ADVANCE METERING INFRASTRUCTURE AND CUSTOMER SYSTEM

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***Abstract*—Electricity is the heart of today's world. And now the world is going to be digital so electricity is very much important aspect. Generation and supply of electricity is the primary task of electricity board but it is also important to measure the power used by the consumer that is taking reading and generate the bills. In current scenario taking a reading and generating bill is manual work. It is very time-consuming. Power theft is the one of the biggest problem in India. Sometimes users do not pay the bill on time so the electricity board worker has to come and disconnect the power manually. In this case, sometimes corruption done by the user or by the worker which leads to the loss for the electric board. In some area camera also used to take the reading but it's the very complicated system and not so friendly-user. To avoid all these problem, we proposed a smart meter automatic payment. We also used the relays to cut down the power supply of unpaid user which would be controlled wirelessly using IOT concept. Reading will be taken automatically and user gets the notification through using application.**

Smart flow meter help improve the water and gas metering accuracy by an order of magnitude compared to traditional meter. Traditional mechanical flow meters measure water and gas usage mechanical components that are prone to friction and get out of calibration easily leading to inaccurate reading and high maintenance cost utilities and industries can leverage on electronic flow meter which are a modern alternative to that old technology. Not only do these smart meters provide the necessary accuracy and precision, they also reduce power consumption and man power.

Index Terms—WI-FI module, Relays, Energy-meter, Arduino UNO(ATMEGA 328)

I. INTRODUCTION

The rapid developments in the Wireless communication technology by the use of microcontrollers, there are many improvements in automating various industrial aspects for reducing manual efforts. The traditional manual meter reading was not suitable for longer operating purposes as it spends much human and material resource. It brings additional problems in calculation of readings and billing manually. Now-a-days the number of electricity, water and gas consumers is increasing in great extent. It became a hard task in handling and maintaining the bills as per the growing requirements.

Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. If the consumer is not available, the billing process will be pending and human operator again needs to revisit. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time. It becomes very difficult especially in rainy season. The availability of wireless communication media has made the exchange of information fast, secured and accurate provides the solution to the above stated problem. There are two types of networks, they are wired and wireless. Wired networks require lot of setup and maintenance cost. In wireless networks there are many technologies. It works well with networks Wi-Fi and server and also provides scalable networking solution which makes it suitable to be used in controlling and monitoring applications. Here the consumed energy bills are paid automatically by the server controller. In case of nonpayment the supply will automatically disabled for respective sources.

In the present billing system the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity, water and gas (optional) quality even if

bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system. The present project "IOT Based Smart Meter" addresses the problems faced by both the consumers and the distribution companies.

The project mainly deals with smart meter, which utilizes the features of embedded systems i.e. combination of hardware and software in order to implement desired functionality. The project discusses comparison of Arduino and other controllers, and the application of server and Wi-Fi modems to introduce 'Smart' concept. With the use of server modem the consumer as well as service provider will get the used energy usage reading with the respective amount, Consumers will even get notification in the form text through App provided for consumer when they are about to reach their threshold value, that they have set. Also with the help of App the consumer can monitor his consumed reading and also the bill automatically paid by use of server.

This system enables the electricity, water and gas (optional) department to read the meter readings monthly without a person visiting each house. This can be achieved by the use of Arduino unit that continuously monitors the all the three meters reading and all the readings are sent to server .the server records the meters reading in its server cloud memory location. This system continuously records the reading and the live meter reading can be displayed on App to the consumer on request and as well in the server (for user only). This system also can be used to disconnect the supply of the house when needed. When the bill amount is due (not paid) the server automatically disables the three sources. If the payment is done it will continue in the enable condition.

II.PROBLEM DESCRIPTION

Issues in the Existing Systems

The electricity smart meters have been introduced in different countries to transfer the meter reading automatically and control the non-technical losses at the power distribution site. Furthermore, by the implementation of electricity smart meters on feeders, transformers and distribution ends, a better online system has been incorporated in the existing infrastructure of electricity.

