# A Survey of IOT Based Electricity Monitoring

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***Abstract***- **In the current scenario, if there is any problem regarding the power supply to houses, the consumer have to call their respective electricity board(EB) which sometimes turns out to be useless. And also during the natural disasters like floods, storms, seasonal power cuts people doesn't even know when the power will be back. In order to rectify all these problems we are going to create a module which will be set in each household. This module detects the power break down and automatically informs to the EB. If EB is going to cut the power to check lines in an area, they can priorly inform the people about the cut. Gas leakage can also be detected and main supply will be turned off automatically.**

**Index Terms- Smart Meter; Power Monitoring; internet of things; GSM; Arduino; Smart Home; voltage regulator; LM35; MQ2; Web Portal.**

## INTRODUCTION

Electricity is one of the most important blessings that science has given to mankind. But this energy used by unauthorized person cause losses to utility and also pollutes the environment. Losses in electricity energy sector can come under two sets: technical and managerial. Technical losses of electrical energy are caused due to the functional tendency of the equipment used from generating station to the distributing station. Non-Technical losses are due to lack of utility labor interference periodically. These losses are much higher in developing countries like India and is difficult to find particular spot where the losses occur.

The proposed system consists of digital energy meter, an Arduino (microcontroller), GSM modem and SSR. After switching power on the Arduino and the GSM modem, turn on the SSR and connects the energy meter to load via SSR. Then read the EEPROM and display the current data in Arduino.

## INTERNET OF THINGS FOR SMART CITIES

The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of a plethora of digital services. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. In this paper, we focus specifically to an urban IoT system that, while still being quite a broad category, are characterized by their specific application domain. Urban IoTs, in fact, are designed to support the Smart City vision, which aims at exploiting the most advanced communication technologies to support added-value services for the administration of the city and for the citizens.

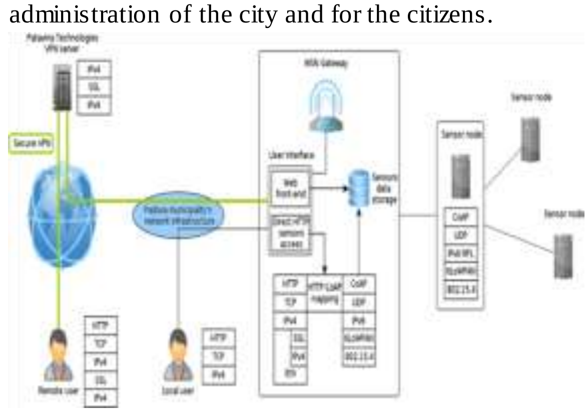


Fig1.example of smart city

| Service | Network type(s) | Traffic rate | Tolerable delay | Energy source | Feasibility |
|---|---|---|---|---|---|
| Structural health | 802.15.4; WiFi and Ethernet | 1 pkt every 10 min per device | 30 min for data; 10 s for alarms | Mostly battery powered | 1: easy to realize, but seismograph may be difficult to integrate |
| Waste management | WiFi; 3G and 4G | 1 pkt every hour per device | 30 min for data | Battery powered or energy harvesters | 2: possible to realize, but requires smart garbage containers |
| Air quality monitoring | 802.15.4; Bluetooth and WiFi | 1 pkt every 30 min per device | 5 min for data | Photovoltaic panels for each device | 1: easy to realize, but greenhouse gas sensors may not be cost effective |
| Noise monitoring | 802.15.4 and Ethernet | 1 pkt every 10 min per device | 5 min for data; 10 s for alarms | Battery powered or energy harvesters | 2: the sound pattern detection scheme may be difficult to implement on constrained devices |
| Traffic congestion | 802.15.4; Bluetooth and WiFi; Ethernet | 1 pkt every 10 min per device | 5 min for data | Battery powered or energy harvesters | 3: requires the realization of both air quality and noise monitoring |
| City energy consumption | PLC and Ethernet | 1 pkt every 10 min per device | 5 min for data; tighter requirements for control | Mains powered | 2: simple to realize, but requires authorization from energy operators |
| Smart parking | 802.15.4 and Ethernet | On demand | 1 min | Energy harvester | 1: Smart parking systems are already available on the market and their integration should be simple |
| Smart lighting | 802.15.4; WiFi and Ethernet | On demand | 1 min | Mains powered | 2: does not present major difficulties, but requires intervention on existing infrastructures |
| Automation and salubrity of public buildings | 802.15.4; WiFi and Ethernet | 1 pkt every 10 min for remote monitoring; 1 pck every 30" for in-loco control | 5 min for remote monitoring, few seconds for in-loco control | Mains powered and battery powered | 2: does not present major difficulties, but requires intervention on existing infrastructures |

