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Large Scale Predictive Analysis for Real-Time Energy Management

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Abstract*: *In recent days consumption of energy is high. As population increases gradually, usage of power is also increasing. In this paper the energy management is predicted by using the LSTM Algorithm and to manage the real-time energy. The data is given in the form of data sets. It has been observed that large amount of energy required in future to train data depending on the consumed energy in future. It can observe training progress in the real time environment. To estimate future event in this paper considered energy consumed per day around 440 values and iterations are about 250. The results are validated by using MATLAB/Simulink.

Index Terms*: *Time-Series Analysis, Curve-Fitting Loop, RMSE, LSTM NETWORK ALGORITHM, ANN.

I. INTRODUCTION

These days, the use of energy is maximum in the areas of industries, maintenance of houses, schools, schools, shopping centres, commercial purposes, etc. With the increase in demand, energy production also increases. Occupancy monitoring in homes and buildings is generally achieved through motion sensors and cameras, while using a fairly different method combining motion sensors and energy consumption [1]. One of the key problems surrounding the "big data" concept is the convenience of huge data created on time. With the arrival of low-cost acquisition and loading devices, it is now conceivable to obtain very comprehensive data for additional analysis [2].The very high feature determination anxieties mostly time. Currently, time running data can be noted from practically at all device, occupation for understanding to distinguish more around the fundamental system or to forecast upcoming measures with higher correctness. There have been done a lot of research in the field of energy reducing measurements for households and buildings. One of the areas that has been emphasized is the development of home energy management systems, which is defined as a system allowing the consumer to control, understand, and optimize the energy consumption in the household[1].ANN is a non-linear data to determine self-adaptive approach as stopped to relative model based method[2]. They were powerful tools for making, particularly when underlying data relationship is not known.

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II. TIME SERIES ANALYSIS

Time Series Analysis is nothing but a detailed examination of values is observed at different time points leads to unique problems[2]. The obvious dependence introduced by the sampling data over time restrictions are able to be applied for many conventional statistical methods that require random samples. The psychoanalysis of such data is commonly referred 'Time Series Analysis'.Managing and controlling actual energy delivery is a resource and prediction problem that depend on many factors, some of them are occurring in monitoring within the grid itself, and some of which are only available outside the network, such as weather, resident's behavior and economics.

III. UNITS

ANN's recognize and study associated designs among input data sets and conforming target values. Subsequently training, ANN's are to be used to predict the outcome of new self-reliant input data. Neural controller is a typical 2- layer neural network model designed with help of neural network.

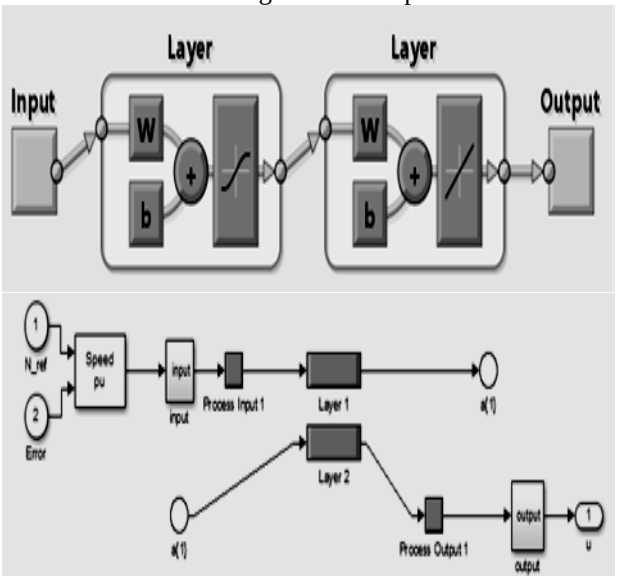

Fig.1. ANN controller

IV. H TIME SERIES FORECASTING

ANN's perspective had been recommended to a substitute method to time succession predicting and it received enormous approval in fore past few years [3]. Foremost detached of ANN's is to project the model and also to copy the intellect of human intelligence into machine.

Alike to the effort of a human brain, ANN's try to distinguish consistencies and designs in the input data, learnt from knowledge and then deliver comprehensive results based in their known preceding recognition.