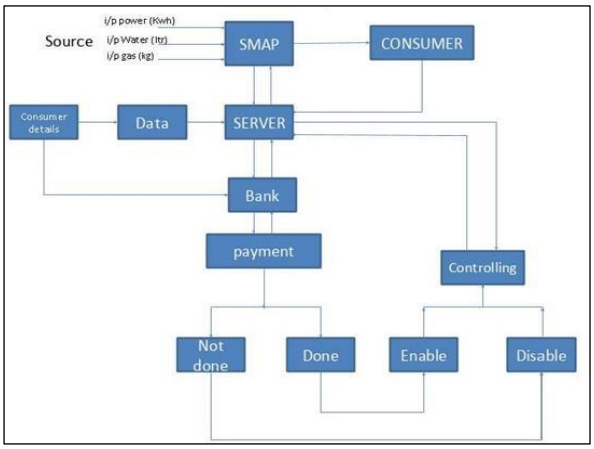
In current water billing system, each building consists of one analog water meter and the total bill amount is equally divided to each home in that building, irrespective of what amount of water that home has consumed, our system is cost effective enough to be installed in every household.

- It takes a lot of time consumption to complete the billing process in a given particular area.
- Subsequently there will be possibility of misplacing the bills therefore data security will be less.
- In particularly during the rainy season the work will get more difficult than other days.
- If the consumers forget to pay the bill then the operator will come and cut the power.

III. SCOPE OF THE PROJECT

- The smart meter can record and measure the power consumption in small amount of time. By recording energy at these intervals, this allows the utility to bill customers using time of use pricing, simply put the cost of energy meter through the day, therefore users will able pay bill at different price instead of flat rate.
- Smart metering will have an AMI system where all the data are stored onto a web server. User can check his unit consumption at any time and can also pay the bill online.
- The user will be able to set the limits for consumption. Beyond the limit of user will generate a warning message to the user.
- Bill can be paid at any time online. There is no need for a person to come home and generate bills. All this work will be done by the system and it will be very reliable.

IV. METHODOLOGY PROPOSED



BLOCK DIAGRAM OF ADVANCE METERING INFRASTRUCTURE AND COSTOMER SYSTEM

A. BLOCK DIAGRAM

The proposed system has two sections mainly, one is Home meter Section and another one is server controlled section. Communication between these two sections is done through wireless network. This system monitors the load, monitoring means calculating the sources consumed exactly by the user at a given time. Sources are utilized and the corresponding readings will be recorded in the server and also application provided for consumers reads continuously and communicated to the controlling base station. The consumers can track the daily usage of all three sources and also amount of consumption.

- The proposed system introduces a new method of meter reading electronically and transmitting to headquarters for further processing. This helps in reducing the manual errors that occur in the present meter reading systems.
- Meter reading system can be used to take readings for different utilities such as Electricity, Water, Gasoline (LPG ,CNG) etc.,
- Let us consider an example of Electricity; here we are connecting the Energy Meter between main supply and load, by which Microcontroller will be able to measure the energy units consumed by the consumer.
- When the various appliances of the household consume energy the energy meter reads the reading continuously and this consumed load can be seen on meter. blinking, the units are counted. Normally, 3200 blinks is one unit.
- In our project we are trying to develop, a system in which Arduino Uno act as main controller, which continuously monitor energy meter.
- As per the blinking of LED on energy meter the Arduino will measure the unit consumption. The measured reading with the calculation of the cost will be continuously displayed on web that we have designed.
- Threshold value can be set on webpage with the help of Wi-Fi, as per the consumer's requirement. When the consumers reading will be near about to the set threshold value it will send a notification value to the consumer.
- This threshold value notification will increase the awareness amongst the consumer about the energy.
- The Microcontroller computes the amount of energy consumed. Then the calculated values are transmitted instantaneously via Wi-Fi to the MAIN STATION and the necessary updates are performed in the DATA BASE of the consumer.
- The Gas Leakage Sensor senses the leakage of gas in house and turn off the mains in case of leakage

V. HARDWARE DESCRIPTION

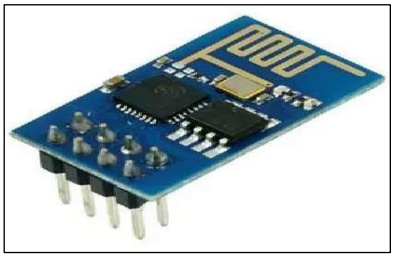
1. ENERGY METER

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, refrigerate 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.

2. Wi-Fi Module (ESP8266)

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which acts as heart for IoT. Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the



readings of units and cost are displayed on webpage. Consumer can accesses the Arduino board and meter with help of Wi-Fi.

