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A Seminar Report On

"Last meter Smart Grid -an application of IOT"

Submitted By

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Certificate

Certifies that the seminar work titled "**Last meter Smart Grid -an application of IOT**" is a work carried out by **Namrata Gudi** bearing **4NI17IS046** in partial fulfilment for the requirements of the sixth semester BE in Information Science & Engineering prescribed by The National Institute Of Engineering, Autonomous Institution under Vishvesvaraya Technological University, Belagavi, It is certified that all correction / suggestions indicated for Internal Assessment have been incorporated. The Seminar report has been approved as it satisfies the academic requirements in respect of the seminar work prescribed for the sixth semester.

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ABSTRACT

Internet of things is one of the rapidly growing fields in telecommunications. There is an exponential increment in electricity consumption due to rapid modernization, artificial intelligence and automations, invention of high energy consuming machineries for industries and smart appliances. This has paved a way which demands a system with energy effective technologies and revealing limited renewable energy resources i.e. economic and environment friendly.

Traditional power grid is revolutionized to smart grid in order to overcome obstacles such as uni-directional flow of energy and information, wastage of energy, authenticity and security. The proposal here is a "Last meter smart grid", a part of smart grid situated at consumer end, embedded in IOT platform and proposes a system of continuous and remote monitoring of electrical appliances.

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INTRODUCTION

An electrical grid is a network for producing and administering electricity from producer to consumer. A traditional electrical grid comprises three main sections – a) Generating station- it produces electrical power, b) Transmission line- HV transmission lines carry generated electricity from source to load sector, c) Distribution section- it connects each consumer. Such a traditional grid worked admirable until electricity consumption was moderate.

But with exponential increase in power consumption these days due to rapid modernization, emergence of artificial intelligence and automation, invention of numerous high energy consuming machineries for industries and smart appliances, many challenges need to be faced. Authenticity, security, rising renewable energy sources, lack of smart technologies, disorganised routing, monitoring to name a few.

In order to tackle the problem, the smart grid is being proposed. A Smart Grid is an electricity network that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety

Chapter 2:

LITERATURE SURVEY

Since the early 21st century, opportunities to take advantage of improvements in electronic communication technology to resolve the limitations and costs of the electrical grid have become apparent. Technological limitations on metering no longer force peak power prices to be averaged out and passed on to all consumers equally. In parallel, growing concerns over environmental damage from fossil-fired power stations has led to a desire to use large amounts of renewable energy.[3]

Smart grid technologies emerged from earlier attempts at using electronic control, metering, and monitoring. In the 1980s, automatic meter reading was used for monitoring loads from large customers, and evolved into the Advanced Metering Infrastructure of the 1990s, whose meters could store how electricity was used at different times of the day. Smart meters add continuous communications so that monitoring can be done in real time, and can be used as a gateway to demand response-aware devices and "smart sockets" in the home. Early forms of such demand side management technologies were dynamic demand aware devices that passively sensed the load on the grid by monitoring changes in the power supply frequency.[2]

Chapter 3:

SMART GRID

A smart grid is integration of traditional grid with Internet of Things platform. The Smart Grid is part of an IoT framework, which can be used to remotely monitor and manage everything from lighting, traffic signs, traffic congestion, parking spaces, road warnings, and early detection of things like power influxes as the result of earthquakes and extreme weather. The Smart Grid does this through a network of transmission lines, smart meters, distribution automation, substations, transformers, sensors, software and more that are distributed to businesses and homes across the city.

Deployment of 'smart' technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation. In the table below you can find few advantages of smart grid over classical one.

Table 3.1 Comparison between smart and classical grid

	Classical Grid	**Smart Grid**
Data flow	Unidirectional	Bidirectional
Power generation	Centralized	Distributed
Topology	Radial	Network
Sensors	Few	Lots
Testing	Manual check	Remote check
Efficiency	Low	High
Control type	Passive	Active
Environmental pollution	High	Low

Features of Smart Grid

Smart grid has several positive features that gives direct benefit to consumers:

- Real time monitoring
- Automated outage management and faster restoration.
- Dynamic pricing mechanisms.
- Incentivize consumers to alter usage during different times of day based on pricing signals.
- Better energy management.
- In-house displays.
- Web portals and mobile apps.
- Track and manage energy usage.
- Opportunities to reduce and conserve energy.

Fig 3.1. Two-way communication in smart grid

Chapter 4:

INTERNET OF THINGS

Internet basically connects people to people and people to things. Internet of things is innovative version of internet where in its an interconnection of many physical objects for instance smart devices, sensors and actuators, with the server or cloud through IP gateway. These objects are embedded with technology to interact with their external environment and internal states,[2] in short IoT connects physical/real domain with digital/virtual domain. The architecture of Internet of Things is divided into four sections.[1]

a. Smart devices and sensors: These frequently gather the information from the nodes/devices and surrounding and transmits the collected data to next stage.
b. IP Gateway: The gateway is the element connecting a sensor/actuator network—if it has no direct IP capability—to the IoT server via an IP link. The gateway is bidirectional: for uplink communication it collects data received from the network nodes, performs reformatting/encapsulation if required, and sends them over a secure TCP/IP link to the message dispatcher.[3]
c. User Interfaces: Consumers, control providers and application designers communicate on IoT stage with the assistance of UIs which can be online or API based.[1]
d. IoT Server: The Data management unit is a collection of software modules, each able to manage the messages of a specific sensor network type. The message dispatcher manages the bidirectional communication between each gateway and the rest of the system. Configuration unit configures networks and nodes according to inputs from users and authorized applications and according to the system status stored in the configuration database.[3] Server also ensures the authentic access.

