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Energy Consumption Prediction Using Decision Tree Regression Model in Machine Learning

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ABSTRACT

Energy is the power derived from the utilization of physical or chemical resources, especially to provide light and heat or to make the machines work. Energy consumption prediction will not only guide the development of the Country but also the operating environment of various industries. Electricity is one of the major energy sources and the electricity consumption rate is rapidly increasing. Due to this high demand, it needs large amount of capital and capacity expansion projects take more time which leads to negative outcomes. Hence a good forecast of electricity demand is needed. Machine learning (ML) methods have recently contributed very well in the advancement of the prediction models used for energy consumption. This paper reviews the state of the art of machine learning models used in the general application of energy consumption that reduces the effect of negative outcomes. So we propose a novel decision tree regression model that forecast the demand of electric consumption for the development of energy sources.

KEYWORDS: Energy Consumption, electricity demand, prediction model, Regression model

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INTRODUCTION

Energy consumption is the amount of energy or power used. Energy consumption is one of the index in the development of a nation. The social and economic development of a nation depends on energy. Modern civilization depends on the availability of energy and whole nation also rests upon energy. As the demand for energy is being increased, efforts are made to expand the technologies for generating energy sources.

The department of energy has divided energy users into different categories like Residential and Commercial, Industrial and Transportation. In residential and commercial sectors, energy is used to light up their homes, for heating and cooling purposes and to fulfill their daily needs. In Industries, energy is consumed for lighten , running machines, for heating and cooling purposes. And we also use energy for transportation of goods from one place to another.

Energy sources are categorized as renewable and non renewable sources. Renewable resources are those resources that can be replenished or renewed naturally over time. Air, water, wind, solar energy etc are all renewable resources. Renewable resources can be easily renewed by nature. Non-renewable resources are those natural resources that are available in limited quantity. These resources cannot be renewed or replenished in short duration. Therefore they are also known as exhaustible resources. Examples- coal, natural gas, petroleum etc.

Electricity is the secondary source of energy where we use energy sources to produce electricity. Electricity is called an energy carrier because it is an efficient and safe way to move energy from one place to another. In India electrical energy requirement is more than the energy is being produced. Hence, a need has been felt to predict the amount of electric energy consumed.

OBJECTIVE

The electricity consumption forecast is particularly important in the development of a nation. The electricity consumption rate is predicted using decision tree regression model in machine learning. The datasets that were collected for predicting the electricity consumption are related to particular city pertaining to the year 2018. The research objective is analyzing the electricity consumption rate in recent years and predicting future consumption.

LITERATURE REVIEW

Electric Power is the most flexible and broadly utilized type of vitality and worldwide request is developing persistently. In present day life all individuals are customer of Electric power. Electricity can be utilized to feel comfort at home, to cool, to warm, light them, wash garments, cook to eat, to engage and different purposes Currently electric energy distribution and deployment with in smart

environment fairly and intelligently faces different challenges. Forecasting customer's electric energy consumption manages and handles challenges that result from currently unbalanced distribution of smart electric energy. Forecasting the electricity consumption by applying different machine learning mechanisms and models is the best approach to save energy as well as economy. Accurate forecasting will empower utility suppliers to design extra assets and furthermore take control activities to adjust the electricity supply and demand. Forecasting electric utilization is an imperative assignment to give insight to smart grid. It includes prediction of maximum power usage of appliance, peak demand and customers level of life style.

PROPOSED SYSTEM

Prediction of electricity consumption has become urgent and important for a region. The proposed model aims to achieve effective performance in electricity consumption forecasts. In our paper, decision tree algorithm is successfully applied to electricity consumption forecasts and obtains favorable forecasting performance compared with the statistical analysis models. Establishment of an accurate and reliable forecasting model for electricity consumption, which could provide valuable information for electricity system operators to formulate policies and plans of electricity, is vital for the management of power system. We predict the energy consumption by taking the dataset of a particular city and year using machine learning decision tree regression model.