The furthermost extensively used ANN's in predicting difficulties are multilayer perceptron's, which use a single unseen layer Feed Forward System. The mode is distinguished by a scheme of 3-layers i.e., I/p layer, Unseen layer, O/p layer. These are associated by a cyclic relation.

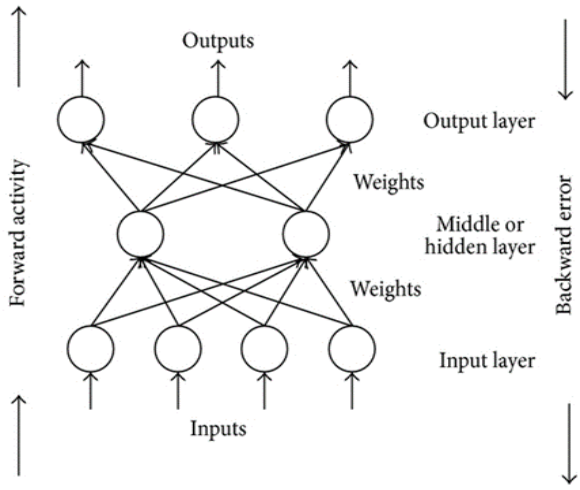

Fig: 3-Layer Architecture of ANN.

V. DEEP LEARNIG

Deep learning" is also identified as Deep structure learning or Graded Study is a part of machine learning methods depends on learning data illustrations, as contrasting to task specific algorithms. Deep learning is mainly are two types.

They are:

1. Organized Learning
2. Unorganized Learning

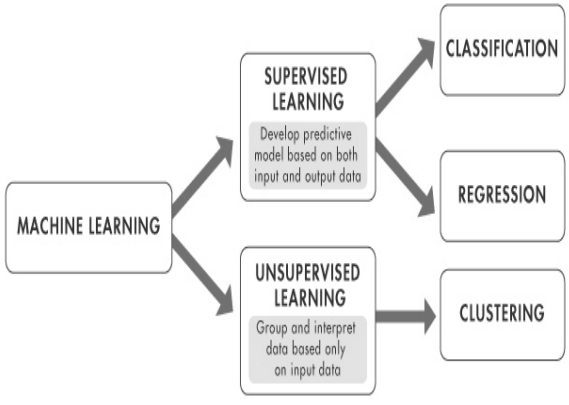

Fig.4. Classification of machine learning

Organized Learning: In this every input pattern is used to train the network is associated with an output pattern which is the target or the desired pattern [4].

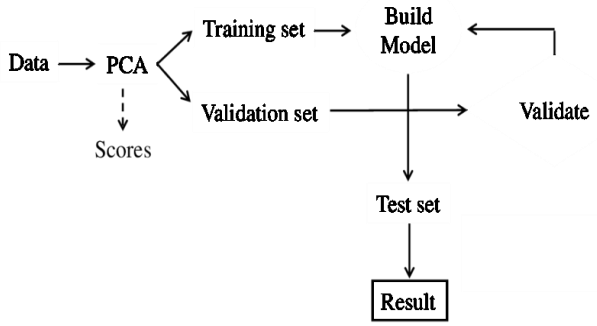

Fig.5. Supervised Learning workflow

Unorganized Learning: In this unorganized Learning method, the final output is not grant to the network[4].

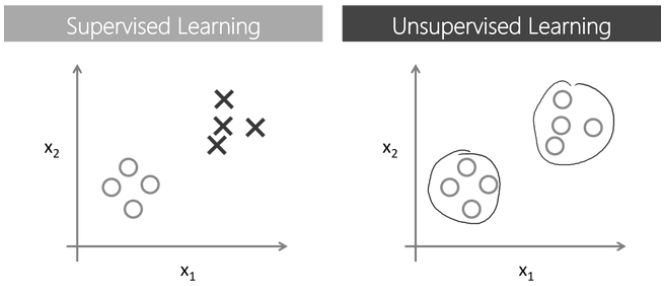

Fig.6. Supervised and Non-supervised Learning

This project was done by using Supervised Learning because every input unanalyzed value is used to train network and is interconnected to an target pattern which is the desired or the target pattern where the Unsupervised study does not do this.

