



## International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 3, March 2014

# An Automated Energy Metering System -Home Based Approach

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**ABSTRACT:** Smart meters are the key component of the smart grid which helps both the user and supplier to control consumption of energy according to availability of resources. Electricity market is facing great losses due to an increase in cost for generation of resources. The wastage of electric energy again results in economical problem, thus smart metering system has been considered as a good method to make use of energy effectively. The proposed energy metering system consists of energy meter, communication using Ethernet and webserver. A single phase energy meter has been implemented using ARDUINO microcontroller and communication part has been implemented using Ethernet communication. Server and consumer end are implemented in webserver. This meter is able to measure energy and will communicate the data to the electricity board, which stores the information and notify the consumer through SMS messages.

**KEYWORDS:** ARDUINO, Energy meter, Ethernet Communication, web server.

### I. INTRODUCTION

Smart grid is an electric power system which does the operations like generation, transmission and distribution of electricity. Smart grid provides a solution for electricity wastage. Smart meters are the key components of smart grid. The two way communication facility of smart meter gives real time consumption information to the users. This helps the consumers to reduce their overall electricity consumption. Smart meters provides remarkable benefits if implemented in smart grids as its two way communication acts as a gateway between the consumers and suppliers to manage their electricity consumption. For conventional meter reading system, meter reader has to go to each and every home and get the reading and record it in reading books. Also the customers have to get bill from the authority. This approach in conventional meter reading system requires more human intervention and will be time consuming one. So implementation of an automatic meter reading system is essential in commercial as well as in industrial field by enhancing both networking system and information system[1].

### II. LITERATURE SURVEY

AMR is the system which collects data using one way communication. The system which has the ability to control and monitor the energy meter is AMI. The combination of both AMI and AMR will make the system smart. AMR reduces the meter cost to suppliers and bills the customer with actual meter reading. Also it allows frequent reading[2]. AMR requires special infrastructures which makes the system to communicate to the server and back to customers. The communication can be wired like Ethernet or PLC or wireless like GSM or Wimax. Automatic meter reading networks are also introduced in [3],[4]. Bluetooth based energy meter has been implemented to retrieve the meter reading with less human intervention[5]. but it has only short range of communication. GSM and zigbee communication can also be used to communicate to the remote server[6]. This also have some practical difficulty while sending message from home to the central server each user has to pay cost of message and if data services fails then it will be difficult to send meter reading when it is requested by the electricity board. Ethernet communication can be used to avoid the network failure problems. Only initial installation cost is required for Ethernet communication. Also communication can be achieved by allocating a small band width along with the home telephone network. The electricity board can be able to get the status of real time energy consumption of each home with less cost. Smart meter is one of the major component of

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smart grid. The grid can be effectively managed by the distributors with the detailed load flow provided by smart meter. Smart meters will act as an intelligent system which maintains electricity services efficiently. Smart meters reduces cost, saves energy and increases reliability of system[7-9]. Smart meters are essential for the success of smart grid.

## III. SYSTEM OVERVIEW

The proposed energy metering system consists of an energy meter, ethernet communication and webserver. A single phase energy meter has been implemented by using ARDUINO microcontroller and communication part has been implemented using Ethernet communication, server and consumer end are implemented using webserver. The communication between the server and consumer end can be carried out using many different technologies such as Bluetooth technology, Wi-Fi, Ethernet, GSM etc. Of which this paper adopted ethernet communication to transmit data from the energy meter to the server.

### a) Energy meter

The energy meter part consists of voltage and current controlling unit, level shifter and ARDUINO. For experimental purpose an incandescent lamp of 60 Watt is used. Current and voltage transducers are used to step down current and voltage to safer values. Voltage and current signals are level shifted and fed to the arduino board. The function of this circuit is used to clamp the ac signal with respect to a preset reference DC voltage. The output from the voltage level shifter is given to the analog input of arduino board at pins A0 and ground. Similarly the output from current level shifter is given to the analog input of arduino board at pins A1 and ground. When the inputs are given to the arduino board, the controller on the board will calculate the energy.

### b) Communication part

The communication part has been implemented by using Ethernet communication so that the stored data can be transmitted to the web page with less cost.

### c) Server and management part

The collected energy consumption is sent to the remote server and it is stored in a database. The server managerial system will take care of controlling and managing the consumption of electricity usage of the consumers.

