IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 9, Issue 7, July 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0907085 |

Clustering Analytics for Streaming Smart Grid Datasets

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ABSTRACT: The underlying aim of every technology is to ease human efforts as far as possible, so with this objective in mind we set off to achieve another such goal. Electricity is the most important driving force behind the development of any country. Thus it has to be made sure that electricity that is generated by righteous of immense expenditure, hard work, labor is supplied to the consumers in an equally judicious way by the aid of latest technology available. The main purpose of this technique is to supply a strong and a handy tool for the energy provider's administration who are concerned with the electrical bill generation of consumers .It will help them in generating the bill without taking much efforts and make things less cumbersome. Parameters of electricity like current, voltage etc. are taken as input from database for training. From dataset of various parameters, we calculated energy and current consumed. Bill is generated from calculated current. The generated bill uses tariff/electricity rate used by MSEB from bill calculation. CNN compares features extracted from input data with those from dataset and accordingly classify and predict 1) power quality, 2) energy, 3) generate bill and 4) forecast load.

KEYWORDS: CNN, Machine Learning, load forecasting, smart meter

I. INTRODUCTION

The awareness of electricity existed, people knew about the shock that was present inside electric fish. There is a rapid progress in the early 19th century in electrical science. Then again, the greatest advances in electrical engineering were made in the late 19th century. The presence of charge gives rise to an electrostatic force: charges exert a force on each other, an effect that was known but not understood, in antiquity. According to the science, motion is an electric charge, and it is measured in amperes. There is a concept called electron, which is nothing but two charge particles produce current.

Electric current can flow through some things called as electrical conductors, but the opposite is called an insulator which will not flow. Electricity generators are the one's which supply electricity, but electricity can also be supplied from chemical sources such as electric batteries or by other means from a wide variety of sources of energy. Electricity is a very convenient way to transfer energy, and growing, number of uses. Incandescent light bulb was discovered in the 1870s. This led to the lighting becoming one of the firstpublicly available applications of electrical power. Electricity was not part of the everyday life of many people, even in the industrialized Western world during the early 20th century.Electricity became very popular during the Second Industrial Revolution. With and becoming a necessity of everyday life in the latter half of the 20th century, it required particular attention by popular culture only when it stops flowing, an event that usually signals disaster.

Electricity has an important role in our day today lives. It has come to a significance that without electricity it is impossible to survive. The electricity consumed by the commons are measured with the electric meter which is fixed at every individual's home. This is then periodically noted by the supplier most probably the government employee to calculate the energy consumed.

Traditional meter reading for electricity usage and reading is done by human operator. He has to go door-to-door and give the bill slips of the utilization to the respective consumer. They go to each and every house to check for the number of units that has been consumed.The manual reading has defects such as errors in reading, inaccuracy, external conditions that influence the measured values, leads to a delay of the work.In addition, the traditional technique also requires large manpower. In order to resolve all these issues, an automatic energy meter reading is proposed. By automating the meter reading process the labor employed could be reduced and they can be used for other works.This is discussed in detail in the subsequent chapters tofollow.

A. Motivation

In the existent system, electricity meter reading for electricity usage and billing is done by human workers from

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home to home and building to buildings. This requires numerous number of workers and long working time to gain complete area data collection and billing. Human workers billing are subject to reading error as sometime the houses electric meter is placed where it isn't easily accessible.Workers billing job is sometimes restricted and slowed down by bad environmental condition. Paper billing has the likelihood of losing in the post box. The increased development of local housing and industrial buildings in the developing country for example, India require more human workers and longer working hours to complete the usage reading task.This enlarges the energy provider's operation costs for meter reading. In this paper, dataset is provided to system, from dataset system calculates power quality, forecast load, generate bill and calculate energy.

B. Objectives

To generate electricity bill after a small period from given dataset. To developed application for electricity bill payment. To monitor quality of power. To forecast load from given set of values. To design and developed a system in Python, which can be able to fulfill above mention objective.

II. LITERATUREREVIEW

In [1], KanchanMahajan et al proposed electricity billing system with an automation that can be achieved by implementing Ad-Hoc networks. The wireless technology can be used to the certain level, such that even complex Problems can be handled in an easier way.Wireless networks are wont to eliminate the utilization of cables and power lines that connect every household during a specific area.In current system there is less automation available for taking the electricity readings so usually readings are taken manually. This system has many drawbacks like since all the readings are taken manually it can be easily manipulated by third person who may affect the EB office as well as customer. Time constraint is also a major factor that affect the process. The amounts of entities involved in this current EB system are affecting the reliability of this system. The end user issolely aware about the consumption of electricity and its habits. This paper will help to automate the process of meter reading collection, the user side interface application is to be designed to automate the process of bill payment.

In [2], the design of a simple low cost dual mode wireless GSM based energy meter and its associated features is presented for making the job of metering easier. Also it enables the energy provider to monitor the monthly readings without the person visiting each house. A GSM-based wireless communication module is integrated with electronic energy meter of each entity to have the remote access over the consumption of electricity. Hence this system has been designed by keeping in view the system which is of paramount importance. The system will also enable the consumer to know his meter-readings at the end of every month through a SMS to his subscribed phone number. This mode of the system provides flexibility and transparency to the customer to pay his due amount on the very day on bill generation.

