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Smart Home Design Using IoT

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***Abstract*-** Energy saving has become prime concern everywhere. When we talk about it, the first thing that comes in mind is Smart Grid. Smart Grids the perfect solution for saving and optimizing the energy usage. IoT do not need any introduction in the current scenario. IoT technology helps in checking the proper usage of energy. In this paper, the focus is given on the design of smart home that will use smart grid coupled with IoT technology. The working of this system, protocols used by this system and challenges of the same is discussed in this paper.

***Keywords*-** Smart Grid, IoT, Smart home

I. INTRODUCTION

At the current time, straight electrical systems looks to be outdated and not able to meet the increased demand for electrical energy availability. Worldwide, the climate is getting worse year by year. This is forcing the people of electric power industry to make more innovative system that should replace the present network of today.

The technology that is presently being developed at great pace is smart grid or smart electrical grid system. According to D. Subagio [2] in his presentation, it is explained that the smart grid especially is focused on the other important factors, which consists better use of energy, especially electrical energy average of 3% per year. Vitality use keeps on expanding in accordance with financial and populace development. In Indonesia's vitality standpoint 2013, as indicated by [2] clarified that the expansion in the normal vitality necessity is evaluated at 4.7% every year during the long periods of 2011 to 2030. Fuel Endowment utilization keeps on expanding every year, populace development is assessed by Bappenas and BPS for the time of 2011-2030 the normal development of 1.23% every year.

More than that, according to T. D.Atmaja, D. R. Saleh [2], the growth of renewable energy is one of seven national focus and is included in one of the national research. According to [2], also secure/make sure of that the use of systems that tool smart or smart grid system is a likely progress in the future to increase the effective use of energy. In a smart grid system, all the parameters from the power plant to the end-user side will be watched/supervised and controlled continuously. This means there must be a complete control that will have more power generators and more customers.

In order to be able to track everything that is malleable from the power plant to the end user's side in real time, a communication system is needed that can transmit data in real time, and communication systems are being intensively built, this is the IoT in which this system allows all to be linked to the internet service.

In this paper we make a design of IoT-based smart grid data systems for constant monitoring and control. There will be some part of the paper, a literature review discussing the theoretical basis, design models illustrating the concept proposed in this paper, the problem in the IoT-based smart grid network identifying some of the system's challenges.

II. LITERATURE SURVEY

A. Internet of Things

IoT is a new technology in communication world. It allows “anywhere, anytime, any media” which inspires further development of communication technology.

Conferring to M. Yun, B. Yuxin [3], the increase of communication technology between devices raises some difficulties and new demands for the optimization of the working of the system itself, and therefore the IoT system is extremely likely to be used as a system which will accomplish the optimization. IoT is put together connected internet services.

Few devices such as Radio Frequency Identification Devices (RFID), infrared sensors, global positioning system (GPS)

they all follow internet protocol. The information can be exchanged in a quicker way among all these devices to know location, track it and as well as monitor it.

IoT system has following important features:
1. **Intelligence:** IoT comes with the aggregate of algorithms and computation, software program & hardware that makes it clever. Ambient intelligence in IoT enhances its skills which facilitate the things to reply in a sensible way to a selected state of affairs and helps them in carrying out unique duties. In spite of all the popularity of smart technologies, intelligence in IoT is best involved as means of interaction among devices, even as person and tool interaction is performed by means of well-known input methods and graphical user interface.

2. Inclusive sense: consisting of the usage of RFID, sensors, two-dimensional code to gather records from the object each time and anywhere.

3. Connectivity: Connectivity empowers internet of things via bringing collectively everyday items. Connectivity of those items is pivotal due to the fact easy item level interactions make a contribution toward collective intelligence in IoT community. It allows network accessibility and compatibility inside the things. With this connectivity, new marketplace opportunities for internet of factors may be created by using the networking of smart matters and applications.

4. Reliable transmission: providing accurate data to provide real-time information from the object through meshing a variety of telecommunications networks and the Internet.

5. Intelligent processing: using intellectual computing such as cloud computing and fuzzy documentation to examine and procedure large amounts of data and information, for the purpose of applying intelligent regulator for the object.

6. Dynamic Nature: The primary activity of web of Things is to gather information from its atmosphere, this is often achieved with the dynamic changes that turn up around the devices. The state of those devices amendment dynamically, example sleeping and rousing, connected and/or disconnected additionally because the context of devices together with temperature, location and speed. Additionally to the state of the device, the quantity of devices conjointly changes dynamically with an individual, place and time.

