



IoT based smart energy meter

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ABSTRACT

It is a proposed system designed to eliminate human involvement in the electricity system. IOT (Internet of things) is the network of physical things with electronics software, sensors, and connectivity to enable objects to collect and exchange data. IOT based automatic meter reading is the technology of automatic collecting data energy meter and transferring data to the server for billing process and if there is any tempering then also detectable. The internet connected to meter collect the data and display data on the LCD by which we can read and understand the things that are going on the system. Current drawn also calculated by the current transformer that connected in series with the load will be shown on the LCD. This data transfer to sever unit at MSEB. MSEB is not a technical word but it is electricity distribution board "Maharashtra State Electricity Board". The data is received by the internet and whenever a key is pressed microcontroller send SMS through the internet to the transmitter to get the reading of the meter. It is difficult to manual reading and calculating bill of individually. This will help for the proper and accurate reading of billing process. By taking all these features that can be done by IOT based smart energy meter easily.

Keywords: LCD, Smart Energy Meter, Current Transformer, Wi-Fi Module, max232, Optocoupler, Power Theft, Automatic Billing.

1. INTRODUCTION

Energy meter billing is an important part of energy distribution. Each time a person is needed from the authority to collect the reading of meter and create a bill to the consumer. But this created a problem because the manual reading needs manpower, time-consuming and may cause an error. So, smart energy meter comes for providing the facilities of automatic reading of meter and also can detect the meter tempering by sending the message with the help of IOT. It also can detect the fault if occurs in the electric system overloading and warn the consumer of overload usage of electricity by sending the message.

Stealing of electricity is an issue, nowadays in energy meters, there is no proof of tempering of meters and are less accurate so it is not reliable more as the IOT based energy meter having the different features and saves the electricity from Theft which is illegal and also protect from overloading of electricity to consumer. Automatic connection and disconnection can be done by passing a code such as a password from the board based on bill payment of consumer through IOT. Directing a fault in distributing system can be done by communicating between the distribution system and consumer energy meter. If there is a supply in the transformer and no supply in the consumer's end it means that there is a fault between consumer and distribution transformer. This transformer enables the electricity department to read the meter reading monthly without person visiting each home. This can be achieved by use of Arduino unit that continuously records the reading of energy meter, its nonvolatile memory location. This system can also be used to disconnect the power supply of home when needed. This paper mainly deals with smart energy meter, which utilizes features of the embedded system i.e. a combination of hardware and software. The paper discusses how and what type of work is done by IOT based smart energy meter. Also with the help of Wi-Fi Modem the consumer can monitor its consumed reading and can set threshold value through the webpage. If the consumer is not aware of threshold notification, then meter gets off automatically after that consumer can increment the threshold value and meter will automatically turn on.

Finally, the overall monthly bill with amount will be sent to the consumer as well as a service provider of text at first day of every month.

Working and Circuit Diagram

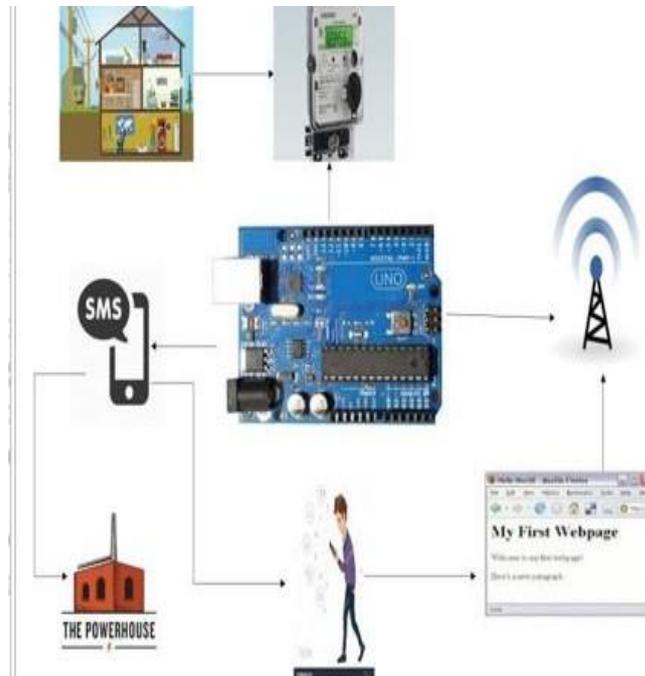
In this microcontroller unit, LCD, sensors, current sensor and Voltage sensors are present. In this proposed system we replace the traditional meter by a metering module which consists metering IC and microcontroller scans the energy meter automatically after every month and transmit to the consumer and propose service provider system.

