WEB APPLICATION FOR ELECTRIC LOAD FORECASTING USING MACHINE LEARNING

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Abstract—Electricity plays an important role in many activities supporting all kinds of developments. To supply adequately and efficiently the demand required can protect the electric power system blackout. Nowadays we see that companies or industries working on a large scale usually consumes enormous amount of electric power, which leads to high operational costs and this has been recognized as a main challenge in terms of economy. The purpose of the short-term electricity demand prediction is to forecast in advance the system load. The basic idea of this project is to determine the load of a user and alert the user in order to reduce consumption of electricity through a web interface accordingly. An efficient electricity prediction model is needed to minimize the electricity bills. Here we are using web application through which we will interact with the user. Power demand forecasting is important for economically efficient operation and effective control of power systems and enables to plan the load of generating unit. A precise load forecasting is required to avoid high generation cost and the spinning reserve capacity. Under-prediction of the demands leads to an insufficient reserve capacity preparation and can threaten the system stability, on the other hand, over-prediction leads to an unnecessarily large reserve that leads to a high cost preparations. Multiple linear regressions are the earliest technique of load forecasting methods. Here, unit of electricity is the main target(dependent) variable that influence the load. The other influential variables are identified on the basis of correlation analysis with load. This study uses the linear static parameter estimation technique as they apply to the twenty four hour off- line forecasting problem. The results of the developed system is a convenient way of monitoring and forecasting electricity usage through the use of web application.

Index Terms- power demand prediction, web application, weather variable, time variable, Multiple Linear Regression(MLR)

• INTRODUCTION

Electricity forecasting plays an essential role in the electric industry, as it provides the basis for making decisions in power system planning and operation. A great variety of methods for predicting electricity demand are being used by electrical companies, which are applicable to short-term, medium-term or long-term forecasting. Electricity demand is based on a number of factors. In such a dynamic environment ordinary forecasting techniques are not sufficient, and more sophisticated methods are needed. Our objective is to effectively identify all the factors that lead to demand change and to determine the underlying causes. In this paper we explain how machine learning can help to predict the demand of energy accurately. Our aim is to achieve more accurate forecast for the electricity demand. The proposed model uses a machine learning approach in electric load forecasting. Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention.

Load forecasting is a technique used by power or energy- providing companies to predict the power/energy needed to meet the demand and supply equilibrium. The accuracy of forecasting is of great significance for the operational and managerial loading of a utility company. Electricity demand forecasting represents the

main task in the planning of electricity production because it determines the required resources to operate the electricity plants such as daily consumption of fuels. Electricity has to be generated whenever there is a demand for it. It is, therefore, imperative for the electric power utilities that the load on their systems should be estimated in advance. This estimation of load in advance is commonly known as load forecasting.

Load forecasting is extremely important in electric energy generation, transmission, distribution and markets. Electrical energy as consumer goods requires maximal consumption due to its difficulty in storage. Therefore, electric load forecasting is key to reducing unnecessary power generation, which prevents wasting resources. Furthermore, it can be used for Transmission and Distribution (T&D) planning, Demand Side Management (DSM), and intelligent trade in the competitive energy market. Here we have discussed three type of load fore- casting which are:- Long-term electric load forecasting used to supply electric utility company management with prediction of future needs for expansion, equipment purchases or staff hiring. This is longer than a year. Medium-term forecasting, used for the purpose of scheduling fuel supplies and unit maintenance. This is usually from a week to a year. Short- term forecasting, it is used to supply necessary information for the system management of day-to-day operations and unit commitment and also implemented for power system operation and DSM.

Depending on the time zone of planning strategies the load forecasting can be divided into following three categories namely:

Short term load forecasting: this forecasting method is usually having period ranging from one hour to one week. It can guide us to approximate load flow and to make decisions that can intercept overloading. Short term forecasting is used to provide obligatory information for the system management of daily operations and unit commitment.

