IOT Based Smart Energy Meter Billing Monitoring and Controlling the Loads

A.Subba Rao, Sri VidyaGarige

Abstract--- The plan and improvement of a keen observing and controlling framework for energy meters continuously has been discussed in this paper. With the end goal to screen the energy consequently, diminish creation cost, the Remote Meter Reading System is produced. Remote energy meters were structured with prepaid appropriation framework. Structure of which utilizes virtual instrument programming design that should be possible on web server that will works with internet of things. The framework basically screens the vitality necessities and status of utilization of intensity. The framework can screen the status and send data to webserver and additionally a ready SMS through GSM will sent naturally, if the conditions get strange, to a concerned experts cell phone and also amount to be paid by customer at the end of month automatically for the next month with current usage statistics. The concerned expert can control the high power expended gadgets on or off to make the framework better through web portal. The web page which we will utilize is secret phrase ensured by adding username and password along with secured API keys. This framework finds a wide application in regions where physical nearness isn't conceivable all an opportunity to control the devices. The framework will be work with ARM processor utilized in the usage of sensor module and other correspondence condition. The framework offers a total, minimal effort, ground-breaking and easy to use method for ongoing observing and remote control of Appliances.

Keywords: Smart Energy Meters, IOT, Electricity.

I. INTRODUCTION

Energy meters in India have overwhelmingly been electromechanical in nature yet are progressively their status of working capability being supplanted by more modern and precise advanced and electronic meters [1]. A high amount of power at destinations is lost because of theft. With few changes made with present existing architecture of energy meters we can overcome the theft. As indicated by an investigation agency distributed by Northeast Group, India is hoping to shrewd lattice framework to help handle a power robbery issue and enhance unwavering quality. Robbery costs the Indian power $16.2bn per year[2]. To control robbery, inaccurate meter perusing and charging, and hesitance of customers towards paying power charges on time. India's administration has officially dedicated billions of dollars in financing for smart grid infrastructure and total spending is anticipated at $21.6bn over the period 2015-2025.Significant measure of income misfortunes can be diminished by utilizing Energy Meters. Indian government has reacted with billions of dollars in guaranteed financing for keen framework. In November 2014, Prime Minister Modi declared $4bn in financing for

smart metering programs. Moreover, over $8bn is accessible for misfortune decrease projects and many undertakings are currently in progress over Indian states. Investigation dissects the complex administrative systems and industry structures over the states. "India's power demand increase to 7% every year throughout the following decade". A prepaid energy meter empowers control utilities to gather energy bills from the shoppers afterthe utilization of intensity by conveying just as much as what has been need for the particular month automatically. The meter contains a prepaid card closely resembling versatile ATM card. The card speaks with the power utility utilizing portable correspondence framework[3].

In the conventional electro-mechanical and computerized metering framework, electric vitality is reviewed by individual and regularly they arranged the bill through suspicion dependent on his history of power utilization. Possibly the buyer has not used the comparable measure of power in the present month as in the earlier months for reasons, for example, holidaying somewhere else or being in the office for long time, and so on. This strategy for charging is additionally not appropriate for the power supply organization since it gives a wrong record of the general power utilization in the buyer's region and may at last outcome in blunders in future arranging by the organization [4]. Over the previous years, metering gadgets have experienced numerous enhancements and turned out to be more convoluted with more highlights and capacities. Electromechanical Meter has next to no exactness and absence of configurability. There are such a significant number of issues require service organizations to conquer, for example, power burglary, meter adjustments and the sky is the limit from there. Moreover, meters are restricted to give the measure of vitality utilization on shopper's premises [5]. In spite of the fact that there were presented paid ahead of time metering framework in a few regions in India, the observing framework isn't accessible and as the unit needs to purchase before the utilization, the customers may not settle the measure of unit which they need to purchase and that is the reason continuous power isn't discovered [6]. Today a large portion of the utilities organizations are searching for answers for beat these detriments. The proposed framework replaces conventional meter perusing strategies and empowers remote access to existing vitality meter by the specialist. Likewise, it can screen the meter readings consistently without the individual visiting each house. A GPRS/ Wi-Fi module is incorporated with electronic vitality

