Smart Grid Using Machine Learning

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Abstract- ***In today's world, wastage of energy has become more frequent which leads to build a system which will take another way to maintain power generation and make proper distribution of energy and that system is called as SMART GRID.In this paper we will be making a Smart Grid which will overcome these issues by using Machine Learning. We will be using solar data power generation prediction by machine learning. This paper will help production or utility company to get knowledge of how much they have generate and distribute.By his paper blackout and energy wastage can be reduced.we developed the application which shows energy generation and user log.***

Indexed Terms- Smart Grid, Blackout, Machine Learning, analysis; visualization.

I. INTRODUCTION

The Electric Grid which is used for Delivering an Electricity through the largest interconnected network build by Humans. The Transition from Actual Electric Grid towards Sustainable, Efficient and Flexible Electricity Network requires Complex Methods. Moreover Urbanization indicates that the total Necessity of an Energy will Increase in Future while at the same time Penetration of Renewable Energy Resource will also Increase.Smart Grid are becoming popular every coming day as they are fast, reliable and efficient. Their popularity is among users as well as in utility companies. The Smart Grid represented as an electric system which uses information, two-way communication technologies, and computational intelligence which is integrated across electricity generation, transmission, substations, distribution and consumption then achieved a system which is clean, safe, secure, reliable, resilient, efficient, and sustainable [1].The Smart Grid represent an Opportunity to transform the Energy industry into an Era of Reliability, Scalability and Efficiency that will Increase our Economic Wealth and Environmental Health.Smart Grid helps in Conserving an Energy Reducing cost , Increasing Reliability and Transparency which makes it more Efficient. As can be figured, that huge quantity of humans demands an equal quantity of energy to fulfil there usual duties for their daily life. Therefore, electricity demand is in a way to grow at the same rate as number of human beings are growing on Earth, and since the Earth has limited, resources, it becomes of major importance to rationalize the use of energy, and also trying to use renewable energies that will provide electricity which can be consumed with lower impact on the planet [7]. To make Smart grid more Efficient we are using Machine Learning. The proposed system provides a Web Application which provides an interface to visualize the relationship between the temperature, irradiance and the energy generation prediction for Present as well as Future Using Weather Data like Temperature for utility companies and also gives the overall list of data of users.

II. LITERATURE REVIEW

Model which will balance conflicting requirements for high prediction accuracy, low computing time between training and prediction of model, and reliability at any time of the week and for variety of customers. Statistical models and Artificial intelligence and machine learning models (AI/ML) like neural networks and support vector machines are used [2] having advantages like Prediction models for D2R depending on few data can maintain high short-term prediction accuracy. Information that can be combined with the knowledge of industrial experts which uncovers hidden saving valuable information, which contributes effectively in better business decisions making. At the same time, MGs are proved reliable and sustainable alternatives for traditional power systems. [3]. Highlight the issues of big data and challenges which is faced by the DEM employees in SG Networks. In this paper, we've summarized the state-of-the-art in the exploitation of big data tools. In smart grid platforms the Dynamic energy management dis done. We've first highlighted that, in order to cope-

up with the Huge size of data, the smart grid requires advanced data analytics, big data management, and powerful monitoring techniques. Having Advantages like High performance computing, insisting on cost efficiency and security issues within the context of SG control [4]. Development of a resilient grid is done to meet public demand, and regulate the overall requirements, is a paradigm shift which should be met with the help of new strategies. This paper explores the challenges and opportunities by detailing the system of energy distribution and advantages are DA could be key ingredient for fulfilling those requirements and developing new strategies [5].a game-theoretic way which schedule the energy consumption of residential customers automatically within the presence of bidirectional energy trading by allowing the residential to buy and sell energy from/to the production company with their PEVs. They formulate a game which is energy management, where the residential users are the players and the daily schedules are their strategies of household appliance which is in use. In addition, the analysis done on the discharging of PEV's battery which shows that the utility company should provide special electricity price which encourage residential users to store and sell electricity energy back to the production company by using their PEVs at proper timings and advantage is The proposed game-theoretic way reduces the total energy cost and individuals daily electricity payment. [6]. Smart Grid is a vision, which requires cost justification at every step/point before implementation, while testing and verification before extensive deployment of it. Use of machine learning, stochastic analysis, and weather impact projections to give predictions of the next most likely events so that proper actions/decisions can be taken which will reconfigure the system before next worst events that can take place. The rapid and safe interconnection between the distributed generation and energy storage at any point and at any time on the system [1]. When smart grid's, end users change into prosumers, they become most important value creators within the smart grid and also a decisive agent which can change there electricity usage. There's a plethora of research and development areas which are related to the smart grid which can be exploited for new business opportunities, thus spawning another branch which is also called as "green economy" which is focused on turning smart energy usage into a profitable business [7].