This stores data sends SMS to the consumer about the billing amount and maybe if any other activities happen in this proposed system such as tempering, overloading, fault etc.

IOT is nothing but the source of communication between consumer and service provider i.e. Web Server. IOT is the worldwide network for the data transfer over and the always online connection between main location and mobile devices. The cost of transferring data is much lesser than the SMS. 8051 microcontroller is interfaced with energy meter and PICF877A which acts as the main controller with the help of RS-232.

In this system power supply is provided to energy meter. A GSM unit shows the interfacing with the microcontroller. Data transfer to office MODEM using user MODEM. Each and every consumer has unique number provided by the authority.

2. ARCHITECTURAL MODEL



Smart ENERGY METER

A smart energy meter is an electronic device that records consumption of electrical energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing. Smart meters enable two-way communication between the meter and central system. Utilities are one of the electrical departments, which install these devices at every place like homes, industries, organizations, commercial buildings to measure the electricity consumption by loads such as lights, fans, refrigerators and other appliances.

Energy meter measures the 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.

Wi-Fi MODULE (ESP8266)

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which plays an important role in the IOT field. Through Wi-Fi the consumer can vary in various threshold values according to the requirement, they can ON or OFF the energy meter. Every time in the last of the month the readings of the units and the cost are displayed on the webpage. Also, the Consumer can access the Arduino board and meter with help of Wi-Fi.

ARDUINO UNO (ATMEGA 328)

Arduino board acts as the heart of the required system. Entire functionality and processes of the system depend on this board. Arduino reacts in response to the 5V supply given by the optocoupler and keeps on counting the supply and then calculates the cost and also the power consumed. This data, it continuously stores on the webpage, so that users can visit anytime and can also check their consumption. It even reacts accordingly as per programmed, to the situations like message passing/sending during threshold values etc.

Microcontroller PIC 16 F877P

The used microcontroller unit is PIC16F877A. The core controller, having a built-in SPI master, is a mid-range family. 16F877A have enough I/O lines for current requirement. It has the capability of initiating all the intersystem communications and connections. The task of master controller is to control each function of the system with a supporting device. The PIC16F877A features 256 bytes of EEPROM data memory, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, self-programming, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either the 2-wire Inter-Integrated Circuit (IC) bus or a 3-wire Serial Peripheral Interface (SPI) and a Universal Asynchronous Receiver Transmitter

(USART). All of these features make it ideal for the more advanced level A/D applications in automotive, industrial, appliances and various consumer applications.

GSM Module

A GSM modem is a specialized kind of modem that accepts a SIM card and operates over a subscription to a mobile operator, just like a cell phone/mobile phone. From the perspective of a mobile operator, a GSM modem looks similar to a mobile phone. It can be a dedicated modem device with a serial, USB or Bluetooth connection, or it may be a mobile phone that provides capabilities of GSM modem. A GSM modem is the one that exposes an interface that allows various applications such as sending and receiving of messages over the modem interface. The mobile operator charges for this purpose and process of message sending and receiving as if it was performed directly through a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. Any phone that supports the "extended AT command set" for sending/receiving SMS messages can be supported by the SMS/MMS Gateway. Note that all the mobile phones don't support this type of modem interface.

WEBPAGE (HTML)

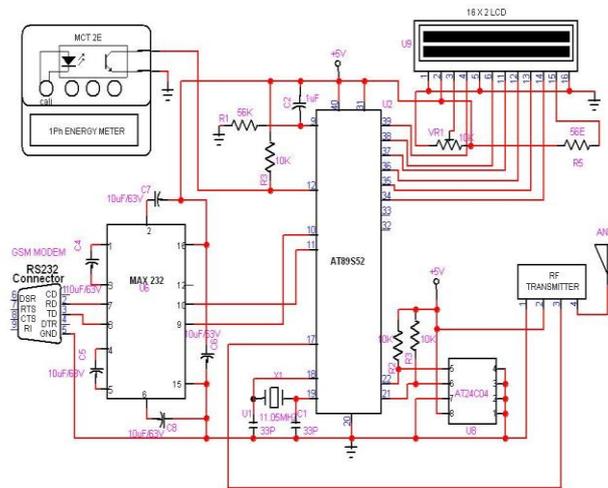
We have designed a webpage for operating Arduino and Energy Meter by making use of HTML. HTML basically stands for Hypertext Markup Language. It is a standard markup language which is used for creating web pages and web applications using Cascading Style Sheets (CSS) and JAVA scripts. It forms a triad of cornerstone technologies for the World Wide Web. The web browser receives HTML documents from the corresponding Webserver or from local storage and renders them into the multimedia web pages.

