ANALYSIS OF HOUSE HOLD POWER CONSUMPTION

TEAM - 9

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CONTENTS  
1. INTRODUCTION

1.1 Overview

1.2 Purpose

2. LITERATURE SURVEY

2.1 Existing problem

2.2 Proposed solution

3. THEORITICAL ANALYSIS

3.1 Block diagram

3.2 Hardware / Software designing

4. EXPERIMENTAL INVESTIGATIONS

5. FLOWCHART

6. RESULT

7. ADVANTAGES & DISADVANTAGES

8. APPLICATIONS

9. CONCLUSION

10. FUTURE SCOPE`

11. BIBILOGRAPH

1.Introduction

1.1 Overview

As smart technology is gaining importance, the electricity consumption is also increasing in the modern era . With the advent of smart devices around us the electricity cost is also increasing. Because of electric power conservation has become the need of the hour. For which a reliable forecast of electrical power consumption is being made with the help of machine learning algorithms. With the help of machine learning models, we will be able accurately predict the individual appliance behavior.

1.2 Purpose

The purpose of this project is to utilize the data set collected. The data set contains global active power of the household along with other variables such as global reactive power, voltage, global intensity(corresponding to global minute average current intensity), submetering1 (corresponding to electricity consumed by kitchen appliances) submetering2 (corresponding to electricity consumed laundry purposes) submetering3(corresponding to electricity consumed by water heater and air conditioner). With these attributes we predict the global active power and we can accordingly reduce the power consumption and in turn effect in the electricity bill.

2.Literature Survey

2.1 EXISTING SYSTEM

India is the world's third largest producer and third largest consumer of electricity. The gross electricity consumption in 2018-19 was 1,181 kWh per capita. In 2015-16, electric energy consumption in agriculture was recorded as being the highest (17.89%) worldwide. Energy use can be viewed as a function of total GDP, structure of the economy and technology.The increase in household energy consumption is more significant than that in the industrial sector. To achieve reduction in electricity consumption, it is vital to have current information about household electricity use.Many households worry a lot due to the high electricity bill. Even they want to save the consumption of power. Due to the lack of information about individual appliances power consumption leads to huge wastage of power as well as money.

2.2 PROPOSED SYSTEM

We are proposing a system that analyzes electricity consumption of individual

appliances, identify the energy consumption patterns apply statistical modeling

and suggest the user about reduction of power consumption.The main objective

of this project is to analyze and visualize energy consumption. The regular

consumption is captured through sensors and stored in a database. Apply various

exploratory data analysis using various libraries, visualize them using matplotlib

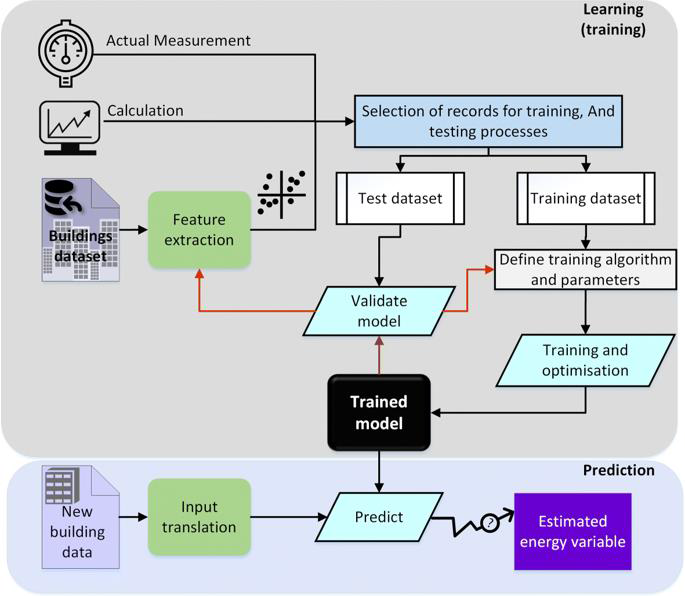
and seaborn and suggest the user based on consumption. Web application to

visualize the Analysis. Get insights from the data. suggests the user based on insights.

## 3. Theoretical Analysis

## 3.1 Block diagram

Following is the block diagram of our proposed system where we use multi linear regression and decision tree for prediction of global active power .