VI. CURVE FITTING TOOL

Curve Fitting Tool is defined as the process of building a curve, and is best fit to a sequence of values, possibly subject to constraints [5]. Curve Fitting Tool is used to predict consumption of power. But it does not predict the next coming data [5]. This is the only drawback with the curve fitting tool so, due to this drawback we are preferring an LSTM Algorithm. LSTM is abbreviated as Long Short-Term Memory Algorithm.

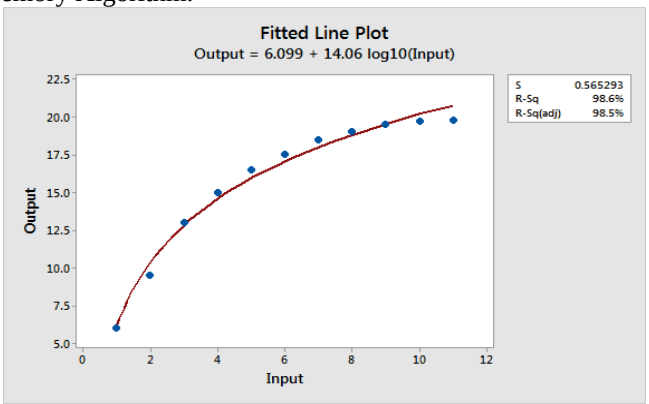

Fig.7. Curve Fitting

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VII. RMSE

Root Mean Square Error is defined , the difference between the predicted data and the actual values[6]. Our desire is to diminish error. Our predictions are most close to the actual data. But, there were unidentical ways that we could minimize error term. We have to diminish the squared error or decrease an absolute value of the error.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

VIII. LSTM NETWORK ANALYSIS

LSTM is abbreviated as Long Short-Term Memory Network Algorithm. RNN is self-possessed of LSTM units and frequently called as an LSTM network [7]. An usual LSTM unit was composed of a cell.

The cell recollects data over arbitrary time breaks and three gates control the flow of information inside and outside of the cell. There were various designs of LSTM units, a familiar construction is collected of a memory cell, an ouput gate and a forget gate. An LSTM cell takes an input and reserve it for some period of time[7]. This is identical to applying the identity function [f(x)=x] to the input because the derivative of the identity function is persistent. When an LSTM network is trained with back propagation through time, the gradient does not disappear.

IX. DATA LOADING METHOD

Power (in watts) holds a one time series, with time steps proportionate to months and values corresponding to number of cases.

data = 1×500

103 ×

3.0118	2.9609	2.8454	2.8201	2.8529	2.9641
3.0039	2.8898	2.7800	2.7912	2.9778	3.1274	3.0909
2.8382	2.5739	2.5687	2.7429	2.9323	3.0637	3.0980
3.0451	2.9628	2.9779	3.0288	3.0920	3.0286	2.9025
2.8979	2.9444	3.0621	3.0860	2.9362	2.8062	2.8267
3.0384	3.2044	3.1672	2.8998	2.6255	2.6168	2.7901
2.9901	3.1339	3.1741	3.1203	3.0385	3.0608	3.1091
3.1625	3.0902					

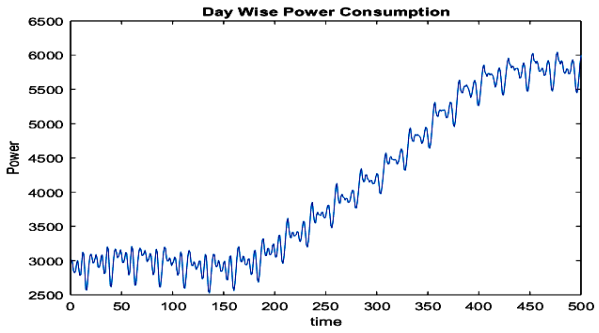

Fig.8.Day wise power consumption

To prognosis data of fore time steps of an array, we have to train a sequence lapse an LSTM system, wherever the replies are being exercise the sequences with data is to be shifted by one-time step.