ADVANTAGES

- Electrical consumption forecasting is an important process that can increase the efficiency and revenues for the electrical generating and distribution companies.
- It helps the power distribution companies to plan on their capacity and operations in order to reliably supply all consumers with the required energy.
- Prediction avoids under generation and over generation of power which helps in maximum utilization of power generating plants.
- Prediction helps in deciding and planning for maintenance of power systems.
- Understanding the future long term load helps to minimize the risks for utility companies.

DECISION TREE REGRESSION MODEL

Machine Learning gives computers the ability to learn without being explicitly programmed. The goal of machine learning generally is to understand the structure of data and fit that data into models that can be understood and utilized by people. Machine learning algorithms allows computers to train on data inputs and use statistical analysis in order to output values that fall within a specific

range. Because of this, machine learning facilitates computers to build models from sample data in order to automate decision-making processes based on data inputs.

It is very difficult to consider the all decisions based on possible inputs. To solve this problem, algorithms are developed that build knowledge from a specific data and past experience by applying the principles of statistical science, probability, logic, mathematical optimization, reinforcement learning, and control theory.

Different kinds of models have different advantages. The decision tree model is very good at handling tabular data with numerical features, or categorical features with fewer than hundreds of categories. Unlike linear models, decision trees are able to capture non-linear interaction between the features and the target.

The decision tree is a simple machine learning model for getting started with regression tasks. A decision tree is a flow-chart-like structure, where each internal (non-leaf) node denotes a test on an attribute, each branch represents the outcome of a test, and each leaf (or terminal) node holds a class label. The topmost node in a tree is the root node.

The collected data set contains tabular data with different fields like purchase-area, street, city number of connections in the city with more than one lakh records capacity. Decision tree model is selected for the prediction since it works good at handling tabular data with large size. Decision tree regression observes features of an object and trains a model in the structure of a tree to predict data in the future to produce meaningful continuous output. Continuous output means that the output/result is not discrete, i.e., it is not represented just by a discrete, known set of numbers or values. Continuous values are predicted with the help of a decision tree regression model.

Step By Step Process

Step 1: Import the required libraries.

Step 2: Initialize and print the Dataset

Step 3: Select the required rows and columns from the dataset

Step 4: Fit decision tree regression to the dataset

Step 5: Predict a new value

Step 6: Visualize the result

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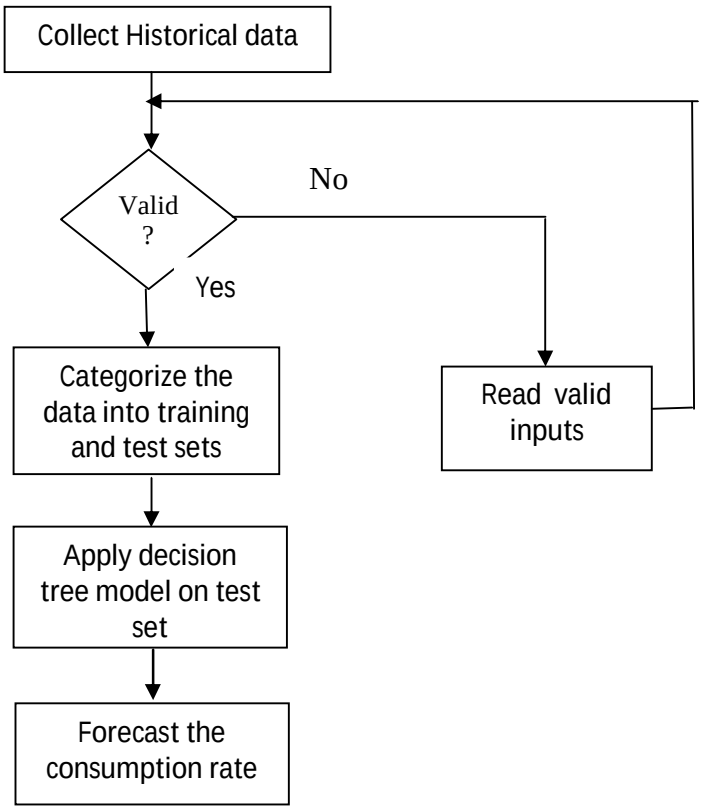