3.2 Software Desgin

* Dataset preparation
* Dataset pre-processing

1. Data visualization
2. Taking care of the missing data
3. Label encoding and one-hot encoding
4. Data transformation

* Model Bulding

1. Training and testing model
2. Evaluation and the final prediction

* Model Deployment

1. Creating HTML file
2. Structuring python code

## 4. Eperimental Investigation

The dataset used is derived from [https://machinelearningmastery.com](https://machinelearningmastery.com/how-to-load-and-explore-household-electricity-usage-data/).The Household power consumption is time variant dataset . The dataset gives us information about electricity consumption of household over a period of 4 years i.e from December 2006 to November 2010. And the data is collected for every hour.

The variables that are varying over the time are :

* Global active power : Global active power is the total power consumed by the household. It is measured in "Kilowatts"
* Global reactive power: Global reactive power is the reactive power consumed by the household. It is measured in "Kilowatts"
* Voltage: Average voltage of the house . It is measures in "Volts"
* Global intensity: Average current intensity in the house. It is measured in "Ampers"
* Sub metering 1: Active energy consumed for the kitchen chores. It is measured in "watts per hour"
* Sub metering 2: Active energy consumed for the laundry chores. It is measured in "watts per hour"
* Sub metering 3: Active energy consumed by appliances related to climate control systems. It is measured in "watts per hour"

Active and reactive energy refer to the technical details of alternative currents.In general terms active power is the power consumed by the household. And the reactive power is the unused power in the lines.

Putting all of this together, we can now load the data and summarize the loaded shape and first few rows.

* Next, we can mark all missing values indicated with a ‘?’ character with a NaN value, which is a float.This will allow us to work with the data as one array of floating point values rather than mixed types, which is less efficient.
* Now we can create a new column that contains the remainder of the sub-metering, using the calculation from the previous section.We can now save the cleaned-up version of the dataset to a new file; in this case we will just change the file extension to .csv and save the dataset as ‘*household\_power\_consumption.csv*‘.
* To confirm that we have not messed-up, we can re-load the dataset and summarize the first five rows. Tying all of this together, the complete example of loading, cleaning-up, and saving the dataset is listed below.
* The dataset is then cleaned up and saved to a new file.We load this new file and again print the first five rows, showing the removal of the date and time columns and addition of the new sub-metered column.
* We can peek inside the new ‘*household\_power\_consumption.csv*‘ file and check that the missing observations are marked with an empty column, that pandas will correctly read as NaN.
* Now that we have a cleaned-up version of the dataset, we can investigate it further using visualizations.

## 5. Flow Chart

## 

6. Results

In this project, we discovered a household power consumption dataset for multi-step time series forecasting and how to better understand the raw data using exploratory analysis. We got to see

* The household power consumption dataset that describes electricity usage for a single house over four years.
* We explored and understood the dataset using a suite of line plots for the series data and histogram for the data distributions.
* How to use the new understanding of the problem to consider different framings of the prediction problem, ways the data may be prepared, and modeling methods that may be used.

## 7. Advantages and Disadvantages

#### Advantages:

* It's easy to understand.
* High accuracy.
* Easily identify trends and patterns.
* No human intervention needed.
* Continuous Improvement.
* Wide Application.

#### Disadvantages:

* Data Acquisition.
* Time and Resources.
* High error-susceptibility.
* The algorithm assumes data is normally distributed in real they are not.
* Prone to outliers.

8. Applications

The purposed solution to reduce the electric power consumption and electricity bill in the household using machine learning. The web application product can then be used to learn from the data and predict the global active power for any sort of input variables. This solution is more applicable and beneficial in India with high ratio of middle class and poor people who find it difficult to pay increasing electricity bills. Which can be extended to industries as well. It will also help in saving the environment by saving the electricity.

9.Conclusion

Machine learning algorithms consume significant amounts of energy. However, the lack of evaluations based on energy consumption of these algorithms can be attributed to the lack of appropriate tools to measure and build power models in existing machine learning suites, and because estimating energy consumption is a challenging task.Analysis of the household power consumption using machine learning helps us to analyse the power consumption and helps us to understand the usage of current at different departments of house.By using visualisation to the datasets we have power consumption is show in pictorial representation. These show us where to reduce electricity usage for a single house and optimise the consumption. this method is also used to predict the future values of power consumtion using training and testing data.

