"SAVE ENERGY'

# Electric Times

EEE- AITS RAJAMPET

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| Vision | MISSION |
|---|---|
| We envision the Department as one of the best in the region with a stimulating environment to make an impact on and lead in the field through its Education and Research. | The mission of the Department is to provide an excellent and comprehensive education in the field of Electrical & Electronics Engineering which in turn moulds the students for a wide range of careers and to exhibit a high level of professionalism, ethical behavior and social responsibility. |

**Student Article:**

## 1. Home security system using internet of things

ABSTRACT:

IoT refers to the infrastructure of connected physical devices which is growing at a rapid rate as huge number of devices and objects are getting associated to the Internet. Home security is a very useful application of IoT and we are using it to create an inexpensive security system for homes as well as industrial use. The system will inform the owner about any unauthorized entry or whenever the door is opened by sending a notification to the user. After the user gets the notification, It can take the necessary actions. The security system will use a microcontroller known as Arduino to interface between the components, a magnetic Reed sensor to monitor the status, a buzzer for sounding the alarm, and a WiFi module

1. Introduction

IoT or Internet Things refers to the network of connected physical objects that can communicate and exchange data among themselves without the need of any human intervention. It has been formally defined as an "Infrastructure of Information Society", because IoT allows us to collect information from all kind of mediums such as humans,animals, vehicles, kitchen appliances. Thus any object in the physical world which can be provided with an IP address to enable data transmission over a network can be made part of IoT system by embedding them with electronic hardware such as sensors, software and networking gear. IoT is different than Internet as in a way it transcends Internet connectivity by enabling everyday objects that uses embedded circuits to interact and communicate with each other utilizing the current Internet infrastructure. The term IoT and its conception can be traced back to 1985 when Peter T Lewis spoke about the concept during his speech at Federal Communications Commission (FCC). Since then the scope of IoT has grown tremendously as currently it consists of more than 12 billion connected devices and according to the experts it will increase to 50 billion by the end of 2020. The IoT infrastructure has helped by providing real time information gathering and analysis using accurate sensors and seamless connectivity, which help in making efficient decisions. With the advent of IoT both manufacturers and consumers have benefited. Manufacturers have gained insight into how their products are used and how they perform out in the real world and increase their revenues by providing value added services which enhances and elongates the life cycle of their products or services. Consumers on the other hand have the ability to integrate and control more than one devices for a more customized and improved user experience.

An important factor to consider when we talk about home automation is Security. Home security is a very important feature of home automation and maybe the most crucial one. Home security made a drastic changes in the past few decades and continue to advance much more in the coming years. Previously home security systems meant having an alarm that would go off when somebody would break in but a smart secure home can do much more than that. Therefore the main objective of our work is to design a system which can alert the owner and others of an intruder break-in by sending a notification to their smart phones. The owner will also have the ability to stop or start the alarm remotely using just his smart phone.

This system will help the users to safeguard their homes by placing the system on the doors or windows and monitoring the activity through their smart phones. There has been an unprecedented growth in the number of devices being connected to the Internet since past few years. All these devices connected to the internet are part of the IoT infrastructure which can that allows these devices to send and receive data among each other. This is why it is beneficial to use such an existing infrastructure for designing the proposed security system. An alarm system that sounds the buzzer is of no use when a user is not present in the home to take action. When the owner is away communicate with each other.

The IoT network consists of embedded electronics, sensors and software from their home, they want to be assured that their home is protected by intruders and thieves while they are gone. This is why the proposed system keeps the owner informed in the real time about the security status of their home. The designed system informs the user as there is a break-in so that the user can take necessary actions. 3. Materials and

## 1. Materials and Methods

Various hardware materials are required to have an home automation system. Some of the essential components are listed below to have and idea about the proposed system.

*1. Arduino Uno*

Arduino is an open source, PC paraphernalia and programming organization, endeavour, and client group that plans and produce microcontroller packs for constructing programmed devices and intelligent object that can detect and control questions in the real world. The inception of the Arduino extend began at the Interaction Design Institute in Ivrea, Italy. The equipment reference plans are appropriated under a Creative Commons Attribution Share. Arduino Uno is shown in figure1.


