

ARM Based Online Energy Meter Reading and Billing System by using wireless communication

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Abstract - The current energy meter methods do not provide information of electricity consumption. Automatic generation of bills is inefficient and has the limited access. On daily basis the readings of energy meter are uploaded to a central public server using computer. As compare to the SMS, Wi-Fi sensor is more cost efficient. So Wi-Fi based method is very useful in frequent update. The checking of reading of electricity bill is automatic i.e. there is no requirement of human to visit every home. The bills are generated automatically at the start week. Users give payment of electricity bills through computers. By using this system, the users will be aware of the electricity utilization in his/her home. With slight moderations to the system, it can be used by industry to measure their power consumption and help them reduce the power loss to a greater scale.

Keywords - Energy Meter, IOT, WI-FI, Server, Portal.

I. INTRODUCTION

The previous method of meter reading was manual where person have to go physically and should take the photo of meter reading then he have to add the reading in the computer according to consumer no then the bill is generated. Due to this process the extra time required to this so we have come with no idea. Electricity department sends employees to take meter reading every month, which is an expensive and time consuming job. We finally thought of building a system that will do the above process automatically. Every energy consumption meter will be attached to ARM7LPC2138 unit that will scan the meter reading after every one month. The meter reading will transmitted in wireless manner to the local server along with the meter number. This data will be processed by the server and generates the bill automatically. Once the bill is generated an SMS alert will be send to the owner's mobile number. The proposed project provides a convenient and efficient method to avoid this problem. The electricity department and the user can get the readings of the energy meter of consumers via Wi-Fi. The loads can also be controlled by the user of this system via Wi-Fi using this project.

II. LITERATURE SURVEY

With the development of country's economy and the improvement of national power, the power requirement is still ever increasing due to use of improper power management systems and the conventional energy metering system[1].Over the past years, metering devices have gone through much improvement, and are expected to become even more sophisticated, offering more and more services. Meters in the past, and today in a few countries, were electromechanical devices with poor accuracy and lack of configurability. Theft detection was also a challenge. Such meters are limited to providing the amount of energy consumption on site.

Ashna K. and Sudhish N. George [2] proposed the design of a simple low cost wireless Wi-Fi energy meter and its associated web interface, for automating billing and managing the collected data globally. In this paper if consumer fails to pay the bill before due date then this system does not cut the power supply. But in our system relay is used to cut the power supply if consumer fails to pay the bill before due date. SMS-based Reconfigurable Automatic Meter Reading System [3] suggested Wi-Fi is used as wireless communication medium between AMR interface and center. In this paper if consumer fails to pay the bill before due date then this system does not

cut the power supply. But in our system relay is used to cut the power supply if consumer fails to pay the bill before due date. Champ Prapasawad, Kittitach Pornprasitpol and Wanchalerm Pora [4] proposed a development of an automatic meter reading system focusing on the design for an energy meter implemented with Zigbee wireless communication protocol conforming to IEEE 802.15.4 standard. They use a microcontroller STM32L152VBT6 to manage energy data and Zigbee to enable communication between the energy meter and data centers. In this paper Zigbee is used as a wireless communication medium but the range of Zigbee is less. Hence in our system we use Wi-Fi as a wireless communication medium. In our system we use the LPC2148 and PIC16f690 microcontrollers instead of microcontroller STM32L152VBT6.

For this work existing meter reading techniques in India are analyzed and conducted an extensive study on different energy measuring instruments available now. 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. Many systems built on various platforms have been proposed by different research groups all over the world for Automatic Meter Reading. There are two types of AMR systems, wire-based and wireless. Power Line Carrier (PLC) and Telephone Line Network (optical/ cable) are wire-based AMR system and several related works are available. Many metering systems have now been proposed, based on GPRS, Bluetooth, Design of an Electric Energy Meter for long-distance data information transfers which based upon GPRS is proposed.

Smart energy meter billing using GSM with warning system in this paper systems can't be implemented so easily because the regular use of GPRS is still a dream to the common people. A Wi-Fi Energy meter with instant billing facility is introduced, but still the problem of missing SMS will degrade the accuracy and performance. A more reliable and user-friendly system with web portal for multiple access using the advanced Visual studio .net frame work is created in this project which will manage the data efficiently even if there is loss of SMS. It makes the design different from the previous proposals. The Wi-Fi/GPRS channel is a very useful means of communication as sending data as SMS turns out to be a very handy tool, due to its good area coverage capability and cost effectiveness. Different state electricity boards in INDIA

started using Wi-Fi facility for fault management and so there is increased demand for this method. For this design, energy meter specifications and tariff structure followed by the Kerala State Electricity Board (KSEB) are adopted. In this project the front end is User friendly and any employee with minimum knowledge of computers can work on this software. Employees can read the meter by sitting in their office.