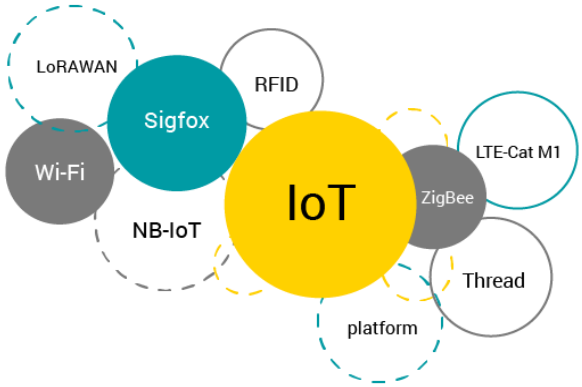

Figure 1: IoT Technology Diagram [AVsystem]

IoT can be thought as having three basic notions, namely "things focused", "internet leaning" and "semantic sloping". When we say things focused, it consists all type of devices that is attached with IoT systems. For example any sensors, any tags and different actuators. As all things are related to the Internet network, it's said to be internet leaning. If we add network of different objects put together it can considered as semantic oriented network.

B. Application of IoT for smart homes

Smart homes can be considered as vital portion of smart grid systems. With smart homes, one can realize the real time interaction among different users and networks. Smart home applications, as described by M. Kaur, S. Kalra [4], the savvy lattice framework that is made to the extent of a home can be utilized to join correspondence systems, electrical gear and electrical administrations. This framework enables shoppers to watch the utilization of power from a separation and can control the utilization of electrical apparatuses. Savvy home

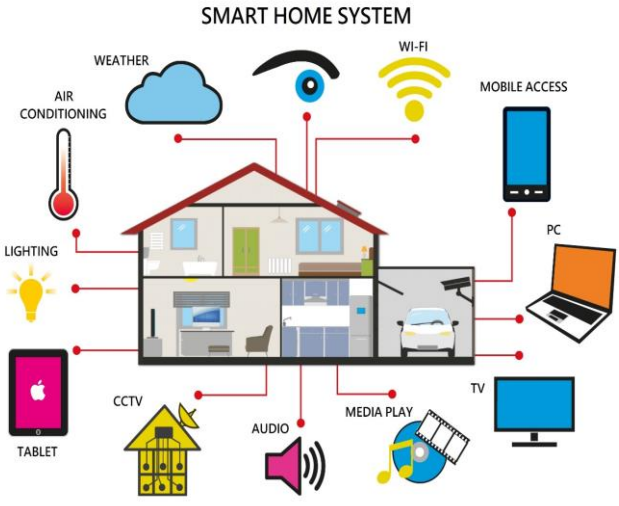

Figure 2: Smart Home Systems [visioforce automation system]

Administrations are generally utilized in power utilization consistently. Everybody can screen the status of their homes consistently and keep away from robbery, keen home framework can be represented in Figure 2.

C. Different IoT Layer

IoT can be categorized into four layers namely device, network, cloud and application layer according to [6]. The device layer is comprised of two sub layers namely things and gateway. If we consider things sublayer, it is having smart plug and smart meter which can be used for monitoring power consumptions in any given area. The main purpose in of a gateway is to connect device layer and network layer as shown in the diagram 3.

The purpose of network layer here is to link device layer and application layer by using wired or wireless connection. Cloud layer is used for storing the data of all consumers. This layer is also responsible for management of data. To process any data, the proper authentication is done in this layer itself.

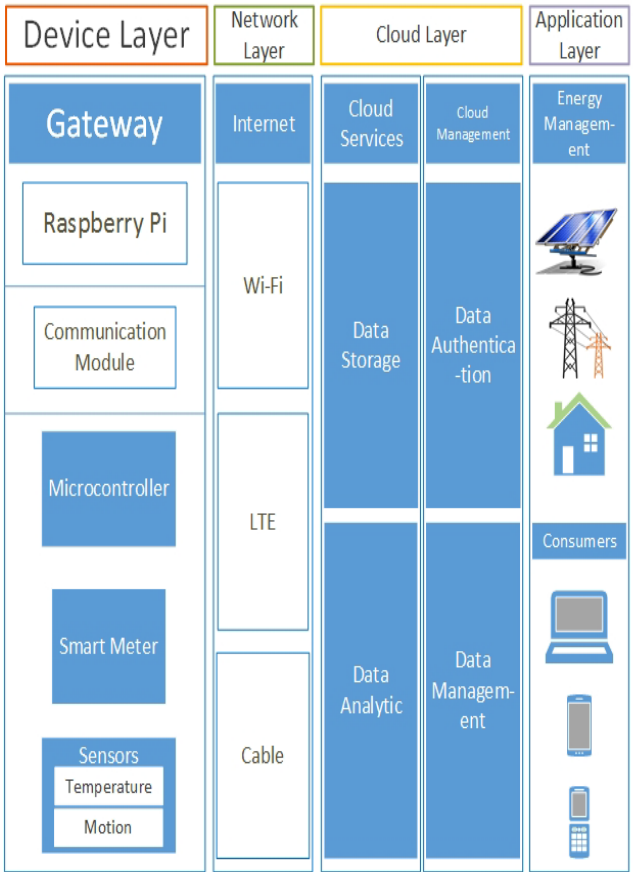

Figure 3: Different IoT Layers

Application layer has two different sublayers. The first sub layer is liable for energy management which takes the responses for energy demand. The second sublayer is consumer whose main job is to give announcements about usage of energy in smart homes.

