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Energy Management by High Speed Remote Monitoring of Energy Meters

P. L. Upadhyay[1], K. M. Vyas[2], A. K. Vibhakar[3]

[1]Department of Electronics & Communication, AITS, Rajkot, Gujarat Technological University

[2]Asst. Prof. Department of Electronics & Communication, DIET, Rajkot

[3]Asst. Prof. Department of Electronics & Communication, AITS, Rajkot

***Abstract*— How Can We Manage What We Do Not Measure? The primary working of high speed remote monitoring of energy meters includes fetching of data from energy meters i.e. voltages, currents, power, power factor etc. and send that data to controller or server. The interface between server & meters will be based on MODBUS RTU protocol over TCP/IP via Ethernet. Reducing energy consumption as well as waste is now widely seen as being good for economy, as well as good for environment. However, the top management of organization typically does not have the information about their energy consumptions, so they make informed to take proactive decisions about their facility's energy use. Energy initiatives too often are one time improvements if that are not monitored & measured properly over time the benefits of these improvements are soon lost to avoid this we have to observe the energy consumption continuously. Energy Remote Monitoring is a perfect solution that delivers a visible impact to the base line. Using Web-based technology, Communication protocols & GSM technology, energy remote monitoring delivers real time information, analysis, and guidance that allow executives to understand their energy use, take appropriate action, and continually improve energy efficiency and performance.**

***Keywords*— Remote monitoring, Serial to Ethernet converter, MODBUS RTU, TCP/IP, GUI (Graphical User Interface), GSM.**

I. INTRODUCTION

The "Energy management" is a term that has various meanings, but mainly concerned with the one that relates to “saving energy” in every sector. Energy saving & energy management includes the process of monitoring, controlling, and conserving energy in a building or organization. Typically this involves the following steps:

1. Metering energy consumption and collecting the data.
2. Finding opportunities to save energy, and estimating how much energy each opportunity could save. One would typically analyze its meter data to find and quantify routine energy waste, and might also investigate the energy savings that could make by replacing equipment (e.g. lighting) or by upgrading your building's insulation.
3. Taking action to target the opportunities to save energy. Typically start with the best opportunities first.
4. Tracking the progress of energy-saving efforts [1].

The basic block diagram of the system is shown in fig. 1. Here at the industry there are many plants and the load of a particular plant is connected to the respective meter. The data of the meter is in serial form i.e. RS485 & it is converted to Ethernet & send to the server. A GUI installed in the server that continuously updated by the data which is given by the meter and stored at the server. So the person who wants to monitor the energy usages of the organisation can easily monitor at his personal computer.

Also GSM Module is interfaced with the developed system which can able to send text messages as a form of alarm from database to the concern people.

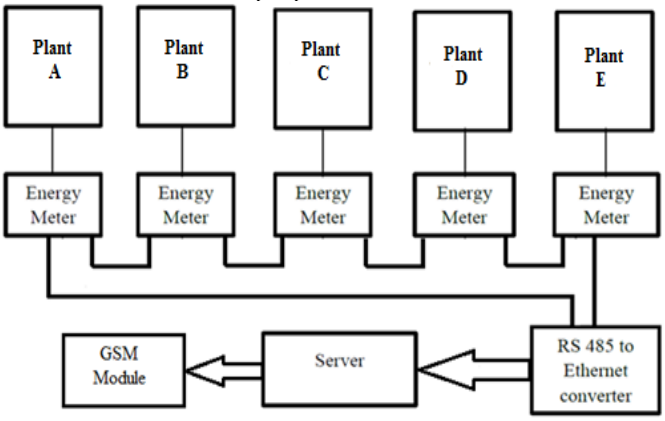

Fig. 1 Basic block diagram of the system

Remote Monitoring:

Remote Monitoring is same as telemetry. Define as to perform the measurements of physical quantity and sending the readings (data) to the main controller at the distance. For this the measuring device is must capable to communicate with other devices & must contain some communication link either wired or wireless [2].

To measure the energy we use Energy Meters that meters are smart meters. It can communicate with the other devices like computer or controller. Electronic energy meters contains memory that can store the data and able to send that data serially.