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meter of every substance to have remote access to the use of power and make a remote system.
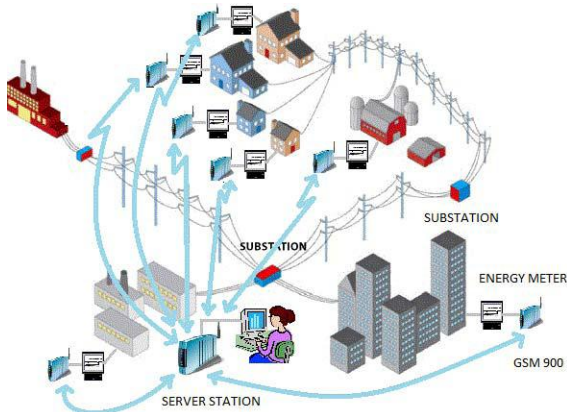

Fig1: Energy monitoring system overview

II.   RELATED WORKS AND MOTIVATION

In recent years many reforms have brought numerous changes to enhance power services benefits across the country. Still there are a few issues in the framework, which influence the nature of administrations and in this manner the level of fulfilment of end clients or open. Among numerous uncertain issues, one of the issue is knowing the consumption by consumer's zone wise/region wise. Indeed, even after establishment of more precise electronic or advanced meters, the issue is proceeded in numerous areas across the country. In present framework the system received by the greater part of intensity supply organizations/offices for getting perusing for power utilization is the manual meter perusing or a portion of its variations like photograph realistic perusing, perusing SMS etc [7].

Some of identified drawbacks of such methodology areTime expending, requires more human resources, efforts and Possibility of incorrect or purposeful manipulated controlling the power consumptionetc.

The proposed model evaluates previously mentioned methodology drawbacks and the present techniques with a computerized framework to remotely gather /control energy meter readings getting a capacity to continuous observing the power utilization. The model recommends establishment of Wi-Fi/GPRS empowered energy meters at consumer end. Such meters have capacity to get associated with the system (through remote or GPRS framework). Such system associated meters can be connected remotely to the server, status of perusing information and also other required information put away in the meters memory can be gathered whenever[8].

These planned techniques will performoperations like consequently associating with the particular meters through their IP Address. Getting current information from the device. Refreshing reading tables at servers.Preparing list of consumer meters with any connection error or any invalid data. Thereby Initiating error reporting and removal routines according to the errors observed. The information gathered through remote meters in each calendar, at that point might be used from the database by the billing programs, the greater part of which are as of now in utilized by the power supply offices. As the framework does not require much

changes in existing billing information/programs, it very well may be advantageously added to the present providers. The model through its planned automated activities, may carry higher execution with condition of control in power supply units.

Automation is a technique for controlling apparatuses naturally for the comfort of clients. Controlling of electrical gadgets in the home that can be modified utilizing a principle controller or even by means of mobile phone (GSM) from anyplace in the world[8]. It likewise includes turning on and off electrical apparatuses like air-conditioners or refrigerators when a desired temperature has been reached. It additionally is utilized to secure a house from thieves by sending caution messages to the closest police station.

