ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 5, May 2019

IOT Based Smart Energy Meter

C.Mani Barathi[1], Nadar Shashikant Ashok[2], Y.Nesan Jose Rajan[3], T.Anto Theepak[4]

[1](Dept of IT, UG Scholar, Francis Xavier Engineering College, movin2013@yahoo.com)
[2](Dept of IT, UG Scholar, Francis Xavier Engineering College, shashikantnadar@gmail.com)
[3](Dept of IT, UG Scholar, Francis Xavier Engineering College,nesan.official24@gmail.com)
[4](Dept of IT, Assistant Professor, Francis Xavier Engineering College,antotheepak.t@francisxavier.ac.in)

Abstract: The demand for power has increased exponentially over the last century. One avenue through which today's energy problems can be addressed is through the reduction of energy usage in households. This has increased the emphasis on the need for accurate and economic methods of power measurement. The main objective of the project is to develop smart energy meter is not only measure the consumer's power consumption in KWH but also to enable and support real consumption in rupees according to consumer tariff, so meter reader doesn't need to visit each customer for the consumed data collection and to distribute the SMS. Here a new method of post paid electronic energy metering is introduced in this paper which will automatic ally sense the used energy, records these reading continuously, then sends it to the billing point through the existing GSM network. The energy consumption is calculated using measurement voltage and current with help of current sensor (IN4148), measure voltage and current respectively. Power product of voltage and current, its unit watt or KW and energy is product of power (watt) and time (Hour).so, we use mentioned standard formula and using Arduino Microcontroller Programming, we are calculating total energy consumption of consumer load. Microcontroller has an interface in size of 16*2 LCD, it shows important data dimensions such as voltage, current, active and power and energy consumption it also shows power qualities.

I. INTRODUCTION

Electrical power has become indispensable to human survival and progress. Apart from efforts to meet growing demand, automation in the energy distribution is also necessary to enhance people's life standard. Traditional meter reading by human operator is inefficient to meet the future residential development needs. So there is increased demand for Automatic Meter Reading (AMR) systems which collects meter readings electronically, and its application is expanding over industrial, commercial and utility environment. Collection of meter readings is also inefficient, because a meter reader has to physically be on-site to take the readings.

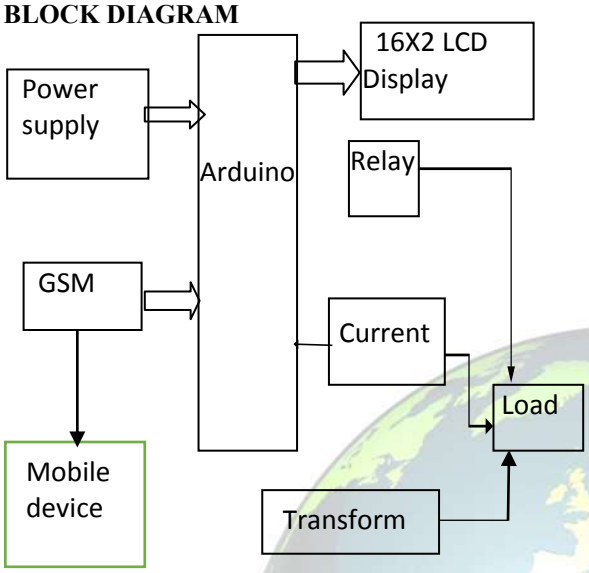
This method of collecting of meter readings becomes more problematic and costly when readings have to be collected from vast, and often scattered rural areas. Meter readers are reluctant to make the effort to travel to such areas and will often submit inaccurate estimations of the amount of electricity consumed. For households at the top of high buildings and luxury housing plots, traditional meter reading is highly inefficient. There exists chance for missing bills, absence of consumer etc. Even though these conventional meters were replaced with more efficient electronic energy meters these problems still persists. So a system which will provide the bill in users mobile will be more suitable in the current scenario. Here a new method of post paid electronic energy metering is introduced in this paper which will automatic ally sense the used energy, records these reading continuously, then sends it to the billing point through the existing GSM network. Finally after processing the collected data bill is generated using a web based system software and is send back to the customer as SMS (Short Messaging System).As it is web oriented once the data is updated, the registered users and authority can monitor and analyse the generated bill of any month by sitting anywhere in the world.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