II. SYSTEM ARCHITECTURE

The system is mainly composed of Energy meters which are connected in RS 485 loop and supports MODBUS RTU protocol for communication & used to measure the various parameters related to Electrical power, Serial to Ethernet converter to convert the serial data to Ethernet packets & vice-versa, Router for LAN, Central Monitoring system server & GSM Module. The system architecture is shown in the figure 2 [3].

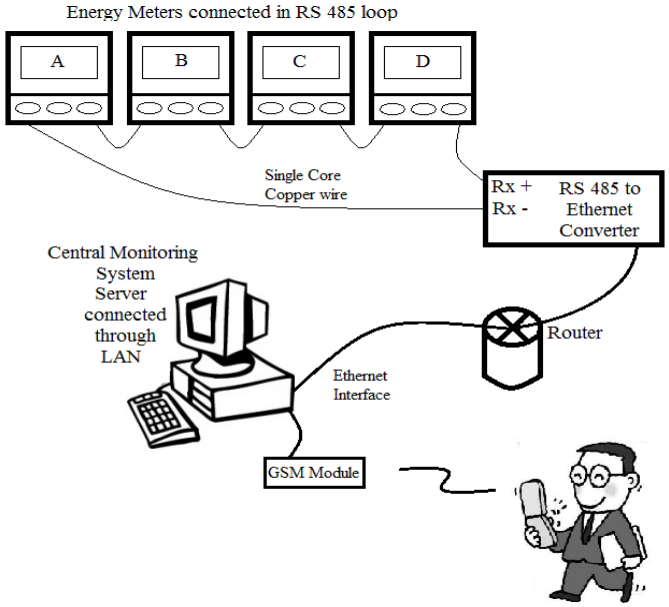

Fig. 2 System Architecture

The main functions of the system are;

1. To measure the electrical quantities like voltages of individual phase w.r.t. neutral as well as phase to phase voltages, Phase currents as well as total current, Active Power, Energy etc. & sends data via RS 485 interface when queried by server [4].
2. To transmit the data and set point values of various parameters over LAN by help of RS 485 to Ethernet converter [5].
3. To display current value of various parameters on to the GUI & it is installed at central monitoring system server using local area network.
4. To store & create the database at server so the data can be accessed when it is required in future.
5. To transmit the current value of given parameter if it crosses the set point values by help of GSM module to the concern people via SMS [6].

III. HARDWARE & DESCRIPTION

The Monitoring system mainly consists of Electronic Energy Meters & a Serial to Ethernet Converter. The selection of energy meters depends upon application here the energy meters selected on the communication basics with serial (RS 485) communication and supports MODBUS RTU protocol. The energy meter used in this project is EMFIS-VIFPE made by SOCOMAC, GERMANY.

The serial to Ethernet converter used in the project is WIZ108SR. It has low power consumption and robust to use in industrial environment [5].

A. Energy Meter

Features of energy meter are as below:

- All electrical and electronics quantity like current, power, voltage, apparent power, real power, frequency etc.
- Consumption/production of old load and old energy on hours features available.
- Primary and secondary CT/PT ratio is programmable for both.
- RS-485 Communication, RS-485 Modbus RTU protocol.
- 4 digit password setting is available.
- DIN Standard 96X96 mm is compatible for outside dimension.
- Class of accuracy is 1.0(0.2, 0.5 accuracy on request).
- High-brightness LEDs display (Red-for value, alpha numeric green-for parameters).
- IEC 62052-11 IEC 62053-22 IEC 62053-23 –standard.

B. RS 422/485 to Ethernet converter:

This serial to Ethernet converter is gateway module that converts RS-485/422 protocol into TCP/IP protocol. This converter enables remote management and control of a device through the TCP/IP network by connecting to the existing equipment with RS-422/485 serial interface. Means similarly WIZ108SR is a protocol converter that transmits the data sent by serial equipment as TCP/IP data type and converts back the TCP/IP data received through the network into serial data to transmit back to the equipment.