III. IMPLEMENTED MODEL

3.1 System Overview

Here first pre-processing of Data is done on the dataset. After this the applications are categorized according to the attributes which we have taken into consideration. And this all is visualized to the user through the interface which we have built.

3.2 System Architecture:

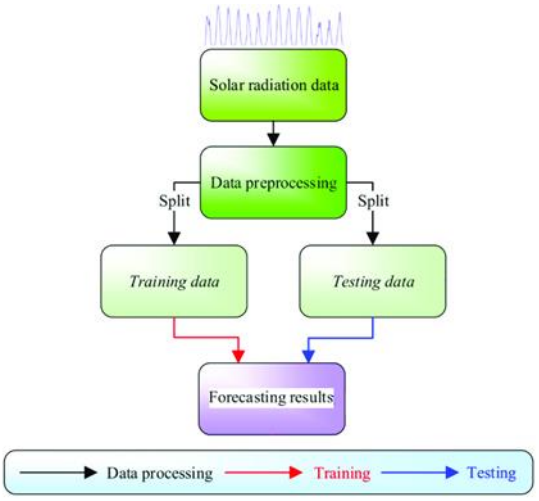


Figure 1: Architecture of the system

The above architecture shows the flow of how the procedure of the system is going to work and how the interface is built. In the above architecture we can see the different steps that are used for the working of the system and the same are explained below:

Dataset: The dataset that we have, there are column like temperature, irradiance, energy generated.

Data Pre-Processing: Since there were no null/missing values in the dataset. However, the raw data needed to be pre-processed to turn it into some valuable information.After it data is splitted into training and testing data.

Training data: This data is given to the system /model, its trains the data and predicts the result.

Testing data: After growing from testing model its predicts the result.

Forecasting results: In this part we predict the results in the form of table or graph.

From the above architecture we can easily understand the work flow of how the system was built and also all the blocks are explained at a detail. So in it we can see that we have created a model by machine learning. The dataset is pre-processed to categorize the data as per the attributes which we are going to take under consideration.

- Homescreen

Figure 2:- Home screen of smart solar system

The home screen of smart solar system is shown in fig. 2. A smart grid is an advance version of our traditional grid system which will not only generate and transmit energy but also redistribute it when not getting utilized by the users. A smart solar system has the power to generate only that much amount of energy that will fulfill the needs of all the users in a sector or area. This prevents wastage of energy and utilizing energy at its best. It consists of the following:

- Energy Generation Prediction:

It consists of data regarding the temperature in a particular area. According it generates the value for solar radiance.

- Energy Consumption Log:

It consists of a list of data regarding the consumption of energy by an individual.

- Energy Generation Prediction:

Figure 3:- Details for checking energy generation

The first and foremost thing is to generate limited amount of energy. For this we have to collect a data set of temperature and irradiance. This data set is provided to machine learning algorithm for analyzing the relationship between temperature and irradiance. After manual entering of city, state and country code(as shown in fig.3), this machine learning algorithm will collect data of temperature of that city and accordingly calculate the value of irradiance.

- Energy Consumption Log

Energy consumption log consists of a list of user data consisting of his/her name, email address and consumption of energy. This data is used to keep a record of consumption of energy by all the users. It comprises of two things:

- Add Log:

It is a manual data entering process wherein the consumption of each user data is entered manually.

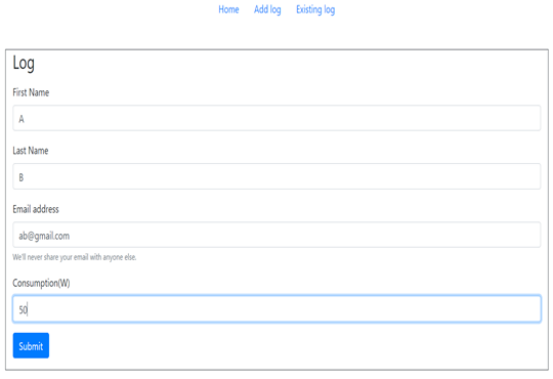


Figure 4:- Entering details for energy consumption data of user

After entering this data, the following will appear on the screen.