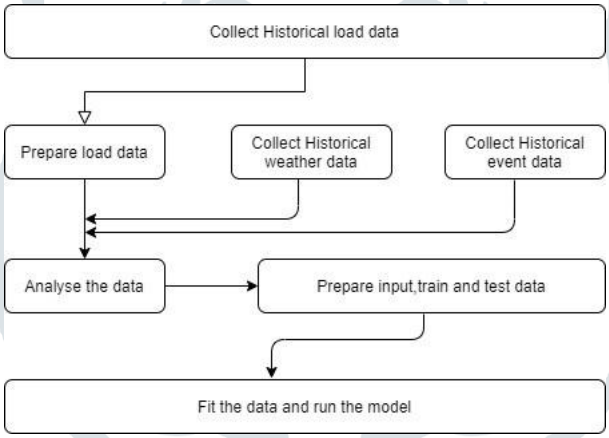

Figure 1. General Load Forecasting Process

1. Medium term load forecasting: this forecasting method has its period ranging from one week to one year. The forecasts for different time horizons are important for different operations within a utility company. Medium term forecasting is used for the purpose of scheduling fuel supplies and unit management.
2. Long term load forecasting: this forecasting method has its period which is longer than a year. It is used to supply electric utility company management with précised prediction of future needs for expansion, equipment purchases or staff hiring.

Load forecast has been a central and an integral process in the planning and operation of electric utilities. The Purpose of load forecasting is proper planning and operation of a power utility requires an adequate model for electric power load forecasting. Load forecasting plays a key role in helping an electric utility to make important decisions on power market, load switching, voltage control, network reconfiguration, and infrastructure development. We try to address some problems in order to apply this new proposed MLR and compare prediction performances in exploration of how much we can improve them with new techniques. Some case studies are conducted to verify our argument with real electric and weather data.

In this paper we have also added the results of our system under the results section which showcases the system functioning. The developed web application has made the monitoring process more convenient.

- **LITERATURE SURVEY**

Short-term Load Forecasting using traditional demand forecasting (Issue: Jan – Feb. 2015): The electrical load forecasting is useful in optimal dispatch of generation, power system security assessment, generation reserve allocation, market operation, etc. Although load forecasting had been an interest for many years, however, in deregulated Electricity Markets (EMs), Short-Term (one hour to a week ahead) Load Forecasting (STLF) especially has gained much more important and greater challenges than ever before, because of the variability and non-stationary in the electricity load time series. In the deregulated (competitive) framework, the precise STLF is an essential tool, not only for the Independent System Operator (ISO) but also for the market participants (e.g., Generating Companies (GenCos), Load Serving Entities (LSEs), retailers, etc.) who do the electricity trading in the Ems.

Important Features	Conventional Methods			
	SMA	WMA	EMA	AR
Load Information	Cosidered	Cosidered	Cosidered	Cosidered
Weather Information	Ignored	Ignored	Ignored	Ignored
Functional relationship between load and weather variables	Ignored	Ignored	Ignored	Ignored
Complex mathematical calculations	Required	Required	Required	Required
Time required for prediction	More	More	More	More
Adaptability	Less	Less	Less	Less

Figure 2. Performance comparison(disadvantages)

[1] Several different methods, techniques and algorithm have been developed to forecast load demands, with the focus on improving the prediction accuracy. The approach using time series analysis is among the main areas with rich research effort, with specially formulated methods for data in various contexts. Time series models are proposed, namely, the traditional techniques model. [2] Different forecasting techniques have been applied to the problem of daily load forecast. Almost all of these techniques fall in the realm of statistical techniques. In this paper a comparative evaluation of five Short-term load forecasting techniques is presented.