*2. ESP8266 (WiFi Module)*

**Figure 2.** ESP8266 (WiFi Serial Transceiver).

The ESP8266 is an ease Wi-Fi chip with full TCP/IP stack and MCU (Micro Controller Unit) capacity created by Chinese . These are the primary arrangement of modules made with the ESP8266 by the outsider producer AI-Thinker and remain the most generally available. They are large alluded to as "ESP-xx modules". To shape a workable advancement Framework the
require extra parts, particularly a serial TTL-to-USB connector and an outside 3.3 volt control supply. The ESP8266 is shown in figure2.

*Reed Sensor Module*

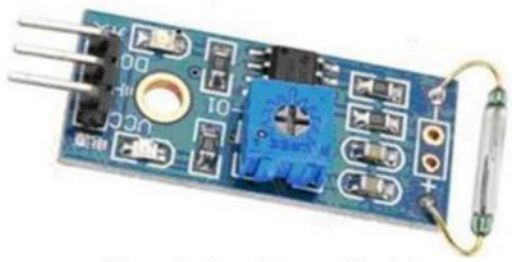


**Figure 3.** Reed Sensor Module.

In general, an electrical switch known as reed switch, worked by a connected field. It comprises of a fixed glass envelope where there are two ferrous flexible reeds and is loaded with idle gas called rhodium. At the point when an attractive substance ways to deal with the glass envelope, the reeds will meet up because of the attractive field subsequently finishing an electric circuit. At the point when the outer attractive field vanishes, two reeds will be isolated in view of their versatility, the circuit is likewise disconnected. It has been connected in printers, clothes washers, fridges, cameras, door magnets, window magnets, electromagnetic transfers, electronic measuring gadgets, level meters, gas meters, water meters, and so forth. Reed sensor module is shown in figure 3.

*3. Bread board and Jump wires*

**Figure4.** Bread board

**Figure 5.** Jump Wires

Before we begin connecting the hardware, we have to get the ESP8266 set up by flashing the latest version of the firmware available for the module. This is because the chip comes with an older version of the AT command firmware pre-installed out of the box which cannot communicate with the Blynk libraries efficiently and will give an error with our code. To flash the latest firmware, download the ESP8266 flasher tool and the latest firmware from the internet which would be in the bin format and set up the ESP8266 to the Arduino Uno as described below in figure 6.

| ESP8266 | ARDUINO UNO |
|---|---|
| GND | GND |
| GP2 | Not Connected |
| GP0 | GND |
| RX | RX |
| TX | TX |
| CHPD | 3.3 V |
| RST | Not Connected |
| VCC | 3.3 V |

**Figure 6.** Setup to enable ESP8266 Flash mode.

Once the ESP8266 has been flashed with the latest firmware, other components can be added to the configuration. For this we will need a breadboard to connect the microcontroller, reed sensor, buzzer and the ESP8266 using the jumper wires. The breadboard is used to interface between the various components available. It also makes it easy to connect multiple inputs to a single pin on the arduino board.

Following sketch shown in figure 7, which has been constructed using the Fritzing software shows how the components are supposed to be connected together using the breadboard and the jumper wires. The final configuration need not be identical to the given sketch, although the pins on each device needs to be connected to the same corresponding pins on the Arduino Uno board . The architecture diagram is shown in figure 8.