D. IoT Communication Technologies and Standard

As we use so many devices in IoT, different communication mechanism must be discussed. All communication protocols use following few standard:

1. Bluetooth with low energy: Bluetooth is a way for sending messages among different devices which consumes very low power. It was established by a group called "Bluetooth Special Interest Group".

2. Zigbee: It is a communication technology which is used in a wireless environment. It works on top of IEEE 802.15.4 standard in a 2.4 GHz band. ZigBee is the most common industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. It is a specification for messaging in a wireless personal area network (WPAN), which can be thought as "Internet of things." ZigBee and IEEE 802.15.4 are low data rate wireless interacting standards that can remove the costly and mutilation inclined to wiring in industrial control applications.

3. Home plug: It is a power line communication method where communication can happen over electric cables. These cables are capable of carrying signal and electric current simultaneously. This was also developed by a group and works on IEEE 1901.2010[5].

4. HTTP: The Hypertext Transfer Protocol (HTTP) is an application-level protocol for circulated, concerted, multimedia information systems. This is the basis for data communication for the World Wide Web (i.e. internet) since 1990. This protocol is based on transmission control protocol or Internet Protocol.

5. LoRa: It stands for low power wide area network. It is basically used in wirelessly operated things for a specific location. It ensures secure bi-directional communication.

6. XMPP: XMPP stands for Extensible Messaging Presence Protocol. It's procedure for issuing XML elements on any network to exchange messages and present information in close to real time. This protocol is used by instantaneous messaging applications like WhatsApp.

E. Smart Grid Systems

Smart grid policy was systematized in Europe as Smart Grid European Technology Platform. It is an electrical grid system which has different operation and energy measures including smart meter as for example. Smart grids will be one of the most significant presentations in coming century [3]. If we consider an expert from United States Department of Energy,

this technology became possible because of computer processing, control systems and two way communication.
These new technologies have new sensors called Phasor Measurement Units that permit technical operators to measure grid steadiness and advanced meters. These smart meters give better information and are able to report automatically for any power outrage. Recovery from different faults is also taken care automatically.

From above discussion it can be decided that smart grid advances the efficiency of electric supply which contain analysis technology, different control mechanism and communications.

Smart grid also functions properly even if the electricity demand increase. If we do not require the electricity for domestic purpose at certain times it can be shifted to industrial and commercial usage. This will help to increase earnings without investing more for the power plants.

III. MODEL DESIGN

In this paper, the design employment is focused on smart grid and smart home. These two entities will be almost non-separable in this implementation.

The service here is between the consumers and grid servers. Grid server here will take care of everything about energy supply. In this scenario if the usage of electricity is low in one area, the same can be redeployed to other areas which needs it. The model strategy of IoT in smart grid is as shown in the given figure 4.

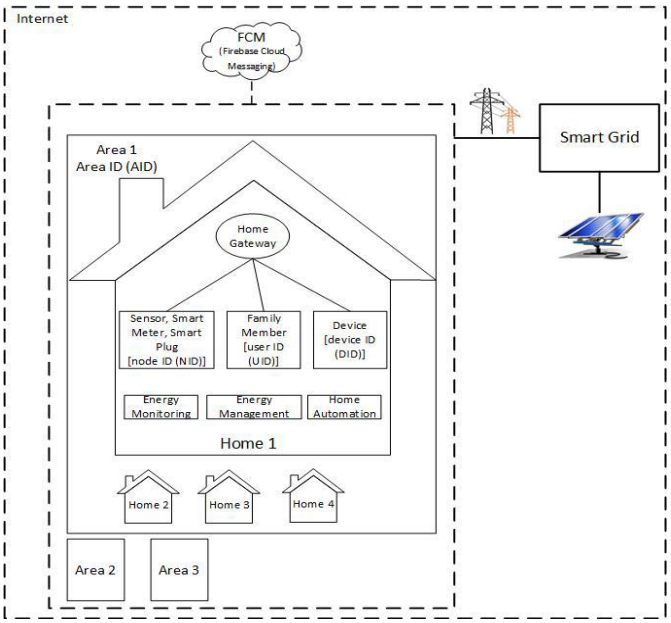

Figure 4: Smart grid IoT design

A. Proposed Architecture:

In this paper, the architecture is based on [6]. The server here can control two operations, the first one is taking responsibilities of energy demand responses and the other one takes care of cloud services which maintains consumer notification controls with the help of smart phones. With the phone we can take help of different home automation controls.