## IV. SYSTEM HARDWARE

Arduino is an open source platform. Arduino uno is a microcontroller board based on ATmega328. It consists of 14 digital I/O pins (6 PWM outputs) and 6 Analog inputs. Clock speed is 16Mhz. Arduino uno can be powered up by using power jack, USB port. It can also be powered using an external battery or using adapter through pin Vin. Shields can be used in Arduino and Arduino compatible boards. These shields are expansions to the base Arduino. There are many shields such as Ethernet, GSM, RF etc of which we used Ethernet shield for our communication. Other than Arduino the energy measurement unit consists of level shifter circuits. Since the output of current transducer and potential transducer are AC signals. It cannot be directly given to Arduino. So level shifter circuits are used to clamp the signal and directly fed the Arduino for calculating energy. and the calculated energy is transmitted to the server by using Ethernet shield, fixed on the top of Arduino board.

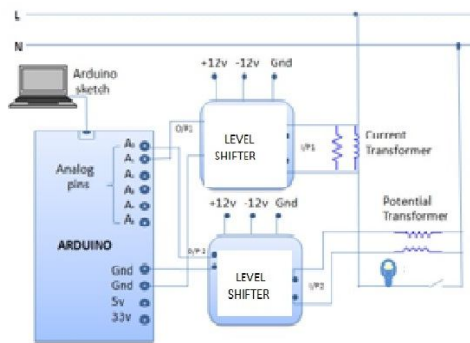


Figure 1: Arduino energy measurement board



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There are two softwares used in this project. They are arduino and WAMP server. Using arduino integrated environment the arduino microcontroller is programmed to communicate with the other components. The arduino microcontroller is the main part of the system in which it will calculate the energy meter reading, and it will be sent to the remote server using Ethernet communication. The Ethernet communication will only be possible by setting up an Ethernet shield on arduino base board.

### V. SYSTEM SOFTWARE

A website is created by using HTML and PHP which provides the information about live energy usage of customers. It will receive the data from the house arduino board on request. If the consumer usage is above the allowed limit then an sms will be sent to the house owners mobile phone as well as an alert alarm will be provided by the arduino. Windows apache mysql php server is used to setup the local server in which the webpage is hosted. By accessing through LAN each home owners electricity consumption can be viewed using the local server and if the consumers energy usage exceeds some limit then a warning message will be sent to the user and power supply will be disconnected.

### VI. RESULT

The energy meter which is developed was tested under a resistive load. A 60W bulb is used as the load and the experimental setup is shown in the figure

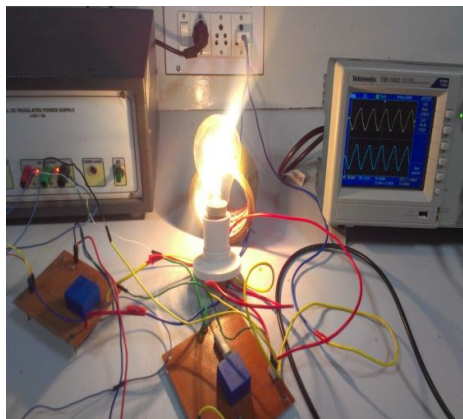


Figure 2: Experimental setup

The arduino is programmed to collect voltages and current from the conditioning circuits and to calculate energy from the collected data. The serial monitor window of arduino shows the consumed energy of the setup, and the consumed energy will be sent to the webserver using Ethernet on request. When the energy consumption is greater than that of allotted energy then an immediate message will be sent to the user as well as an alert alarm will be turned on the smart meter to notify the users to reduce their consumption. Figure 3 shows the serial monitor window in arduino IDE which shows the real time energy reading and figure 4 and 5 shows the various pages of electricity boards webpage created by using HTML and PHP. Figure 6 shows the sms sent to the users mobile phone when electricity usage exceeds certain limit.