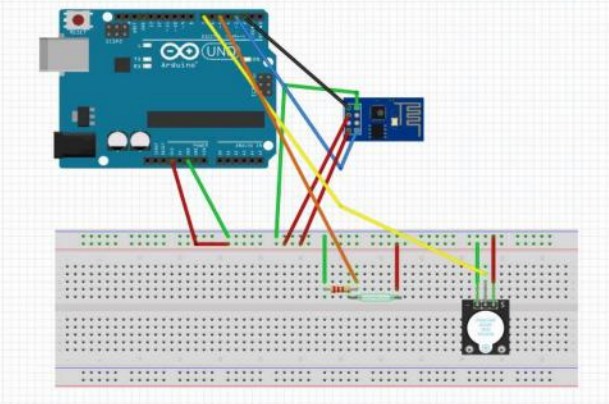


**Figure 7.** Sketch Diagram

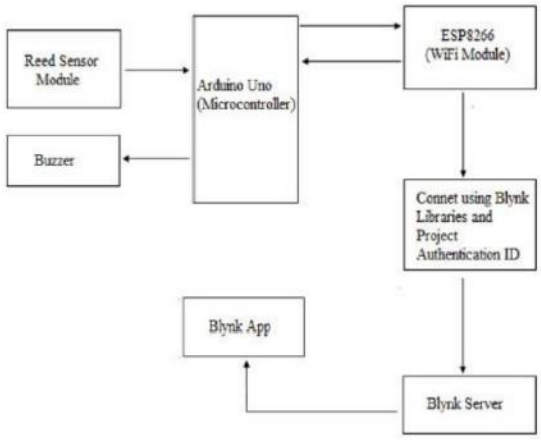



**Figure 8**: Architecture

## 2. Configuring Blynk App

After the user installs the Blynk app on the smartphone, an account has to be created in the app to access its services. The first time the app is opened, it will ask to either sign in or create an account. Create an account and add a new project to get started as given in figure 9. Each project has its own authentication code which is used by the code to communicate with that particular model as provided in figure 10. To interface with our components, we need to add widgets to our model. To add widgets press „+" to add to the model. The app provides a neat interface to add all the required widgets and setting them up according to the code as shown in figure 11. The Blynk needs to be running in the background for the user to get real time notifications.

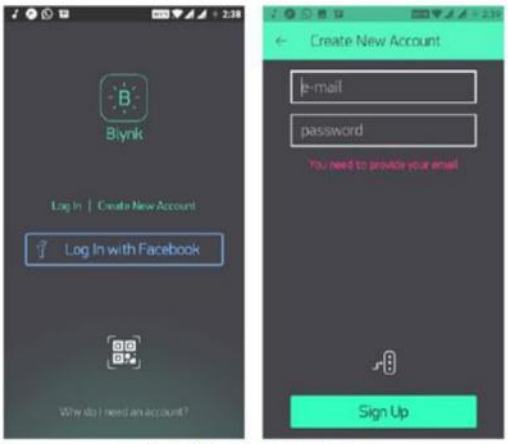



**Figure 9.** Creating a new account.

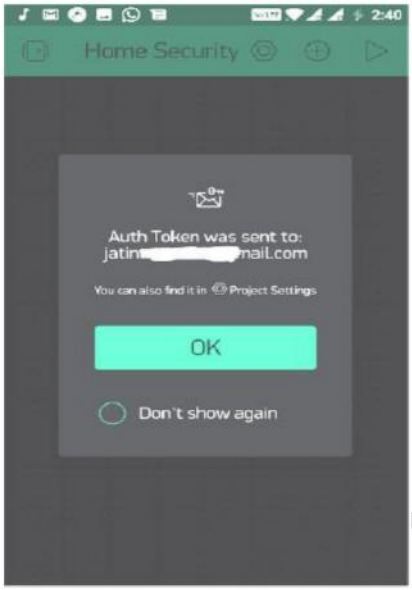



**Figure 10.** Authentication token.

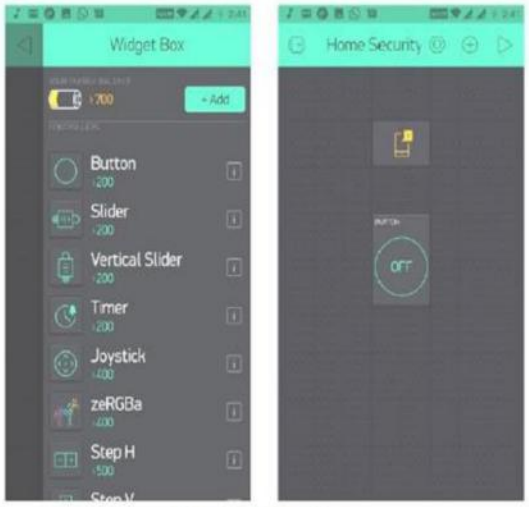



**Figure 11.** Adding widgets.

## 3. Experimental results

The experiment was carried out in Pentium iv 2.60GHz intel dual core processor, with 4 GB RAM, 15" LCD monitor with hard disk as 40 GB. The software required are Blynk App, Arduino IDE, in windows operating system using C++ programming language. The resultant system was checked thoroughly by repeating the motion of opening the door multiple times to see if each time a notification is sent or not and by remotely switching the buzzer on or off from the Blynk app which showed that the system works in the intended way and flawlessly. To test the endurance of the hardware, the setup was left turned on for a couple of hours and tested afterwards. The components got heated which is acceptable but still worked and the notification was shown in figure 12.