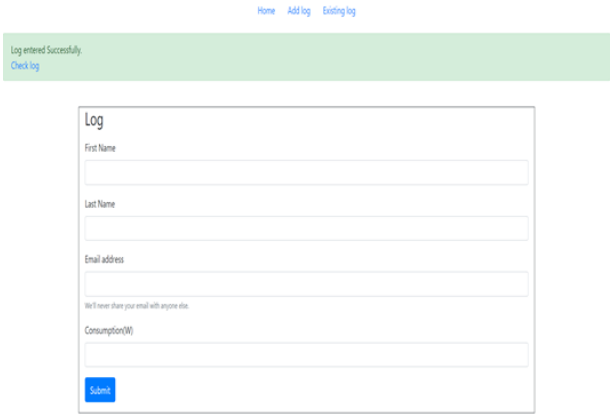


Figure 5:- Adding Log

- Existing Log:

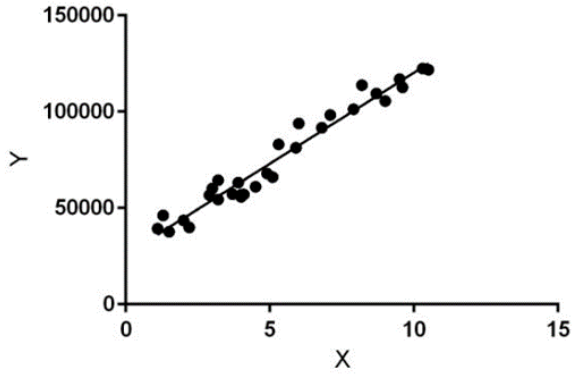
The existing log comprises of list of user data that consumes energy. This data is used by machine learning model to predict further consumption of energy by the user. Accordingly, that much amount of energy is transmitted to the user. This ensures that the energy is not getting wasted.

Figure 6:-List of user data in existing log

3.3 System Model:

The application uses enormous volume of information/data for training and testing of model for energy production. We are using linear regression model for training and testing. Linear Regression is a Machine learning model which performs regression task. Linear regression consists of two types: Simple Linear Regression and Multiple linear Regressions. We're using Simple Linear Regression model in our paper. This model predict the target value based on independent variable. Simple Linear Regression is a technique for Statistical Data Analysis which is used to determine to extent there is relationship between two continuous variables or between variable and forecasting.

Linear regression predict dependent or target or response variable(y) using independent or predictor variable(x). This technique finds out the relationship between x and y (input and output).



$Y(predict) = \theta_1 + \theta_2 * x$

In training model:

x:inputs in training data

y: labels(supervised learning)

While training the model – model fits the best line to predict energy production/output(y) for a gives values of x. The model gives best regression fit by finding best values of θ_1 and θ_2.

θ_1:intercept

θ_2: coefficient of x

By finding best θ_1 and θ_2 values we get best regression line

We've analyse the pre-collected data set of temperature and irradiance onto which we are applying linear regression model. Using this model, we're predicting irradiance (dependent variable) with the help of temperature (independent variable) collected through the changing weather. The value of irradiance will help us analyze the amount of energy required for generation. This energy will be transmitted to all the locations. This transmitted energy when not required in one place, is further redistributed to another user who is requesting for more energy. This energy is redistributed by using FCFS (First Come First Serve) algorithm. The user requesting first will be provided with this redistributed energy irrespective of the amount of energy required by the users.

IV. RESULTS AND ANALYSIS

After analyzing the values of temperature and irradiance, the following energy generation result is obtained which shows how much energy is required to transmit in a particular area.

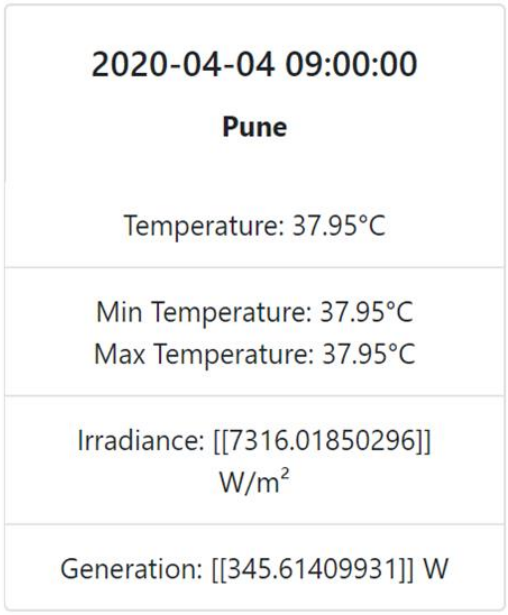
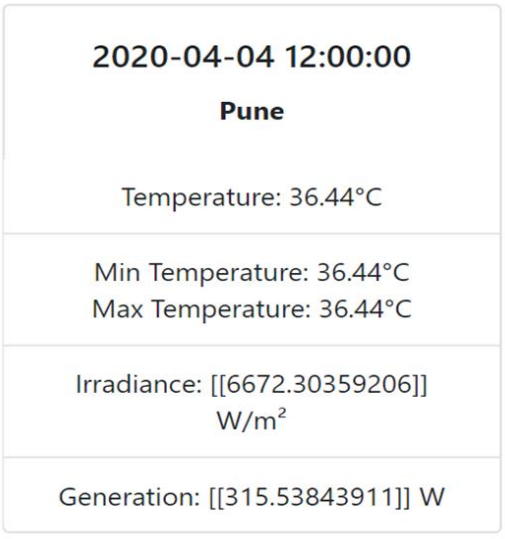