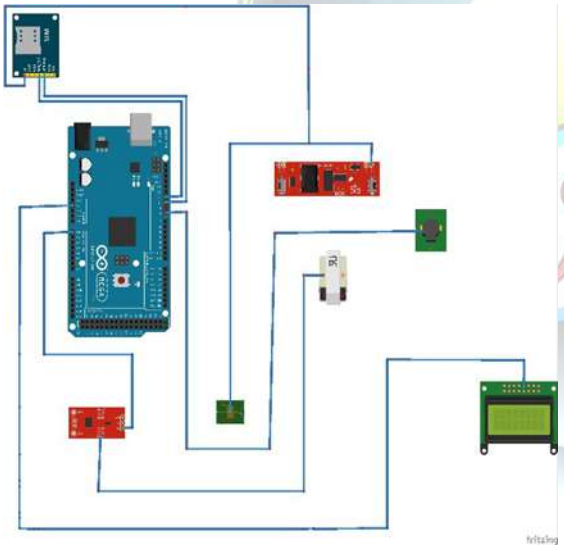
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 5, May 2019

II. EASE OF USE

BLOCK DIAGRAM



III. ARCHITECTURAL DIAGRAM



3.1 ENERGY METER

Energy meter or watt-hour meter is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities is one of the electrical departments, which install these instruments at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerators and other home appliances. Energy meter measures the rapid voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.

3.2 GSM Module (SIM800)

GSM stands for Global System for Mobile communication. It is widely used mobile communication modem system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the GSM 850MHz, EGSM 900MHz, DCS 1800MHz, PCS 1900MHz frequency bands. It has ability to carry 64kbps to 120Mbps of data rates. In our system GSM is used to send the notification for sending message of total consumption of unit with cost to the service provider and consumer.

Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

3.3 ARDUINO UNO (ATMEGA 328P)

Arduino board is the heart of our system. Entire functioning of system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost. Voltage can be calculated using voltage divider and current can be measured using current Sensor.

3.4 CURRENT SENSOR

It is very important for us to understand the working of the IN4148 Current sensor as it is the key component of the project. Measuring current especially AC current is always a tough task due to the noise coupled with it improper isolation problem etc. But, with the help of this IN4148 module which was engineered by Allegro thing have become a lot easier.

This module works on the principle of Hall-effect, which was discovered by Dr. Edwin Hall. According his principle, when a current carrying conductor is placed into a magnetic field, a voltage is generated across its edges perpendicular to the directions of both the current and the magnetic field. Let us not get too deep into the concept but, simply put we use a hall sensor to measure the magnetic field around a current carrying conductor. This measurement will be in terms of millivolts which we called as the hall-

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 5, May 2019

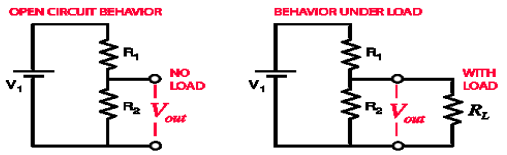
voltage. This measured hall-voltage is proportional to the current that was flowing through the conductor.
The major advantage of using IN4148 Current Sensor is that is can measure both AC and DC current and it also provides isolation between the Load (AC/DC load) and Measuring Unit (Microcontroller part). As shown in the picture we have three pins on the module which are Vcc, Vout and Ground respectively.

3.5 POWER SUPPLY

The regulated power supply accepts unregulated inputs from 7.5V to 15V AC or DC and gives regulated output of 5V and 12V suitable for microcontroller projects which needs precise voltage to work. The input can come from power transformer or wall mount DC adapter. Since board has Diode Bridge input polarity does not matter.