Short-Term Electricity Demand Forecasting Using a Functional State Space Model (Published: 2 May 2018): The electricity demand involves many sources such as economic activities, household need and weather sources. All of these sources make electricity demand forecasting difficult. To fore- cast the electricity demand, some proposed parametric methods that integrate main variables that are sources of electricity demand. Others proposed a non parametric method such as pattern recognition methods. In this paper, we propose to take only the past electricity consumption information embedded in a functional vector autoregressive state space model to forecast the future electricity demand. The model we proposed aims to be applied at some aggregation level between regional and nation-wide grids. To estimate the parameters of this model, we use likelihood maximization, spline smoothing, functional principal components analysis and Kalman filtering. Through numerical experiments on real datasets, both from supplier Enercoop and from the Transmission System Operator of the French nation-wide grid, we show the appropriateness of the approach.

Effect of Artificial Neural Network Approach in Load Forecasting Methods(Published: June 2019): In activity tracking system using image processing there are several activity taking place such as Object classification, Edge detection of the object in image form, Military, Space science, Object counting in different environment according the condition. An efficient method of removing noise from the images, before applying image processing them for further analysis is a great challenge for researchers. The noise can degrade the image at the time when we capturing or transmission of the image. Before applying image processing tools to an image, noise removal from the image is done at highest priority. The kind of noise removal algorithms to eliminate from the noise depends on the types of noise present in the image. In this paper we used two methods for removal the noise from the image and compare the result of proposed system

and Median filter in the terms of PSNR parameter. The results show that the proposed system is better than the Median filter.

• PROPOSED SYSTEM

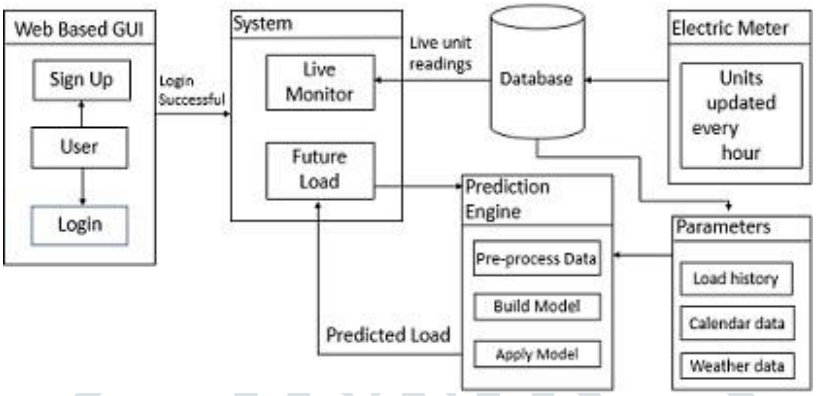

Figure 3. System Architecture

The proposed system involves a web application interface which would be accessible to the users through which the users would be able to get electric load prediction of a desired period or day and even of a specific time. The users also have an option of monitoring their energy usage through a graphical representation of the electric loads.

Here we have a simple system architecture in which the overall system is figured in different modules. The user would be provided a web gui through which options for viewing prediction and usage monitoring would be given. The user will sign up and login into through the web based application. Under usage monitoring, a graphical representation of the electricity usage with respect to time would be displayed which would help in electricity usage analysis. The prediction would be done based on the different parameters specified.

Input Parameters:

1) Load / Demand
2) Time
3) Calendar days
4) Weather data

The parametric data would be stored on a centralized database; this data would be used to train the prediction module. Whenever a prediction request would be made through the web interface by the user the various data would be fetched from the database by the prediction module and the prediction would be displayed in the form of units (Kwh).Under usage monitoring a graphical representation would be displayed depicting energy usage in every hour of the day.

• SYSTEM IMPLEMENTATION

We are predicting and monitoring the electricity usage of a number of users by using the machine learning algorithm. Here we have used Multiple Linear Regression algorithm to predict the load or demand of electricity. In any type of machine learning algorithm we have to feed a huge amount of data so that the algorithm can perform well. Similarly, a number of parameters are to be considered so that the model can predict the real time data against real time data on the basis of correlation of these parameters. We have considered some parameters that are mentioned above in the System Architecture section. The data used to process the model is real time data that can be extracted from the electricity meter which is used to measure the electricity usage in units(kwh) or also a data file(say a .csv file) can be uploaded to the model for

prediction purpose.