Figure 7:- Generation of energy with the help of temperature and irradiance



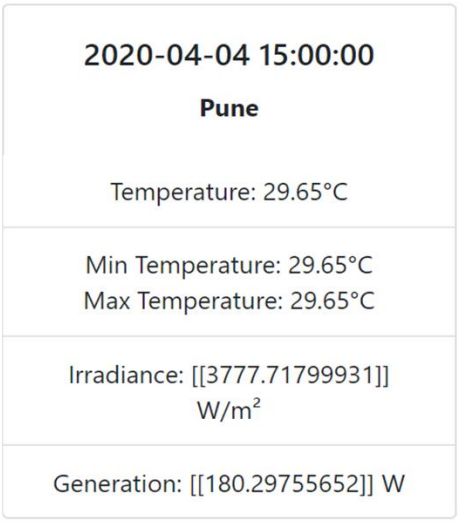


Figure 8:- Generation of energy with the help of temperature and irradiance

Table1: Comparison between existing technique (without smart grid) and implemented technique.

Features	Existing Technique	Implemented Technique
Data	Yes,Offline, scarce data	Yes,Online, abundant data (big data)
Built Interface	No	Yes
Analysing the Data	Yes	Yes
Uploading Dataset	No	Yes
Energy generation prediction	No	Yes
Energy	Focus on non-renewable energy	Focus on renewable energy

Also data storage is provided so the data which can be further used for checking no of users are there. The interface which is built shows us the various co-relations of attributes which we have selected and how it effects the overall ratings of the applications.

When we upload a Dataset it takes time loading onto the system and the information is pre-processed and

represented onto us by doing all the analysis for predicting the result

The below graph depicts prediction of irradiance using temperature ,in this graph actual irradiance given in the data set is denoted by blue line and the predicted irradiance is denoted orange line i.e figure 9.

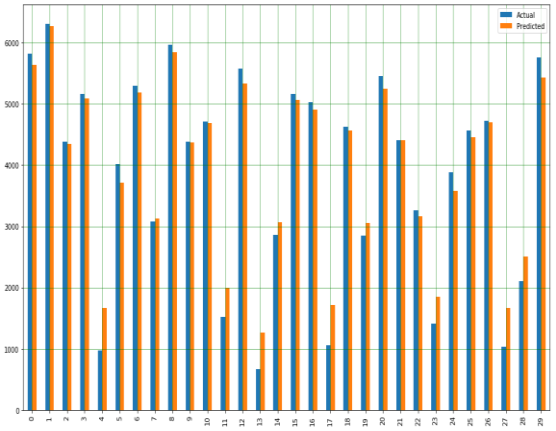


Figure 9:- Graph of Generation of irradiance with the help of temperature

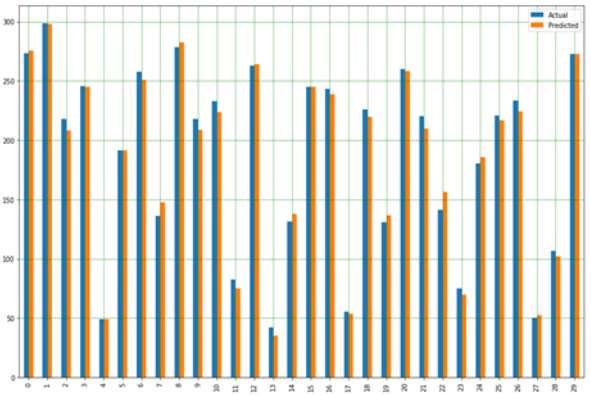


Figure 10:- Graph of Generation of energy with the help of irradiance

The above graph shows the data analysis done by linear regression algorithm and predicted energy generation with the help of irradiance which is shown in above Table II and figure I. In above graph blue line depicts actual amount of energy generation and orange one denotes predicted one.

CONCLUSION

In this paper, a machine learning regression model is detailed for predicting energy generation issue for future by giving location by the user to the system. This project displays Energy Generation prediction in the form of cards by entering details like city, state, and country in the form. The energy consumption log is also displayed in the interface like add log and existing log. While predicting energy generation we get 98% accuracy using regression model.

FUTURE SCOPE

The future extent of this paper is vast and can be used in several ways and not just as a energy generation prediction. It can be furthered used for time series forecasting. It can also be furthered used for theft detection of electricity. Analyzing the amount of energy being consumed. Reducing of global warming.

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