

Smart Electric Metering and Billing using IOT

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Abstract— In the present busy world, automation is ruling the world. In this paper there is a system that implements the automation on electric metering and billing. It uses IOT sensors to estimate the usage of electricity and billing is done accordingly. There is also application of intelligence where if someone steals the electricity it must be indicate the supplier about it. This will reduce the human effort very much and also reduce the power wastage, and helps for proper utilization of electric power and also making the earth a better place to live in.)

Keywords—Automation, iot, intelligence.

I. INTRODUCTION

From the time of invention, till day, energy meters have undergone several advancements, from electromechanical meters to more sophisticated and accurate digital and electronic meters. Traditionally in India the conventional electromechanical meters are used but now in resent time those are replaced by new electronic meters to improve accuracy in meter reading but still those new meters are not cost efficient and needs human interference[1] ,an employee from electricity office needs visits every house periodically, takes the meter reading and submits these readings at main office. These readings are used to generate the bill[2].

So there is a need for an automated electric billing system that could automatically collect the meter reading from each house and calculate the bill accordingly. And send the bill amount through text message or email. Implementing this system could highly reduce the human involvement and this will also increase efficiency. By observing the data which is collected across from different place one can estimate the total power consumption and predict the power loss. This system can also be used to detect the power theft by analyzing the power consumption. Energy theft constitutes an issue of great importance for electricity operators[3]. This paper presents a computational method that uses energy consumption measurement patterns to detect illegal residential consumers in a smart grid environment. In general, electronic meters (smart meters) collect real-time information from the consumers several times per day. The sensors and arduino used in the system which makes this system highly automatic the customer has to pair this system with his smart phone this is the only work which needs human involvement. This system also includes the data analysis. In which data is collected continuously and based on the user activity the electricity theft will be detected, so how this analysis is done is explained in bit at the end of this paper.

II. LITERATURE SURVEY

The energy billing system used nowadays need many labour and its time consuming. Errors are inevitable at every stage of billing. Some are human errors while noting down the meter readings, and during other stages of billing, this may cause heavy loss to the electric board and also effect the efficiency of the system. So to overcome this a new automated system has to be created [1].



Fig. 1. Old analog electro-mechanical electric meter



Fig. 2. New digital electric meter

In this paper the author has proposed a Automatic Electricity Billing , in this method employs a camera which is fixed in front of the meter is used to take the snapshot. The captured image is then processed and the meter reading is extracted. The bill amount is calculated and is send to customer as SMS via GSM module. A copy of SMS is sent to the electricity board for documentation purpose [2].

Energy theft constitutes an issue of great importance for electricity operators. The attempt to detect and reduce non-technical losses is a challenging task due to insufficient inspection methods. With the evolution of advanced metering infrastructure (AMI) in smart grids, a more complicated status quo in energy theft has emerged and many new technologies are being adopted to solve the problem. In order to identify illegal residential consumers, a computational method of analyzing and identifying electricity consumption patterns of consumers based on data mining techniques has been presented. Combining principal component analysis (PCA) with mean shift algorithm for different power theft scenarios, we can now cope with the power theft detection problem sufficiently [3].

In this research, studies have been conducted in making wattmeter which is interfaced with a personal computer utilizing Arduino microprocessor and LabVIEW program. This study consists of conditioning analog signals, converting the analog signal into a digital signal (ADC), and digital data processing. This wattmeter displays voltage, electric current, power consumption, energy use, frequency of the power source, and the usage fees calculation[4]

In this paper author has present a system using an Android smart phone that collects, displays sensor data on the screen and streams to the central server simultaneously. Bluetooth and wireless Internet connections are used for data transmissions among the devices. Also, using Near Field Communication (NFC) technology, we have constructed a more efficient and convenient mechanism to achieve an automatic Bluetooth connection and application execution. Furthermore, a Java-based central server application is used to demonstrate communication with the Android system for data storage and analysis.[5]

“Bluetooth” wireless technology is designed as a short-range connectivity solution for personal, portable, and handheld electronic devices. Since May 1998 the Bluetooth SIG has steered the development of the technology through the development of an open industry specification, including both protocols and application scenarios, and a qualification program designed to assure end-user value for Bluetooth products[6].

