

Information Technology ‘AISSMS Institute of Information Technology, Pune, India’

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Abstract: Today, our world is frequently facing a challenging environment everywhere. The main problem is energy crisis. New technologies like sensor networks have been incorporated in the management of buildings for organizations and cities. In recent years, Sensor networks have led to an exponential increase in the volume of data available, and monetary savings. For this purpose, new approaches and techniques are required to investigate information in big data environments. For this problem, having a relevant system to monitor the power usage is the only solution. This paper proposes an analytical model using energy profiles, which gives power consumption of a consumer over a period of time, to perform quantitative analysis using smart meters that automatically acquire context information. There are devices which are capable of measuring customer's energy consumption for example smart meter. In this paper, there are two modules. The first one emphasis on receiving the data from the smart meter and also send it to the data analyst. The second module is the predictive module which uses consumption data and information of the consumer in order to understand the behavioral patterns of the consumption of electricity. These trends can be used to predict energy consumption and also identify irregularities and outliers. The customer gets acknowledged about abnormal usage.

Keyword: Power consumption, Smart meter, Data analysis.

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I. Introduction

As electricity is time dependent phenomena, it is generated, transmitted and distributed in order to satisfy Consumer's demands and needs in certain moment. Power consumption in households has a significant influence on total consumption at distribution level. Huge amount of energy is consumed by various large scale industries like steel, iron, petro-chemical etc. Power consumption can be defined as power is the rate of doing work or transferring heat that is the amount of energy transferred or converted per unit time and consumption means the action of using up the resources. Power consumption in electrical terms is defined as amount of energy used per unit time. It is important thing that in industries and in digital system where we used electricity in huge volume. Digital system draw both dynamic current. Dynamic power is definitely used to charge capacitance as signals change between 0 and 1. Static power is definitely used even when signals do not change and system is idle. Power consumption is usually measured in units of Watts (W) or kilo-Watts (KW). It is the product of voltage as current supplied to the appliance. Every appliance or electronic device we use is reflected in our monthly bills. But, some of those devices are costing us more than others. To know such devices power consumption is necessary. With power consumption We can understand which device has consumed how much power and thus control the energy hogs and lower down our bills. Even small adjustments can help whittle down our expenses. We only need two numbers to get started: The device's wattage and the number of hours we use it per day. It is also estimated that the price of electricity and demand is going to increase in upcoming years.

This paper mainly deals with power meter, which utilizes the features of embedded system i.e. the combination of hardware and software in order to implement the desired functionality. It also discusses the use of SmartMeter-Elite-440-445, ethernet module and IOT Gateway with sim-card. Smart meter is an electronic device

which records the consumption of electric energy and communicates the information to the electric supplier for billing. Elite 440 is a multi-line- three phase panel for accurate and reliable measurement of electric parameters. Using this we can achieve a cost effective online monitoring. Similarly, IOT Gateway is a device which provides the bridge between IOT devices in the field, cloud and other user equipments. It provides critical functionality i.e. device connectivity. Whatever data is collected through the smart meter is connected to the server or the cloud using IOT gateway. Hence using these devices this paper basically aims to analyse the consumption of electricity consumed by a particular appliance, which in order notifies the user about the increase in consumption and thus reduces the bills and electricity consumed.

I. FACTORS INFLUENCING ELECTRICITY PRICES

Power sector is not only a question of financial or electrical engineering but also about telling the consumer to pay the power they have consumed.

1. Fuel:- Fuel cost vary during periods of high demand such as natural gas which results in higher price for fuel and in return it gives higher price of electricity.

2. Transmissions systems:- These systems provide electricity on a very large scale which repairs the damage to the system from extreme weather conditions. As the cost and supply of electricity varies minute by minute the grid of the power reflects the real-time cost of supplied electricity. Electricity demand is mostly high afternoon and evening which is directly proportional to the cost. Many users pay prices according to the seasonal average cost, they do not experience such type of fluctuations. So, the problem of electrical consumption goes and we may not use less electricity in our day to day life but we have to access some features which helps us to lessen the amount of money. People can save money by making use of power saving products. But these power saving modes optimizes the electricity that moves through the system and makes sure that whether it is not wasted and that all is utilized by the consumers.

II. Literature Survey

Monitoring and control of electricity consumption using raspberry Pi through IoT() in this paper researchers tested functionality of system by using different appliances. They were able to design a system which allows the user to monitor home energy consumption. The system is connected to the database where user can view the past readings of energy consumption. As it monitors and controls electrical lines it does not analyse the data and predict the data consumed

Big Data Analytics for Discovering Electricity Consumption Patterns in Smart Cities(Ruben Perez-Chacon,Luna Romera) in this system the model based on the k-means algorithm was designed for the purpose of using the distributed computing advantages of Apache. The studies about their CVI's optimized for parallelization-the DB Dunn was carried out. From these numbers majority voting strategy was applied in order to choose optimal number clusters. In case in this system the depth analysis of clusters were performed but they were not analysed daily or hourly basis.

