



# **A Review on IoT Based Smart and Multi-Functional Energy Meter**

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**ABSTRACT:** An IoT based Smart and Multi-function Energy Meter for Automatic Meter Reading using Arduino kit. It has provision of connecting with Central database maintained by energy provider using Cloud computing as well as Tampering detection of energy meters. It can prevent theft detection from unregistered users saving losses due to it. Remarkable feature of this meter is Internet of Things based implementation. According to the market requirements of Arduino Meter there is necessity of smart Arduino Meter. Nowadays the system will use Wireless system for communication protocol. The Wireless is used since the application need high speed data rate, need to be low powered and low cost. In this project presenting the remote wireless Arduino Meter Reading System. This aims at resolving the shortcomings of the technology of the traditional Arduino Meter Reading, by combining the characteristics of the Wireless technology and IEEE 802.15.4 standard with AVR Microcontroller ATmega16. The hardware implementation was designed, and then analyzed the use cases for Arduino Meter. There are more chances of manual error, delay in processing, tampering of the meter and misuse of the Electricity by other sources. It requires so many workers, one set of workers to note down the reading and other set to cut the power if the payment is not paid at the right time and we have very poor servicing.

**KEYWORDS:** Arduino, AVR Microcontroller, Internet Of Things. etc.

## **I. INTRODUCTION**

Smart Meters which are used previously are electromechanical meters, which are used for the calculation of power usage and depending on that power usage for particular month, consumer pay electricity bill. Electromechanical meters are now replaced by Digital meters, which can give power consumption reading on digital display. But these digital display meters use one-way communication method, that is only energy provider company can get information about power consumption of consumer. Energy provider company generate electric bill. Consumers cannot have any control on equipment connected with those digital energy meter. We can define Smart meters are special type of solid state programmable devices which can perform numerous functions. This Smart meters are employed with new technology called Internet of Things (IoT). With the help of IoT technology, each smart meter is given unique IP address. With the help of this IP address, user can control electrical devices connected to that energy meter. Sensors are deployed in each smart plug through which electrical devices are connected. Some of the functions these smart meters can perform are:

- [1] Pricing based on time
- [2] Consumer and utility both can monitor data consumption.
- [3] Metering with the help of Internet of Things technology.

Embedded System is defined as "A System which is used to do specific task and application contains embedded software and Real-Time OS is called as Embedded System."

The three main components of Embedded System is:

- 1] Hardware is embedded in it. ROM and Flash memory contains software which is used to program embedded system.
- 2] Main application software is embedded in it. series of tasks or process or threads can be performed by application software.

# International Journal of Innovative Research in Computer and Communication Engineering

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Vol. 5, Issue 1, January 2017

3] The application software which is used to run hardware is supervised by Real Time operating system(RTOS) and organizes access to a resource according to the priorities of tasks in the system. Meter tampering creates a huge loss in terms of revenue to Energy provider companies. This losses can be controlled with the help of this newly designed energy meter which indirectly providing a benefit to developing countries like India.

A System-on-chip: A system on a VLSI chip that has all the necessary needed analog as well as digital circuits; for example in a mobile phone.

We have designed an Embedded System-on-chip(SoC and use of VLSI circuit design technology.

Lately, embedded systems are being designed on a single silicon chip, called System-on-chip(SoC), a design innovation. SoC is a system on a VLSI chip that has all the necessary analog as well as digital circuits, processors and software.