10. Future Scope

This system can be used in all the households in the country in the coming future time to limit and reduce the electricity consumption. We can save the consumption of power and therefore avoid wastage of power as well as money that occurs due to the lack of information about the consumption of power by individual appliances.

## 11. Bibliography

* <https://machinelearningmastery.com/how-to-load-and-explore-household-electricity-usage-data/>
* <https://data-flair.training/blogs/advantages-and-disadvantages-of-machine-learning/>
* <https://link.springer.com/article/10.1007/s11277-019-06845-6>

12. Appendix

"""

from flask import Flask,render\_template,request

import pickle

app=Flask(\_name\_)

model=pickle.load(open('mlr.pkl','rb'))

@app.route('/')

def hello\_world():

return render\_template('index.html', \*\*locals())

@app.route('/login',methods=["POST"])

def login():

vol=request.form["vol"]

sb1=request.form["sb1"]

sb2=request.form["sb2"]

sb3=request.form["sb3"]

gi=request.form["gi"]

gr=request.form["gr"]

total=[[int(vol),int(sb1),int(sb2),int(sb3),int(gi),int(gr)]]

p=model.predict(total)

p=p[0][0]

return render\_template('index.html',label=p)

if \_name=='main\_':

app.run(debug=True,port=5000)

<!DOCTYPE html>

<html lang="en">

<head>

<style type="text/css">

.border{

border-radius: 25px;

padding: 20px;

border: 4px solid black;

background-color: white

}

.jumbotron text-center{

background-color: white

}

</style>

<title>Power Analysis App</title>

<meta charset="utf-8">

<meta name="viewport" content="width=device-width, initial-scale=1">

<link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">

<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>

<script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>

</head>

<body background="data:image/jpeg;base64,">

<div class="jumbotron text-center">

<h1>Power Consumption Analysis For House Holds</h1>

</div>

<div class="container">

<div class="row">

<div class="col-sm-4">

<div class="border">

<u><h3>Data Visualization</h3></u>

</div>

</div>

<div class="col-sm-4">

<div class="border">

<h3>ABOUT</h3>

<p align="justify">We have proposed a system that analyzes electricity consumption of individual

appliances, identify the energy consumption patterns apply statistical modeling

and suggest users about reduction of power consumption.The main objective

of this project is to analyze and visualize the energy consumption. The regular

consumption is captured through sensor and stored in database.We applied various

exploratory data analysis using various libraries, visualize them using matplotlib

and seaborn and suggest the user based on consumption. Web application to

visualize the Analysis. Get insights from the data. suggests the user based on insights.</p>

<p>Things used:</p>

<ul>

<li>Time series analysis</li>

<li>Matplots</li>

<li>Resampling techniques</li>

<li>Multiple regression</li>

<li>Python for data analysis</li></ul>

</div></div>

<div class="col-sm-4">

<div class="border">

<h3>Prediction</h3>

<div class="form-group">

<form action="http://localhost:5000/login" method="POST">

<label>Voltage:</label>

<input type="text" class="form-control" name= "vol">

<label>Submetering1:</label>

<input type="text" class="form-control" name="sb1">

<label>Submetering2</label>

<input type="text" class="form-control" name="sb2">

<label>Submetering3</label>

<input type="text" class="form-control" name="sb3">

<label>Global reactive power</label>

<input type="text" class="form-control" name="gr">

<label>Global intensity</label>

<input type="text" class="form-control" name="gi"><br>

<button>Submit</button>

<p>Global active power:</p>

<b>{{label}}</b>

</form>

</div>

</div>

</div>

</div>

</div>

</body>

</html>

<!DOCTYPE html>

<html>

<meta name="viewport" content="width=device-width, initial-scale=1">

<style>

body {

font-family: Verdana, sans-serif;

margin: 0;

}

\* {

box-sizing: border-box;

}

.row > .column {

padding: 0 8px;

}

.row:after {

content: "";

display: table;

clear: both;

}

.border{

border-radius: 25px;

padding: 20px;

border: 4px solid black;

background-color: white

}

.column {

float: left;

width:30%;

}

/\* The Modal (background) \*/

.modal {

display: none;

position: fixed;

z-index: 1;

padding-top: 100px;

left: 0;

top: 0;

width: 100%;

height: 100%;

overflow: auto;

background-color: black;

