

Evolution of Smart Energy Meter Monitoring and Billing using IOT

K. T. Venkatraman¹, K. T. Meenaabarna²

¹Lecturer, Department of Electrical & Electronics Engineering,
Government Polytechnic College, Korukkai, Thiruthuraiipoondi

²Assistant Professor, Department of Computer Science Engineering,
FEAT Annamalai University, Chidambaram

Abstract:- Energy meter billing is an important part in the Energy Management System (EMS). Each time a person is required from the electricity board authority to collect the reading of energy meter and create a bill to the consumer. But this created a problem because the manual reading needs manpower, time consuming and may cause an error. This paper present an Internet of Things (IOT) based smart energy meter. Smart energy meter is introduced to overcome the above stated problem by providing the facilities of automatic reading of meter and automatic connection & disconnection can be made based on the electricity bill payment of consumer through IOT. The proposed system consists of both hardware and software for monitoring the various parameters like voltage, current, energy and cost. This system sends the details of energy consumed by the consumer (kWh) & total bill amount to the consumer via Short Message Service (SMS) at the end of each billing period (Bi-monthly). In addition to that, consumer receives the SMS from the system when the usage of total energy exceeds certain limits based on tariff and the details of tariff are displayed in the website. The above concept is shown in prototype model and also simulated in PROTEUS software.

Keywords: Smart Energy Meter, IOT, Energy Meter, Energy Management System, PROTEUS.

I. INTRODUCTION

In the recent years, by the growth of IOT and digital technologies, smart grid has been becoming smarter than before. IOT can be used for various applications like distributed power plant monitoring, power consumption monitoring, smart meter and electric vehicle charging. Now days, electricity is one of the basic requirement in our life. Due to rapid increase in human population and the human's dependency towards electrical energy, the demand of electricity has increased. Hence we are in a position to manage the electricity consumption. This can be achieved by making the people to get aware on tariff method which is followed by Tamil Nadu Electricity Board (TNEB). This will helps to save the electricity by their effective usage of loads. A lot of research work is carried out in this field are as follows.

The consumers are able to monitor their power consumption (bill) anytime from anywhere by using their mobile phone via SMS through smart energy meter is demonstrated [1]. An Arduino and a GSM based smart prepaid energy meter is modeled and investigated [2]. Smart metering is capable of monitoring various parameters of electrical energy like voltage, power factor, current, energy

consumption in kWh etc., and the consumer can take suitable precautions to safe guard the electrical appliances. This makes the consumer an active part of energy management [3]. A control application of developed IOT energy meter is introduced [4]. A smart energy system for the residential customers is developed. Further, a virtual instrumentation has been developed which can be operate in any computer to function as, In Home Display (IHD) for energy management system [5]. The design and implementation of GSM based smart energy meter for home applications is proposed and it proves. This device is user friendly, make consumers conscious about the amount of energy they spend and help to conserve the already depleting resources [6]. Smart energy meter billing using GSM with warning system is developed and examined [7]. A novel smart energy meter for an automatic metering and billing system is discussed [8].

II. EXISTING SYSTEM

In existing system either an electronic energy meter or an electro- mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. The kWh units used then still have to be recorded by meter readers monthly, on foot. The recorded data need to be processed by a meter reading company. For processing the meter reading, company needs to firstly link each recorded power usage datum to an account holder and then determine the amount owed by means of the specific tariff in use. In present system the energy meter reader visits each house and records the meter reading manually then issues the bill. In manual reading human error may possible and does not provide reliable meter reading, especially, during rainy days it is difficult to go to every house and take reading.



Fig.1 Electronic Energy Meter

In the present system people try to manipulate meter reading by adopting corrupt practices such as current reversal, bypass meter, magnetic interference, etc. If the payment period exceeds, the EB employee need to go to each and every house to disconnect power supply. Fig. 1 shows the electronic energy meter.

III. PROPOSED SYSTEM

Smart Meters are an electronic measurement devices used by utilities to communicate information for billing customers and operating their electric systems. The combination of an electronic meter with two-way communications technology for information, monitor, and control is commonly referred to as Advanced Metering infrastructure (AMI). IOT is nothing but the source of communication between consumer and service provider i.e. web server. Since IOT is cost effective compared to SMS, monitoring of energy meters at lower cost is made possible. Current sensor is used to read the current drawn by the load from the power supply. Voltage sensor is used to identify the voltage drop and apply voltage to the load from power supply. Relay is used to control the power ON and OFF to the home. Using the voltage and current sensor the power consumption is identified by the ARDUINO microcontroller and this data are uploaded to the server or website through IOT modem. The block diagram of the proposed system is shown in Fig.2 and the proposed hardware model is shown in Fig.3.

