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NEW ENERGY MANAGEMENT SYSTEM BASED ON INTELLIGENT DIGITAL POWER MONITORING

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ABSTRACT

Nowadays, increasing power consumption is a major cause of failure at grid due to maximum peak load and this electricity irregularity is pushing users to face troubles. This paper introduces a new Energy Management System (EMS) based on intelligent digital power monitoring. This system consists of micro controller with GSM connection to server for any decision and current transformer for monitoring of line current which is core parameter for monitoring power consumption. Our proposed algorithm will be very good solution for electrical companies to offer new electricity packages and to have a control over their user in more prominent way.

Keywords: Energy Management System, digital power monitoring, GSM.

INTRODUCTION

Large scale power networks (grids) have been an area of continuous research and innovations for a long time. Consequently, there is a rich set of both theories and technologies for their control and management; the major of this was demand-side-management. However control and management of large scale power network (Grid) is largely un-explored. With recent development in variety of sophisticated power line communication (PLC) technologies and supporting micro processors, it is technically and economically feasible to implement a management system for demand side networks. If Automatically Meter Reading (AMR) is implemented, user can be able to improve the energy (de Groot, 2007). There are many interesting applications of GSM in power control and monitoring system and in load management. A latest is home electric control. Today a wide variety of home appliances are required to support our quality of life, however those appliances are not fully controlled. If a GSM communication system is applied, the functionality can be improved (Petrick et al., 1998).

Traditionally industrially applied wire transmission media to transmit remote monitoring data. However due to wide distribution of power equipments, poor flexibility and questionable stability will rise by using wire configuration. Hence this research design a wireless real time monitoring system by using power monitor chip with conversion components to get the data including three phase power voltage, electric current, electric frequency and electric power. Applying GSM mobile module to send the SMS containing the controlling code to control end of the system. In this paper, monitoring device which can monitor automatically and in real time the electric consumption of a house in premises

or in any other building, monitoring the total consumption of all installed appliances consist of Source Input, measuring means, control and processing means, selection and storage means, indications means, communication section to server/master meter, circuit breaker for any decision to be implemented from vendor, some means of encryption/coding. Some extensions might be included in this system like key-pad for data entry for units, password input etc. Also after implementing future enhancements, this system will be able to create an intelligent network connected to a central station (Buse and Wu, 2007). This paper organized as follows Section two introduces the basics of GSM, need of control over large scale power networks, Third section technical system descriptions ,application of 3G Network to control power monitoring, hardware to be used methodology, diagrams and Section four expected results, shows the faster and reliable control over power networks. Finally, possible extensions and future enhancements like pre-paid electric meter, securities issues are also discussed in conclusion section.

SYSTEM DESCRIPTION

One of the main reasons that GSM is superior to mobile analogue networks is its ability to perform error detection and correction on both telephony and data signals. Also there is no need of conversion to send or receive data, either communicating between any other networks. The network structure of GSM is as under (ETS, 2004).

- Interface radio link between mobile station, (MS) and Base Station Transceiver, (BTS)
- Interface ABIS between BTS and Base station Controller,(BSC)
- .Interface A Between BSC and Mobile Switching Center, (MSC)
- Interface B between MSC and Visitor Location register Register,(VLR)
- Interface c between MSC and Home location Register(HLR)
- Interface D between HLR and VLR

The main reason for selection of GSM for proposed algorithm is its faster speed of communication, to send or receive and signal/data (Lubar, 2002). For example time between transmission of a dial command and receiving of carrier signal from a remote location is as;

$$Tset= t_{PC} +t_m +t_{ln}+t_{gn} \quad (1)$$

where t_{PC} is time taken to send the dialed command
t_m is processing time of MODEM
t_{ln} is the time on PSTN
t_{gn} time on GSM network

Selection of GSM for design of algorithm is also based on the fact that GSM networks are almost available in each part of country, no need to install a new setup which may be much cost oriented. The central processor is a PIC family microprocessor (James, 2000), having ability to take any action on basis of pre-defined instruction, including every possible fact and operation. This instruction set is designed using a high level language, C++ (Sickle, 2001).

SYSTEM IMPLEMENTATION

Figure1 shows possible monitoring equipments for this device. Important is CT measuring equipment connected to AC line, and this equipment includes feed source, which after filtering and stabilizing the current passes it to different monitoring devices. This measuring equipment is connected to a digital system**,** a micro controller based, with memory for storage of consumption values for future calculations.

