A Survey on Energy Optimization Techniques through Machine Learning

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Abstract— Considering the concern of energy conservation and the crucial need of optimization of its utilization prediction based algorithm can be applied on current power sensing techniques. Machine learning techniques can be applied on the power measurement data and better performance of energy utilization can be achieved. The electricity bill can be obtained beforehand and instantaneously which can warn the user about his/her energy consumption. The statistical analysis and energy consumption in monetary terms can suggest the user various optimization techniques.

Key words: Machine Learning, Internet of Things, Energy Conservation

I. INTRODUCTION

Electrical energy has been the source of utmost importance since its discovery. It has gained an undisputed place in the path of progress. Electrical energy is been used in every aspect of life right from house hold usage to industrial applications. Electricity is the base for machinery all over the world. Factories that used heat energy have now been replaced with machinery that works on electricity. Especially in developing countries like India where electrical energy is one of the intangible necessities its wastage is still the main concern rather than its better use. In India wastage of electricity is one of the prime concerns and yet somehow the most neglected one. People in India have yet to be liberated about the importance of conservation of energy. In order to prevent the depletion of electrical energy the conservation of the same is most important. Some times in house hold chorus electricity is used at much higher rate than needed and this very wasted energy can be stopped if warned at the instance. People would be more concerned about the conservation if it is conveyed to them in monitory terms. Various machine learning algorithms can be applied and a prediction model with higher accuracy percentage can be acquired.

II. LITERATURE SURVEY

1) In this paper the author investigates an optimization scheme for extreme learning machine (ELM) regression, named OELR. Extreme learning machine (ELM) has been proposed as a novel learning algorithm for single hidden layer feed forward networks (SLFNs). To overcome the limitation of ELM that it may lead to over fitting on large training data sets. Compared to support vector regression (SVR), OELR has less optimization constraints. OELR performs linear regression in the ELM feature space using□□-insensitive loss and, at the same time, tries to improve model generalization ability by minimizing the norm of the output weights. OLER offers a better trade-off between computational accuracy and sparseness requirement.
2) Here in this paper the author talks about extrapolation where he states that prediction errors from a linear model tend to be larger when extrapolation is involved, particularly when the model is wrong. This article considers the problem of extrapolation and interpolation errors when a linear model tree is used for prediction. It proposes several ways to curtail the size of the errors, and uses a large collection of real datasets to demonstrate that the solutions are effective in reducing the average mean squared prediction error.

   These algorithms employ a divide-and-conquer strategy to find f^(x): first partition the training sample into several pieces and then estimate the function within each partition (represented by a leaf node of the tree) with a linear model estimated from the training data in the partition. Thus, f^(x) consists of one or more linear pieces, and extrapolation occurs whenever x lies within a partition but outside the convex hull of the data in that partition (note that x may lie within the convex hull of the whole training sample, in which case the problem may also be viewed as one of interpolation). One way to reduce the size of the extrapolation errors is to truncate the fitted functions.
3) In this paper the author applies a trust region Newton method to maximize the log-likelihood of the logistic regression model. The proposed method uses only approximate Newton steps in the beginning, but achieves fast convergence in the end. Experiments show that it is faster than the commonly used quasi Newton approach for logistic regression. Large-scale logistic regression arises in many applications such as document classification and natural language processing.
4) The author in this paper presents the design and implementation of an Ethernet-based Smart Home intelligent system for monitoring the electrical energy consumption. The system works on real time monitoring and voice control, so that the electrical devices and switches can be remotely controlled and monitored. It monitors the usage in order to conserve the precious natural resources by reducing electrical energy consumption.

   The model is an Ethernet based system that let users monitor real time switching information of the electrical devices and controlling them. It will regulate our lights, heat, AC, and other come appliances and devices, turning them on and off as we enter and exit rooms and as they "learn" our schedule, save money on energy use, while keeping your office or building comfortable. The cost of simply forgetting to turn off your classroom lights and electric appliances can really add up over time. Controlling temperature and lighting

based on time of day or occupancy can really reduce energy costs.

5) The author introduces Energino, a scalable and affordable solution for energy consumption monitoring in wireless networks. The Energino power meter is a standalone plug–load meter based on the Arduino platform providing high resolution and sampling rate capabilities. Results show that the solution is capable of isolating high resolution/frequency dynamics that cannot be analysed using commercially available tools. Energino is a plug–load meter designed to monitor the energy consumption of DC devices. It consists of hardware and software components both based on the Arduino platform. A management backend written in Python is used to configure Energino's operating parameters, e.g. sampling rate and resolution, and to gather the energy consumption statistics.

III. COMMON ISSUES

Due to lack of concern for energy wastage various issues have been duly noted from various aspects of hardware and software side to develop a product that can enable the user to view his/her energy usage in monetary terms. Following are the issues found out:

1) Electricity bill is provided by government bodies at the end of the month and hence no energy optimization techniques can be applied throughout the month.
2) No sensors are placed on the electricity grid and hence no accurate measurements can be obtained. The degree of accuracy is limited in today's sensing circuits.
3) User is unaware of his/her current usage of energy utilization.
4) Instantaneous energy utilization in monetary terms is not available.
5) No fault tolerance is possible by current billing and sensing techniques.

IV. CONCLUSION

The paper has summarized the current power measurement and sensing techniques. The drawbacks and objectives to overcome the same have been included and various techniques of machine learning have been implemented to combine the recent trends of computer field with power measurement techniques to deliver a better performance in energy utilization and optimization.

REFERENCES

[1] Xiao-jian Ding, Xiao-guang Liu and Xin Xu" An Optimization Method of Extreme Learning Machine for Regression"
[2] WEI-YIN LOH, CHIEN-WEI CHEN, and WEI ZHENG" Extrapolation Errors in Linear Model Trees"
[3] Shuang Wang, Xiaojun Chen, Joshua Zhexue Huang, Shengzhong Feng, "Trust region Newton methods for large-scale logistic regression"
[4] Gupta, Punit, and Jasmeet Chhabra. "IoT based Smart Home design using power and security management."
[5] Karina Gomez, Roberto Riggio, Tinku Rasheed, Daniele Miorandi, Fabrizio Granelli. "Energino: a Hardware and Software Solution for Energy Consumption Monitoring"