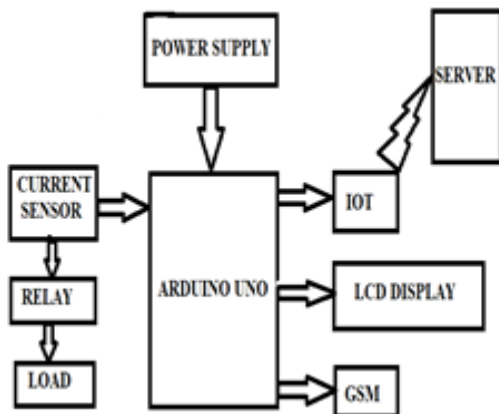


Fig.2 Proposed System



Fig.3 Prototype Hardware Model

IV. HARDWARE DESCRIPTION

ARDUINO UNO (ATMEGA 328)

Arduino board acts as the heart of the required system. Entire functionality and processes of the system depend on

this board. Arduino reacts in response to the 5V supply given by the Opto-coupler and keeps on counting the supply and then calculates the cost and also the power consumed. This data, it continuously stores on the webpage, so that users can visit anytime and can also check their consumption. It even reacts accordingly as per programmed, to the situations like message passing/sending during threshold values etc.

Internet of Things (IOT)

Internet of things has become heart of data transfer and communication. It is a network for inter-linking physical devices or objects with embedded platforms, sensors, actuators to exchange data from any part of the world. The devices which are linked through IOT can be controlled and monitored from anywhere and at any time.

Architecture of IOT

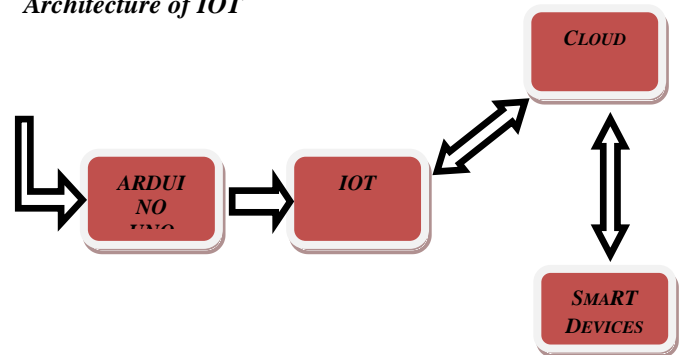


Fig.4 IOT Architecture

NODE MCU

Node MCU is the Wi-Fi equivalent of Ethernet module. It can be used as access point and/or station, host a web server or connect to internet to fetch or upload data. It is open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266.

GSM Module

A GSM modem is a specialized kind of modem that accepts a SIM card and operates over a subscription to a mobile operator, just like a cell phone/mobile phone. From the perspective of a mobile operator, a GSM modem looks similar to a mobile phone. A GSM modem is the one that exposes an interface that allows various applications such as sending and receiving of messages over the modem interface. The mobile operator charges for this purpose and process of message sending and receiving as if it was performed directly through a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. Any phone that supports the "extended AT command set" for sending/receiving SMS messages can be supported by the SMS/MMS Gateway. Note that all the mobile phones don't support this type of modem interface.

RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state

relays. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

POWER SUPPLY

The ARDUINO and other devices get power supply from AC to DC adapter or from direct AC lines through voltage regulator. The adapter output voltage will be 12V DC non - regulated.

V. SIMULATION AND RESULTS

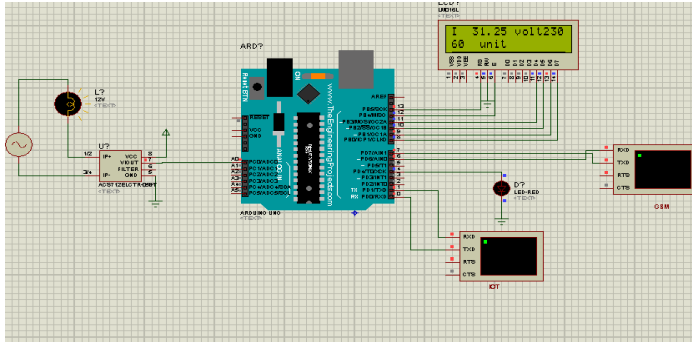


Fig.5 Simulation Diagram

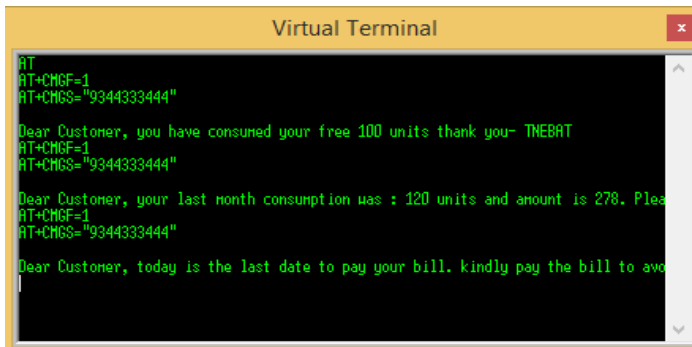


Fig.6 Simulation Output

The proposed system is simulated using PROTEUS software and the simulation diagram & results are shown in Fig. 4 & 5. From the simulation, we obtain various electrical parameters like Voltage, Current, Energy and also the cost.

VI. CONCLUSION

The proposed model of IOT based Smart Energy Meter is used to measure the various parameters of electrical energy like Voltage, Current & energy consumption in kWh. In addition to this, bill amount with total energy consumed (kWh) is sent to the consumer via SMS and also automatic connection/disconnection of power supply is made based on the payment of energy bill. Further, this proposed work proved that it overcome from the problems (such as large number of manpower required for making energy bill, billing errors due to carelessness of human, large time consumption to pay the bill in queue and unaware of tariff) which are all faced by the existing energy meter.

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