System proposed in [3] measured the energy consumption in each house and generates the bill automatically with Arduino and Wi-Fi. The main goal of this work is to reduce the energy consumption in houses by notifying the owner continuously about the amount of units that are consumed. The goal of this work is to automate the billing process by checking the electricity unit's consumption in a house and hence eventually reduces the manual labor. The calculations are carried out automatically and the bill amount is updated on the Internet by the help of Wi-Fi. The bill amount can be checked by the owner anywhere and at any time by just visiting the website or the online portal.

In [4], system proposed eliminates the need of manpower for the electricity billing system. Not only does it eliminate the need of manpower but it serves to be a more accurate method as there is no human intervention. It also requires no paper for billing purpose. The chances of losing the bill is also eliminated as the bill amount is being sent to the customer as SMS using a GSM module interfaced with the energy meter.

In [5], an automatic electric bill payment system is proposed which reduces human effort. Further the solution that has been proposed supports the smart city vision. The system measures electrical units that are being consumed by the consumers, using Raspberry Pi, and it sends consumption data to the supplier's cloud server wirelessly. The consumption cost is calculated at the server as per government norms. An e-bill is generated at the server side and delivered to the customer via developed Android application. The proposed system has been tested in real time and the usage statistics displayed on the Android application is verified.

In [6], an efficient monitoring of power qualities parameters is presented. A power quality monitoring system can be developed by designing virtual instruments using Lab-VIEW software, which is an interface with hardware data

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acquisition system. The PQ-Monitors are designed and installed at the customer level so as to trace the PQ disturbances generated by various nonlinear loads. The PQ-Monitors are designed for multipurpose usage such as event recording, raw data collection and also further PQ analysis purpose.

In [7], a system is proposed with high efficiency and robustness. The user has to register first and then the data of user will be stored at the cloud. The access to the internet is via android which has a unique MAC id so the exchange of meter can't be possible. The billing are going to be automatic through the server-based unit. For defaulter, the customer electricity connection can be cut through the relay on the electric meter. Thus, manual work gets avoided.
In [8], a voltage sag detection technique for a single-line-to-ground (SLG) fault is presented using the PMU measurement data for improving the power quality. Various voltage sag detection techniques have been discussed to detect the voltage sags. This technique detects the voltage magnitudes, frequency, rate of change of frequency and phase jump of voltage for a single-line-to-ground(SLG) fault.
In this Paper [9] it has been reviewed the various recently used devices such as Remote terminal unit, digital signal processor, microcontroller, etc. that can monitor the power quality issues. The survey also discusses the communication techniques like wireless, wire-based communication used for the transmission of knowledge from the facility system network to the system operator and control techniques like Dynamic Voltage Restorer, Shunt Active Power Filter, etc. In addition to that, the paper has discussed the monitoring of various power quality parameters in the transmission line using a motor load experimental setup. The SIGVIEW software is capable of capturing the real-time signal under different conditions and analyzes the various distributions of the signal such as frequency distribution, probability distribution, etc. using MATLAB program In, survey id carried out mainly on power quality monitoring systems which are composed of various tools, software, communication links etc. that work together as one coherent system.

Further goal is to develop an understanding about the quality management in the area of power industry. Some of the methods and techniques that are presented have discussed about the power quality meter placement techniques. Finding the best locations to place the power quality monitors in the electrical-grid is done by developing numerous algorithms and approaches to find the appropriate number of monitors and the appropriate locations are placed in order to reduce the cost of the PQM system and increase its efficiency. The paper discussed the basic idea of each method or system in order to have an understanding about its importance and role.A simple comparison is made between the techniques in terms of their advantages and disadvantages.

III. SYSTEM DESIGN

A. *Specification ofinput/output*

Input: Smart Grid Dataset
Output: Predicted Meter Reading & Bill, Load Distribution Graph, Voltage Change Graph, Load Forecasting Graph

B. *SystemArchitecture*

System Architecture Automatic Electric Bill Generation System is a prolog to digitize the paper work and the reduce the human efforts for the energy provider and well as the consuming authority. The main motive of this system is to issue a robust and a handy tool for the energy provider's administration who are concerned with the electric bill generation of customers. It will help them in generation of the bill without much struggle and make things less cumbersome. Block diagram of stated system is shown in figure below:

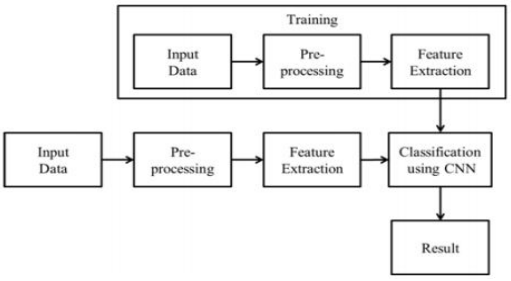

Fig 1: System Architecture

International Journal of Innovative Research in Computer and Communication Engineering

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C. Convolutional Neural Networks

A Convolutional Neural Network (CNN) is an algorithm which recognizes the spatial and the temporal dependenciesin the image through application of relevant filters for differentiating one image from another. For classification problems, one or more full connection (FC) layers are often employed. The final layer outputs prediction values (such as posterior probability or likelihood) for K kinds of objects where the input image should be classified in layers.

