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Last Meter Smart Grid Embedded in Platform of Internet-of-Things

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Abstract: In modern days power grids are getting transformed into smart grids in order to solve the problems arising due to unidirectional information flow, energy wastage, growing energy demands, reliability and security.But the typical approach system are distributor centric rather than customer centric which results in poorly scalable system. The smart grid is the most recent term which is used to describe the communication and control facilities integrated to conventional grid.The proposed method enables the direct communication between user and consumer using internet of things for energy consumption and billing information using Raspberry Pi.
Keywords: Internet of Things (IoT) , Consumer domain ,GSM, Last meter, Raspberry Pi, Smart grid, Smart meter.

I. INTRODUCTION

A. Motivation

A traditional power grid constitutes a large number of interconnected synchronous alternating current grids. The three major functions performed by a power grid are: generation, transmission and distribution of electrical energy. In this system power flows only in one direction that is from a distributers to the consumers.[1] mostly the whole process of generation, transmission and distribution of electrical energy is owned by utilities company who provide electrical energy to consumers and bill the accordingly to recover their cost and earn profit. The traditional power grid performed very well until 1970 [1]. Even though the demand of energy rises exponentially from the consumers side. But , since 1970, the load of electronics devices has become the fastest growing element of the total electricity demand which result in a dramatic change in nature of electrical energy consumption.[2]-[4] Furthermore, there are many other challenges apart from growing energy demand, such as reliability, security, emerging renewable energy resources and aging infrastructure problems. In order to overcome these problems, the smart grid model was proposed as a promising solution which has variety of information and communication technologies.[5]

B. Last Meter Smart Grid

The smart grid architectures focus on the power distributors to manage the complete power grid. The typical proposed model of smart grid are distributor centric rather than customer centric. To overcome this problem, we propose a detailed architecture and implementation of a last meter smart grid embedded in an Internet of Things (IOT).[6] The last meter smart grid is that part of the smart grid which is closer to the home that is on consumer premises. The main advantage of this concept is that it allows a two way data flow between consumers and electric utilities thus resulting in the transformation of traditional passive end user into active players in the energy market.[7] National Institute of Standards and Technology [8], proposed that last meter smart grid corresponds to consumer domain and enables residential, commercial and industrial customers to optimize energy consumption and local generations and to participate to demand response policies.[9] The last meter smart grid is a broader concept of smart home and smart buildings.

II. INTERNET OF THINGS

The Internet of things is defined as interconnection of network that can connect any object with the internet for exchanging information and communication among various devices to get monitoring, tracking, management and local identification objectives.[11] IoT offers a cost effective way to reduce the amount of energy wasted and an opportunity to offer location based services. It has the potential to dramatically increase the availability of information to transform company and organisations in virtually every industry around the world.[12] Over the past few years, the IoT technology has gained significance attention in many applications, and has allowed for interconnection of internet to various network embedded devices used commonly.

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A platform of Internet of Things has been developed as a scalable distributed system to support an in home smart grid. It consists of three main parts : sensors and actuators, IoT server and the user interface for visualization and management. Sensors and actuators nodes are used to communicate in a reliable bidirectional way with the IoT server.

Table 1.1 Main components of IoT Platform

Parts of IoT Platform	Main Components
Sensor and Actuator network	• Sensor and Actuator node • IP Gateways
IoT Server	• Message Dispatcher • Data management unit • Configurator unit and database • Secure acess manager
User Interfaces	• Visualization interface • Configuration interface

III. EXISTING SYSTEM

In existing energy meter grid technology, meter reading is done by the help of manpower. This method involves a person from distribution unit reading and hence accuracy cannot be guaranteed as there can be errors. Also consumer can deliberately consume more amount of power than required. Zigbee based energy meter installed in every consumer unit and an electricity e billing system. ZPM is single phase digital kWh power meter with embedded Zigbee modem. In GSM based energy meter, energy meter also had blinking led for the counting pulses from led and fed to microcontroller for count operation. GSM communicates over wireless system. It also control load by sending messages.

IV. PROPOSED METHODOLOGY

A proposed method provides the communication between the Electricity Board section and the consumer section using Internet of things (IOT) for transmitting the customer’s electricity consumption and bill information that is calculated using Raspberry PI. The power and billing information is continuously transmitted by the use of Internet of Things and monitored by the Electricity Board section. GPRS performs the IOT operation where and through which the information is sent to the Web server. This data is then transmitted to the server unit. The power consumption can be checked by the owner anywhere globally also. And also we are controlling the Loads from the web server. Along with provide security to the Energy meter and house from fire by using Temperature sensor and LDR. A block diagram regarding proposed methodology is shown in below figure 1.