A SoC may be embedded with the following components:

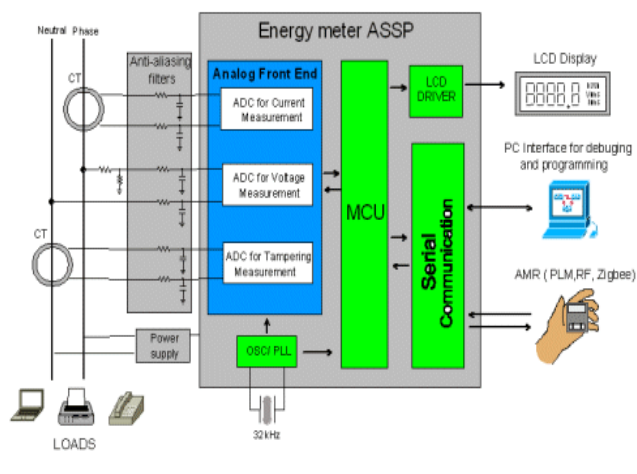
- 1]Embedded processor GPP or ASIP core.
- 2]Single purpose processing cores or multiple processors
- 3]A network bus protocol core,
- 4]An encryption function unit

A microcontroller is an integrated chip that has processor, memory and several other hardware units in it: These form the microcomputer part of the embedded system.

Just as a microprocessor is the most essential part of a computing system, a microcontroller is the most essential component of a control or communication circuit. A microcontroller is a single-chip VLSI unit(also called 'microcomputer') which ,though having limited computational capabilities, possesses enhanced input output capabilities and a number of on-chip functional units. Micro-controllers are particularly suited for use in embedded systems for real-time control applications with on-chip program memory and devices.

## II. RELATED WORK

Nowadays different types of Energy Meters are available in market using systems such as Zigbee ,PLC modem connection ,General Packet Radio service technology(GPRS) but this energy meters only use one way communication that is ,this meters can be controlled by controlling office of Energy provider company. Consumer do not have any control on this energy meter. Consumer cannot control electrical devices and appliance at home with this technology based energy meters.



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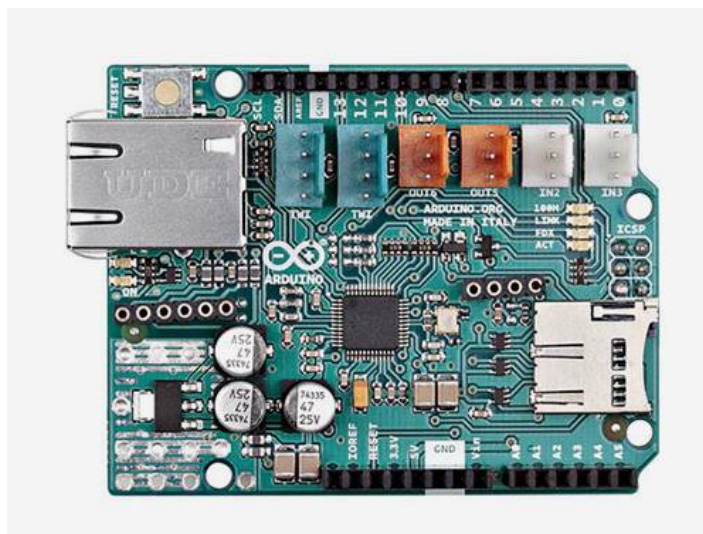
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## III. PROPOSED WORK



It consists of following hardware: Arduino UNO is an open source platform. It is programmed with the help of Arduino IDE. ATmega328 microcontroller uses UART i.e. Universal Asynchronous Receiver Transmitter transmission mode i.e. it does not use clock signal. There are different types of communication mode which are chip to chip communication, chip to device communication. In our project, we are using chip to device communication. Here, ATmega 328 microcontroller acts as a chip and our energy meter microcontroller acts as a device.

UART serial port communication is usually either 10 bits or in 11 bits format: one start bit, 8 data bits, one optional bit and one stop bit. UART communication can be full duplex, which is simultaneously both ways, or half duplex, which is one way. It is an important communication mode. Synchronous, iso-chronous and asynchronous are three ways of communication. Clock information is transmitted explicitly or implicitly in synchronous communication. The receiver clock continuously maintains constant phase difference with the transmitter clock. HDLC is bit-oriented protocol. It is a data link protocol for computer networks and telecommunication devices. RS232 and UART are asynchronous communication standards. ATmega328 microcontroller uses (1) input voltage :7V-12V (2) Operating voltage of 5V (3) CPU speed:16MHz (4) Analog In/Out:8/0 (5) Digital I/o/PWM:14/6 (6) EEPROM:1KB (7) SRAM:2KB (8) Flash:32KB (9) USB type is regular. USB is a Universal Serial bus protocol. Maximum 127 devices can be connected to USB. USB does not require any external power.