3. ELECTROMAGNETIC REALY

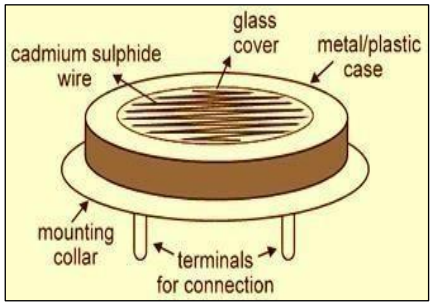
Electromagnetic relays are those relay which operates on the principle of electromagnetic attraction. It is a type of a magnetic switch which uses the magnet for creating a magnetic field. The magnetic field then uses for opening and closing the switch and for performing the mechanical operation,

When power flows through the first circuit (1), it activates the electromagnet (brown), generating a magnetic field (blue) that attracts a contact (red) and activates the second circuit (2). When the power is switched off, a spring pulls the contact back up to its original position, switching the second circuit off again.

This is an example of a "normally open" (NO) relay: the contacts in the second circuit are not connected by default, and switch on only when a current flows through the magnet. Other relays are "normally closed" (NC; the contacts are connected so a current flows through them by default) and switch off only when the magnet is activated, pulling or pushing the contacts apart. Normally open relays are the most common. Here's another animation showing how a relay links two circuits together. It's essentially the same thing drawn in a slightly different way. On the left side, there's an input circuit powered by a switch or a sensor of some kind. When this circuit is activated, it feeds current to an electromagnet that pulls a metal switch closed and activates the second, output circuit (on the right side). The relatively small current in the input circuit thus activates the larger current in the output circuit

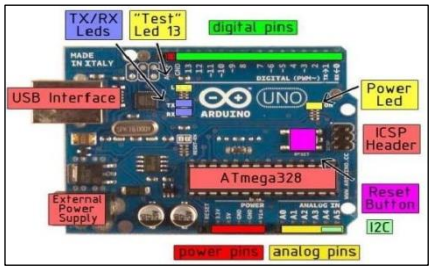
4. LED

The general purpose photoconductive cell is also known as LDR – light dependent resistor. It is a type of semiconductor and its conductivity changes with proportional change in the intensity of light. The complete principle of an LDR is as follows. In a semiconductor an energy gap exists between



conduction electrons and valence electrons. As an LDR is also known as semiconductor photoconductive transducer, when light is incident on it, a photon is absorbed and thereby it excites an electron from valence band into conduction band. Due to such new electrons coming up in conduction band area, the electrical resistance of the device decreases. Thus the LDR or photoconductive transducer has the resistance which is the inverse function of radiation intensity.

5. ARDUINO UNO(ATMEGA 328)



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. This data, it continuously stores on webpage, so that users can visit any time and check their consumption. It even reacts accordingly as per programmed, to the situations like message sending during threshold value etc.

6. LCD

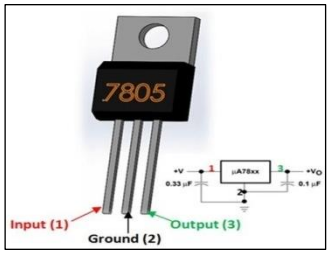
LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology.

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins: A register select (RS) pin that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.

A Read/Write (R/W) pin that selects reading mode or writing mode An Enable pin that enables writing to the registers. 8 data pins (D0 -D7). The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

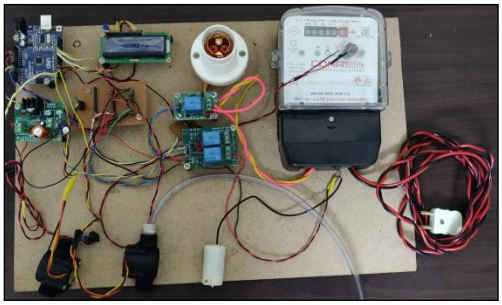
7. VOLTAGE REGULATOR

The LM317 is an adjustable 3−terminal positive voltage regulator capable of supplying in excess of 1.5 over an output voltage range of 1.2 V to 37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow−out proof. The LM317 serves a wide variety of applications



including local, on card regulation. This device can also be used to make a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM317 can be used as a precision current regulator. Features • Output Current in Excess of 1.5 A • Output Adjustable between 1.2 V and 37 V Internal Thermal Overload Protection • Internal Short Circuit Current Limiting Constant with Temperature • Output Transistor Safe−Area Compensation • Floating Operation for High Voltage Applications • Eliminates Stocking many Fixed Voltages • Available in Surface Mount D2PAK−3, and Standard 3−Lead Transistor Package • NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable • These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant.