**Figure 12.** Screenshot of Notification.

## 4. Conclusion and future scope

The sensors placed on the door informs the home owner as soon as the door is opened by sending a Push notification. The user will get this notification irrespective of whether the phone is locked or unlocked or even if any other app is opened at the moment. This was the main objective of the project, which is the user feels safe and not worry about any intrusion or break-ins when he is away from home. This setup can also be used in commercial offices where some areas are restricted for certain personnel, such a system will immediately inform

the administrator of any unauthorized personnel trying to access such an area. Therefore the extensibility and applicability of such a system is only limited only by the imagination. Another important component of the project is the connectivity between the ESP8266 (WiFi module) and the Blynk server. The system successfully connected to the Blynk server using the authentication token and the Blynk libraries. As a result, we were able to get the notification on our smart phones as soon as there was any change in the status of the reed module sensor. Also the additional ability to control the alarm remotely is very beneficial and can be very useful in some unforeseen circumstances. It was also observed that the Blynk app worked smoothly and carried out all communication between the hardware and the app very accurately.

The developed system can also be used to in industrial and commercial applications such as offices, warehouses and other areas where some areas are reserved for authorized personnel only or other places where safety and precautions are of primary concerns such as internet server room of a big MNC from where corporate data can be stolen. The system can also be easily upgraded to add extra safety features such as cameras, motion detection sensors, etc. for increased safety. The system can also further be developed by adding an RFID scanner so that the authorized users need only carry a RFID or NFC tag with them on their person. The RFID scanner will work by scanning the tag wirelessly and if the user is authorized to enter, the alarm system will be disabled for some time so that the user can enter.

## 2. A REVIEW ON DEREGULATION OF POWER SYSTEM- P. Leela Vani

**Abstract:**

The content of this paper is intended for wide range of audiences - planning, dispatching, grid operations, energy trading businesses and electricity markets, with companies involved in the energy sector financing. The term electric deregulation is the process of changing the rules and regulations governing the electricity sector, which gives consumers the choice of electricity suppliers. In deregulation Removal of control and improving an economic efficiency of electricity are achieved. Due to competition, electricity prices are likely to fall in electric sector, which benefits consumers.

**Introduction:**

In regulated regimes, many old, inefficient or obsolete plants can continue to operate and recover investments, while in competitive regimes they may be out of the market. During regulatory regimes, consumers pay for stagnation, which leads to higher efficiency prices, while in a competitive environment, excessive capacity costs fall. Under competition, most of these risks are initially accepted by the owners they are responsible for bad decisions, good results and the profits of management practices. There is a strong appeal for investors to devise mechanisms to mitigate these risks by using a variety of tools available in the financial markets. Competition also improves transparency that adds significant value for customers. Restructuring the electricity supply industry is a very complex exercise in terms of national energy strategies and policies, economic developments and conditions, and its use varies from country.It is important to point out that there is no one solution that works for all countries and that there are different types of trends. Liberalization and deregulation or (restructuring) and privatization are all processes under the general label of market reform. Liberalization refers to the introduction of a less restrictive regulatory framework for firms within a power sector.

This can be subject to restriction, which is a modification of the existing regulation. Given that the new laws in the industry are in place with regulatory oversight bodies appointed to protect the interests of consumers, it could be argued that regulation is a more accurate term than regulation. If so, a

truly liberalized energy market operates within a regulatory framework, seen by a regulator, and the sale of government assets to the private sector without external political influence on participation, privatization is not enough Introduce competition in the reformed sector.

Competition will be the result of careful regulation of privatized firms to allow new entrants to access the market. Most market reforms have a competitive base and it has been introduced to reduce costs and increase efficiency. There is considerable variation in the amount of competition introduced. For example, competition can be introduced to create new productivity and is referred to as competitive bidding, where an existing manufacturing company invites tenders to build, operate and sell power to a monopoly at a certain price.