}

/\* Modal Content \*/

.modal-content {

position: relative;

background-color: #fefefe;

margin: auto;

padding: 0;

width: 90%;

max-width: 1200px;

}

/\* The Close Button \*/

.close {

color: white;

position: absolute;

top: 10px;

right: 25px;

font-size: 35px;

font-weight: bold;

}

.close:hover,

.close:focus {

color: #999;

text-decoration: none;

cursor: pointer;

}

.mySlides {

display: none;

}

.cursor {

cursor: pointer;

}

/\* Next & previous buttons \*/

.prev,

.next {

cursor: pointer;

position: absolute;

top: 50%;

width: auto;

padding: 16px;

margin-top: -50px;

color: white;

font-weight: bold;

font-size: 20px;

transition: 0.6s ease;

border-radius: 0 3px 3px 0;

user-select: none;

-webkit-user-select: none;

}

/\* Position the "next button" to the right \*/

.next {

right: 0;

border-radius: 3px 0 0 3px;

}

/\* On hover, add a black background color with a little bit see-through \*/

.prev:hover,

.next:hover {

background-color: rgba(0, 0, 0, 0.8);

}

/\* Number text (1/3 etc) \*/

.numbertext {

color: #f2f2f2;

font-size: 12px;

padding: 8px 12px;

position: absolute;

top: 0;

}

img {

margin-bottom: -4px;

}

.caption-container {

text-align: center;

background-color: black;

padding: 2px 16px;

color: white;

}

.demo {

opacity: 0.6;

}

.active,

.demo:hover {

opacity: 1;

}

img.hover-shadow {

transition: 0.3s;

}

.hover-shadow:hover {

box-shadow: 0 4px 8px 0 rgba(0, 0, 0, 0.2), 0 6px 20px 0 rgba(0, 0, 0, 0.19);

}

</style>

<body>

<h1 style="text-align:center">Data Visualization</h2>

<div class="row">

<div class="column">

<img src="gap-m.png" style="width:100%" onclick="openModal();currentSlide(1)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="gap-q.png" style="width:100%" onclick="openModal();currentSlide(2)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="gar-m.png" style="width:100%" onclick="openModal();currentSlide(3)" class="hover-shadow cursor">

</div>

</div>

<div class="row">

<div class="column" >

<img src="gar-q.png" style="width:100%" onclick="openModal();currentSlide(4)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="sb1-m.png" style="width:100%" onclick="openModal();currentSlide(5)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="sb1-q.png" style="width:100%" onclick="openModal();currentSlide(6)" class="hover-shadow cursor">

</div></div>

<div class="row">

<div class="column">

<img src="sb2-m.png" style="width:100%" onclick="openModal();currentSlide(7)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="sb2-q.png" style="width:100%" onclick="openModal();currentSlide(8)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="sb3-m.png" style="width:100%" onclick="openModal();currentSlide(9)" class="hover-shadow cursor">

</div>

</div>

<div class="row">

<div class="column">

<img src="sb3-q.png" style="width:100%" onclick="openModal();currentSlide(10)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="vol-m.png" style="width:100%" onclick="openModal();currentSlide(11)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="vol-q.png" style="width:100%" onclick="openModal();currentSlide(12)" class="hover-shadow cursor">

</div>

</div>

<div class="row">

<div class="column">

<img src="w1.png" style="width:100%" onclick="openModal();currentSlide(13)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="w2.png" style="width:100%" onclick="openModal();currentSlide(14)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="w3.png" style="width:100%" onclick="openModal();currentSlide(15)" class="hover-shadow cursor">

</div>

</div>

<div class="row">

<div class="column">

<img src="revssb1.png" style="width:100%" onclick="openModal();currentSlide(16)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="revssb2.png" style="width:100%" onclick="openModal();currentSlide(17)" class="hover-shadow cursor">

</div>

<div class="column">

<img src="revssb3.png" style="width:100%" onclick="openModal();currentSlide(18)" class="hover-shadow cursor">

</div>

</div>

<div id="myModal" class="modal">

<span class="close cursor" onclick="closeModal()">&times;</span>

<div class="modal-content">

<div class="mySlides">

<div class="numbertext">1 / 18</div>

<img src="gap-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">2 / 18</div>

<img src="gar-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">3 / 18</div>