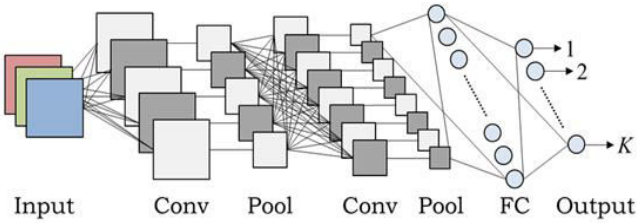

Fig 2: CNN Layers

IV. RESULTS

The system is capable of forecasting meter reading and corresponding bill amount for single household. Also system provides several graphs for analysis purpose.

A. Meter reading and bill amount forecasting

This module forecasts the smart meter reading and its bill amount using CNN algorithm. It calculates the bill amount according to current MSEB guidelines.

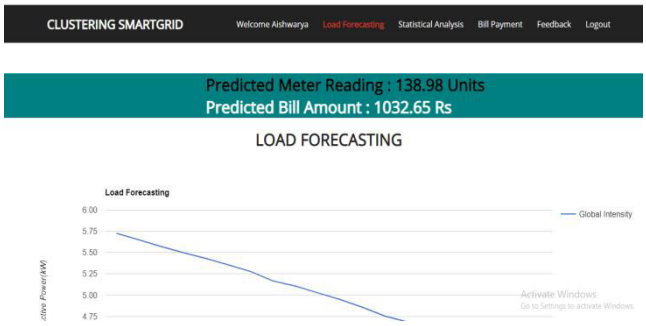

Fig 3 : Bill Predication

B. Load Distribution

This module provides the line graph which shows the load consumed by three sub-meters of smart meter.

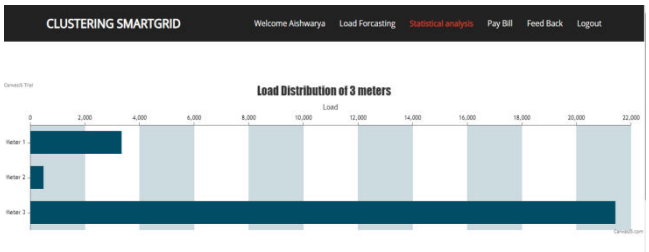

Fig 4 : Load Distribution

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C. *Change in Voltage*

This part of system provides the line graph. It is the depiction of change in voltage occurred according to dataset. It shows the change in voltage for 10 days and helps in alerting user about voltmeter needs.

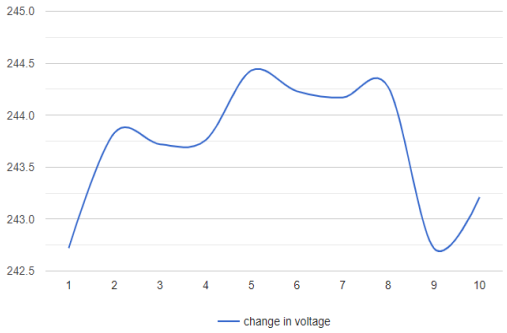

Fig 5: Change in voltage

D. *Load Forecasting*

This module provides load forecasting for next few days by considering the existing values. This provides the line graph of Global intensity v/s Global Active power.

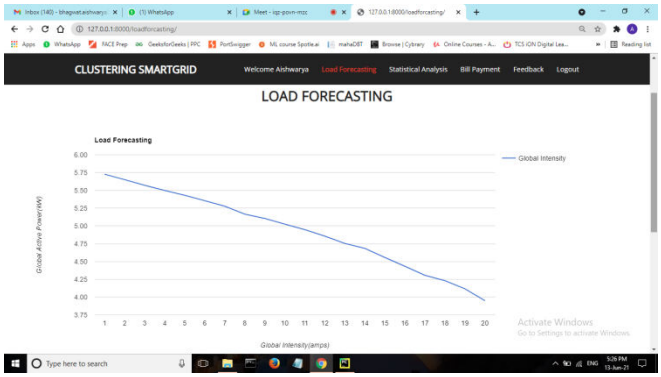

Fig 6. Load Forecasting

V. CONCLUSION

The designed system are going to be very beneficial to our society also as country's economic development. This system allows consumer to watch the electricity usage on frequent basis. The system enables the service provider to autonomously disconnect the power-transmission to the actual meter from a foreign server. The system is efficient because it reduces human involvement, increases accuracy in meter reading, prevent billing mistakes.The meter reading system has the benefits, such as, transmission speed is quick, the reliability is high, realtime is robust and therefore the operating expense is low. From the experimental results we have observed that the automatic electric billing system overshadows the traditional system of taking the readings by many factors.

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| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 9, Issue 7, July 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0907085 |

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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