**Methodology:**

## Reformed Model:

The traditional central utility structure, it is not difficult to envisage that the high prices of electricity due to monopolies could drive some societies to resort tore form.

Generally speaking, the reasons for reform are complex and often political. In fact, the reformed structure is influenced by party politics in most cases. For instance, some government favor privatization because they wish to increase the net state revenue through asset sales and divestiture (divestiture refers to the sale, liquidation or spinoff of a corporate division or subsidiary) of fiscally draining state enterprises. However, this is beyond the scope of electrical engineering and readers who are interested can refer to the documents issued by the Energy Information Administration at its web site. The UK pioneered privatization and has been introducing full competition in its energy market. This is based on the belief that the regulated utilities know better how to make efficiency improvements when they are given the incentive to make the. Price- cap regulation is adopted as an attempt to reduce the power of natural monopolies in sectors that do not or cannot acquire full competition. The other motives of privatization included the reduction of central government's role in economic decision making, forcing privatized companies to become more accountable to owners and encouraging the creation of a shareholder society through wide spread stock ownership. However, not all countries follow there form as in the UK, many others prefer to introduce competition in generation with a centrally operated transmission system. The motives are obvious: efficient operation is essential to profit making and inefficiency is eradicated through competition.

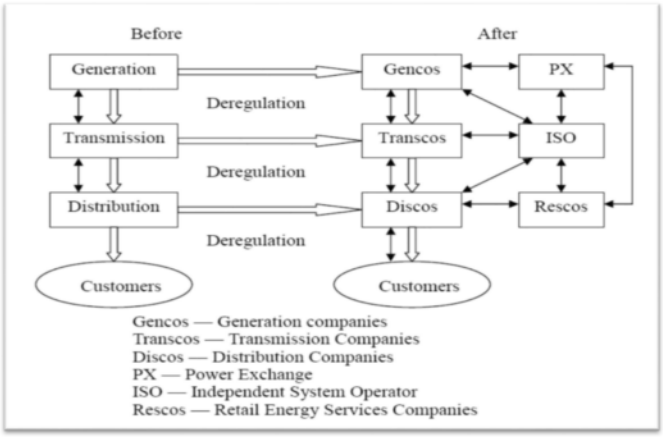



Figure: 1 Structure of Deregulation Environment

Components Involved in Deregulation:

- **Gencos**
- **Transcos**
- **Discos**
- **Rescos**
- **PX**
- **ISO**

- **Customer**

## Gencos:

Automatic Generation Control (AGC) is one of the all-important issues in the design and operation of electric power systems. The main purpose of AGC in a power system is to take care of the frequency of a given power area. If the interconnected facility is taken into account, AGC generators can adapt to unstable load demands by adjusting the megawatt output, without breaking the die-line power close to conventional values. Power Framework Models and Control Procedures. Structures Concerned with AGC Prevention Plan and Application Issues. Furthermore, a discussion of the challenges and judgments regarding the control techniques / structures reviewed is presented.

**Transcos:**

Whenever physical or functional barriers are active on a transmission network, the system is said to be congested. Limitations of congestion include: line heat limits, transformer emergency ratings, bus voltage limits, transient or oscillatory stability. These limits limit the amount of electrical energy that can be transmitted through an exchange between two locations through networking.Due to voltage instability, a contingency network should not allow flows to increase in the event of a fall. Distribution automation began in its simplest form, as discussed in the previous section Used to improve delivery quality. This level includes installed automation Auto- regenerators and auto-converter devices. The installation of remote terminal units provides the basis for a distributed communication system that can be used to enable partial automation. For the convenience of the reader, a backlink to comprehensive distribution automation and communication systems in a competitive environment has been added.

**Discos:**

As discussed in the previous section distribution automation in its simplest form has begun to be used to improve quality of supply. At this level the automation installed consists of auto reclosers and auto change-over devices.The installation of remote terminal units provides the basis for a distributed communications system that could be used to implement some degree of automation. For the convenience of the readers, an appendix is included below to detail distribution Automation and communication systems under a competitive environment.

