated multiple simple regression and self-regression strategies to predict monthly power energy consumption of large-scale public buildings. within the work of Cho et al., [2] the regression model was developed on 1-day, 1-week, and 3-month measurements, resulting in prediction errors within the annual energy consumption of a hundred, 30%, 6% respectively. These results show that the length of the measuring amount powerfully influences the temperature dependent regression models.

Mohamed and Bodger.,[3] planned a multiple statistical regression model victimization GDP, electricity value and population as selected variables deemed most relevant for electricity consumption in New Sjaelland. The result showed the forecast was terribly comparable with the national forecast with accuracy of eighty nine.

Kimbara et al.,[4] developed associate Auto-Regressive Integrated Moving Average (ARIMA) model to implement on-line prediction. The model was 1st derived from the past load, and then used to predict load profiles for following day. ARIMA with external inputs (ARIMAX) model has conjointly been applied to some applications, predicting the ability demands of buildings.

Ghaderi et al.,[5] calculable electricity demand perform for seventeen groups of industries in Asian nation, employing a Non-Linear Auto-Regression Model and annual time-series knowledge from 1980 to 2002. The estimation results indicated the weak sensitivity of business energy consumption to cost amendment that is that the principal independent issue among the quantity of economic variables. The above applied mathematics require great amount of data relevant to appliances, customers, political economy etc., which can not be pronto obtainable. In other words, the outcomes of their predictions could also be addicted to some unknown variables, whose effects on the method cannot be calculable and frequently contain noise that can not be off out. consistent with Sarlak et al.,[6] applied mathematics ways do not manufacture satisfactory results once accustomed estimate voltage consumption, as a result of their effectual factors are strongly nonlinear and complex.

III. METHODOLOGY

This work is focused on predicting energy consumption of a house using Neural Network. The implementation work is used to FeedForward Back Propagation Network and Elman BackPropagation Network. FeedForward Back Propagation Network is worked in 3 phases. The phases are Feedforward Phase, Backpropagation of error Phase and weight updation Phase.

Simple Algorithm for Training FEEDFORWARD BACK PROPAGATION Network

Step0: Initialize weight and learning rate.
Step1: Perform Step 2-9 when stopping condition is false.
Step2: Perform Steps 3-8 for each training pair.
/* FeedForward Phase-I */
Step3: Each input units receives xi and send it to hidden unit.
Step4: Each hidden unit calculate net input
Zinj=w0j+$\sum_{i=1}^{n} xiwij$
Calculate output for hidden unit Zj= f(Zinj).
Step5: input for each output unit Yink=V0k+$\sum_{j=1}^{n} ZjVj\,k$
Output =Vk= f(Yink).
/* BackPropagation of Error Phase-II */
Step6: Each output unit receives target pattern based on which errors are find.
δk=(Tk-Yk)f'(Yink) .
Update weight ΔVjk=αδkZj, ΔV0=αδk
Step7: Each hidden unit
δinj= $\sum_{k=1}^{m} \delta kVjk$ error δj= δinj *f'(Zinj)
Δwij= α δjxi; Δw0= α δj.
/* Weight and Bias Updation Phase-III */
Step8: Each output unit updates the bias & weight.
Vjk(new)= Vjk(old)+ Vjk
V0k(new)=V0k(old)+ΔV0k
Each hidden unit updates weight and bias
wij(new)=wij(old)+Δwij
w0j(new)=w0j(old)+ΔV0j
Step9: Check for stopping condition.

IV. RESULTS AND DISCUSSION

In this work in prediction for a single home is done by using FeedForward BackPropagation Network and Elman BackPropagation Network. The same dataset is used for both algorithms.

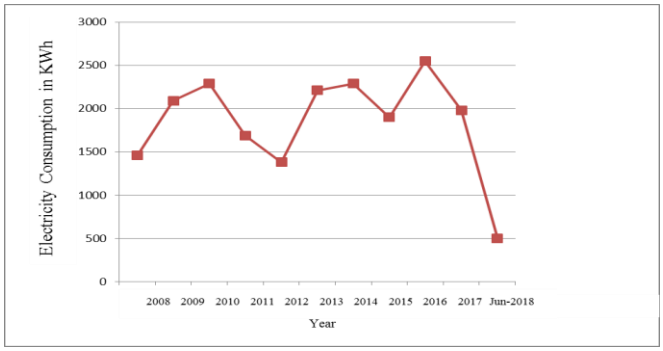

Fig.1 Electricity consumption pattern in Single house

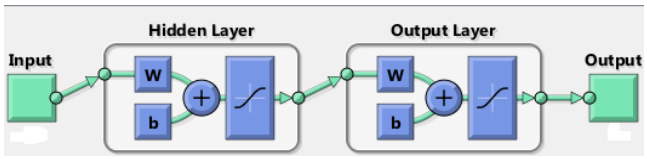

Fig. 2 Feed Forward BackPropagation Network

In Fig.1, Resembles the output of the actual data. Actual data which is collected over the past 10 years, (i.e) 2008 to Jun-2018. In Fig.2, Resembles the FeedForward BackPropagation Network.