This system integrates GSM (Global system for mobile communication) with the low power electric energy meter. This system measures the power used very accurately and sends the usage data to the consumer at the end of each billing period. It also monitors the error in the reading. Arduino will read the pulses from energy meter via optocoupler. After switching Arduino and GSM the relay will turn ON and connects the energy meter to Load. Then it will read the EEPROM and Display the current data [5]. Intelligent energy meter with advanced billing system and electricity theft detection in this paper. The developing countries are still deficient in the generation of Electrical energy in contrast to demand of the country. In addition to this, prominent problem they are facing is gargantuan electrical power loss. The inadequate power quality, unpaid bills and power theft are the most vital factors behind this huge power loss. Many appropriate solutions for this problem were proposed but still there is scope for improvement. So, this paper presents an Intelligent Energy Meter (IEM) which provides solution for maintaining power quality, provides superior metering and billing system also controls power theft. The concept of intelligent energy meter is validated by experimental setup, consisting of Arduino, GSM and RASBERRYPI model B [6]. Electricity, the most usable form of energy is used widely through the whole world. With the evolution of modern technology, the usage of electricity is escalating gradually. But the production of electricity is confined due to deficiency of resources. So power must be used in a concise way. In many countries, electrical energy is measured by energy meter which is inspected by a human. According to their inspection, the electric bills are prepared and most often these are prepared on the basis of assumption which could be inaccurate, costly, time-consuming as well as error prone. Due to the absence of regular monitoring system, sometimes consumer use electrical energy month after month without paying any bill. Energy meter monitoring and digital billing system is a kind of system which would be able to avoid traditional meter reading, save human resources, improve the accuracy and prevent the power theft. In this paper, a remote monitoring of energy meter and digital billing system is inaugurated through GSM 900. For monitoring server, major programming languages had been introduced to relate the methodologies, execute logical functions, store data in a database and send the monthly bill to the consumer cell phone

number and finally disconnect the unpaid consumer[7]. Electronic energy meter with remote monitoring and billing system in this paper Electronic energy meter is capable of taking readings and can store it into its memory. Taking energy meter reading is time consuming and an expensive task. The meter reader travels for a long distance and take the reading manually to prepare the bill. Consumers have to go to the billing office, stand in a long line and submit the bill. This is a boring job and time consuming also. It can be avoided by remote monitoring of electronic energy meter and prepaid billing system by the use of cash card. In this paper measurement of energy, remote monitoring, preparing of bill and billing system is presented. Low cost ATMEGA8L microcontroller is used here to control the whole system. Sampling of voltage and current is done by it. Then it processes data to achieve power in that instant. Then it stores the value of total energy consumed by the consumer and can calculate energy charge according to the tariff. LCD display is attached with this system to show total energy consumed, power factor and amount of charge etc. Communication between central energy distribution office and energy meter is done through power line. Complex tariff rate set up and cash card based billing is possible in this system. Electronic meter gives high accuracy for nonlinear loads than conventional rotating disc type electro-mechanical meter. Greater accuracy and stability can be maintained in this system[8]. GSM Enabled Smart Meter and Automation of Home Appliances in this paper Electrical utilities are suffering from huge losses due to power theft, inadequate usage of energy, unpaid bills, distorted power quality. Many viable solutions are proposed out of which smart energy metering, energy management system and smart home automation are some that seems to be potent enough. These technologies are presently used by developed countries. Under meter data acquisition system of Restructured Accelerated Power Development and Reform program (R-APDRP) scheme in the year 2009-10, India plans to develop Advanced Metering Infrastructure (AMI). But no effort has been made to develop an economic model for the customers which would play a key role in better acceptance of the scheme. In this paper, a smart energy system for the residential customers is developed and a smart switch board which can curtail the need to upgrade to smart appliances to make the system more economic. 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 [9]. Low cost Electricity Meter Reading System using GSM The proposed system focusses on development of low power and low cost electric energy meter reader. The system consists of two modules, measurement and communication module. The measurement module measures the line current and voltage in order to measure wattage and