**Rescos:**

This type of model is also called direct access model where all customers can choose their own suppliers. There is open access to transmission and distribution lines. Distribution is separate from retail operations and then competitive retail is wheeling. Retail is increasingly using competitive forces to bring all end consumers to the market. Retail competition greatly increases transaction costs by requiring more sophisticated trading arrangements and measurement**.**

**PX:**

PX handles the electric power pool, which provides a forum to match the electric energy Supply and demand based on auction prices. The time limit of the pool market may be in the range Half an hour to a week or more. Is the most conventional day facilitation market Energy trading a day before each operating day. The market ahead of the hour is also useful. This is because it offers more opportunities for energy trading to settle in the short term. In volatility, both the ISO and PX functions in the E&W system are within the NGC. In Arrangements for the future of emerging Asian organizations are more serious Discussion, e.g. China, India, Thailand, Indonesia and most of Africa.

**ISO:**

ISO is the highest company in the control of the transmission system. The basic requirement of an ISO is to deviate from all the market participants and free from any financial interest in the generation and distribution business. However, In the context of need, separate transfer rightsand open access to operations. For example, the owner and operator of the National Grid Company (NGC) (E&W) Transmission in England and Wales. The roles and responsibilities of ISOs vary Widespread and this issue will be discussed later in the next section. In countries like India. And regional phases of regional or state government and organization owned by China. The interconnectedness is now growing rapidly towards the national stage. Future ownership and ethics of operation are still evolving.

**Customer:**

The controlling economy benefits consumers because they can participate in efficient procurement and efficient consumer behavior and are rewarded with better customer service, because the customer is the king of the market economy.

**Different Models Of Power Utility Restructuring:**

- Vertically Integrated
- Integrated Model
- Open Access Model
- Retail Competition Model

- Spot Market Model
- Decentralized Generator Model

**(i) Vertically Integrated:**

The current generation is used for retail. Total sales are based on the new generation and the existing (excess) generation market (assuming regulatory approval). Utilities integrated with service obligations acquire incremental requirements through requests for projects. Applications may or may not bid on the "self-build" (rate-based) option. Utilities have a choice of price and non-price factors and signs that increase in terms of purchase power agreement (typically 5-7 years). Utility affiliates can also bid if approved by state regulators. Over time, as more and more are produced by purchasing power contracts, the rate base decreases. Transfer and delivery planning and operations are continuously done through integrated use. Integrated utility distributes power and makes retail sales at a rate determined by state regulators.

**(ii) Integrated Mode**

In this Integrated model, the generation and transmission functions are strongly coordinated on a long-term basis. The generation and transmission entities are integrated or at least have cross monopoly. The distribution can also be integrated to the generation-transmission benefit. The exists of competitive integrated model where generation is open to competition, but individualistic power producers or Non-Utility Generators (NUG) have no access to the grid and can only sell to the utility to which they are connected on long-term contact basis. This is also named as 'Purchasing agency model'.

**(iii) Open Access Model:**

In Deregulation OP Power System The Independent Power Products (now) R Permit to Transmit the Power Sizing Utility Transmissions and Distribution Systems. Generators need access to the transmission network and commercial arrangements for the network are required. In the Total Access System, the competition is expanding, where all generators can be sold to 47 customers. More buyers make the market more competitive and energetic.

**(iv) Retail Competition Model:**

This type of model is also called direct access model, where all customers can choose their own suppliers. There is open access to transmission and distribution lines. Distribution is separate from retail operations, and then the competitive retail cycle. Retail is the marketplace for all end users to bring competitive forces. Retail competition greatly increases transaction costs by requiring more sophisticated trading arrangements and measurement.

**(iv) Spot Market Model:**

In this model, generation and transmission companies are separated, and under certain rules of generators, there is a spot market model organized by a transmission or grid company. Consumers can compare their offers and demands. The spot market is short-lived (usually one day ahead), and generators and distributors can hold long-term contracts with consumers to create consistency with prices.

**(v) Decentralized Generator Model:**

This model will come directly to the distribution system or consumers in the future with decentralized generation (DG) mechanisms (fuel cells, photovoltaics, wind etc.). This pattern varies from country to country, depending on the objectives of implementation: A) to reduce electricity costs, b) to guarantee the supply of electricity and security, c) to seek private investment,
e) To reduce the 48 environmental effects, c) to contribute to social and political objectives.