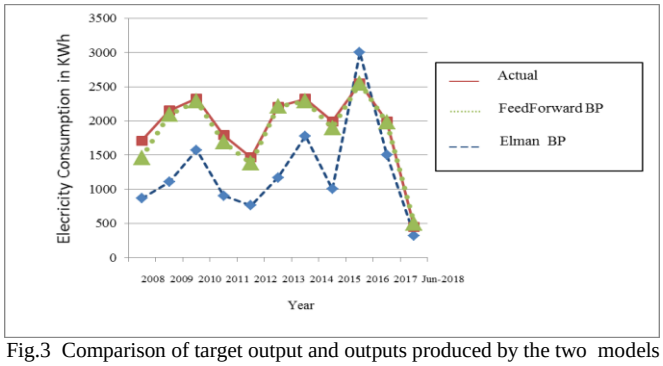

Fig.3 Comparison of target output and outputs produced by the two models (KWh)

In Fig.3, Resembles the comparison of Actual data, FeedForward BackPropagation Network and Elman BackPropagation Network which clearly states that FeedForward BackPropagation Network is the best for energy consumption prediction.

V. CONCLUSION AND FUTURE SCOPE

The results obtained from the study showed that FeedForward BackPropagation Networks are capable of predicting electricity consumption with high - level precision than its Elman BackPropagation Network, evident from the computed SSE values and correlation coefficient values. Further research can be directed towards comparing the predicted results of electricity consumption using the proposed FeedForward BackPropagation network with those of any other sophisticated techniques like support vector machine (SVM), neuro-fuzzy predictor, and using statistical tools to verify if there exists a significant difference between the outcomes.

REFERENCES

[1] E.E. Enebeli, "*Causality Analysis of Nigerian Electricity Consumption and Economic Growth"*. Journal of Economics and Engineering, ISSN: 2078-0346, iss. 4, Dec. 2010.

[2] M. Sarlak, T. Ebrahim, and S.S. Karimi Madahi, "*Enhancement the accuracy of daily and hourly short-time Load forecasting Using neural network*," Journal of Basic and Applied Scientific Research, vol. 2, iss. 1, pp. 247-255, 2012.

[3] V.O. Oladokun, A.T. Adebanjo, and O.E. Charles-Owaba, "*Predicting students' academic performance using artificial neural network:A case study of an engineering course*," Pacific Journal of Science and Technology, vol. 9, iss. 1, pp. 72-79, 2008.

[4] O. Folorunso, A.T. Akinwale, O.E. Asiribo, and T.A. Adeyemo, "*Population prediction using artificial neural network*," African Journal of Mathematics and Computer Science Research, vol. 3, iss. 8, pp. 263-271, 2010.

[5] K. P. Amber, R. Ahmad, M. W. Aslam, A. Kousar, M. S. Khan, "*Intelligent techniques for forecasting electricity consumption of buildings*", Energy, Volume 157, 15 August 2018, Pages 886-893.

[6] Kunlong Chen, Jiuchun Jiang, Fangdan Zheng, Kunjin Chen, "*A novel data-driven approach for residential electricity consumption prediction based on ensemble learning*", Energy, Volume 150,1 May 2018, Pages 49-60.

[7] Jihui Yuan, Craig Farnham, Chikako Azuma, Kazuo Emura, "*Predictive artificial neural network models to forecast the seasonal hourly electricity consumption for a University Campus*", Sustainable Cities and Society, Volume 42, October 2018, Pages 82-92.

[8] Aowabin Rahman, Vivek Srikumar, Amanda D. Smith, "*Predicting Electricity consumption for commercial and residential buildings using deep recurrent neural networks*", Applied Energy, Volume 212, 15 February 2018, Pages 372-385.

[9] Juan Vilar,Germán Aneiros, Paula Rana, " *Prediction intervals for Electricity demand and price using functional data*", International Journal of Electrical Power & Energy Systems, Volume 96, March 2018, Pages 457-472.

[10] Sukumar Mishra, Vivek Kumar Singh, " *Monthly Energy Consumption Forecasting Based on Windowed Momentum Neural Network*", IFAC- PapersOnline, Volume 48, Issue 2015.

[11] Javeed Nizami, S. S. A. K., and A.Z. Al-Garni, "*Forecasting electric energy consumption using neural networks*," *Energy Policy*, vol.23, iss. 12, pp. 1097–1104, Dec. 1995.

[12] Perez-Lombard, L.; Ortiz, J.; Pout, C. "*A review on buildings energy consumption information*". Energy Build. 2008, 40, 394–398. [CrossRef].

[13] Suganthi, L.; Samuel, A.A, " *Energy models for demand forecasting—A review. Renew*". Sustain. Energy Rev. 2012, 16, 1223–1240. [CrossRef].

[14] Gonzalez, P.A., and Zamarreno, J.M., "*Prediction of hourly energy consumption in buildings based on a feedback artificial neuralnetwork*," Energy and Buildings, vol. 37, iss. 6, pp. 595 – 601, 2005.

[15] Radiša Z. Jovanović, Aleksandra A. Sretenovic, Branislav D. Zivkovic, "*Ensemble of various neural networks for prediction of heating energy consumption*", Energy and Buildings, Volume 94, 1 May 2015, Pages 189-199.

[16] L. G. B. Ruiz, R. Rueda, M. P. Cuéllar, M. C. Pegalajar, "*Energy consumption forecasting based on Elman neural networks with evolutive optimization*", Expert Systems with Applications, Volume 92, February 2018, Pages 380-389.

Authors Profile

Ms. N. Saranya is currently the research scholar in pursuing M.Phil in Computer Science from Bharathidasan University, Trichirappalli, India and done her B.C.A. in Computer Applications and M.C.A.in Computer Applications from Periyar University, Salem. Her area of interest is Soft Computing, Prediction, Mathematical Algorithms, etc.

Dr. B. Smitha Evelin Zoraida, Presently she Professor in Computer Science at Bhara Tiruchirappalli, India. Her area of research incl and Molecular Computing.