<img src="gap-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">4 / 18</div>

<img src="gar-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">5 / 18</div>

<img src="sb1-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">6 / 18</div>

<img src="sb1-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">7 / 18</div>

<img src="sb2-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">8 / 18</div>

<img src="sb2-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">9 / 18</div>

<img src="sb3-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">10 / 18</div>

<img src="sb3-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">11 / 18</div>

<img src="vol-m.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">12 / 18</div>

<img src="vol-q.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">13 / 18</div>

<img src="w1.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">14 / 18</div>

<img src="w2.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">15 / 18</div>

<img src="w3.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">16 / 18</div>

<img src="revssb1.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">17 / 18</div>

<img src="revssb2.png" style="width:100%">

</div>

<div class="mySlides">

<div class="numbertext">18 / 18</div>

<img src="revssb3.png" style="width:100%">

</div>

<a class="prev" onclick="plusSlides(-1)">&#10094;</a>

<a class="next" onclick="plusSlides(1)">&#10095;</a>

<div class="caption-container">

<p id="caption"></p>

</div>

<div>

<div class="row">

<div class="column">

<img class="demo cursor" src="gap-m.png" style="width:100%" onclick="currentSlide(1)" alt="Nature and sunrise">

</div>

<div class="column">

<img class="demo cursor" src="gap-q.png" style="width:100%" onclick="currentSlide(2)" alt="Snow">

</div>

<div class="column">

<img class="demo cursor" src="gar-m.png" style="width:100%" onclick="currentSlide(3)" alt="Mountains and fjords">

</div></div>

<div class="row">

<div class="column">

<img class="demo cursor" src="gar-q.png" style="width:100%" onclick="currentSlide(4)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="sb1-m.png" style="width:100%" onclick="currentSlide(5)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="sb1-q.png" style="width:100%" onclick="currentSlide(6)" alt="Northern Lights">

</div></div>

<div class="row">

<div class="column">

<img class="demo cursor" src="sb2-m.png" style="width:100%" onclick="currentSlide(7)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="sb2-q.png" style="width:100%" onclick="currentSlide(8)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="sb3-m.png" style="width:100%" onclick="currentSlide(9)" alt="Northern Lights">

</div></div>

<div class="row">

<div class="column">

<img class="demo cursor" src="sb3-q.png" style="width:100%" onclick="currentSlide(10)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="vol-m.png" style="width:100%" onclick="currentSlide(11)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="vol-q.png" style="width:100%" onclick="currentSlide(12)" alt="Northern Lights">

</div></div>

<div class="row">

<div class="column">

<img class="demo cursor" src="w1.png" style="width:100%" onclick="currentSlide(13)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="w2.png" style="width:100%" onclick="currentSlide(14)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="w3.png" style="width:100%" onclick="currentSlide(15)" alt="Northern Lights">

</div></div>

<div class="row">

<div class="column">

<img class="demo cursor" src="revssb1.png" style="width:100%" onclick="currentSlide(16)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="revssb2.png" style="width:100%" onclick="currentSlide(17)" alt="Northern Lights">

</div>

<div class="column">

<img class="demo cursor" src="revssb3.png" style="width:100%" onclick="currentSlide(18)" alt="Northern Lights">

</div></div>

</div>

</div>

</div>

<script>

function openModal() {

document.getElementById("myModal").style.display = "block";

}

function closeModal() {

document.getElementById("myModal").style.display = "none";

}

var slideIndex = 1;

showSlides(slideIndex);

function plusSlides(n) {

showSlides(slideIndex += n);

}

function currentSlide(n) {

showSlides(slideIndex = n);

}

function showSlides(n) {

var i;

var slides = document.getElementsByClassName("mySlides");

var dots = document.getElementsByClassName("demo");

var captionText = document.getElementById("caption");

if (n > slides.length) {slideIndex = 1}

if (n < 1) {slideIndex = slides.length}

for (i = 0; i < slides.length; i++) {

slides[i].style.display = "none";

}

for (i = 0; i < dots.length; i++) {

dots[i].className = dots[i].className.replace(" active", "");

}

slides[slideIndex-1].style.display = "block";

dots[slideIndex-1].className += " active";

captionText.innerHTML = dots[slideIndex-1].alt;

}

</script>

</body>

</html>