HTML describes the structure of web page originally and semantically and includes cues for the appearance of the documents and files. The elements of HTML are the building blocks of HTML pages.

MAX 232

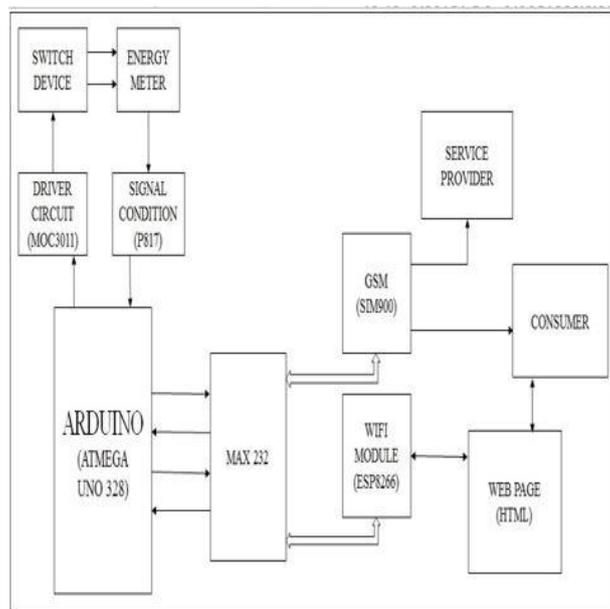
We are using MAX 232 for serial communication with the components that are GSM module and Wi-Fi module. MAX232 is used to provide TTL to the components according to requirement. GSM needs TTL so it is connected to Arduino by MAX232. Some Wi-Fi module doesn't require TTL because it's already built in it and some may require according to its working.

3. CIRCUIT DIAGRAM



- Allowing the electrical consumer to reduce costs by increasing energy consumption during off-peak chapter tariff periods.
- Allowing electrical appliances to be automatically control.
- Influence the energy consumption of their users.

4. BLOCK DIAGRAM



5. ACKNOWLEDGEMENT

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6. FEATURES OF SMART ENERGY METER

- We can observe load consumption of consumer remotely.
- The capability of temper detection.
- We can control the load remotely.
- Theft detects easily.

7. CONCLUSIONS

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 easy and accurate. Hence it reduces the wastage of energy and brings awareness among all. Even it will deduct the manual intervention.

8. REFERENCES

- [1] <http://www.mobilegpsonline.com/downloads/GM28-29%20Datasheet%20R1G.pdf>
- [2] <http://www.mobilegpsonline.com/GSMJC01Spec.pdf>
- [3] http://www.visualgsm.com/wire_sms_index.htm
- [4] <http://en.wikipedia.org/wiki/Gsm>
- [5] Himshekhar Das, L.C.Saikia, “GSM Enabled Smart Energy Meter.
- [6] Ofoegbu Osita Edward, “An Energy Meter Reader with Load Control Capacity.
- [7] Yingying Cheng, Huaxiao Yang, Ji Xiao, Xingzhe Hou, “Running State Evaluation Of Electric Energy Meter”,
- [8] Sahana M N, Anjana S, Ankith S, K Natarajan, K R Shobha, “Home energy management leveraging open IoT protocol stack, IEEE 2015.
- [9] Luigi Martirano, Matteo Manganelli, Danilo Sbordone, “Design and classification , IEEE 2015.
- [10] J. Widmer, Landis, “Billing metering using sampled values”, IEEE 2014.
- [11] Cheng Pang, Valierry Vyatkin, Yinbai Deng, Majidi Sorouri, “Virtual smart meter IEEE 2013.
- [12] Amit Bhimte, Rohit K. Mathew, Kumaravel S, “Development of smart energy meter , “IEEE INDICON 2015 1570186881”, 2015.
- [13] The 8051 Microcontroller by Kenneth J. Ayala
- [14] The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi.