

Ethernet Based Smart Energy Meter

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Abstract: In recent year implementation of smart technology in various fields has been increased. Simplifying the daily activities by using smart devices is very significant these years. The smart energy meter based on Ethernet shield receives the energy consumption of household activities and transmits the same information to user via internet as a source of medium, the same information can also be stored in sd card for future references. Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting. The Ethernet and sd card systems are used to transmit information if user is away from home and also there is a LCD module connected to system which displays consumption details on screen itself. The meter has complete details required for postpaid billings and user can have complete details of his household consumption with vivid clarity.

KEYWORDS: Ethernet energy Meter, Wireless Energy Meter, Smart Energy Meter, Automatic Energy Meter, SD-CARD, LCD, Ethernet, Arduino.

I.INTRODUCTION

The traditional energy meters are known for their faulty results. Over the span of the years the efficiency of this energy has been decreasing rapidly. To overcome their drawbacks a smart energy meter is required. There are many technologies that can be implemented for wireless data transmission in energy meter. But Ethernet technology as upper hand when compared to other technologies because of its effective and efficient data transmission. Ethernet [1] is a family of computer networks commonly in local area networks(LAN), wide area networks (WAN).^[1] It was commercially introduced in 1980. It has since been refined to support higher bit rates and longer link distances. Ethernet has largely replaced competing wired LAN technologies such as token ring FDDI and ARCNET. Ethernet has higher edge when compared with other wireless transmission technologies like Bluetooth, wifi, infrared because of efficient and effective transmission of data without losses.

The smart energy meters can be communicated to various other energy meters and can also give complete energy consumption details of a locality or a city. Even yearly and weekly data can be stored and retrieved. It simplifies the task of producers and as well as consumers. The requirement of staff can be reduced since complete system is automatic and there is no involvement of employee for calibrating and retrieving information from smart meter.

II.SYSTEM ANALYSIS

Smart energy meters are new age energy meters they will give details about household power consumption and can also give the details of power losses, power failures. These meters create a universal network so that real time data of all the energy meters in given locality, state or country can be processed at a single location.

In proposed model we made use of Arduino based on ATmega328 microcontroller. The ATmega 328[2] is a single-chip microcontroller created by Atmel in the mega AVR family. For transmitting data over the internet we have used Ethernet chip ENC28J60. The ENC28J60 is Ethernet controller has Integrated MAC and 10BASE-T PHY. It also has Receiver and collision squelches circuit. It supports one 10BASE-T port with automatic polarity detection and correction.

This system reads the information from loads and the transmits it to arduino for processing and results are displayed over lcd screen as well as we can see the same results in smartphones and remote pc's once the information is uploaded to internet by Ethernet shield. The problems of traditional energy meters can be avoided because the manual works is completely eliminated here. Delay in billing due to human faults can be avoided. No stranger coming to our houses and calibrating the meters will happen once this system is completely established across the country.

In this developed smart world, in the era of smart cities energy meters that work on their own are very necessary. In the dream of achieving smart cities smart energy meters plays an active role. This helps the future goal of completely automation of the power generation and distribution systems.

III.PROPOSED SYSTEM

The main objective of this project is to study the energy distribution and consumption systems and provide smart solutions to problems that are occurring in those systems. Implementing the same using open source hardware and software like arduino.

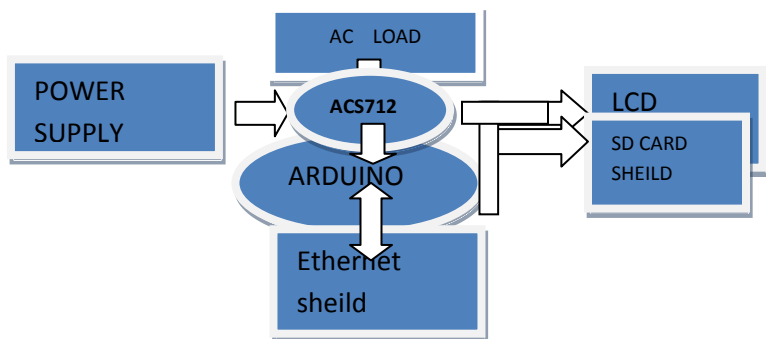


Fig.1The block diagram of proposed system

The smart meter here gives no of units consumed in predetermined time. It uses a real time sensor ACS712. ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems.

POWERSUPPLY: For various embedded parts of the system we have used 12v dc power supply from an external power adapter(A/C to D/C).Alternatively we can also use 12v dc battery.

ENERGY MEASURMENT [3] : ACS712 Hall effect sensor is used to measure the consumption of power by the energy by A/C load. The ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switch mode power supplies, and over current fault protection. The device is not intended for automotive applications.