Table1:

The Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet. The IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices such as, for instance, home appliances, surveillance cameras, monitoring.

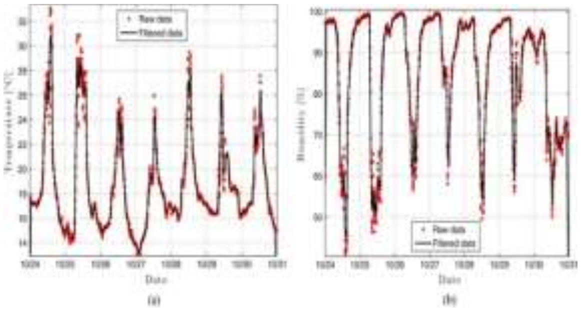


Fig2.Example of data collected by Padova Smart City: (a) temperature and (b) humidity.

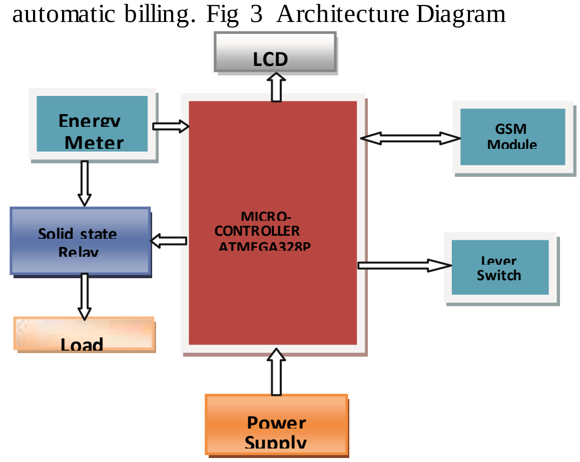
In this we analyzed the solutions currently available for the implementation of urban IoTs. The discussed technologies are close to being standardized, and industry players are already active in the production of devices that take advantage of these technologies to enable the applications of interest, such as those described in Section II. In fact, while the range of design options for IoT systems is rather wide, the set of open and standardized protocols is significantly smaller. The enabling technologies, furthermore, have reached a level of maturity that allows for the practical realization of IoT solutions and services, starting from field trials that will hopefully help clear the uncertainty that still prevents a massive adoption of the IoT paradigm. A concrete proof-of-concept implementation, deployed in collaboration with the city of Padova, Italy, has also been described as a relevant example of application of the IoT paradigm to smart cities.

❖ Smart Energy Metering and Power Theft Control using Arduino & GSM:

Energy theft is a very common problem in countries like India where consumers of energy are increasing consistently as the population increases. Utilities in electricity system are destroying the amounts of revenue each year due to energy theft. The newly designed AMR used for energy measurements reveal the concept and working of new automated power metering system but this increased the Electricity theft forms administrative losses because of not regular interval checkout at the consumer's residence. It is quite impossible to check and solve out theft by going every customer’s door to door.