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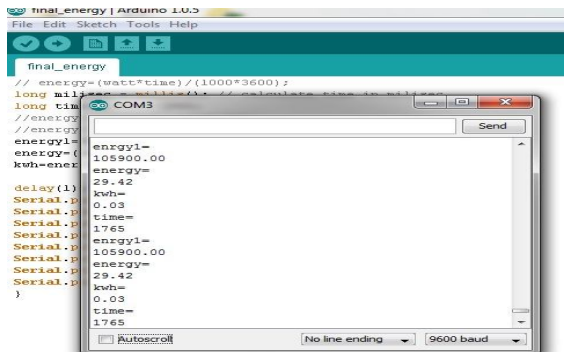


Figure 3: Arduino serial monitor

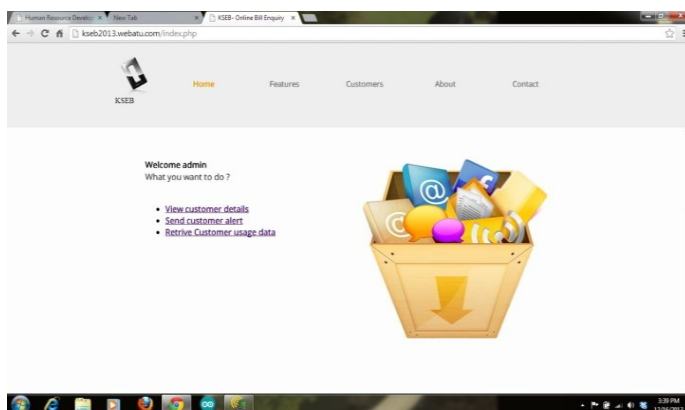


Figure 4: home page of web page

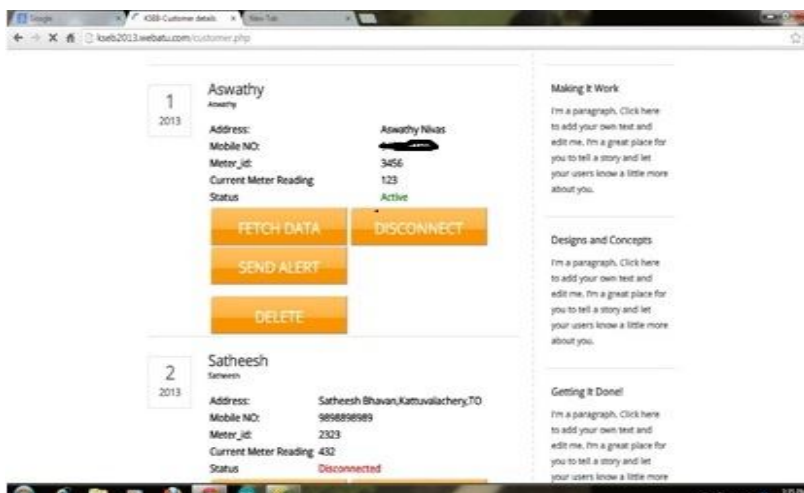


Figure 5: web page for viewing customer details



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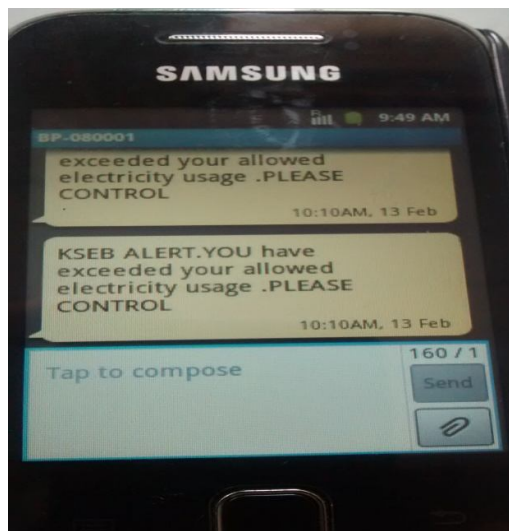


Figure 6:SMS received on users mobile phone

## VII.CONCLUSION

The aim of this project work was to design a device which monitors the energy consumed in a home and to send the consumed energy to the remote server as per request from the electricity board. The data is collected and it will be checked whether the consumption of electricity usage is more or not. An Ethernet communication is used in this paper since the data will be available without any delay. Ethernet features will be further exploited in future. Other future work will include building new prototypes of the device in real scenarios such as installing it in houses.

This system allows the consumers to monitor and track their energy usages. Now a days if consumers want to know their energy usages to limit their use they should wait until the electricity bill comes. By using this device the consumer will be able to get alert messages when their electricity usage exceeds certain limit. The information about the energy consumption helps the users to reduce energy usage and therefore save both energy and money.

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ISSN (Print) : 2320 – 3765  
ISSN (Online): 2278 – 8875

## **International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering**

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 3, Issue 3, March 2014**

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