Many houses in a given area put together will have an Area ID (AID). Every house will have a home gateway device that with a Gateway ID (GID). These two information will be useful for monitoring energy usage and its redeployment. With the help of AID the energy intake in an area can be calculated easily. Every sensor will be given a Node ID (NID) which further will be connected through home gateway. Every gadget that a consumer uses comes with a Device ID (DID). Every family member will be given a unique ID named as User ID (UID). With the help of DID and UID data authentication can be done.

B. Topology

All the houses in any area will be connected in a mesh topology. Usage of RFID with this network topology is called as Wireless Mesh Network (WMN). This will reduce implementation cost. On a large scale Lora can be used to upkeep WMN.

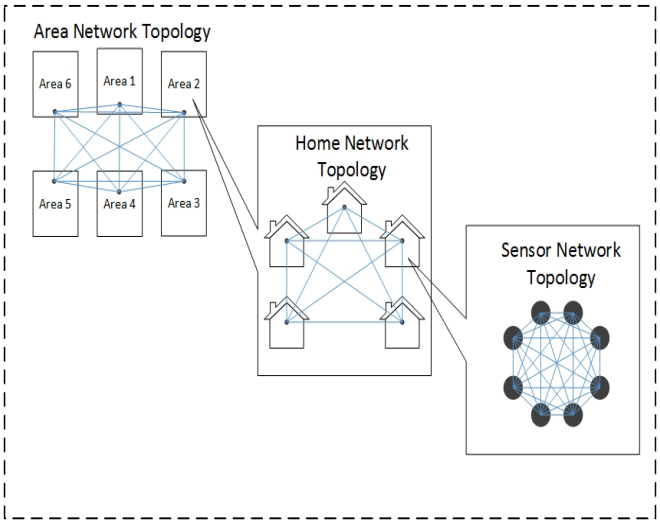

Figure 5: Network topology used

C. Network Protocol

There are many protocols used in this paper. The discussed device layer is uses IEEE 1901.2010 standard. The sensors devices used Zigbee and BLE. All these protocols are further looped with a home gateway based on Raspberry pi Minicomputer. Different sensor devices will be used to help this home automation and energy management. For example

if a motion sensor does not detect the users in a room it will turn off all the devices automatically.

The data from different sensors is periodically uploaded to cloud through HTTP protocol. These data will depict the usage of energy. The commands from different consumers is handled through XMPP.

IV. CHALLEHGES IN DESIGN

There are few challenges in designing the smart grid system. These include communication, cost and some information related issues.

A. Cost

The expansion of smart grid is a costly affair. As per Prof Martin Djamin,[7] in the United States this costed about one trillion dollar. Even if we consider about renewable energy as an option, it is costlier. If we take solar cell as another option its efficiency is relatively low.

B. Communication

For any smart grid systems, the responses will be real time and must be captured in the same way. For example at any time if the power usage is more in any area, the additional power information must be transmitted in real time.

To send a response from one area to another area in real-time, a strong communication medium is required. A strong communication medium should have fast responses and a negligible amount of latency. So any IoT communication system definitely should have fast internet connection to run the operations smoothly.

C. Information security

The main problem in smart grids are cyber-attacks. Hackers will attack on grid control and its interfaces. They try to infect the server with different malware. Hackers try to send false information so that the server do not get the correct data. If cloud servers are attacked, then unauthorized party can control the appliances in home.

V. CONCLUSION

IoT has emerged as a technology with highest impact. It is going to change the way we look at telecommunication, transport, homes and so many other things of our day to day life. If we consider the internet survey, the total installed base of Internet of Things (IoT) connected devices is projected to amount to 75.44 billion worldwide by 2025, a fivefold increase in ten years. This paper puts a light on how IoT supports smart grids and smart homes. If we use IoT, the energy consumption can be reduced. The predictions tell us that by 2025, this technology can be implemented by at least 50%.

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Mr Raushan Kashypa Bachelor of Technology and Master of Technology from Visvesvaraya Technological University,Belgavi 2016.. I have published two papers in field of Cloud Computing. I have done five NPTEL courses with good scores. I have a total experience of 4 years in industry and teaching put together. Currently, I am working as an Assistant Professor in Acharya Institute of Technology in the department of information science and engineering.