WIZ108SR configuration: Fig. 3 is configuration tool version 1.4.4.0 which is open licence software used to configure the WIZ108SR module. First turn on the power supply to configure the module and required connections of LAN cable to exiting LAN. After this start the configuration tool. The window shows various options [5].

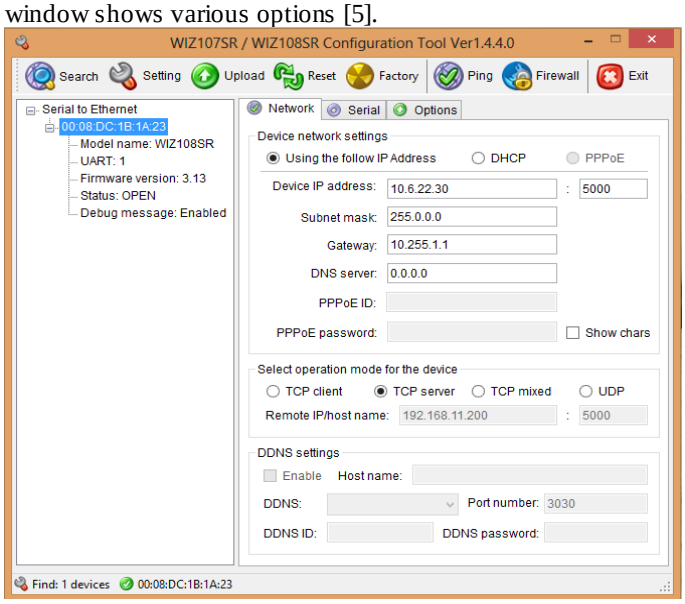

Fig. 3 Configuration tool version 1.4.4.0 [5]

IV. SYSTEM SOFTWARE

There are two type of software is used one is visual studio 11, and it is used to do programing for collecting data from the meter and the programming for the notification service via GSM module as well. And second is MYSQL 5 it is used to maintain database in the central monitoring system server and display that data on the GUI (Graphical user interface).The following flow chart for remote monitoring system is shown in fig. 4.

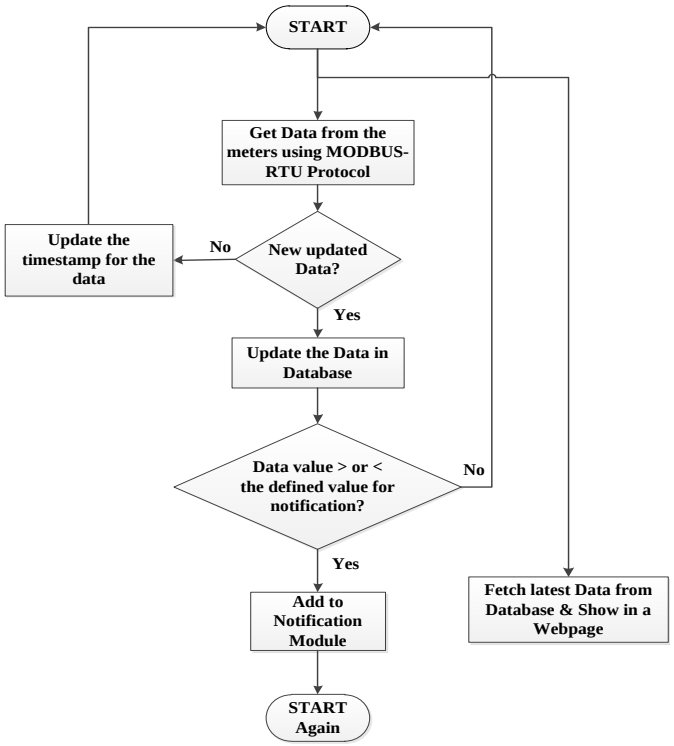

Fig. 4 Flowchart of the Monitoring System

The complete GUI is has been developed using visual studio 11. Visual studio is specialized software for designing graphical user interface as per requirement. The designed GUI is also able to create database of the previous measured values of various parameters of electrical power. Developed GUI is access to monitor real time data over LAN on to the PC or laptop to monitor the data remotely. Also the user can set the values for the notification & notification timeout as well which is compared with the real time values.