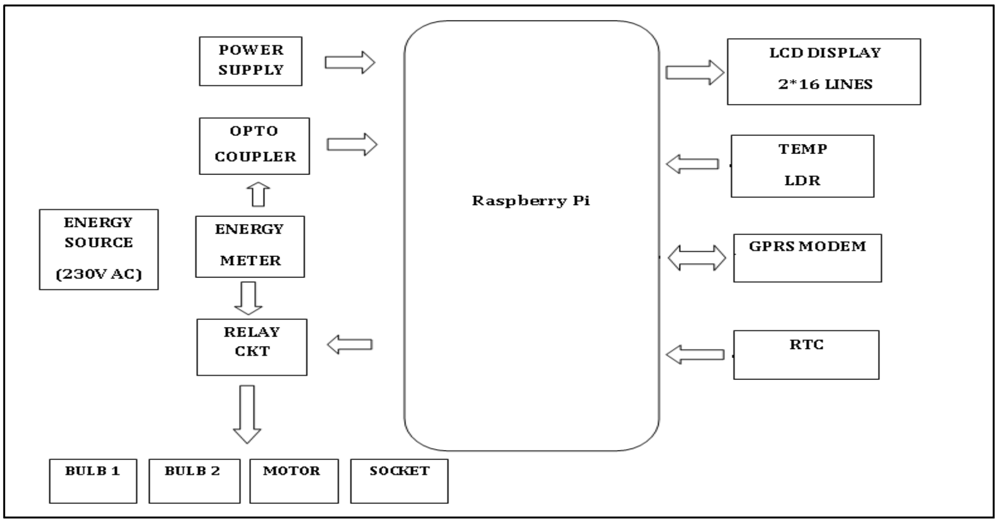

Figure 1 Block Diagram of Proposed Methodology

Moreover we can manage the load with the help of GSM (SIM800L). In this procedure we send messages to the GSM regarding ON and OFF of the loads used (Here bulbs). The messages used is shown in the figure 2 shown below.

The immediate consequence is the ability to benefit from an integrated wiredwireless solution that can help to achieve significant energy saving, reduced operational cost, perform risk management and enhance employee productivity. Furthermore, the IoT flexibility permits to easily upgrade the system at reasonable costs. The IoT platform allows quick development and bringing to market of innovative IoT applications, at a reasonable cost, and at a fraction of the time compared to other approaches. This result is thanks to the integration of a largely distributed network built on the lighting infrastructure, with IoT devices, and adds success between energy management and IoT systems. The main infrastructure is ready and easily available, facilitating rapid application of intelligent solutions. The distributed intelligence can be shared as well as the abundance of sensors.

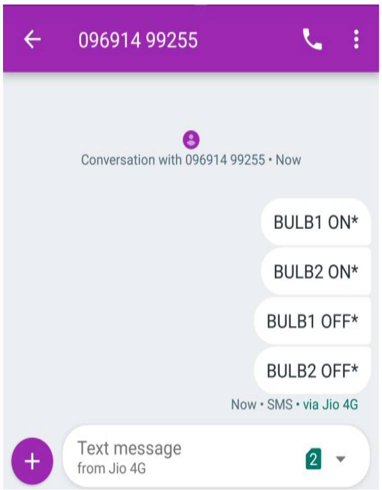

Figure 2 Messages regarding ON and OFF of the loads

V. RESULT AND CONCLUSION

We have presented an architecture, implemented and demonstrated customer domain of the smart grid, based on internet of things platform. Our proposal has unique advantage and elements of novelty with respect to state of art : it is customer centric, it minimises the deployment of specific smart grid infrastructure and it leverages possibly available smart home applications. We believe that it is a widespread acceptance of smart grid applications and equipment to be deployed at home.

The connection diagram of project equipments are shown below in figure 3. And the result of the experiment done using Raspberry Pi 2 is shown in figure 4. The result is showing the amount of units used by the load of the project and displayed in the Raspberry Pi 2 desktop page. In future we will upload the result in cloud for the real time analysis of the system which will also be beneficial for the consumer at the end of the distribution system.

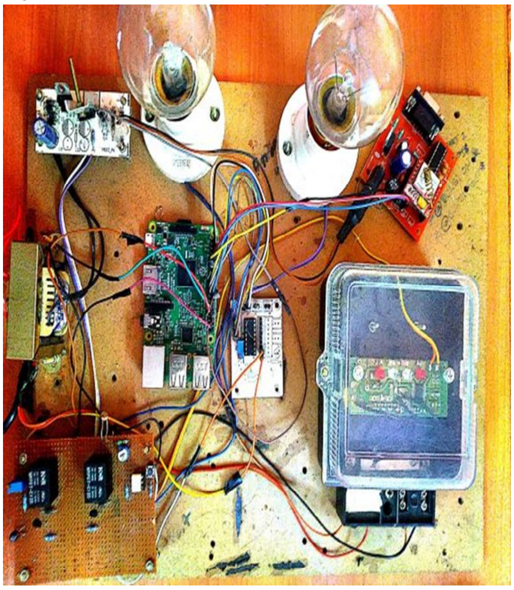

Figure 3 Connection Diagram

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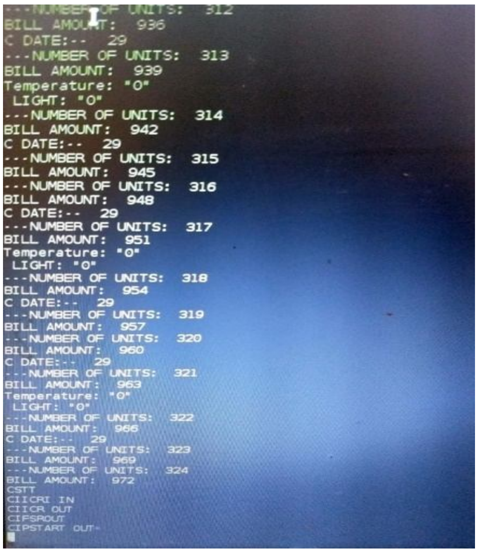

Figure 4 Result using Raspberry pi 2

VI. FUTURE SCOPE

The present power grid using the technology of 1970, but are connected to increase with the progress in different concept of power generation, problems with the power outages and theft, and also due to the demand, we need a modernized grid to fit the needs of the customers even in the to take the situation in claim hype, what can be called "Smart Grid". The Smart Grid performs various functions, so that it increases network stability, reliability, efficiency and ultimately reduces the conduction losses. The Smart Grids are the two-way processing power of the consumers who may have distributed generation. Various technologies such as sensors and measurement, use of advanced components are used for the successful functioning of the network. Confronted in this paper, Smart Grid, its features, technologies in smart grid used, implementation and challenges of Smart Grid are discussed.

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