SHORT PAPER: AURDUINO BASED SMART
ENERGY METER FOR UTILITIES

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Abstract:

Through this paper an ARDUINO based automatic remote meter reading has been presented. Monitoring and recording of the reading of energy meter is done using microcontroller. Application of this work has uses as follows. No physical visits are required for data collection of energy consumed or distribution of bills. Utility connection can be disconnected or re-connected without any physical visit using in-built software. All service alerts can be forwarded to the customers and they can check the status of respective electricity load from anywhere through IOT software. The overall circuit is also flexible and cost effective.

Keywords—Energy meter, Arduino module, IoT, Wi-Fi, webpage.

I. INTRODUCTION

In this technology driven era, more and more systems are coming in place for better monitoring and ease in our day to day life.

For improvement in security, minimalism, saving electricity and time in the current billing system, we are proposing automation. This automation will be able to monitor load of consumer’s every month, assuring billing to be accurate, Monitoring demand and consumption threshold value. The recent billing system used by distribution companies are not able to keep track of the varying maximum though the payment of the bill is paid timely. Hence we aim to develop an advanced energy billing system with automation considering all above mentioned factors [1].

Two of the latest technological advancement viz. Arduino Module and IOT will be used in our system in integration. Arduino is an energy efficient system. So it consumes less energy but at same time it has 2 nos. of UARTS and is the fastest. Our paper suggests a Cost effective Smart Meters. The current infrastructure (installed meters at consumer end) will be used, we just need to install few modifications in the same meters. This preface will be user friendly also. We will be designing a website for Consumer admittance, they will be given access Logins for their respective connection. These Logins can be used for noting current usage with cost. This system will help in involuntary ON & OFF of meter, brink rate setting and conveying notices [2].

The IOT is the system which intelligently links sensors and actuators to the Internet, aiding the communication between two devices, users and devices. This integrates all the run-of-the-mill devices around us like TV, Mobile phones, Internet. IOT has revolutionized communication technology in recent years.

“IOT based Smart Meter” as presented in this paper is the solution for users and distribution entities. For achieving better functionality, it would be utilizing embedded systems of software and hardware [4-5].

For introduction of our SMART METER concept, let us discuss assessment of Arduino with other controls and the application of Wi-Fi, IoT, Implementation of IOT will be both user friendly for consumer and energy distributor. The information interface will give full access to the consumer. Information like amount of used energy reading with the respective cost, current threshold value. Automated notifications will be engineered in the system. Both energy distributor and consumer can set the value of threshold energy usage. Consumer can use Wi-Fi Modem and webpage [6-7].

Arduino unit which uninterruptedly perceives and archives the energy meter findings in its perpetual (non-volatile) memory site. Hence through this structure electricity subdivision can perform the meter analysis periodically without a person visiting every domestic electricity consumption unit. So the structure constantly registers the findings. The Live meter finding can be presented on webpage to the user on entreaty and disconnecting the power supply.

The challenge for the current industry is to unravel the value of this emergent interlocked web of devices, often referred to as the Internet of Things (IoT), describing it as the tool in our future surveillance. [8-10].

II. DESCRIPTION

As mentioned earlier our system is much more user friendly so consumer may find our system as further more flexible and use it with common applications like android. The proposed system is developed in such a manner to avoid the drawbacks of the existing system and support more reliability, ease, ability and security. Schematically the architectural block diagram is shown in Fig. 1.
Current reading of the energy meters (LED) is done as per the counts of blinks. These blinks are generated based on energy consumption of household appliances such as light fittings, TV, AC etc. As a standard thumb rule one unit is equal to 3200 Blinks.

Our ANDRINO UNO based system will count the blinks and convert it into consumption unit which will be displayed on individual login at the website.

As mentioned earlier consumer can manage setting of threshold value. The automated notifications will be sent to the consumer and distributor agency. The Energy meter will be programmed to switch off as soon as the threshold value is reached. Consumer can anytime login into the individual account and rest the threshold value with increase to avoid the automatic switch off the system or to restart the energy supply.

This will create affirmative mindset about energy conservation and usage of the energy amongst the consumer. Also the monthly consumption of the energy with its corresponding cost will be sent to the energy distributor and user by Text Message on the registered number.

**III. EASE OF USE**

Fig.2 represents the proposed Aurdino Based Smart Energy Meter.

**A. SMART ENERGY METER**

Smart Energy meter is a machine used to measure intake of energy which is predominantly electrical. It multiplies voltage and currents which flows rapidly due to consumption (through devices) and provide power consumed over a period of defined time slot. The infrastructure of the meter is responsible for monitoring of the readings, bi-directional communication, and storage of non-volatile data. It can also detect any tempering if done at the user ed. It can be used to switch ON or OFF the energy supply.

**B. ARDUINO UNO(ATMEGA 328)**

This is a single board micrometer made for optimum adoption to IOT Smart Meter. It generates C++ coding for implementation. It requires less than 5 Volt supply for counting the signals using A7 Mega 328 chipset. It is the advance version which works on programming of USB to serial convertor. It is the driving engine of the system as it controls receiving communication from sensors, processing and storing the signals for command out situation when required.
C. Wi-Fi MODULE (ESP8266)

Arduino Uno Wifi is processed to work both Offline and Online. ESP8266 is to be connected to the internet for connecting Arduino in the Smart Meter to start the function once through modest connectivity through UART interface and serial communication. Few of the devices required are adaptor, Wireless internet access interface and design based on micro-controller. The Module used here is ESP8266 which is modeled with 50C integrated in IP protocol stack that is very easy to access with right configuration because of OTA programming. This aids transfer through WIFI firmware.