The ACS712 interfaced with arduino and Ethernet shield also sends the information to internet which is uploaded on www.xively.com

ARDUINO[4]: Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

The current sensor ,lcd module and Ethernet shield are connected to arduino and code in written in arduino ide for functioning of all components in the circuit.

LCD[5]: LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

ETHERNETSHIELD[6]:The Arduino Ethernet Shield connects our Arduino to the internet in mere minutes. It is based on W5500 with internal 32K buffer. Its connection speed is 10/100Mb.It connects with arduino on SPI port. The Arduino Ethernet Shield 2 allows an Arduino Board to connect to the internet. It is based on the (Wiznet W5500 Ethernet chip). The Wiznet W5500 provides a network (IP) stack capable of both TCP and UDP. It supports up to eight simultaneous socket connections. Use the Ethernet library to write sketches that connect to the Internet using the Shield. The Ethernet Shield 2 connects to an Arduino Board using long wire-wrap headers extending through the Shield. This keeps the pin layout intact and allows another Shield to be stacked on top of it.

SD 9CARD SHEILD[7]: This provides a storage space for your Arduino. Users can read/write SD card via Arduino's built-in SD library. It supports SD, SDHC and Micro SD cards. It will only occupy the SPI port of our Arduino.All the details regarding energy consumption can be stored on sd-card. The operational voltage of this shield is 3-5v.The operational current is 0.1-100 milli amps.It supports sd/micro sd cards upto 32gb capacity. The connection scheme of arduino to sd card shield is as follows D4:SD_CS,D11: SD_DI,D12:SD_DO,D13:SD_CLK.

IV.RESULTS

Smart energy meter takes the power consumption details from the load and displays on lcd screen and also transmits the data to other output modules.



Fig.2 module of smart energy meter displaying power consumption.

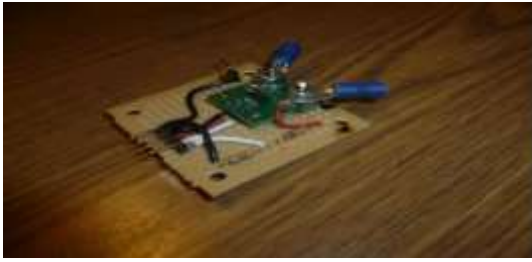


Fig.3 Current sensor soldered on pcb.

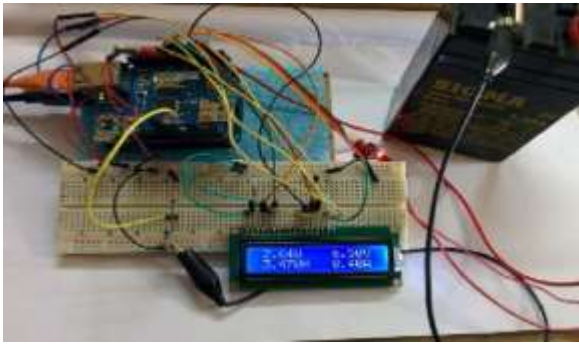


Fig.4 Complete hardware setup of smart meter having Ethernet shield and 12v dc battery along with lcd module and sd card shield.

[4] Arduino uno based on ATmega328p

<https://www.arduino.cc/en/main/arduinoBoardUno>

[5] Specifications for LCD module

<https://www.openhacks.com/uploads/productos/eone-1602a1.pdf>

[6] Arduino Ethernet shield overview

<https://www.arduino.cc/en/Main/ArduinoEthernetShield>

[7] SD card v7.0 introduction wiki seed

http://wiki.seeed.cc/SD_Card_shield_V4.0/

V. ADVANTAGES

The smart meter ends the system of estimated bills. Once we have smart meters installed we can get accurate bills just like our mobile phone bills. Smart meters also mean accurate bills, so you can be confident that you're only paying for what you've actually used, rather than overpaying, as you sometimes do with estimates. Smart meters are paving the way for a more energy efficient future. They make it easier for us to identify the situations where we're using a lot of energy and might want to make changes to reduce it. In addition, smart appliances will be able to interact with smart meter systems to help us save energy.

VI. CONCLUSIONS

Effective power usage is very much essential in these days. Smart meters pave a way for it. Future development of technology helps various devices to interact with smart meters for effective energy consumption

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[1] Ethernet <https://en.wikipedia.org/wiki/Ethernet>

[2] Atmega 328p datasheet http://www.atmel.com/Images/Atmel-42735-8-bit-AVR-Microcontroller-ATmega328-328P_Datasheet.pdf

[3] Fully Integrated, Hall Effect-Based Linear Current Sensor IC with 2.1 kVRMS Isolation and a Low-Resistance Current Conductor <https://www.allegromicro.com/~media/files/datasheets/acs712-datasheet.ashx>