All outputs are brought to screw terminal. There is also an unregulated output voltage to drive high current loads like relays and motors.

3.6 VOLTAGE DIVIDER



$$V_{out} = V_1 \frac{IR_2}{I(R_1 + R_2)} = \frac{V_1 R_2}{(R_1 + R_2)}$$

OUTPUT VOLTAGE UNDER "NO LOAD" CONDITION (open circuit)

OUTPUT VOLTAGE UNDER LOAD

$$V_{out} = V_1 \frac{IR_2}{I(R_1 + R_2)} = \frac{V_1 (R_2 \parallel R_L)}{(R_1 + R_2 \parallel R_L)}$$

A Voltage or Potential Divider Circuit is commonly used circuit in electronics where an input voltage has to be converted to another voltage lower than then the original. This is very useful for all analog circuits where variable voltages are required, hence it is important to understand how this circuit works and how to calculate the values of the resistors required to make a voltage divider circuit to output the desired voltage.

The range over which the Arduino can measure voltage can be increased by using two resistors to create a voltage divider. The voltage divider decreases the voltage being measured to within the range of the Arduino analog inputs.

3.7 RELAY

This product is a 1-channel relay module board with LED indicators; it can be controlled by microcontrollers such as Arduino, AVR, PIC, ARM any other microcontroller operating at 5V.

It controls the Arduino when the power in switched on and it is used to cutoff the power when overload detection and theft detection.

3.8 LCD DISPLAY

This 16X2 LCD Display Module is used to interface with any kind of microcontroller target boards like 8051, AVR, Arduino and any other processors. The module comes with 4-bit data and 3-bit control pins. The LCD Contrast can be varied with the potentiometer provided on board.It displays the current energy consumption in watts with rupees.

IV. ABBREVIATION USED

IOT	Internet of Things
LCD	Liquid Crystal Display
GSM	Global System for Mobile
AC	Alternating Current
DC	Direct Current
LED	Light Emitting Diode
SIM	Subscriber Identity Module

V. EQUATIONS AND MATHEMATICAL CALCULATION

Voltage Divider Calculation

R1 = 47000.0;
R2 = 33000.0;
value = analogRead(A0);
voltage = value * (5.0/1024)*((R1 + R2)/R2);

Current Sensor Calculation

adcValue = analogRead(currentPin);
adcVoltage = (adcValue / 1024.0) * 5000;
currentValue = ((adcVoltage – offsetVoltage) / sensitivity);

Power

To measure power
power=voltage*currentvalue
Energy=power/3600;
Total Energy(T.E)= TotalEnergy+Energy

Energy Consumption in Rupees

If TE <=50
Rupees=Energy*3.60
If TE>50 and TE<=100
Rupees=Energy*4.25
If TE>250
Rupees=Energy*5.25
Notification will be sent to consumer 15 days once

Energy Consumption Calculation

The energy E in kilowatt-hours (kWh) per day is equal to the power P in watts (W) times number of usage hours per day t divided by 1000 watts per kilowatt:

E(kWh/day) = P(W) × t(h/day) / 1000(W/kW)

Electricity Cost Calculation

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 5, May 2019

The electricity cost per day in dollars is equal to the energy consumption E in kWh per day times the energy cost of 1 kWh in cents/kWh divided by 100 cents per dollar:

Cost($/day) = E(kWh/day) × Cost(cent/kWh) / 100(cent/$)

5.1 UNIT:

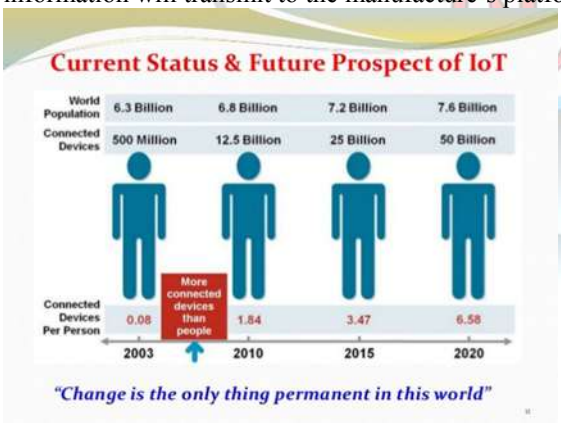
Normally, basic unit of electricity is Kilowatt hour (KWh). 1kWh = 1000 watt for 1 hour.