Electricity Consumption and Clustering Using Smart Meter Data(Alexander TurecZek, Per Sieverts Nielsen) In this, paper has been showing that the transformation of data and information prior to the K-means clustering can effectively progress the results or performance and enabling K-means to handle data of different types for which it was not originally intended. This results make it possible to produce clusters from smart meter data that are better defined through smaller clusters with less within-cluster variance. Furthermore, this paper implemented an unsupervised version of cross validation enabling stability measures of the validation indices.

The Determination of Load Profiles and Power Consumptions Of Home Appliances(Faith Issi) In this system the idea that they have evaluated and observed from obtained data, the working cycles and structures of each home appliances are determined in brief. Behaviour of energy consumption and power consumption analysis were performed and load profile data for each home appliance. It creates a large and huge realistic load profile and power consumption data which are used by researchers and power distribution energies. The residential consumers take the opportunities of available resources and optimum capacity

An Advanced IoT-based System for Intelligent Energy Management in Buildings(Vangelis Marinakis, Haris Doukas) In this system implementation of web based and integrating the above mentioned architecture has been done. Tool has performed a very important role of immediate and complete virtual distribution on the Internet of the energy consumption in buildings and commercial buildings..Users might get updated on the energy consumption and other indicators like energy, CO2 emissions on the website. The system analyses data amongst four major groups and displays the result.

Average Power Consumption Estimation and Momentary Power Consumption Profile Generation of Softcore Processor(Berna Ors) In this module post implementation simulation and power consumption was performed using different outputs and different work environments. A momentary power consumption profile generation method has been introduced to be later used in channel attack resistance analysis, with some graphical results presented.

III. Proposed Methodology

The implementation of this model involves the hardware and software stages. The hardware involves the gathering of all the required information while the software involves the programming(Analysis) and monitoring of the collected data. The architecture of the model is shown in Fig. 1

1. Power Supply:

Power is supplied to the model to carry out the complete process by converting the electric current from the source to current voltage.

2. Smart Meter:

Elite 440 (Smart Meter) is a multi-line three-phase digital panel meter for accurate measurement of electrical parameters such as voltage, current, power and frequency for industrial and commercial applications. Smart meter plays an important role in collection of data. It is not the same as regular meter because it not only displays the consumed data but also saves all the received data for certain limit(days or years). It is a device which will record the consumption of electric energy and would communicate it to the supplier for monitoring and also for billing. Smart meter will record the information hourly or frequently, and report at least each day. Communication from the meter to network can be via wired(Power Line Carrier) or wireless(Cellular communication, WiFi, ad hoc networks, ZigBee, etc) method of communication.

3. Cloud (Transfer of data from smart meter to cloud):

To transfer the data from smart meter we have used a hardware called as IOT Gateway. It is used for remote monitoring of analog and digital inputs via Cellular network. It acts as modbus master for multiple slave field devices and provide data connection to the server. It is designed to be used in industrial panels and operate on 24V DC, 1A power supply

4. DataAnalysis process:

4.1 Collection of Data Smart meters would use a secure Wifi connection to automatically send the actual energy usage to the supplier. This means there won't be any estimated or false values of household readings. The meter will automatically send the readings to supplier in intervals of 15 minutes to 1 hour. All these readings which are collected by the system are forwarded to perform further processing. 4.2 Preprocessing of the collected data Data preprocessing is a method of data mining that involves transforming raw data into an understandable format. Power consumption information may be incomplete, inconsistent or lacking in certain behaviors, and maybe it contains many errors. Data preprocessing is used to prepare raw data for further processing. The missing values in the data set are filled in with the average of that column or NULL. 4.3 Analysis of Parameters The clustering of consumers is being performed on the type and number of appliances they are associated with. In order to do so the different types of appliances and their consumptions are to be identified. The effect of each and every appliance on the complete consumption is always understood to set the parameters for clustering.

5. Display of predicted and analysed data:

The data collected in cloud is being processed or analysed, using this analysed data the further data is also predicted. Purpose of predicting data is that we can take measures before something goes wrong. So to acknowledge the user about the power consumption per day, per week,etc; we will display analysed as well as predicted data in the form of graphs, pie charts,etc for better understanding of the end user.

Fig 1. Architecture of proposed model

IV. Conclusion And Future Work

Smart meter is used to produce considerable volume of data presenting the opportunity to enhance for utilities end customer service, improve energy efficiency and lower the cost and to reduce the bill and save energy for consumers. The system aims to analyze the data, understand the energy profiles and appliances that affects the consumption profiles to group similar consumers together. Setting standards for efficient energy consumption is aided by the analysis and it also identifies the outliers and irregularities in the consumption patterns. The system also calculates the energy consumption of devices and even make the energy unit reading to be handy. Hence it also reduces the wastage of energy and bring awareness among them. Even it can reduce the manual intervention..The proposed system will overall help all the industries to lower down their electricity bills and will give a detailed analysis of the electricity consumed by appliances during the particular duration of time.

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