It is important to highlight the difference between energy consumption and demand. Consumption is the total amount of energy used, expressed in KWh, whereas demand is the immediate rate of that consumption, often expressed in KW. Commercial consumers are typically charged for both consumption and demand, although the pricing models differ among distribution companies. Consequently, in addition to consumption prediction, commercial consumers are interested in predicting energy demand peaks because lowering these peaks would result in a reduced electricity bill. Therefore, this paper considers consumption and peak demand prediction.

With respect to demand prediction, the focus here is on the accuracy of the predicted daily demand peaks because these peaks drive overall electricity cost. In other words, the main interest is not in evaluating overall demand prediction accuracy, but in the accuracy of demand peaks.

The implementation of the project has been followed by dividing the project work into modules which makes the work simple enough. The modules are as follows,

Modules:

1) Login Module
2) Preprocessing Module
3) Prediction Module

Login Module: A number of user credentials are used in for creating a user account on the web application. In computer security, logging in (or logging on, signing in, or signing on) is the process by which an individual gains access to a computer system by identifying and authenticating themselves. So, the consumer will login into the system by the unique consumer id as their login id and a preset password. After logging in, the consumer will be able to see their daily electricity consumption in a graphical manner and accordingly predict the load for future.

Preprocessing Module: Data preprocessing is an important step in the data mining process. Data-gathering methods are often loosely controlled, resulting in out-of-range values which may have a negative impact on the forecasting results. Analyzing data that has not been carefully screened for some problems can produce misleading results. Thus, the representation and quality of data is first and foremost before running an analysis. Often, data preprocessing is the most important phase of a machine learning project. Data preprocessing includes cleaning, Instance selection, normalization, transformation, feature extraction and selection, etc. The product of data preprocessing is the final training set.

Prediction Module: A prediction or forecast is a statement about the way things will happen in the future, often but not always based on experience or knowledge. While there is much overlap between prediction and forecast, a prediction may be a statement that some outcome is expected, while a forecast is more specific, and may cover a range of possible outcomes. Based on the parameters such as calendar days, weather data, time and units, that is, KWH the load can be predicted. The prediction of load is carried out on a hourly basis that is the consumer can access the prediction on a hourly basis.