VI. RESULT AND DISCUSSION



1. The proposed system displays Current unit with cost will be displayed.
2. When threshold is about to over, the message will be sent to consumer.
3. Monthly consumption of power will be send a message to the consumer with total bill of electricity.
4. The monthly bill with unit consumption and user Id will be sent to service provider.

VII. CONCLUSION

In a rapid changing environment, online data is necessary for correct, convenient and safe operation of power grid and that is proposed by this model. An attempt has been made to make a practical model of 'IoT Based Smart Energy Meter.' The proposed model is used to calculate the energy, water and gas consumption of the household and even make the usage handy. Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

The advanced metering infrastructure is relatively a new concept which needs improvement in the areas of communication, data analysis and control schemes. This concept removes the technical complexity from the sector and allows easy devolution in a way that electricity will support economic growth.

VIII. ADVANTAGES

- Accurate reading.
- Secured payment.
- Reduces the man power.
- The human error and corruption can be reduced.
- Consumer can be updated by the daily consuming details

Of all the three sources of energy.

- They can turn off and on by using the SMAP (smart meter automatic payment) application it can reduces the wastage of all the three sources.
- Power theft can be reduced.

IX. APPLICATION

- Settlement and billing

More accurate settlement smart metering improves settlement procedures by providing accurate and rather up to date consumption data for metering points. Thus most needs to estimate consumption data and correct the settlement and billing afterwards are removed. In other words DSOs may eliminate costly additional settlements procedures.

- More frequent and cheaper switching of retail electricity suppliers

One of the core functions in Smart Metering is a possibility to request metered data from a metering point at any time. Considering that regulators require steady shorter periods for changing of retail electricity suppliers (in Norway it is two weeks now and will be reduced even further) possibility to read data remotely at any moment of time, reduces costs for DSOs. In the future it will also provide a possibility to implement an automated supplier switching procedure.

- Correct and timely billing

The EU Commission emphasizes in its ESD Directive 2006/32/EC the importance of providing actual energy consumption data to customers and billing, based on actual consumption data. Smart Metering obviously enhances this possibility.

- Continuous monitoring of voltage quality enables fast and accurate response to customer complaints. It also enables preventive reaction to power quality problems, before any harm or damage to the network or to the customers occurs. The traditional approach of bringing power quality analyzer to the complaint location after a complaint is inefficient and labor intensive and is inadequate as a proof of power quality during the incident causing the complaint.

REFERENCES

[1] Himshekhar Das, L.C.Saikia, "GSM Enabled Smart Energy Meter and Automation of Home Appliances", PP-978-14678-6503-1, 2015 IEEE.

[2] Ofoegbu Osita Edward, "An Energy Meter

Reader with Load Control Capacity and Secure Switching Using a Password Based Relay Circuit", PP-978-1-4799- 8311-7, 'Annual Global Online Conference on Information and Computer Technology', IEEE 2014.

[3] Yingying Cheng, Huaxiao Yang, Ji Xiao, Xingzhe Hou, "Running State Evaluation Of Electric Energy Meter", PP978-1-4799-4565-8, 'Workshop on Electronics, Computer and Applications', IEEE 2014.

[4] Sahana M N, Anjana S, Ankith S,K Natarajan, K R Shobha, "Home energy management leveraging open IoT protocol stack ", PP- 978-1-4673-6670-0, 'Recent Advances in Intelligent Computational Systems (RAICS)', IEEE 2015.

[5]Luigi, Martirano, Matteo Manganelli, Danilo Sbordone, ''Design and classification of smart metering systems for the energy diagnosis of buildings'' IEEE 2015.

[6] J. Widmer, Landis," Billing metering using sampled values according lEe 61850-9-2 for substations", IEEE 2014.

[7] Cheng Pang, Valierry Vyatkin, Yinbai Deng, Majidi Sorouri, "Virtual smart metering in automation and simulation of energy efficient lighting system" IEEE 2013.

[8] Amit Bhimte, Rohit K.Mathew, Kumaravel S, "Development of smart energy meter in labview for power distribution systems", "IEEE INDICON 2015 1570186881", 2015.

[9] H. Arasteh, V. Hosseinnezhad, V.Loia, A.Tommasetti, O.Troisi, M.Shafie Khan, P.Siano, "IoT Based Smart Cities: A survey"IEEE 978-1-5090-2320- 2/1631.00, 2016.

[10] Clement N. NYIRENDRE, Irvine NYANDOWE, Linda SHITUMBAPO, "A comparison of the collection tree protocol (CTP) and AODV routing protocol for a smart water metering.", PP NO. 1-8, 2016.