III.   SYSTEM DESIGN

This system principally monitors electrical parameters of appliances and subsequently calculates the units consumed. As WSN's are having many advantages, here we have designed smart meters predicting the usage of power consumption. However it is low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements, wifi technology for networking and communication, because it has low-power characteristics, which enable it to be widely used in home and building environments.
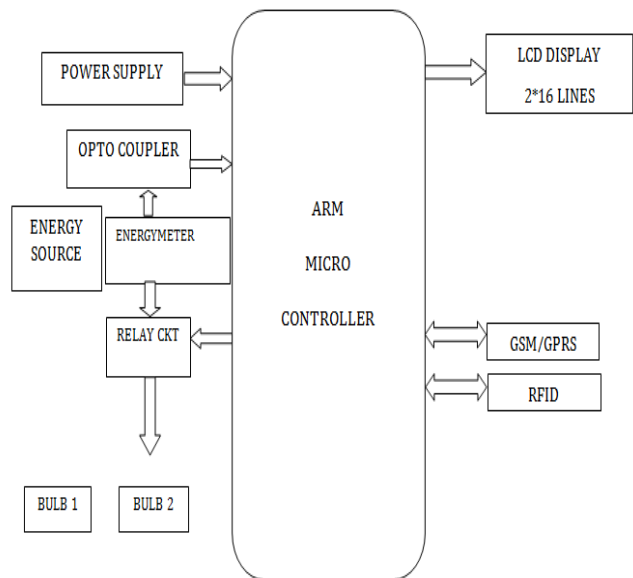

Fig2: Block Diagram of the proposed system

IV.   METHODOLOGY

The proposed system uses ARM7-LPC2148 Processor that can process the instructions according to our requirements such as power delivered to appliances and status of devices i.e on state or off state. The control signals generated through Wi-Fi/GPRS are fed to the

microcontroller which will drive the appliances that are connected to LPC2148 through energy meter. The energy meter that is connected to LPC 2148 through opto coupler will regularly calculates the number of units consumed and the billing amount. The same will be displayed on LCD along with the same information will send to web server about number of units consumed in terms of graph. We could able to reduce the consumption of power by switching off through web links that are defined while programming the web server and ARM. As we are defining the prepaid energy meter we need to refill the number of units that are required approximately per month by estimating the consumable load. However we could able to add the units if completed early. Units are remained at the end of the month will added to next month if they done the refill before consumption of remaining units. Prepaid bill payments can be done by using RFID based prepaid recharge tags or through wallets that are supported the parent organization which will be supplying power. The detailed billing graph will be provided in web server which can be accessed by giving the user details. The whole arrangement provides an effortless, convenient, quick and smooth navigation experiences. The hardware implementation of this projected system consists of an ARM7 microcontroller, Energy Meter with opto coupler for connecting with processor, appliances connected through relays to micro controller. To communicate with server we need Wi-Fi/ GPRS and RFID reader along with prepaid tags for bill payment. RFID reader is used to read the tag information check about validity, available amount for the purpose of power subscription.

The various steps in implementation and execution of this project is depicted below.

Step1: Initialize the hardware according to the requirements, programmed the controller according to the requirements and collecting information about input devices and output devices working according to the instructions.

Step2: Initialize Wi-Fi and RFID in the hardware.

Step3: Initialize web server along with secured API keys which need to be add in the programme.

Step4: Read the prepaid tag for the purpose of payment. Devices will be initialized after refill. Step5: Respond to the web links and operate the devices if need to operate. Energy consumption will be displayed web portal with pre-defined programme used in the controller.

V. HARDWARE COMPONENTS

Opto coupler:

Optocouplers, is a combination of light emitting device and a light sensitive devices. These two are connected into a single package but not connected together. The light sensitive devices we could able to use are photo diodes, LDR, photo transistor and TRIAC etc. Present world will be using these in many electronic equipment. The signal is applied to the LED, which then shines on the transistor in the IC. Here in my paper am using the opto coupler used to measure the number units that are produced by energy meter.

Fig3. Opto coupler connected to energy meter

Relay:

A relay isan 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 separate low-power signal, or where several circuits must be controlled by one signal. In our paper relays were used to connect devices with the processor ARM7 LPC2148 and energy meter.