finally energy. Current transformer (CT) senses the line current while the potential transformer (PT) measures the line voltage. The outputs, obtained from CT and PT, are current to voltage converted, rectified, filtered, attenuated and analog to digital converted. The energy is summation of the power used over a known period of time. The amount of energy is transmitted to Power supplier as well as consumer via SMS (Short Messaging Service) at predefined intervals. The system also notifies Power Company in event of meter tampering[10]. GSM Based Smart Energy Meter for Advanced Metering and Billing System in this paper Electrical utilities are suffering from huge losses due to power theft, inadequate usage of energy, unpaid bills, distorted power quality. Many viable solutions are proposed out of which smart energy metering, energy management system and smart home automation are some that seems to be potent enough. These technologies are presently used by developed countries. Under meter data acquisition system of Restructured Accelerated Power Development and Reform program (R-APDRP) scheme in the year 2009-10, India plans to develop Advanced Metering Infrastructure (AMI). But no effort has been made to develop an economic model for the customers which would play a key role in better acceptance of the scheme. In this paper, a smart energy system for the residential customers is developed and a smart switch board which can curtail the need to upgrade to smart appliances to make the system more economic. 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 [12]. Experimental Study and Design of Smart Energy Meter for the Smart Grid in this paper The demand for energy is increasing as a result of the growth in both population and industrial development. To improve the energy efficiency, consumers need to be more aware of their energy consumption. In recent years, utilities have started developing new electric energy meters which are known as smart meters. A smart meter is a digital energy meter that measures the consumption of electrical energy and provides other additional information as compared to the traditional energy meter. The aim is to provide the consumer and supplier an easy way to monitor the energy. Smart meters are considered a key component of the smart grid as these will allow more interactivity between the consumers and the provider. Smart meters will enable two-way and real-time communication between the consumers and the provider. Considering the increase of electricity demand in Saudi Arabia, smart meters can decrease the overall energy consumption. This paper presents the development of a GSM and ZigBee based smart meter. This meter can measure the energy and send the informal- Every management system is trying to make automatic, portable and remote control. This work presents a

novel smart energy meter for an automatic and superior metering and billing system. The integration of the Arduino and GSM Short Message Service (SMS) provide the meter reading system with some automatic functions that are predefined. Firstly, we have simulated the project in PROTEUS 8.0 then successfully implemented on the circuit board in laboratory. The proposed energy meter system can incorporate with embedded controller and GSM modem to transmit the data like consumed energy in kWh, generated bill, security services (line Cut/On) over GSM mobile network such as data can be then fed and integrated into existing energy management systems located at power companies or organizations to provide the services among the customers without man-power. Our implemented project is able to provide all required services remotely for metering and billing with high fidelity. In addition to the service provider, who can store this information and notify the consumer through SMS messages or through the internet[13]. Arduino and GSM Based Smart Energy Meter for Advanced Metering and Billing System in this paper Every management system is trying to make automatic, portable and remote control. This work presents a novel smart energy meter for an automatic and superior metering and billing system. The integration of the Arduino and GSM Short Message Service (SMS) provide the meter reading system with some automatic functions that are predefined. Firstly, we have simulated the project in PROTEUS 8.0 then successfully implemented on the circuit board in laboratory. The proposed energy meter system can incorporate with embedded controller and GSM modem to transmit the data like consumed energy in kWh, generated bill, security services (line Cut/On) over GSM mobile network such as data can be then fed and integrated into existing energy management systems located at power companies or organizations to provide the services among the customers without man-power. Our implemented project is able to provide all required services remotely for metering and billing with high fidelity. The growing demand of energy and the need of finding alternative energy sources to the traditional ones, due to the progressive decrease of fossil fuels and an increasing concern towards the environment, have led to a revolution in terms of energy production in the last decade. As a consequence, the distributed generation is more and more widely spreading. The network, in this new dimension, has to change its management and the energy distribution so to achieve and maintain high efficiency requirements. Coming to drop the concept of centralized production, it is immediate to conclude that an efficient distribution of energy must necessarily bring into account the energy footprint of the area, because the energy transport should be always as short as possible, to minimize losses and maximize the efficiency of the network. This concept is the core of the smart-grid idea, on