Figure1. Data Flow Diagram For Decision Tree Regression Model

SYSTEM ARCHTECTURE

The overall system design consists of following steps:

1. Data Collection

The dataset used in this paper was an open source dataset from KaggleInc. It consists of more than 1 lakh records with 14 parameters that have the possibility of affecting the consumption rate.

2. Preprocessing

It is a process of transforming the raw, complex data into systematic understandable knowledge. It involves the process of finding out missing and redundant data in the dataset. Entire dataset is checked for NaN and whichever observation consists of NaN will be deleted. Thus, this brings uniformity in the dataset. There was no missing values found meaning that every record was constituted its corresponding feature values. However out of these 14 parameters only 4 were chosen which are bound to affect the consumption rate. Parameters such as zipcode_from, zipcode_to, city, number of connections.

3. Data Classification

Classification is the problem of identifying to which of a set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known.

4. Data regression

Regression is basically a statistical approach to find the relationship between variables. In machine learning, this is used to predict the outcome of an event based on the relationship between variables obtained from the data-set. The accuracy of the output is calculated for various regression models. It is observed that decision tree regression model produces better accuracy compared to other models. Hence, we choose decision tree regression model to predict the power consumption rate

5. Prediction of Output: Annual Electric power consumption rate can be predicted effectively.

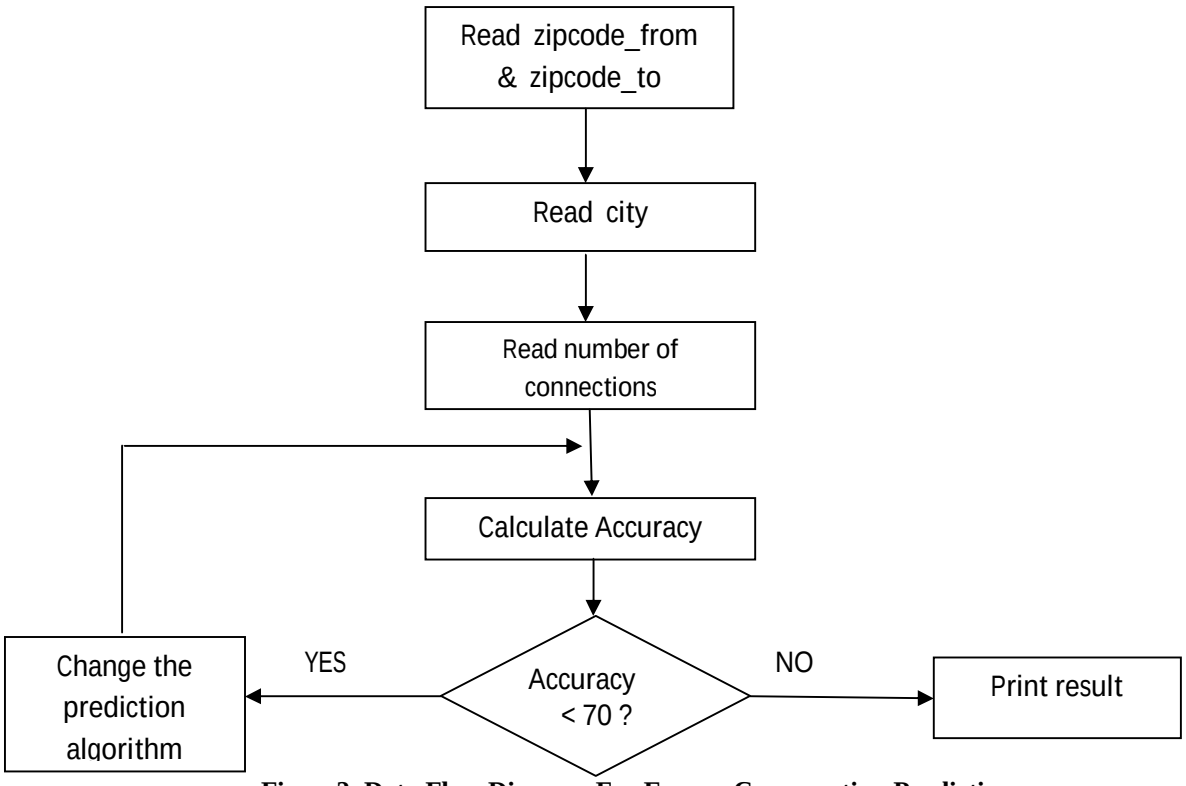

Figure2. Data Flow Diagram For Energy Consumption Prediction

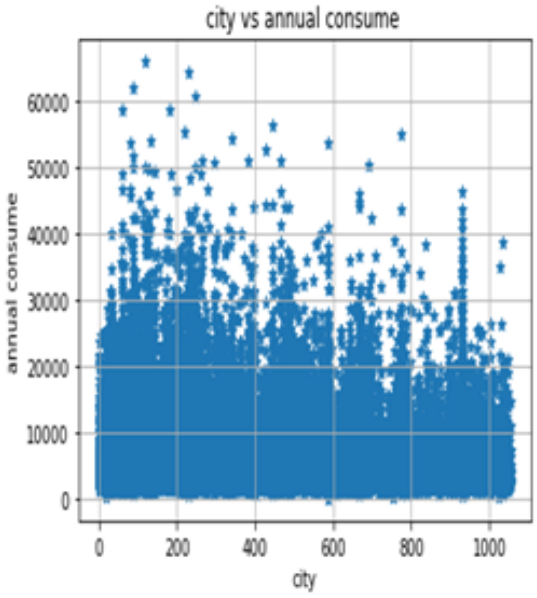

Figure3. Plot Between City And Annual Consume

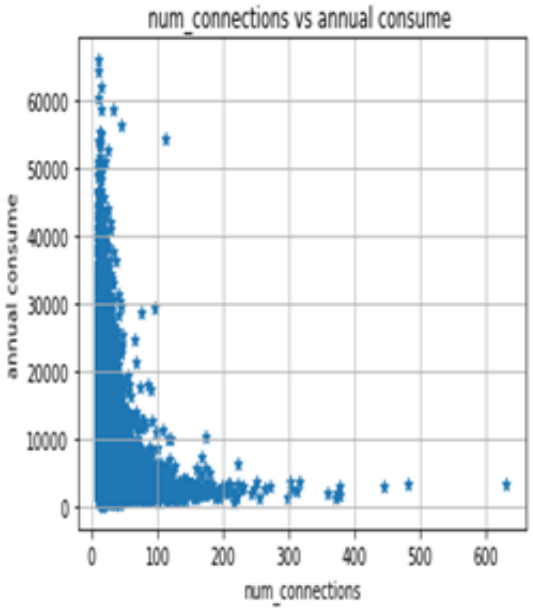

Figure4. Plot Between number of connections And Annual Consumption

CONCLUSION

A good demand forecast is needed for the effective development of energy policies, as it can reduce the possibility of errors during the implementation of capacity expansion projects. Energy consumption prediction in cities is a challenging task, because of randomness and noisy disturbance. We can use various machine learning algorithms to obtain better results in terms of accuracy on collected data. Different statistical measures are used for performance measurements of these algorithms. To obtain a better prediction of electricity power consumption, in this paper we proposed a model which uses decision tree regression in machine learning. The statistical measures indicate that the performance of proposed decision tree regression model is far better as compared to other counterpart algorithms.

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