III. PROPOSED SYSTEM

In the system we are trying to automatically fetch the electric meter reading and send that reading to the customer smart phone and later the reading will be sent to the electric board and bill will be generated and this bill copy is sent to customer. The meter reading will be automatically fetched by the system and this will be sent to the customer Smartphone. This can be done by using Arduino Uno, and this reading can be sent to customers smart phone using Bluetooth module [4]. Whenever the user connects to the system using Wifi/Bluetooth the reading will be synchronized with the consumers smart phone and the meter reading data will be sent to the electric distribution board. Using this data the electric distribution board will charge for the power consumption and bill will be generated, and distribution of this bill will be made using email or a text message.

IV. METHODOLOGY

This research, designed a wattmeter with a simpler sensing circuit. Input circuit consists of only voltage and current sensors, while processing circuit using 4051 analog multiplexer and Arduino Uno microcontroller which has been integrated with a power supply. The output is shown using computer monitor. In this research, power supply circuit of the microcontroller, which consumes USB power, is used as the power supply of wattmeter circuit. Measurement simulation of voltage, current, power consumption, and used energy is done using LabVIEW software. After that, the wattmeter is tested by comparing the measurement results with the other trusted wattmeter. Phase difference can be determined through the programming process. Thereby, wattmeter designed using the Arduino microcontroller and the LabVIEW program is more effective and efficient use of materials[4]. Later using Bluetooth wireless connection the collected data reading will be sent to the user smart phone, Arduino that communicates via Bluetooth with the smart phone for data collections, and streams data simultaneously to the central server for data storage and analysis via the Internet[5].

A. Theft detection technology

Later in a electricity distribution board a computational methodology for automated detection of illegal use of electricity in a local low voltage distribution network based on Principal Component Analysis (PCA) combined with the mean shift clustering, which is verified from the presented experimental results will be implemented. Simulations with different numbers of power theft scenarios, different percentages of partial power theft cases different percentages of power overload cases, and different consumption patterns for every consumer. The insertion of smart meters via commercial power system analysis software is essential for the implementation of the proposed method in order to receive energy consumption measurements several times per day.

Except for the frequent electricity consumption scenarios mentioned, various combinations of these scenarios can be simulated. The number and the type of electrical device used on a daily basis at home is constantly changing. Nevertheless, the most intense loads are space heating, space cooling, water heating, refrigeration and lighting. The freezer is included in the base load because it is a permanent electricity consumer for the whole year, while the cooling load(heating, ventilation, air condition) is seasonal. The electrical loads that are included for residential consumption patterns are shown in Table 2.

TABLE I. FREQUENT ELECTRICITY CONSUMPTION FOR DOMESTIC SCENARIOS OF RESIDENCIAL CUSTOMERS

Scenario	Description
1	Absence from home 09:00 up to 13:00. Possibly inhabitants have part-time work in the morning.
2	Home absence from 09:00 up to 18:00. Possibly inhabitants have a full time work.
3	Home absence from 09:00 up to 16:00.

4	Full home presence. Possibly infant existence under people supervision or elderly people presence
5	Home absence from 13:00 until 18:00. Possibly part time job during evening
6	Full absence on weekdays and partial presence during weekends. Possibly cottage existence near to the permanent residence
7	Almost complete home absence. Presence only some days of the year for holidays. Possibly existing cottage far away from the permanent residence

TABLE II. LOAD CATEGORIES AND ELECTRIC LOAD

Load Categories	Electrical Loads
Personal hygiene	Water Heater, Hair Dryer
Watching TV	Television
Heat, Cooling	Electrical Heating, Heat pump
Household chores	Vacuum cleaner, dishwasher, washing machine
Study	Computer
Base Load	Refrigerator, Freezer

the electricity consumption data at the consumer level are analyzed in order NTLs to be identified when unusual electricity consumption events are observed. Moreover, in the beginning of every line and for every consumer, we have installed the minimum number of sum meters and smart meters respectively, in order to examine the total power consumed over 6 months and for every 15 minutes. At the moment, smart meters are able to measure the electricity consumption every minute, but, because of communicational system limitations, they send data once a day or once a week or even once a month. However, such measurements would be available in the near future. Moreover, in the real world,

consumer smart meters do not work synchronously and because of communication delays, there is a slight time difference among the measured values recorded. This difference would be a source of error in the method proposed due to the fact that the method considers the measurements of all meters to be received at the same time instance. By mining this data and analysing the reading one can detect the electricity theft.

CONCLUSION

This system uses very simple technology and can perform with high efficiency and stability. By using simple IOT technology one can overcome two problems of electric billing that is involvement for any human error while billing and other is electricity theft. Using this system it is very convenient for the customer to pay the electric bill. This technology can be implanted in every home which has Smartphone with internet connection. This system can be installed in both domestic and corporate usage.

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