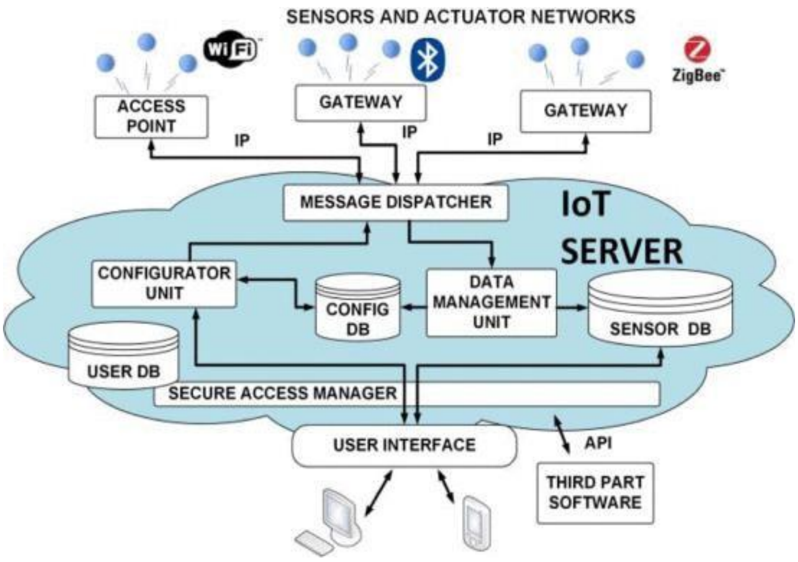

Fig 4.1 IoT Platform

Chapter 5:

IN-HOME PROTOTYPE FOR LAST METER SMART GRID

The last-meter grid is the portion of the smart grid closer to the home, and the one with which customers interact. It allows a two-way data flow between customers and electric utilities, transforming the "traditionally passive end-users into active players" in the energy market.[3]

The last-meter smart grid corresponds to the "customer domain." It enables residential, commercial, and industrial customers—based on their different energy needs—to optimize energy consumption and local generation, and to actively participate to demand-response policies, one of the most disrupting aspects of smart grids.[3]

There are numerous researches in the field of smart grid, however these researches are applicable to small scale, but the massive energy consumption needs to be tackled in large scale. There is a system that exists which uses ZigBee network connected to internet of things. In our proposed model, Raspberry Pi 2 is used. It boasts of a Broadcom 900MHz quad-core ARM Cortex-A7 processor, 1GB of RAM and thus bringing as much as six times more performance to the existing models.[1]

To illustrate the working properly an in-home model is built and several tasks have been performed on it to verify the accuracy and reliability of the system. The model last meter smart grid is shown in the figure below.

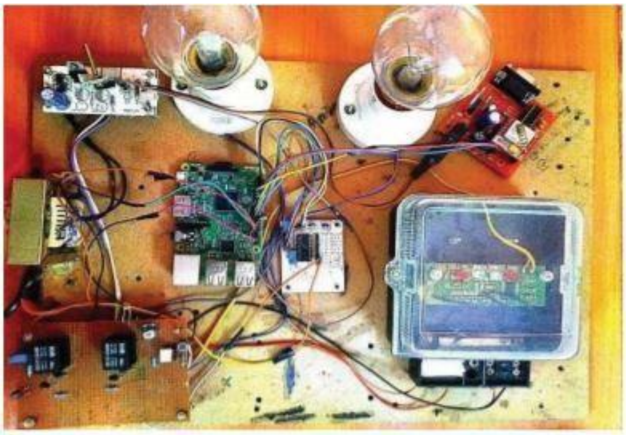

Fig 5.1 Smart grid prototype

The whole operation is divided into three categories –

A. Consumer section- In this section, a smart meter is installed at the customer premises which continuously measures the unit consumed and send it to raspberry pi, which is used as an operating system for this model.
B. Smart grid- Raspberry pi gathers the data, calculates the units consumed and estimates the billing price. It also shows the room parameters such as temperature and humidity. After estimation it uploads the data in the website of the electricity board.
C. Monitoring section- After the data is uploaded; the application manager at electricity board office and the consumer can monitor the consumption of energy. This prototype provides facility to the consumer to control their home load by sending message through their smart phones as shown in figure. [1]

Fig 5.2 Message display of ON & OFF of loads

CONCLUSION

The last meter smart grid architecture implements and demonstrates Customer Domain of the smart grid, based on a platform for the IoT that can host a broad range of smart home applications.

The ultimate result obtained is the output of the prototype confirm two-way flow of energy and information as well as energy efficiency of smart system, increases in security, cost reduction, flexibility. This proposal has unique advantages and elements of novelty with respect to the state of the art: it is customer centric, it minimizes the deployment of specific smart grid infrastructure, and it leverages possibly available smart home applications, sensors, and networks.

The possible future enhancement in that the smart grid ought to be increasingly associated, interoperable, verified and made practical for use and has to involve progressively wise checking framework to monitor electricity stream.

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