

# Cloud Enabled Automatic Energy Meter Reading System

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## Abstract

Energy production & consumption are the key words that account for a nation's growth. The progress of a nation is mainly determined by the amount of clean and green energy that the nation is able to afford for its citizens. It becomes the responsibility of every citizen to preserve energy and help in the growth of the nation. The objective of this work is to monitor energy utilized by every individual and make them aware of their energy usage, thereby helping them use energy in a sensible way reducing the expenses incurred on energy purchase. The automated energy monitoring system also reduces the errors due to manual intervention and helps the users plan their energy usage & reduce their billing accordingly. This system is implemented using cloud enabled Machine Learning Application. The high end easy implementable feature makes the prototype easily attachable to the existing system in every user's place. The System also reduces the cost spent on energy usage per user there by saving the amount spent on energy consumption of every user.

**Keywords:** Automation, Cloud enabled system, Energy consumption, Machine learning.

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## I.INTRODUCTION

Extensive research work is done for the purpose of energy production & its effective utilization. The metering system for energy was introduced in the early 18<sup>th</sup> century. The first energy meters were electro mechanical in nature, slowly moved on to electronic techniques and communication methods got gradually incorporated in the process of meter reading. Various sophisticated device friendly meters came into usage later with the development of technology. Few examples of this category include plug in electricity meter which provides high accuracy. The new era of electricity meter bloomed up with great advancements in the field of electronics. Ever since electronic meters was

introduced, the concept of smart solutions became quite possible in their implementations.

The various applications of electronic metering include recording power usage in blocks, Automatic meter reading (AMR), Remote meter reading (RMR), Home energy monitoring etc. Some advancements in metering like pre-payment meters, time of day metering, Power export metering came possible in due course. These developments in metering marked a good start for energy producers and consumers to plan their energy production & consumption. Fig.1 gives various types of electrical meters since its inception.



Figure 1. Various electrical meters

These electrical meters vary in size & shapes and their usage in real time varies as per the application. This proposed system goes for the development of an Add-On device to the already available electricity meters. This add-on device is incorporated with real time monitoring of the energy usage. Real time energy measurement makes possible various control techniques to be incorporated into the system. The difficulty faced in the past scenarios were overcome by the recent advances in computing mainly cloud computational techniques. This paper incorporates cloud storage. This paper is divided into the following sections: Earlier systems, proposed methodology, results & discussion followed by conclusion.

## II. EARLIER SYSTEMS

The earlier method for the purpose of AMR observations are

1. Touch technology
2. AMR Hosting
3. Radio Frequency Network
4. Hand held meters
5. Mobile meters
6. Satellite transmission methodology
7. Power Line Communication
8. Wi-Fi

These are techniques that were used in the previously used methodologies and are discussed below in detail. In Touch technology, a probe with

data collection device or a computer is used. The probe when brought close to the meter notes the reading of the energy meter. The data collection device is available with software and notes the serial number of the energy meter and saves it for future use. In the methodology using AMR Hosting, offline technique is used. The User can track their electricity usage over the internet. A web application is used in this method which the users for various kind of analysis like knowing about tariff component analysis, to analyse on their load profiles etc. This is the current methodology which we use in India and consumers know about their energy consumption online and pay their energy bills accordingly.

The Radiofrequency (RF) network methodology uses licensed and unlicensed RF bands for transmission of readings from the meter. The form of communication used in this can be single way or the system can use two way communication. In One way communication, the electricity meter can be only a transmitter keeping on broadcasting the data in regular intervals and the reading device on the other side will be a receiver only. The RF devices have the limitation of regulation barrier in many countries. The RF methodology takes up various variants like Hand held type, Mobile meters and satellite transmitters. The RF technologies use either narrow band or spread spectrum for communication. Certain electricity meters use Wi-Fi as the mode of communication. In Power Line Communication (PLC), the electronic data is sent via the power lines. It is one of the very old technique that has the limitation of the data being transmitted when the power line is cut or damaged by any other sources. This limitation led to the advent of electronic meters.

All the methods used earlier had its own limitations and it was not completely real time and user friendly in the complete perspective. To overcome these limitations, the proposed system implements energy meter reading in real time and with reliable cost of implementation to the already existing meter.

### III.SUGGESTED SYSTEM

The Suggested System incorporation can be divided into three sections:

1. Customer side
2. Hub for a region
3. Cloud storage

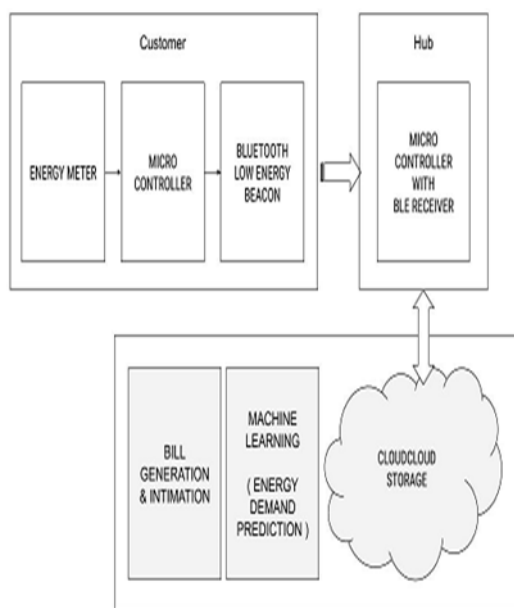


Figure 2: Proposed system

The first section in the proposed system starts from the customer side. The energy meter available with the user is added on with a microcontroller and a blue tooth low energy beacon. This microcontroller and the blue tooth energy beacon continuously transmits data from the used side to the hub. This data transfer is similar to energy sent using RF methodology to the receiver. But RF technology had the disadvantage of regulation barrier difficulties. This difficulty is overcome by using Blue tooth technology.