VI. Overview Of Internet Of Things

The entire process starts with the devices themselves, such as smartphones, digital watches, electronic appliances which securely communicate with an internet of things platform. IoT platform collects and combines data from multiple devices and platforms and applies analytics to share the most valuable data with applications to address industry-specific needs.

Let's start with a simple real-life example- a car after taking a long road trip, Rajesh notices that his check engine light and finds that it needs to look by a mechanic but doesn't know if there is something minor or serious. As it finds out, the sensor that triggered the check engine light monitors the pressure in the inner break line. This sensor is one of the many sensors present in the car which are constantly communicating with each other.

A component called the diagnostic bus gathers the data from all these sensors and then passes it to the gateway in the car. The gateway collects and sorts the data from different sensors. This way only the most relevant diagnostic information will transmit to the manufacture's platform.



VII. Why ARDUINO board than other controller?

- Arduino Power Measurement is an advanced method of determining power and this method is more advantageous than other software's such as MATLAB. Cross-platform
- The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers.
- The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.
- ARDUINO is even less in cost as compared to other controller.

VIII. RESULT

1] Calculation of power and cost display in LCD Display

2] 15 days once consumption of power will be sending a message to the consumer with total bill of electricity.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 5, May 2019

IX. CONCLUSION

The Development of our proposed model energy meter demonstrates the concept and implementation of new power metering systems. This proposed system is flexible has low operating costs and less man power is required. This system is well suited for smart cities.An attempt has been made to make a practical model of 'IoT Based Smart Energy Meter.' The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be handy. Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

REFERENCES

[1]. Andrey.E and Morelli.J, "Design of a smart meter techno-economic model for electric utilities in Ontario," Electric Power and Energy Conference (EPEC), pp. 1-7, 25-27 Aug 2010.

[2]. Arun Chandra P, Mohith Vamsi G, Sri Manoj Y , Gerardine Immaculate Mary "Automated Energy Meter Using WiFi Enabled Raspberry Pi" IEEE International Conference On Recent Trends In Electronics Information Communication Technology Pg.no 1992 to 1997 May 20-21, 2016

[3]. Birendrakumar Sahani, Tejashree Ravi Akibjaved Tamboli, Professor R.S. Pisal." Smart Energy Meter" International Research Journal of Engineering and Technology (IRJET),pg.No:96 to 101 Volume: 04 Issue: 04 | Apr -2017

[4]. Dinesh Thanth ,Amol Borole "Wi-Fi Based Smart Energy Meter VLSI & Embedded System Design" Gujarat published in International Journal of Research in Computer and Communication Technology,19 to 21, Vol 4, Issue 4 , April -2015

[5]. Masudur Rahman; Noor-E-Jannat; Mohd. Ohidul Islam;Serazus Salakin, "Arduino and GSM Based Smart Energy Meter for Advanced Metering and Billing System" 2nd Int'l Conf. on Electrical Engineering and Information & Communication Technology (ICEEICT) 2015 Jahangimagar University, Dhaka-I 342, Bangladesh, 21-23 May 2015

[6]. ARDUINO WITH GSM - Making a Call & Sending SMS Ref. https://youtu.be/WAvZ3SSQR74

[7]. Arduino with SIM800A for receiving SMS commands Link: https://youtu.be/m5_bwRNWMvM

[8]. Send SMS from GSM module link: https://youtu.be/iTyxZ182uhE