A new procedure is followed based on MICROCONTROLLER Atmega328P to detect and control the energy meter from power theft and solve it by remotely disconnect and reconnecting the service (line) of a particular consumer. An SMS will be sent automatically to the utility central server through GSM module whenever unauthorized activities detected and a separate message will send back to the microcontroller in order to disconnect the unauthorized supply. A unique method is implemented by interspersed the GSM feature into smart meters with Solid state relay to deal with the non-technical losses, billing difficulties, and voltage fluctuation complication.

The Keywords are GSM, power theft, Smart meter, Nontechnical losses, power monitoring, tampering, automatic billing. Fig 3 Architecture Diagram




Drawbacks of the regular energy meter:

Highly depends on meter reader.

- Human error cannot be avoided for the manual meter reading.
- Always there is no cross checking or recheck of human readers for energy utilization.
- High chance of stealing and bribery always high to misuse it especially during events.
- Possibility to change the reading when taking photos of energy meter by using software tools.

- More number of meter reading employees is extra expenses to the company for hiring them and their expense on traveling too expensive one.
- Wherever energy meter installed inside the house, which may lead to non-checking of reading due to lock.
- The consumer is not receiving updates of his regular usage of energy.
- The consumer may not receive his energy bill as per regular interval of the due date.

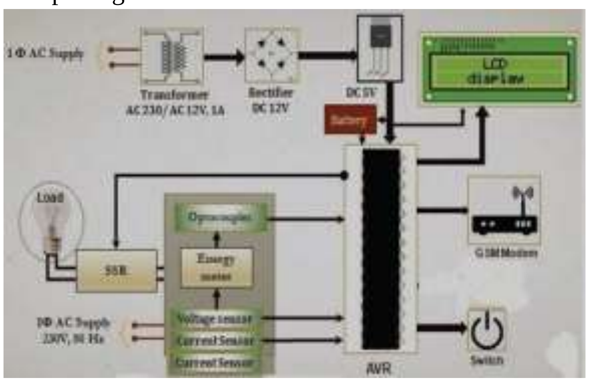



Fig 4. AVR system Implementation Circuit Diagram

This is the combined hardware advantage for both utility and the customer. Arduino, SSR, and GSM stationed Energy Meter for smart metering, power theft detection, and voltage variation is built which is able to read and send data via wireless protocol using GSM technology through GSM modem, capable of managing and controlling the supply to that meter through SSR. In the case of power theft, defaulter meter line cutting/joining labor system is reduced. Power consumption, power quality, and its accuracy can be monitored by the consumers directly in their mobile. This process will reduce the labor work and human error in the distribution system and also protect the consumer equipment.

Power cloud based energy monitoring in smart cities

In the last few years, the strong decentralization of energy production, fostered by the adoption of small renewable energy plants directly connected to the grid, has been placing the end user at the center of the electrical system management. Indeed, the end user has become at the same time producer and consumer of electricity. In addition, groups of end users are encouraged to form the so-called energy districts in which the energy is exchanged locally or negotiated, without intermediaries, directly with the energy provider. This paper proposes Power Cloud, an Internet of Things solution for energy districts.

Power Cloud injects smartness into the management of an energy district by supplying a distributed computing layer that controls the physical devices of the end users, and interacts with a centralized cloud component that manages the whole district. In particular, each end user dwelling is equipped with a Smart Energy Aware Gateway (SEAG), which monitors and controls a nanogrid and a home automation system. The SEAG computes the optimal energy strategy for the local dwelling, starting from information achieved by means of complex prediction algorithms that are purposely executed on the cloud.

