Energy Management System using Remote Data Logging

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***Abstract*— Network based systematic method is used for energy management system. Energy management systems are often commonly used by individual commercial entities to monitor, measure, and control their electrical building loads. An energy management system (EMS) is a system of computer-aided tools used by operators of electric utility grids to monitor, control, and optimize the performance of the generation and/or transmission system. A network topology is the arrangement of a network, including its nodes and connecting lines. Using the network topologies the measuring instruments are connected together as a network and communicate to system via Modbus TCP/IP protocol. Energy readings at remote location are monitored and logged into energy management software. From the energy management software the data are used for further development.**

***Keywords*— Remote Data Logging, Modbus TCP/IP, IP Address, Wired Networks.**

I. INTRODUCTION

The energy management software using remote data logging is based on Modbus TCP/IP protocol and wired network in a energy measurement devices. From the energy management software, monitor at remote location, collect & analyse the energy values. All the Electronic devices are connected through wired network and communicate with energy management software through Modbus TCP/ IP protocol. Based on this we can reduces the human resources, time delay and cost. The collected data are shared through email.

Main objective of the project is to find the energy consumption for home or industry bases on devices that are connected in network. It will avoid the human error in while taking the reading. The readings are sent to customer in time to avoid the penalty .Based on the energy consumption of particular area allocate the energy resources to another areas that area required the energy. Each and every device have own IP address in a network . All the devices are act as a slave devices and main server act as a server to monitor, store and analyse the data for further improvement.

The term Energy Management System can also refer to a computer system which is designed specifically for the automated control and monitoring of those electromechanical facilities in a building which yield significant energy consumption such as heating, ventilation and lighting installations. The scope may span from a single building to a group of buildings such as university campuses, office buildings, retail stores networks or factories. Most of these energy management systems also provide facilities for the reading of electricity, gas and water meters. The data obtained from these can then be used to perform self-diagnostic and optimization routines on a frequent basis and to produce trend analysis and annual consumption forecasts.

II. EXISTING SYSTEM

In existing system, a particular person physically come and take the measured reading of device by manually in home or industry every two months once. But many industry does not know the exact energy availability .Because of more usage in energy, finally they need to pay penalty also. In home, the EB bill comes in end of every two month once. So some time they need to pay more because of high energy consumption and sometime they need to pay less because of lees energy consumption. Even a industry don't know, how much the energy bill for a month. This is the major problem in many industry.

III. DESIGN

A. Connect through Network

All the instrument/ devices are connected through network using RJ45 cable and each instrument having one unique IP address for communication purpose. Any given node in the LAN has one or more physical links to other devices in the network; graphically mapping these links results in a geometric shape that can be used to describe the physical topology of the network. Conversely, mapping the data flow between the components determines the logical topology of the network. A network topology is the arrangement of a network, including its nodes and connecting lines.

B. Modbus TCP/IP

Modbus TCP/IP (also Modbus-TCP) is simply the Modbus RTU protocol with a TCP interface that runs on Ethernet. The Modbus messaging structure is the application protocol that defines the rules for organizing and interpreting the data independent of the data transmission medium.

MODBUS TCP/IP is a variant of the MODBUS family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of MODBUS messaging in an 'Intranet' or 'Internet' environment using the TCP/IP protocols. The most common use of the protocols at this time

are for Ethernet attachment of PLC's, I/O modules, and 'gateways' to other simple field buses or I/O networks. In MODBUS, data transactions are traditionally stateless, making them highly resistant to disruption from noise and yet requiring minimal recovery information to be maintained at either end. MODBUS TCP/IP handles both situations. A connection is easily recognized at the protocol level, and a single connection may carry multiple independent transactions. In addition, TCP/IP allows a very large number of concurrent connections, so in most cases it is the choice of the initiator whether to reconnect as required or re-use a long-lived connection.

Developers familiar with MODBUS may wonder why the connection-oriented TCP/IP protocol is used rather than the datagram-oriented UDP. The main reason is to keep control of an individual 'transaction' by enclosing it in a connection which can be identified, supervised, and cancelled without requiring specific action on the part of the client and server applications. This gives the mechanism a wide tolerance to network performance changes, and allows security features such as firewalls and proxies to be easily added. Similar reasoning was used by the original developers of the World Wide Web when they chose to implement a minimal Web query as a single transaction using TCP/IP on well-known port 80.

C. Remote Data Logging

Communications methods for Remote Data Logging systems cover both wired and wireless, with PSTN & private wire, GSM/GPRS, Licensed and De-licensed radio, ADSL, Ethernet, PROFINET, Ethernet TCP/IP, Modbus TCP/IP, IEC60870-5-104, CANopen, Device Net, PROFIBUS, BACNet, LON, Modbus, Mewtocol, IEC60870-5-101, and others.

Data often needs to be collected from places that are nowhere near a nice costly office. The data might need to be collected at all times of the day and night or during weekends when people might be away from work. Data might also need to be collected from dangerous places such as volcanoes or from places where it is not practical or safe for a human to be, maybe deep in the ocean, in the upper atmosphere or even on other planets. The term 'data logging' refers to collecting or gathering data over a period of time.

Remote Data Logging systems can be battery powered, solar powered, wind powered or from mains power source. Sensors are used to take readings or measurements of their environment at regular intervals. The sensors may be either analogue or digital. If they take analogue readings, an Analogue to Digital Converter (ADC) will be needed to convert the signal into digital data which the computer can understand. As the sensor takes a reading, the data is sent though a cable or wireless link to the data logger. The data logger usually stores the data for a period of time before sending it in a large batch to a computer which will process and analyze it.