V. RESULTS

As a result of experiment, it can be said that concern people are able to monitor the real time data of their energy usage. Fig. 5 shows the GUI which shows real time data. The data measured by meter is updated continuously and it can be monitor from the remote place.

The notification module is activated when entered condition is satisfied, as a result the SMS of alert from the system is sent to the concern mobile number. The auto generated SMS from the system is shown in fig. 6.

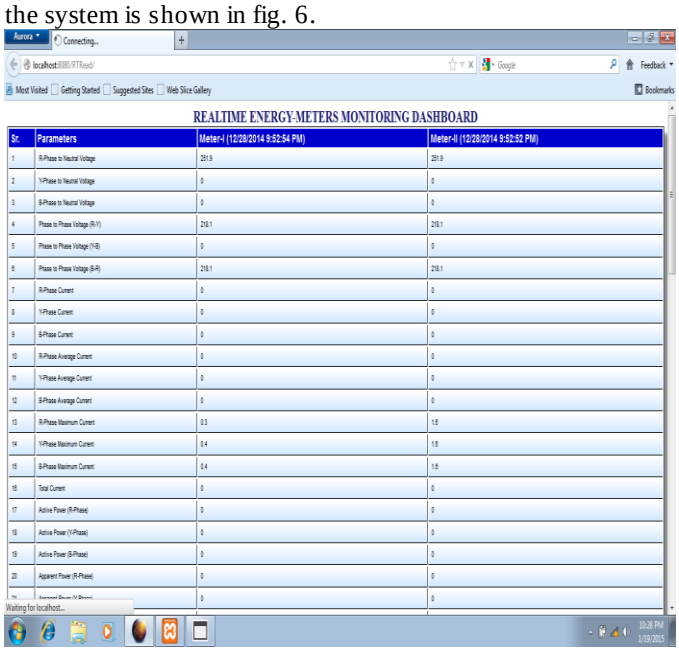

Fig. 5 GUI shows realtime data

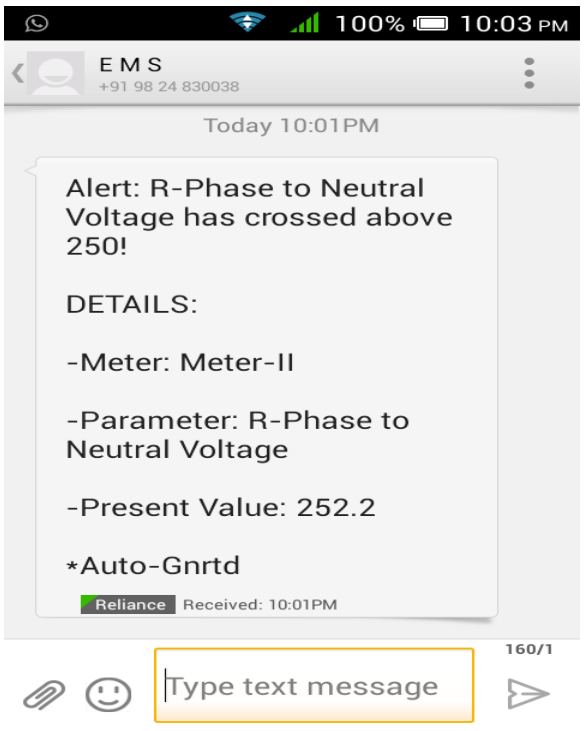

Fig. 6 Auto generated SMS from the system

VI. CONCLUSIONS

Remote monitoring is the first step towards control a system remotely if we have data on the real time bases then we can control the critical applications & also it can provide alerts by simply interfacing another communication technology like GSM or Internet and can communicate with concern people.

GSM Module interface makes this system worthy because alert as well as total report on the end of the day will be available on the mobile which is very handy.

This concept is further used in smart grid, can be used to monitor the load pattern of the particular area. This system can be used in BEMS (Building Energy Management System). A smart system can communicate with any other systems which make this system applicable in number of fields.

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