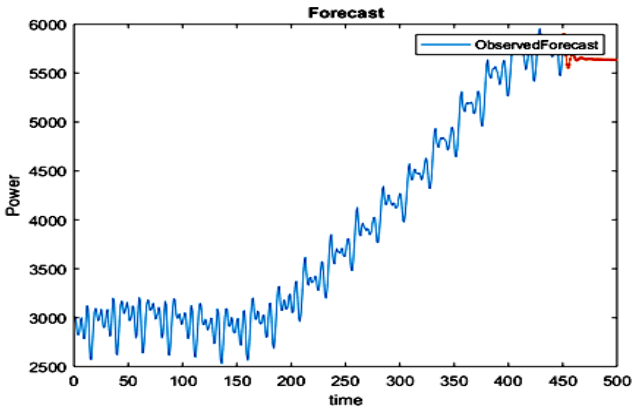

Fig.9.Forecasting without updates

Train for the first 90% of the information order and test on the last 10%. To prediction the values of forthcoming time stages of a sequence, enumerate responses be the practice sequences with values shifted with one time step. At each time step of input sequences, the LSTM network assimilate to forecast the data of the next time step[8].

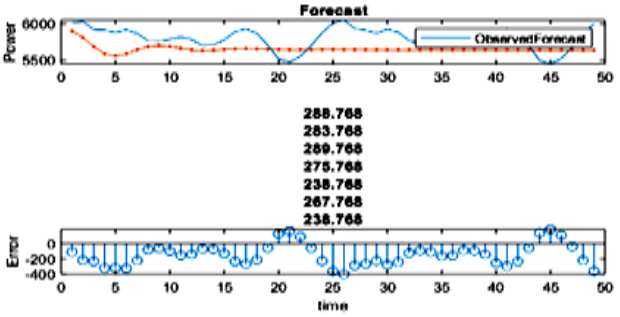

Fig.10.Forcasting without updates (rmse = 66.3617)

If we observe the above shown figure error is immensely elevated so, inorder to reduce that error we have to forecast the particulars. If the misconception is minimized then the network will be properly.

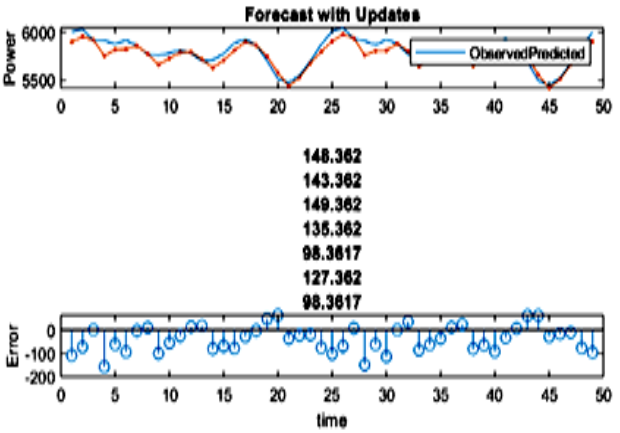

Fig.10.Forcasting with updates

In above shown figure error is reduced by forecasting the data, hence the predictions are high definite when renovating state of the network with the perceived values instead of predicted values.

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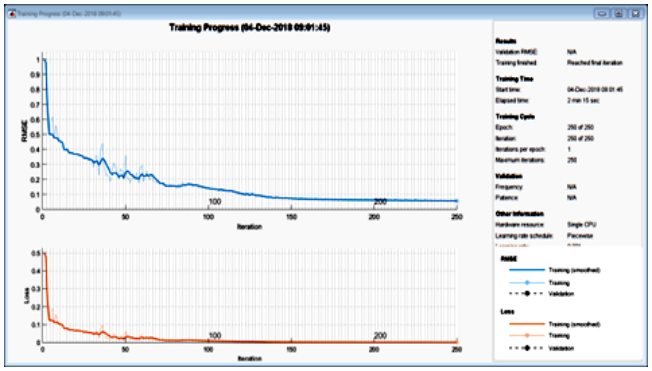

Fig.11.Training progress of real time energy management per day (rmse = singlen206.7675)

CONCLUSION

In this paper the energy management is predicted by using the LSTM Algorithm and to manage the real-time energy. finally obtained the diminish in loss. Hence, with the help of MATLAB SOFTWARE, forecasted data with the updated values and error is minimized by using the LSTM Network Algorithm.

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