In our project, we are deploying hardware with the help of co-ordination with arduino board and arduino Ethernet shield. Arduino Ethernet shield contains Wiznet W5500 Ethernet chip. It is capable of providing network IP stack. It can



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support both TCP and UDP connection. Files can be stored on micro-SD card slot. Ethernet shield can work with Arduino Uno and Mega also. Sd library is used to access on-board micro-SD card. There is also provision of reset controller which ensure that W5500 Ethernet module is properly reset on power-up. This shield is capable of connecting with Power Over Ethernet module (PoE) which can extract power from conventional twisted pair cable.

## IV. PROTOCOLS

HTTP is an application layer protocol is as per the application. This layer accepts the data, for example, in HTML, or text format and puts the header words as per the protocol and sends the application layer header plus data to transport layer. HTTP uses port number 80. A port-assigned number supports multiple logical connection using a socket. Each socket has IP address and port number. A registered port number supports multiple logical connections using a socket. Each socket has IP address and port number. A registered port number can be between 0 and 1023. Registration is done by IANA (Internet Assigned Number Authority). Port number 0 means host itself. A user unregistered server can have number above 5000. Http is a standard protocol for requesting for a URL (Universal Resource locator) address. A URL defines a web page resource. HTTP interaction scheme is that a client requests server directly or through proxy or a gateway. An HTTP message is therefore either request or response.

Internet Protocol (IP): Internet Protocol is used to communicate with different devices on the network. To transmit data on the network, a smallest unit of data is used which is called as Packet.

Ethernet technology: Ethernet uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD) technology. There are various types of Ethernet having different speeds such as Standard Ethernet (10 Mbps), Fast Ethernet and Gigabit Ethernet. Autonegotiation feature is added to it.

## V. RESEARCH ANALYSIS

Nowadays digital electronic meters are used which are used to monitor electrical consumption of electrical energy which have some shortcomings such as tampering can be done easily on it. So, there is scope of improvement in those meters. Such as it should be controlled remotely. User can also monitor the electrical consumption on day to day basis. So, a two-way communication meter is developed which is used to monitor electrical energy. It should be remotely controlled so that bill is not paid in correct time, energy monitor company can remotely connect as well as disconnect it. Nowadays different types of meters are available on the market with different technologies such as Zigbee, Supervisory Control and Data acquisition (SCADA) as well as other technologies.

## VI. CONCLUSIONS

This project is mainly concentrated on IOT network. When we discussed certain points to be notify. First point is we converting conventional energy meter which is about the project there are electromagnetic into a digital meter. We are doing automatic reading and also connection and disconnection of meters using WIFI module. Then meter reading has come faster. It is publically available for the customers. Both the peoples will be using the information as per their requirements and they will be having freedom to check the bill, tampering, when the meter has been connected and disconnected before the due date. Finally concluding our project that we are successfully monitored the tampering i.e. seal tampering and we have read the meter bills which also be uploaded on the website using IOT concept. Overall the new things we are worked with in our project are ARM controller coupled with Arduino controller and the IOT model.

Live metering Meter Reading (LMR) is a unique solution for problems in existing manual system. Live metering Meter Reading is self assured automation system. Implementation of Live metering Meter Reading with the help of standalone system is an innovative idea. There are more chances of manual error, delay in processing, tampering of the meter and misusage of the Electricity by other sources but with the help of Live metering Meter Reading, we can easily overcome this anomalies.



ISSN(Online): 2320-9801  
ISSN (Print): 2320-9798

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirccce.com](http://www.ijirccce.com)

Vol. 5, Issue 1, January 2017

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