which the global scientific community is investing heavily in research, the idea is a power distribution grid, based on the experience in the information and communications technology field, which can route the energy through appropriate algorithms that are able to determine the optimal path. Of course, behind all this there must be a network structure capable of acquiring detailed data from widespread production and consumption of energy and make them easily available along with additional information, e.g. the Power Quality of the energy exchanged. This information is demanded by simple user, who wants to personally evaluate the functioning of the system, and also by technical personnel, who needs to access to reliable data to perform targeted and efficient interventions. In the present paper, the authors propose a smart energy meter for energy management in power grids. The measurement system has been projected and developed according to the IEEE 1451 (ISO/IEC/IEEE 21451) guidelines. The system is based on a mobile application in order to improve the data exchange and availability[15]. A Smart Prepaid Energy Metering System to Control Electricity Theft in this paper Power utilities in different countries especially in the developing ones are incurring huge losses due to electricity theft. This paper proposes a prepaid energy metering system to control electricity theft. In this system a smart energy meter is installed in every consumer unit and a server is maintained at the service provider side. Both the meter and the server are equipped with GSM module which facilitates bidirectional communication between the two ends using the existing GSM infrastructure. Consumers can easily recharge their energy meter by sending a PIN number hidden in a scratch card to the server using SMS. This paper presents some measures to control meter bypassing and tampering. The bidirectional GSM communication using SMS ensures the effectiveness of these measures. Pilferage of electricity can be substantially reduced by incorporating the proposed measures along with the prepaid metering scheme. Legal actions against dishonest consumers can also be taken in this system [16].

III. SYSTEM DESIGN

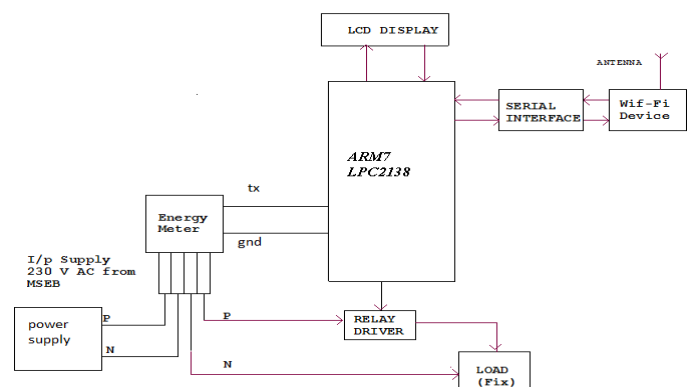


Fig.3 Data transmission using energy meter-

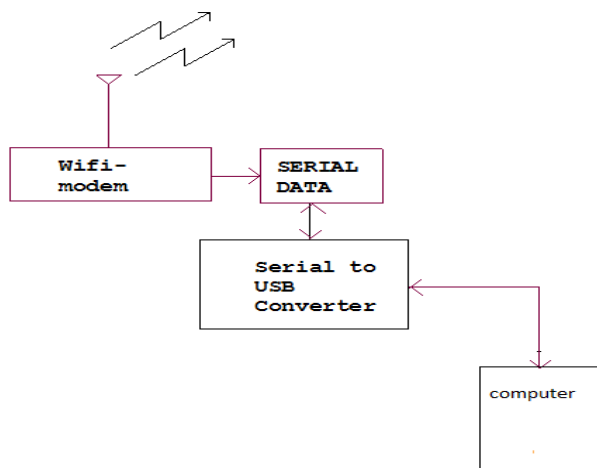


Fig.4 receive serial meter data using computer

1. Hardware used

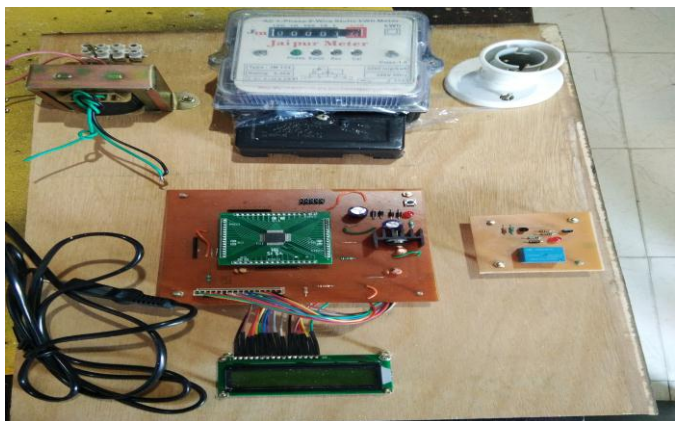


Fig. 5 Hardware setup of Energy system

Figure5 shows the component are mounted on flywood.the component are mounted are as follows step down transformer, Energy meter,ARM7 LPC2138,LCD display, Wi-Fi module, relay driver, load ect.The hardware part of energy billing system of the project consist of energy meter, ARM7 LPC2128 controller, relay driver, power supply, Wi-Fi Module, LCD display ect. when the system is turn ON,240 v supply is given to step down transformer. it is used to convert that voltage to 9V and consist of current rating of 750 m A. the diode 1N4007 convert Alternate current to direct current placed in the power supply circuit. 100UF capacitor are used to convert this 9V voltage to 12V.this 12V voltage are given to IC LM7805 which convert this 12V voltage to 5V.this 5V supply are given Relay Driver, LCD display, Wi-Fi module. The 3.3V supply is given to ARM controller by using IC LM1117.this is all about the hardware part explanation; on the other side the software is also important. the software part are built in visual studio were the backend end is design on c#(sharp)and front end is also design. the command such like ON,OFF, Status for energy meter from Wi-Fi module is given to ARM7 LPC 2138,it send the ACK to the Wi-Fi module that command is recieved,after receiving the command relay is ON