GSM/GPRS:

GSM (Global System for Mobile communications) is a standard that was developed by the European Telecommunications Standards Institute (ETSI). It will describe the protocols for mobile connectivity by using cellular networks. It will be used to send or receive information from mobile to LPC2148 which is used in our project. Our project mainly works with GSM and GPRS applications that will be done by using messages generated by LPC2148. Loads can be switching ON or OFF based on the commands received from mobile. SMS related AT commands were used like sending SMS using (AT+CMGS, AT+CMSS), read (AT+CMGR, AT+CMGL), write (AT+CMGW) or delete (AT+CMGD) SMS messages and obtain notifications of newly received SMS messages (AT+CNMI)etc[9]. The initialization of GSM can be done by registering the mobile number using the message sending options that is done star followed by mobile number.

Fig4. GSM/GPRS Used For Sending And Receiving The Information

RFID:

RFID or Radio Frequency Identification System is a technology based identification system which helps identifying objects just through the tags attached to them, without requiring any line of sight between the tags and the tag reader. All that is needed is radio communication between the tag and the reader.The number of units that were consumed by customer with predefined paymentthen it will ask for next payment through smart card. Until the payment completion process the loads will be in off state only. After smart card reading process was done it will check about sufficient balance availability. If the sufficient balance will be available then loads will be on.

Fig5. LCD display showing about status of card reading.

Experimental Results:

The hardware components of the system were assembled as per the requirements of application. In this paper we are integrating the system for payment using RFID tags, Information about consumption can be done by using SMS which will be sent to registered mobile number about consumption of units and cost of consumption. The consumption details will also be saved in server. Here in our implementation we are using free server that was associated with MATLAB i.e thing speak server.We could able to on or off the loads though web by clicking on the links given through thingspeak server or sending message as star one or zero[10].

Fig6: Experimental hardware arrangement and information display about number of units consumption along with initialization process
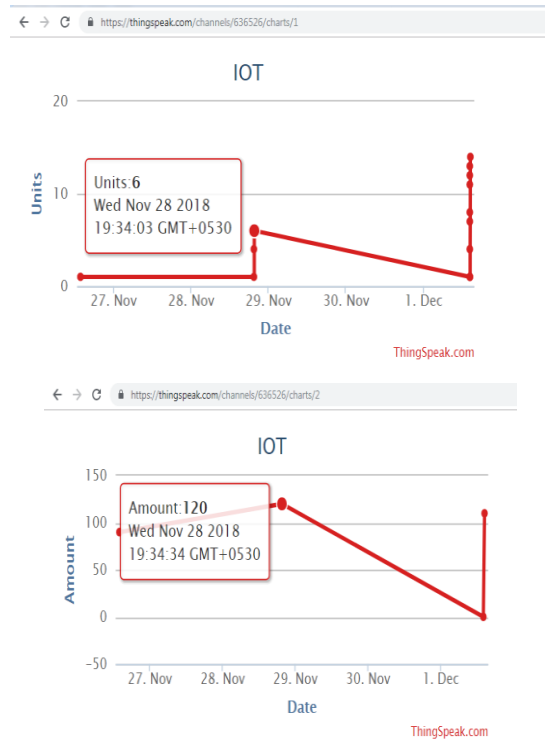

Fig7: Units and amount representation in thingpeak server.

VI. LIMITATIONS

Installation of Wi-Fi/GPRS enabled meters at consumer end will not be possible over a certain period. It takes a lot time to do. Man power requirement will be high at the time of installation and initialization. The cost of implementation will be high.

The requirements of the system varies based on place the consumer need the smart energy meter. According to the requirements given by consumer need to develop the hardware and it should be configured according to the rules and regulations framed by that state government. As the unit charges will be varies according to the category of supply and power distribution units.

This system will have many drawbacks in hill stations, forests and the places where the network coverage problems arise.

VII. CONCLUSION

Good governance will be possible with this model. We could able to monitor the energy requirements of each consumer with very small time gap. With the easy governance we could able to made decision for the next year power supply requirements according to that only we could able to give the information to generation units to avoid un interrupted power. Policies that are updating by the distribution unit could also be updated with few steps followed through web. Which makes the system upgradation easy. The paper concluded with making the system functionality as user friendly and provide long term product efficiency.

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