**Conclusion:**

Deregulation brings many benefits to businesses. First, businesses are left to themselves to determine their operational processes and

strategic imperatives without interfering with their operations. This means that their new products, start, demand and supply in accordance with set pricing, new territories and regions of the enlarging thousand permits taking of land and other fixed assets may, finally, businesses consumers with direct contact agenda or the agenda.

## 3. ROLE OF SMART METERS IN SMART GRID- R. Deepthi

The Government of India's initiatives like 'Make in India' and 'Smart Cities' need the efficient, reliable and continuous power supply. India's power sector in the present day is facing a lot of problems like AT&C losses, inefficient distribution and transmission system because of age old infrastructure and power theft. The advanced energy management and increased use of renewable energy resources are the foremost areas to concentrate by governments for the development of country. The government cannot take initiatives for complete change of electrical equipment across the country but there is a need for changing the way of operation and control of the electrical equipment. For this Ministry of Power has initiated ISGF (Indian Smart Grid Forum) which works very closely with public, private and research organizations for developing standards and policies so as to deploy the 'Smart Grid' to assure efficient and cost effective power for all stakeholders. The smart meter is very important constituent for smart grid and is expected to provide cost-effective, social and ecological advantages for various stakeholders. The most significant key factors that determines the success of the smart meters is data analysis that deals with data acquisition, communication, processing and elucidation that benefits to consumer, utility company and government.

The idea of smart grid increases the efficiency of power usage by the introduction of bi-directional flow of information from utilities to consumer and vice-versa. This can be possible by the introduction of 'Advanced Metering Infrastructure (AMI)'. The information about electrical consumption of a consumer is recorded in a timely manner and this data is aggregated and analyzed by 'smart meter' installed at consumer premises. The analyzed data is communicated to utilities using AMI. The AMI includes the advanced communication system including home area networks (HAN), neighborhood area networks (NAN) and wide area networks (WAN). Thus, AMI not only communicates the smart meter data to utilities but also transmits information to consumer from utilities about the peak demand, cost of energy consumption enabling the consumer to shift peak loads to some other time. Smart grid using smart metering and AMI technologies establishes the wide area monitoring, protection and control.

### Traditional Electricity Meters

In India, mostly electricity utilization of a consumer is recorded by traditional electromechanical meter or an electronic meter (with digital display). The bills are generated by utility personnel just by recording usage for a specific period of time (monthly or bimonthly). This traditional process has no relation with advanced monitoring or control. In general, the traditional meter has following architecture as shown in the figure 1.

### Smart Meters

The smart meter is future for power industry and serves as an interface between consumer and the utility company. The smart meter records the power usage of consumer and communicates this data in a timely manner to utility center. For smart meter, it is very essential to collect precise and appropriate data in a timely manner which includes gathering of data, its communication and storage. The smart meter allows the bi-directional flow of information, as shown in the figure 2, from consumer to utility and vice versa. The systematic analysis from the data acquired will lead to many prospective decisions by utility center that assures the efficiency and reliability of smart grid. This allows the utility center for better monitoring and control. The data communication in real time basis allows the utilities with advantages like real time pricing, outage detection, identification of power theft, avoids meter data tampering and provides better service. With the data received in timely manner utilities shall have a better opportunity to work better with increased stability. Smart meters can definitely cut the domestic or commercial energy consumption by giving a lot of useful information to the consumer, but this information is useful only if consumer looks into it. Smart meter gives best home energy management solutions for smart homes using wireless technologies like (Zigbee or WiFi). Several sensor and actuators based appliances are commissioned in smart buildings to manage the connection of electrical load remotely based on the consumer choice

Figure1: Traditional Electromechanical Meter Architecture


Figure 2: Smart meter Architecture

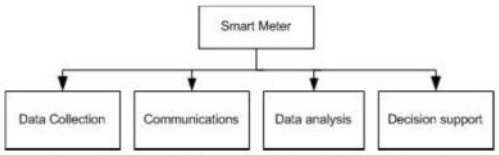
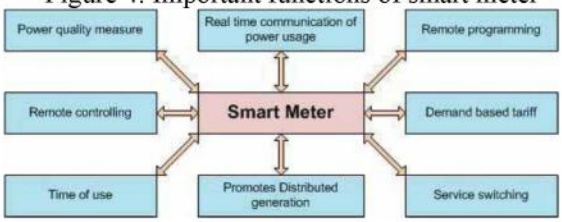