D. WEBPAGE (HTML)

For cohesive working of the customer interface with Arduino, an HTML webpage was required. So we made a Hypertext Markup Language (HTML) which is basically the structure and content of the webpage i.e. where things go and what is on the page. From the lookout of the server side placement there are two types of Web pages, Static and Dynamic. Static can be recovered from the web serves file system without any alteration while dynamic will be created by the web server on the hover. Usually representation from a record to fill out a web template, before being sent to the users’ browser. This runs in built-in structure of every web browser. The official web standards are upheld by World Wide Web consortium (W3C). Such we can create a content structure of website and application. It is lowest level of frontend technologies that serves as basis for styling CSS can be added and for functionality we can implement JavaScript.

E. OVERVIEW OF INTERNET OF THINGS

Overview of Internet of things consents articles to be detected or monitored distantly across network frame, making prospects for more uninterrupted integration of the reading and systems. IoT representation is shown in Fig. 3. IoT can be used for communication amongst user and Utility by Ethernet shield linked through Arduino Uno. This process is quite cost effectual. This communication aids User and Utility to give-and-take statistics about the energy intake through an IP address and also the utility collects user data using same IP address via WEB CLIENT PROGRAM.
By the means of Ethernet communiqué the customer and utility gets the existent standing of Energy consumption with cost efficient way equated to other communication systems. When IoT is amplified with actuators and sensors, it transforms in an illustration of common cyber physical system, comprehending in to smart grid technology and other smart domestic and commercial utilities.

F. Comparision of Arduino Baord with other systems

Arduino UNO qualities has made it a widely used software in vivid applications and project interfaces. It is user friendly, even beginners can use it with ease same as advance users.

Amongst other competitor micro controller supports existing for corporeal calculating viz Parallax, basic stamp, Net Medias’ Bx-24, Phidgets, MITs’ handy board and several similar deal in analogous purpose. These tools yield the disorganized specifics of micro-controller user interface design and binds it in a user friendly array. It minimalizes the process of working with microcontroller but it proposes certain plusses above other methods for example listed below
1. Low-priced
2. Cross stage communication
3. Modest perfect software development settings
4. Uncluttered source and encompassing software
5. Open foundation and incorporating hardware

IV. CONCLUSIONS

Smart meters proposed in this work has following advantages to the consumers. Consumers can set the monthly electricity billing budget. No need to wait for the month end bill. They know exactly how much power is being utilized. Efficient use of energy. It has following advantages to the utility. Less labor cost. There is no need of human operator to go to the consumers address to take down the reading. Remote access of the meter reading. Optimum generation cost, raw material, losses and hence increase in revenue. The readings recorded can be used by research and development department.

REFERENCES

[1] Javed, N., Shafi, M.A., Khan, N. and Khan, M., Design of a Smart Energy Meter with Overload Trip Facilities. International Journal of Engineering and Advanced Technology (IJEAT), pp.2249-8958.

[2] Sahani, B., Ravi, T., Tamboli, A. and Pisal, R., 2017. IoT Based Smart Energy Meter. International Research Journal of Engineering and Technology (IRJET), 4(04), pp.96-102.

[3] Barman, B.K., Yadav, S.N., Kumar, S. and Gope, S., 2018, June. IOT based smart energy meter for efficient energy utilization in smart grid. In 2018 2nd International Conference on Power, Energy and Environment: Towards Smart Technology (ICEPE) (pp. 1-5). IEEE.

[4] Das, H. and Saikia, L.C., 2015, June. GSM enabled smart energy meter and automation of home
appliances. In 2015 International Conference on Energy, Power and Environment: Towards Sustainable Growth (ICEPE) (pp. 1-5). IEEE.

[5] Edward, O.O., 2014, December. An energy meter reader with load control capacity and secure switching using a password based relay circuit. In 2014 Annual Global Online Conference on Information and Computer Technology (pp. 58-63). IEEE.

[6] Cheng, Y., Yang, H., Xiao, J. and Hou, X., 2014, May. Running state evaluation of electric energy meter. In 2014 IEEE Workshop on Electronics, Computer and Applications (pp. 43-46). IEEE.

[7] Martirano, L., Manganelli, M. and Sbordone, D., 2015, August. Design and classification of smart metering systems for the energy diagnosis of buildings. In 2015 IEEE International Conference on Smart Energy Grid Engineering (SEGE) (pp. 1-7). IEEE.

[8] Widmer, J. "Billing metering using sampled values according IEC 61850-9-2 for substations." In 2014 Saudi Arabia Smart Grid Conference (SASG), pp. 1-7. IEEE, 2014.

[9] Pang, C., Vyatkin, V., Deng, Y. and Sorouri, M., 2013, September. Virtual smart metering in automation and simulation of energy-efficient lighting system. In 2013 IEEE 18th Conference on Emerging Technologies & Factory Automation (ETFA) (pp. 1-8). IEEE.

[10] Widmer, J., 2014, December. Billing metering using sampled values according IEC 61850-9-2 for substations. In 2014 Saudi Arabia Smart Grid Conference (SASG) (pp. 1-7). IEEE.

[11] Bimite, A., Mathew, R.K. and Kumaravel, S., 2015, December. Development of smart energy meter in LabVIEW for power distribution systems. In 2015 Annual IEEE India Conference (INDICON) (pp. 1-6). IEEE.