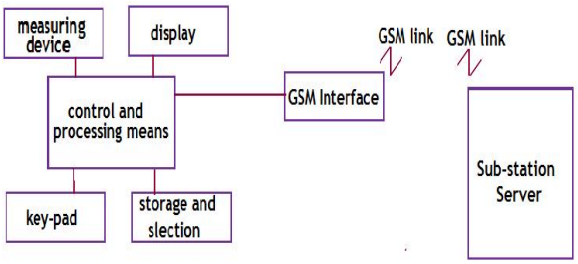

Figure 1: Energy system Block Diagrams

The Energy Controller should include both automatic and manual switches, the timer, energy consumption recorder and some protection devices. The block diagram of the EC as shown in Fig.1 Micro processor is connected to two different sections as follows:-

1. GSM Interface via hand set. Preferably Siemens or NOKIA handset, using DB-9 connector, and far-end is sub-station Main computer, Server.
2. Display screen for all programmed values and measured, i.e. Current consumed units, current bill, remaining unit (in case of pre-paid), and any warning message.

In case of enhancement this display screen can be used to input any type of data and also password input. Micro processor can be connected to a personal computer in such a way that monitoring device act as energy control, whereas this PC acts as a master for this device, to make any decision, to stop all the operation. The core equipment, CT, is able to display all measuring values to the screen and therefore can be easily made different type of power levels, like safe, medium, overloaded/warning level. Current Sensor transformers are widely used in a variety of applications ranging from power management to precise current measurement.

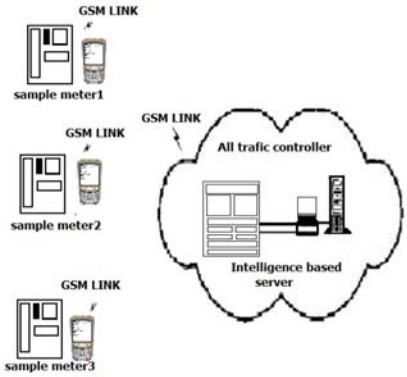

Figure 2: System Implementation

RESULTS

Installation of this device will be very easy, directly connected to power I/P, main line at homes, coming from the electric meter and also this device will be user friendly, to get any type of information. What vendors need to define is a pre-defined electric package rate as shown in Figure 3 and specified coding for this is in an advance language. For example to calculate bill from 4:00 to 08:00; specimen coding for this part is any advance language.

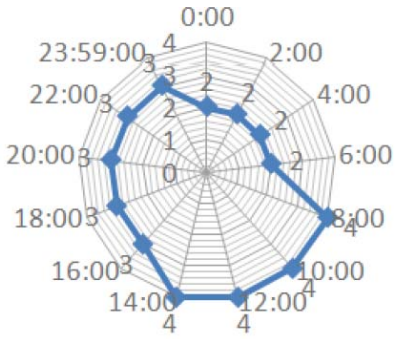

Figure 3: Graph tariff varying with time

For future enhancement when we want to connect device to server using wireless communication, GSM, AT commands will be used to make an interface of micro-controller with handset/GSM MODEM.AT commands will help to send and receive in text format, SMS, in any mode either PDU mode or in text mode.

Like
AT+CNMI= used to display new SMS
AT+CMGS=send an SMS
AT+CMGR=read any new SMS from any specified location

Hand set is connected to PC COM port, with specific baud rate normally 9600bps. Transformer picks up AC current as input and produces proportional electric signals, which are an input to PIC micro controller. And this input is just like a clock count to counter/timer of microcontroller. Now this is job of microcontroller to count electrical pulses for a specific time using counter and to calculate bill for consumed units. This calculated bill is displayed to LCD Display and also sends to main server/substation with time to time through GSM interface. Substation is a Master computer for all users, which is capable to give any command at required time, to stop the operation, using relays and power circuitry attached to monitoring device at user end. All GSM communication takes place via SMS. Hand set connected to micro controller using DB-9 connector use AT commands for any type of communication, to send receive data.

CONCLUSION

At peak hours, as newly defined tariff rates, users are now careful for using electricity at that time, and no more load at substation. Planning from vendor side is also made to avoid any collapse between industrial, commercial and residential user, so no more saturation at same time. Monitoring device is also digital, user friendly and all measurement parameters, also payable amount is in front of him all the time. Enhancement may be made on the

basis completion of proposed algorithm like, pre-paid electric meter, using GSM network, Security measurements for meter like passwords encryption.

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REFERENCES

Petrick, A.; Newbury, J. and Gargan, S. 1998. Two Way Communication system in Electricity Supply Industry. *IEEE transaction on power delivery*, 1:13-19.

Buse, D.P. and Wu, Q.H. 2007. *IP Network Based Multi Agent System for Industrial Automation*. London: Spring Verlog

Lubar, D. 2002. *Wireless messaging demystified: SMS: EMS: MMS and other*. NY: McGraw-Hill Professional.

ETS (European Telecommunication Standard), Network Architecture, (03.02). 9-17

de Groot, M. 2007. Energy Service Enabling technology. Tasmania ICT Center, CSIRO Australia.

James, M. 2000. *Micro controller cookbook for PIC*. 2nd edition, ISBN 0-7506-4832-5.

Sickle, T.V. 2001. *Programming Micro controllers in C.* 2nd Edition, ISBN 1-878707-57-4.