Figure 3: Tasks carried out by smart meter

Figure 4: Important functions of smart meter




## SmartMeterFunctionsand Advantages

*The smart meter is expected to work in the following way. Data is collected from nodes, establishes the two- way communication, analyze the data and based on analysis it supports the controlling. The important tasks of smart meter is shown in figure 3. The data is collected from the individual appliances and is recorded at regular intervals of time. The data collected is stored in the memory and prioritization of the data is done for communicating to utility center. The command signals can be received from the utility center and the smart meter plans for load scheduling and controlling based on consumer choice. Automatic billing can also be done using smart meter. The figure 4 shows the important functions carried by smart meter.*

Advantages of Smart Meters for Government

- The encouragement for smart meters will allow utilities to perform better in monitoring and controlling aspects of power systems.
- Encourages the renewable energy resources by consumers.
- An encouragement for environmental conditions with less $CO_2$ emissions.
- Prevents blackout by better monitoring and load forecasting for power grid.

The smart meter should communicate the data to utility center in a highly reliable and secured way. The system collects the data from local smart meters and communicates it to utilities using different wired and wireless technologies involving the HAN, NAN and WAN. The data communication in HAN is carried by using power line communication (PLC), radio frequency (RF), Zigbee, WiFi. The data communication in NAN involves, copper or optical fiber, WiFi, general packet radio service (GPRS) and WiMax. The data communication using WAN includes optical fibre, cellular, Satellite.

The smart meter system communication technologies at end user premises are PLC, RF, Zigbee and WiFi. These technologies are employed based on geographical conditions and business needs defined by utility center. Factors of selecting the technology include assessment of existing equipment, influence of new technology to the existing appliances, functionality, should be economic to the end user and should be adaptable for long run based on present and future needs.

## PLCbasedSmartMeter Measurements:

The smart gird data communication challenges can be fulfilled by employing the PLC communication by using existing power lines i.e, by using simple electrical conductor lines converting them as hybrid power lines useful for transmission of electricity and bidirectional data communication.

The utility companies have adopted the following two types of PLC standards for smart metering networks. The data communication using narrowband (NB-PLC) using IEEE P1901.2 and ITU-G.9955/9956 can be used for low voltage (LV) electrical networks can be employed in large scale. Broadband-PLC (BB-PLC) defined by the coexistence standards ITU – T G.hn and IEEE-P1901 is actually an extension to HomePlug AV2 specification and is employable for medium voltage (MV) lines based data communication. The G3-PLC is developed for addressing the issues of rural or dense areas. G3-PLC uses OFDM.


Figure 6: Smart meter by EVB

## Smart Meters in Indian Scenario

The government of India is very keen in the development of industrialization and world is recognizing India as one of the fastest growing economies. For the growth of industrialization, an adequate electricity resource has to be taken care by government keeping in the view of future needs. The Ministry of Power is very keen in taking initiatives for future energy demands and advocating the ideology of smart grid and has unveiled sixteen smart grid pilot projects that employ the combination of smart metering and various technologies for increasing the efficiency and reliability of power systems. ISGF under the Ministry of power is very active in the development of smart grid technologies in the Indian power sector. Some remarkable smart metering pilots are the 'Puducherry Smart Grid

Project,' with more than 1400 SMs equipped with different technologies; the 'Bangalore Pilot Project,' which will reach 2,000 residential and commercial customers and the deployment started in 2008 in New Delhi (with 500,000 SMs installed in 2011) where SMs include automated meter reading and a prepaid system utilizing PLC technology. Industry reports estimate that India will install 130 million SMs equipped with both PLC and wireless technologies by 2021.

## Summary

The main objective of smart meters is for assuring the systematic energy management with the active participation of end user by coordinating utility companies in making intelligent decisions. The smart grid will enhance the stability and reliability of power systems using AMI technologies. The better outage management increased remote monitoring on power losses and controlling them and accurate billing are most important advantages of smart meters using AMI. The goal of this article was to provide the knowledge on the role of smart meter technology in the smart grid. The commissioning of smart grid pilot projects for research and supporting them by Government of India shows the interest of future development. Smart meter definitely has a great role in smart grid and is considered as most important for future energy management.