and condition for the energy meter are displayed on the LCD display. the programming part of ARM7 controller are done keil 2.0 software. the code is burn by using the flash magic software. the visual studio software are also used for the c#(shaft) coding which are done for backend designing and front end design are also done this software.

2. System software

- ALTIUM for PCB making
- Kiel software 3.0 for Embedded C programming

3. Implementation Algorithm

- Initialize timer, interrupt, LCD, Wi-Fi, relay, LED.
- Display on LCD "welcome to \n "kkw coe"&delay for 4 Sec.
- Display on LCD "online meter reading using Wi-Fi"& delay for 4 sec.
- Wait for ACK.
- Check ACK.
- if #ON* ACK is received the meter is ON,Relay is ON,counter,timer start.
- if #OFF* ACK is received the meter is OFF, Relay is OFF,counter,timer start.
- if #STS* ACK is received then it send the status of energy meter on Wi-Fi.
- End.

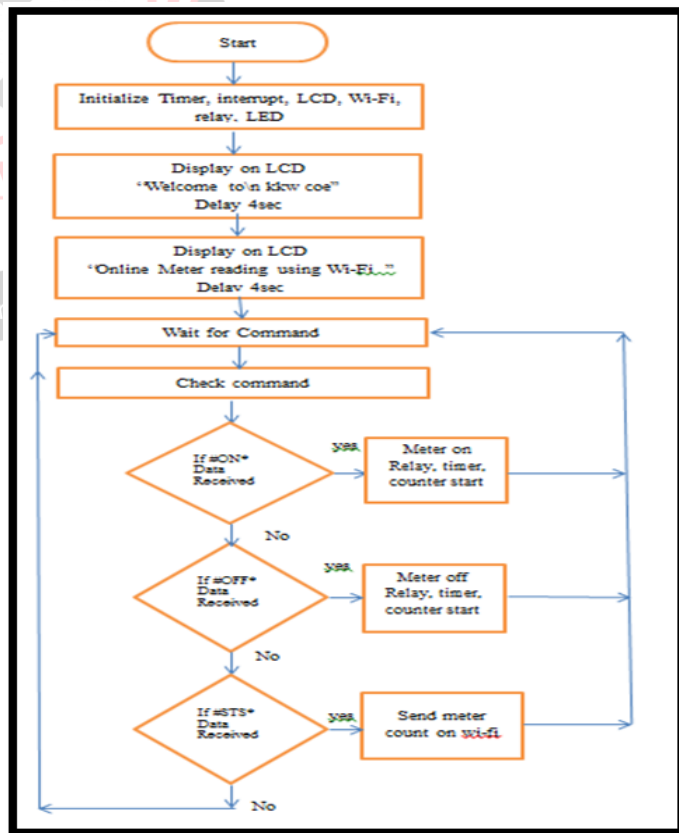


Fig 6 Flowchart showing the workflow of the system designed for energy meter reading and billing system using IOT.

IV. ADVANTAGES OF SYSTEM

System is wireless hence reduces wired structure and complications.

Low implementation cost.

System is used to measure reading accurately.

User will always update with the current readings so user can reduce bill.

V. RESULT

The below fig7 shows the energy meter is ON. The ON condition for the result is #ON1*



Fig 7 result for hardware setup

VI. CONCLUSION

In this project energy meter billing system based on IOT is design. This project is based on the IOT application. Current reading on energy meter can be monitor by using this concept. This system overcomes drawbacks of conventional meter reading system and provides additional services such as power cut alert and tampering alert. Developed system also gives information about daily, monthly and yearly power usage. Details regarding daily power consumption will help consumer to manage their power usage. This developed system is reliable and secure as only authorized person can access the system.

The project mainly aims at providing overall infrastructure of the energy meter presently used for the smart city concept. The main improvement for the future is going to make energy meter readings, tampering identification techniques, and connection and disconnection and also the pre information providing to the users all is going to happen on Wi-Fi internet. Where we are going to develop some Wi-Fi hot spots in each area through which all the energy meters are get connected and set 4 to 5 parameters which is also going to be monitored. And the overall improvement information will be providing to the energy meter.

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