The 'Logging Interval' is the period of time over which measurements are taken by the sensors. If the measured value changes very rapidly then the time interval needs to be rapid as well, otherwise crucial events will be missed. On the other hand, if the data is going to change very slowly, then you would take readings much less often so that you do not get too much data

D. Advantages

a. Data Logging can be used in remote or dangerous situations.
b. Data logging can be carried out 24 hours a day, 365 days of the year
c. Time intervals for collecting data can be very frequent and regular, for example, hundreds of measurements per second
d. Can be set up to start at a time in the future.
e. No need to have a person present.

Data logging is often more accurate because there is no likelihood of human error.

IV. RESULTS OBTAINED

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data logging the Energy management system performance is shown in figure 1 to figure 7.

Fig. 1 Energy Management system –Remote Data logging system Software

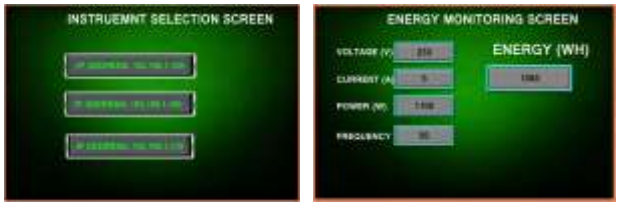

Fig. 2 Energy Management system –Instrument Selection and Live reading

Energy measuring instrument selection and live reading is shown in figure 2.Each energy instrument having unique IP address .Based on the IP address, the particular instrument communicate with system. The reading from the each instrument reading will show in live reading screen. Voltage, Current, Power, Frequency (Hz) and Energy (WH).

Fig. 3 Energy Management system –Tariff setting and Alarm Setting

Tariff setting and alarm setting screen is shown in figure 3. The unit price for energy reading can be set in Tariff setting. To make alarm on particular energy value, set the required energy value in alarm setting screen. When the set the value reached, alarm will enable..

REMOTE DATA LOG					
IP ADDRESS : 192.168.1.150					
SL.NO	DATE	TIME	VOLTAGE (V)	CURRENT (A)	ENERGY(WH)
1	10.05.2017	09:00:00	225	5.5	1000
2	10.05.2017	10:00:00	226	7.1	1100
3	10.05.2017	11:00:00	231	6.5	1200
4	10.05.2017	12:00:00	230	5.7	1300
5	10.05.2017	13:00:00	227	5.9	1400
6	10.05.2017	14:00:00	222	6.2	1500
7	10.05.2017	15:00:00	220	6.5	1600
8	10.05.2017	16:00:00	218	6.8	1700

Fig. 4 Energy Management system Remote Data Logging

Remote data logging screen shown in figure 4 and it store the parameter like date, Time, Voltage, Current & Energy from the various instruments and various place.

Based on the remote data logging data, unit consumption graph was generated by energy management system. Figure 5 shows the unit consumption graph .

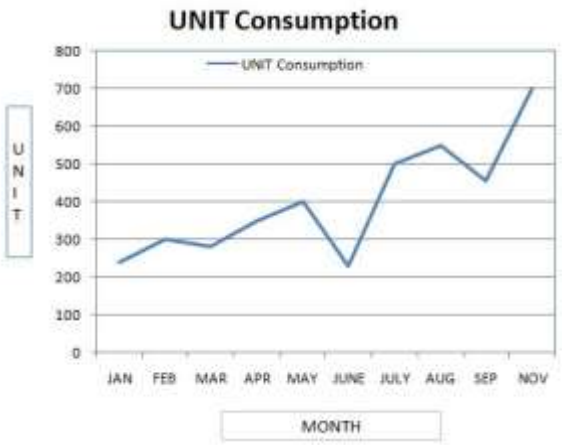

Fig. 5 Energy Management system –Unit consumption

Figure 6 shows the bar chart of unit consumption in rupees. Based on the unit consumption and tariff setting. Based on that we manage the energy consumption.

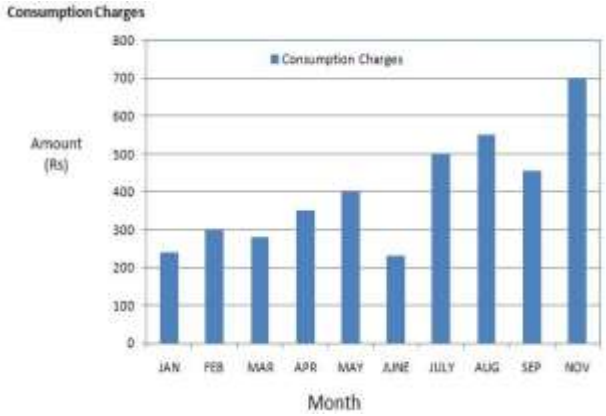

Fig. 6 Energy Management system bar chat–Unit Consumption (In Rupees)

In energy management system, email id can be set for each energy consumption user. Every day readings send to their registered Email-id. Based on that ,each consumer can use the energy in future.

Fig. 7 Energy Management system –Email Setting

V. CONCLUSION

A method is proposed for energy management system in home and industry. Using network topologies, the network was built and connected to server through LAN connection. Using the wired network the devices are communicate through the Modbus TCP/IP protocol. All the devices having the unique IP address and the devices are communicate through RJ45 cable to the server system. Using remote data logging the overall energy management carried out. All the measured data are stored in system and the details are mailed to customer email id. In future, all the data can store in cloud system.

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