The Index Terms are Nanogrid, Home automation system, Power Cloud, Prosumer

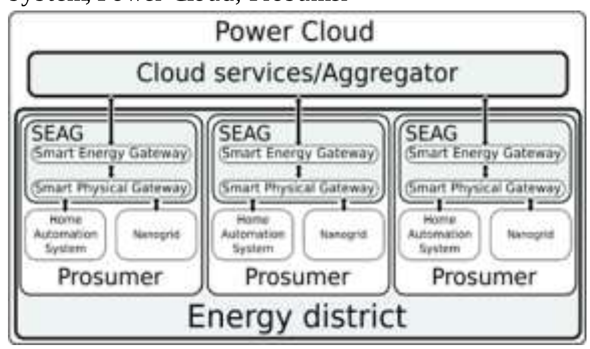



Fig 5:Architecture of a Power Cloud system

The two layers of the SEAG, i.e., the Smart Energy Gateway and the Smart Physical Gateway, are mapped respectively to the two layers of the iSapiens homemiddleware, namely the agent layer and the virtual object layer. In particular, a set of virtual objects are defined to abstract:

- the loads;
- the generation plants;
- the storage system;
- the distribution grid.

In addition, a set of agents are developed to execute the daily tasks summarized in Figure 2 and to monitor and control the physical devices through the virtual objects. As can be seen from the figure, the daily activities of a SEAG can be subdivided at a coarse-grain level into two stages. Moreover, it is possible to identify six phases, as outlined in the figure by the horizontal black dashed lines.

In the first phase, the dwelling inhabitants can set their preferences about the power profile of the loads for the following day. This operation must be concluded before a predetermined hour, after which all the SEAGs start the second phase. The user preferences can be set once and maintained for the following days, so there is no need to set them every day.

In the second phase, all the SEAGs ask the cloud service provider for the forecast of the production of their power plants and the hourly prices for importing/exporting energy. At this point, the SEAGs have all the information required to run the prosumer problem and move on to the third phase in which each of them communicates its hourly imported/exported energy profile to the aggregator. This concludes the first stage, as well as the third phase, since the aggregator is now able to compute the aggregated power profile for the whole district.

In this we have introduced the Power Cloud, an IoT solution for smart energy districts. All the dwellings in an energy district (prosumers) are purposely equipped with a Smart Energy Aware Gateway (SEAG) in charge of managing the nanogrid and the home automation systems, in order to optimize the energy behaviour of the dwellings. All the SEAGs interact with a centralized cloud component devoted to managing issues related to the whole district. The SEAGs take into account day ahead information retrieved from the cloud component in order to plan a suitable energy management for the following day.

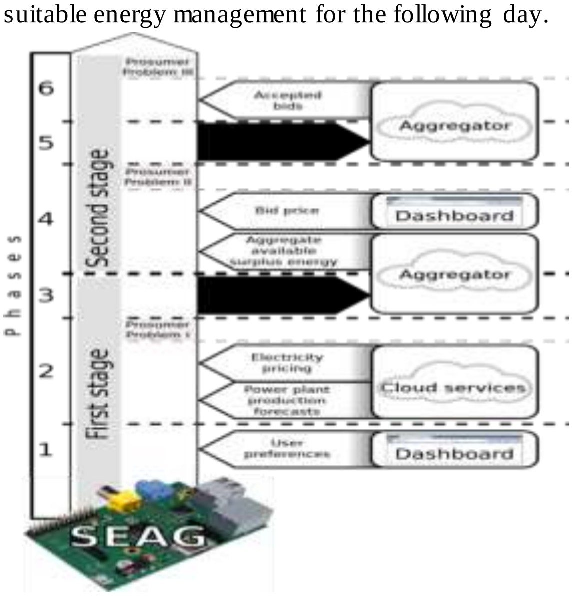



Fig.6

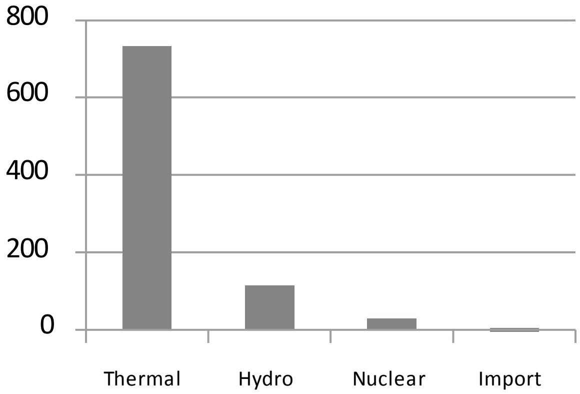
In particular, the daily-based work flow is divided in two stages. During the first stage the SEAGs plan a schedule for their devices based on the renewable energy production forecasts and the energy prices supplied by the cloud component. Afterwards, in the second stage, the cloud component engages with a set of auction procedures in order to reallocate any surplus of energy remaining after the first stage. Ongoing and future work is geared at:

1. Analysing the bidding strategies that optimize the energy reallocation during the second stage and the corresponding user benefits;
2. Testing the architecture in an actual energy district;
3. Integrating the thermal management of the dwellings.

❖ Distribution of Smart Electricity in Residential Areas

Energy is the foundation block for any socio economic development. There is a significant disparity in the growth rate of population fuelling a demand for energy and the installed capacity base of energy generation in India. Many countries worldwide, have adopted smart cities and smart metering program to cope up with the pressure of growing population and limited infrastructure with mixed results. The Indian government smart cities program to develop over hundred cities will require efficient power management to ensure uninterrupted power supply to all house hold and commercial establishments. This would require commissioning of smart meters generating petabytes (PB) of data on current readings, pilferage, damage, over current drawn, power factor and prepaid billing among other parameters of interest. This huge flow of data would require a supporting Information Technology infrastructure hosted on anytime-anywhere and highly scalable cloud platform providing storage and immense computing power. The beneficiary of such infrastructure would be the citizens, distribution companies and its analytics would help the policy makers. This paper aims at identifying the current energy developments in India, identify the use of ICT technology including Cloud and Internet of Things being adopted worldwide and finally the authors suggest key technology and power components for a Residential Smart Energy Distribution and lists down innovative analytics which can be derived from these components. Finally it lists down some futuristic suggestions by the authors to improve energy conservation, reduce operational costs and empower the customer with usage analytics.

Keywords— Internet of Things, Smart Metering, Cloud Processing, Data Intensive Computing, Electricity, Web Analytics



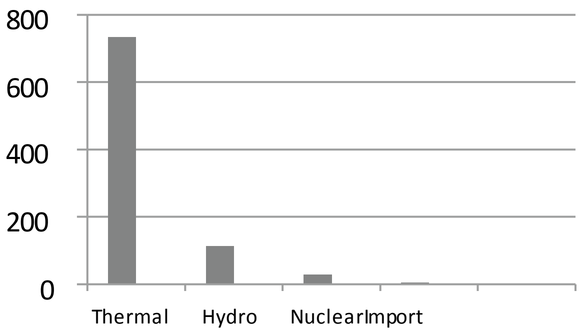




Fig. 8.April 14 - Jan 15 (BU) produced
Fig. 9.Demand vs Availability Jan 2015

Worldwide in Europe, America ,UAE and China consumers hardly face any power disruption mainly because of better energy production , consumption and conservation. India on the other hand has old and traditional methods of energy production , distribution and monitoring leading to heavy wastages of energy which could otherwise be channelized to provide uninterrupted power supply thereby improving quality of life overall. While industrial energy has many dynamics and challenges , residential power can more easily be regulated and managed and the authors feel the above small steps could prove to be a major facilitator on achieving this goal.

Future Work-The scope of future is that the system can be implemented for detection of power theft by recording and comparing the input supply and the power used by the houses present there. As an extension, the system can be made to learn about the pin perfect faults occuring in the distribution of power.

## CONCLUSION

This system detects fault in power supply to houses. As it is fully automated, it reduces the human effort to a large extent. It is very easy to implement with very low cost. A major drawback would be requirement of human source for constant monitoring of the web server. This system easy to operate and more efficient in controlling the power supply during the threatened times like gas leakage etc. It also helps to detect the power theft and spots the approximate location if there is any short circuit in power supply.

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