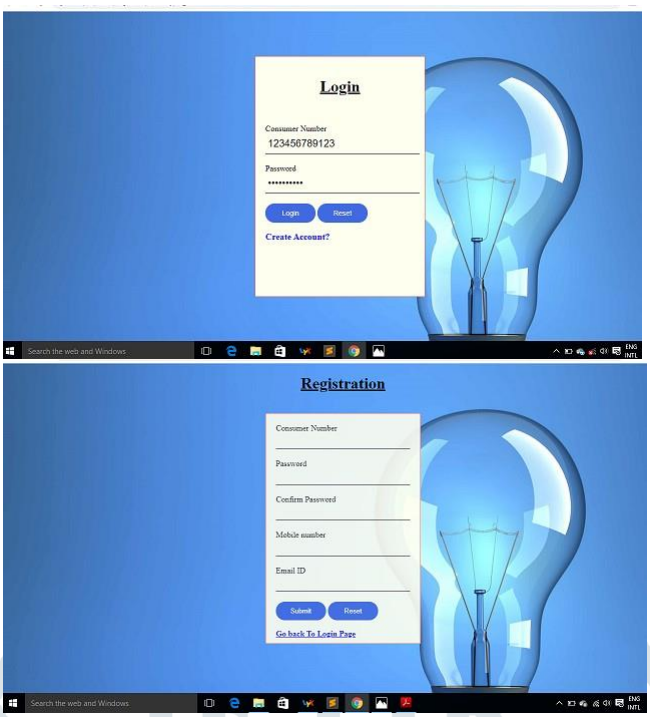

Figure 4. login module demonstration

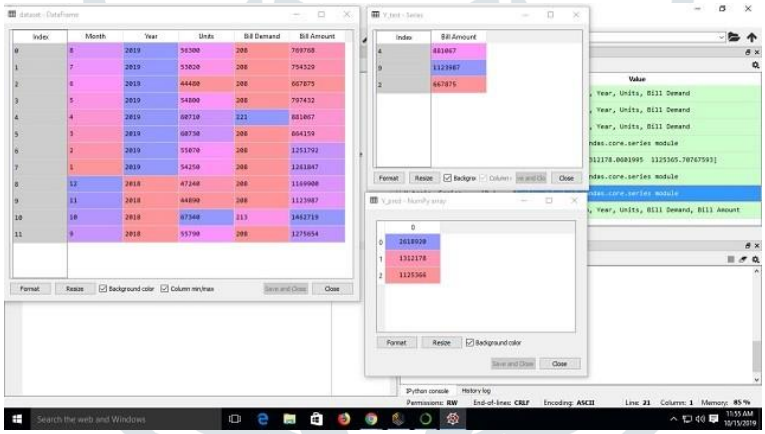

Figure 5. prediction module demonstration

- **EXPERIMENTS AND RESULTS**

Here we have mentioned some of the experiments through- out the project along with their so called results in the form of screenshots. The screenshot shows the prediction of a user based on the stored data. It also features a graph representing the energy usage at different times.

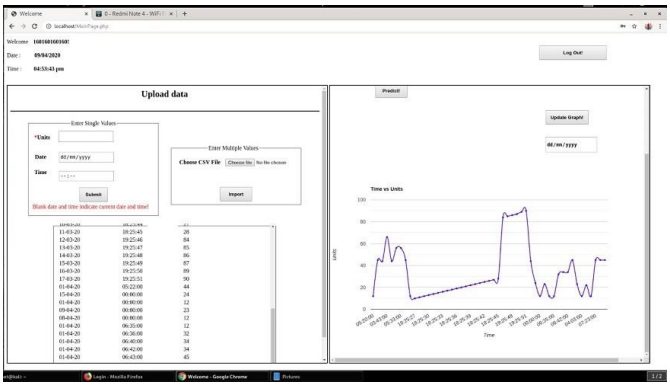

Figure 6. Result I

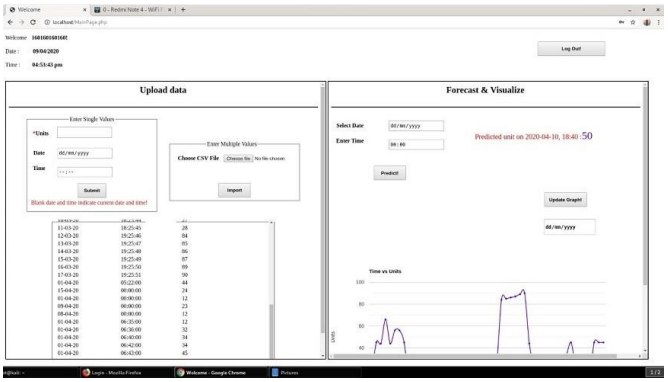

Figure 7. Result II

The prediction made is in units. This would also be used to predict the consumption cost. The accuracy of the prediction is based on the amount of data collected; more the training data , more the accuracy of prediction.

• CONCLUSION

Here in this project, we have mentioned some parameters that are totally eligible to affect the load on a daily basis. The parameters include calendar day, weather data, time and the units itself and with the help of these parameters we are able to predict the power demand of electricity. This will help the consumers to use the electricity very effectively and efficiently for their domestic purpose along with having a control on their electricity bills which is helpful in economic means as well.

• FUTURE SCOPE

The use of Automation in the model for fetching input parameter values would ease the use of the model. Even it can be implemented on a large scale. The accuracy of the forecasts can be improved, if one would study these applied mathematics models and develop mathematical theory that explains the convergence of those algorithms. The social events parameter could be used for prediction based on dynamic data that would enhance the system performance. More electric load affecting factors could be added to work with for increasing the accuracy of the model.

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