The data sent from the user in the first section is transmitted to the hub nearby which is available with blue tooth enabled receiver together with a microcontroller. This part is to be incorporated as a hub when users of a particular area send their energy usage to the nearby hub. This is similar to data transmitted from user to substation.

The data from the hub is then transmitted to cloud storage. The cloud storage takes the complete responsibility of storing the energy consumed per user as per their serial number allotted. In addition, machine learning technique is used for complete energy utilization analysis of the user. This helps the user in planning his energy utilization and reducing his bills accordingly. The energy savings when computed on a long term basis helps in easy redemption of the add-on investment paid.

### IV.SUGGESTED SYSTEM FEATURES

In India, the current scenario for power utilization billing is that the meter reader comes bi-monthly to every user's place & records the readings in a hand held device. This reading noted is then made online in a day or two. The user can either the energy consumed by him online or the meter reader marks the same in the electricity bill book and pay for the energy consumption by him for the corresponding two months. The user can also verify online about the split of energy usage charged to him as making him aware of the number of units utilized by him day wise for the corresponding 2 months. He can also verify his bi-monthly consumption details year wise and have knowledge on the peak and very less paid tariff of his energy consumption over a period of one year.

The implementation of this system makes the recording of energy consumption per user as and when the user makes use of his utilities. This eases the laborious task of the meter reader going into every user's place and noting down the reading in regular intervals and uploading the same online. Also, the errors in meter can be known only when the meter reader comes & checks for the reading. But in the proposed system the errors incurred in the meter will be known immediately and the errors can be rectified now and then the problem occurs.

Consider the scenario of user payment bill as shown below:

TABLE I: Tariff chart for Bimonthly and monthly electricity meter reading

Users	Number of Units	Tariff	Rate
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	Consumed monthly		(Rs.)
User I (S.No.100001)	250(100+150)	Rs.2 for first 250 units	$250 \times 2 = 500$
User II (S.No.100002)	500(225+275)	Rs.2 for first 250 units and Rs.4 for next 250 units	$250 \times 2 = 500$ $250 \times 4 = 1000$ Total to be paid : <b>1500</b>

It is clear from the user I (S.No:100001) perspective that if it's monthly or bi-monthly the proposed system is not going to make a big change in his energy consumption bills. This is evident from the comparative analysis in Table I.

As far as when User II(S.No: 100002) is considered,his energy consumption chart when done monthly will fetch him a lot of benefits.If the meter reading is done monthly, he would pay a cost of Rs.450 for the first month and Rs.600 for the second month. The sum of the amount paid for both would give a cumulative total of Rs.1050 only when compared to his Rs.1500 payment when the reading is done bi-monthly. The amount payment details of User 1& User 2in the bar chart given in Fig.2.

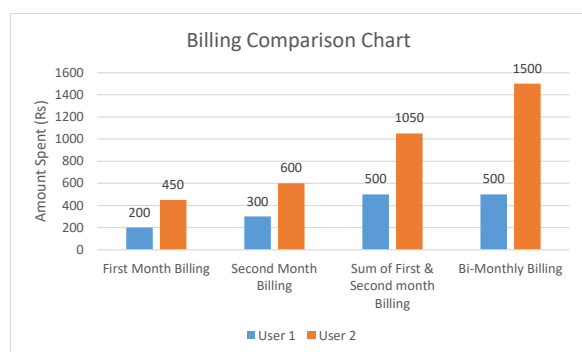


Figure 2 Comparative User Billing Chart

When the payment is done monthly, User II gets a savings of Rs.450 for just two months. In the long run, the user will be hugely benefited and the initial investment can be easily redeemed.

## V.MACHINE LEARNING

Machine learning is a specific approach to Artificial Intelligence (AI).It can be looked upon as a categorized channel of AI.This technology makes the device learn the minds of users and are capable of giving sensible fruitful suggestions. The proposed system is also incorporated with machine learning techniques that help in proper planning of energy consumption.

When considering the example above, the user II could have still reduced his energy consumption bills if he was able to reduce his consumption by 25 units less for the second month. If he had done so, he would have got as cost savings of Ra.100 on his monthly bill for the second month.

Machine learning is an approach that is capable of doing this task so easily and accurately by means of various algorithms. These algorithms build their own model based on the sample data they receive and use this data for future references as and when needed by the user. It uses the concept of predictive analysis and can alert the user of preponing or postponing his energy consumption task there by giving a large savings on costs incurred in energy consumption.The various algorithms that machine learning incorporates can be supervised learning, unsupervised learning,Reinforcement learning, Self-learning,Feature learning,sparsedictionary learning etc.

Supervised and self-learning algorithm gives a better result for the proposed system. The Supervised learning algorithm trains the system with specified number of standard inputs & outputs.

The Machine learning algorithm not only helps the users, but also supports the energy providers with the pattern of energy consumption per user over an area.This study of energy consumption in a particular area helps the providers to plan their allotment of power to particular sector there by avoiding unnecessary power shutdown,



Low Voltage issues etc. The energy providers will be aware of sudden rise & fall of energy requirements and can guarantee a reliable supply throughout the year. This also safeguards the devices & equipment used for transmission of power. The equipment will not have to undergo sudden surge currents through them.

## VII. CONCLUSION AND FUTURE WORKS

This paper presented an Add-on device that can be incorporated with the existing electricity meters capable of adding benefits to both energy providers & consumers. The one time investment of this add-on device at the user side can reap him benefits multifold. The providers are also made aware of the energy requirements of the users and plan energy diversion from substation accordingly. This would greatly ensure safety of the devices used for transmission of energy. The future scope of this work can be extended in terms of adding the add-on device to existing energy meters and incorporating various machine learning algorithm and compare the same.

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