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International
Journal
Of Modern Engineering Research (IJMER)

Wavelet Based Analysis of Online Monitoring of Electrical Power by Mobile Technology

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ABSTRACT: *Electrical automation is an important option for obtaining optimal solution while monitoring the electrical power consumption. While using the conventional methods the errors in continuous monitoring of power consumption is more. But the system requires not only the monitoring of the energy but also requires the analysis of the monitored energy. In this paper wavelet analysis is used for the analysis of the monitored energy/power which is monitored by GPRS technology. By using the GPRS mobile technology the energy consumption is monitored continuously and the observed data is interfaced to the computer by RS 232 port. By using MATLAB the monitored data is processed to obtain in depth analysis of the monitored power. The proposed method not only monitors the data but also provides efficient means to analyze the observed data by Wavelet Transform*

Keywords: *Energy monitoring, GPRS system, Hardware system, Multi Resolution Analysis, Real time monitoring, wavelet transforms*

I. Introduction

On line Monitoring of the electrical energy in terms of voltage and current is very important for taking appropriate steps basing on the observed data. Online monitoring of energy supports remote monitoring of electrical energy if the system is interfaced with mobile technology such as GSM (Global System for Mobile Communications or GPRS (General Packet Radio Service) systems. GSM is an interface connects the automated meter to home appliances [1] .Similarly GPRS system interfaces the electrical energy to be monitored to remote units where the monitored energy is observed continuously to take corrective measures if any sort of anomalies are observed. In general voltage profile, current profile, KWH profile is monitored continuously as the load is changing continuously. Basically the monitored electrical variables will be measured by the meter which consists of microcontroller programmed to monitor the variables and the meter consists of a modem which communicates the observed variables to remote units by GPRS technology. At the sight of remote unit ,appropriate decision will be taken with the help of monitored data[2].As an illustration ,if the measuring instrument consists of the said characteristics then it is called intelligence meter where logistics can be implemented such as the meter disconnects the supply to home appliances or industrial customers if the consumer consumes more than the intended power. That is the control center can monitor remotely about the level of energy consumption by a particular consumer and can take the appropriate decision.

In order to achieve the online monitoring of electrical power, microcontroller based designs can be preferred due to its versatile features while processing the data corresponding to the parameters. During the past years a number of researches contribute with the help of microprocessors and controllers for continual monitoring of system parameters. During theft of the power there will be corresponding changes in the Power levels and these changes in the magnitude needs to be monitored via online process.

While doing so wavelet analysis can be implemented by interfacing the monitored data with PC by using RS 232 port. Wavelet analysis identifies even slight changes in the monitored data and thus facilitates indepth analysis of the monitored power.

Thus Real-time monitoring of electrical power necessitates great abilities of data-handling and data-processing. These requirements limit the possibility of monitoring, in spite of the fact that microprocessor-based monitoring systems have observed vital development in their storage and computational power[3]. Development of compact algorithms will benefit power quality because they will allow monitoring of more points simultaneously for large systems, and, they will help in building powerful embeddable monitoring architectures within small power devices.

II. Online Monitoring System

The introduction of wireless communication has allowed many technical applications around the world to carry out technical activities in a novel way. General Packet Radio Service is a new, high-speed, packet-switching technology, for GSM networks. It makes sending and receiving large volumes of data over a mobile telephone network possible. A simple way to understand packet switching is to relate it to a puzzle.

GPRS offers a continuous connection to the Internet for mobile phone and computer user's. In most of the applications data communication require continuous data transfer especially in the cases of energy monitoring applications. GPRS provides a significant advances to mobile data usage and usefulness..Its main innovations are that it is packet based, that it will increase data transmission speeds, and that it will extend the Internet connection all the way to the mobile PC – the user will no longer need to dial up to a separate ISP.

GTPRS will complement rather than replace the current data services available through today's GSM digital cellular networks, such as Circuit Switched Data and Short Message Service

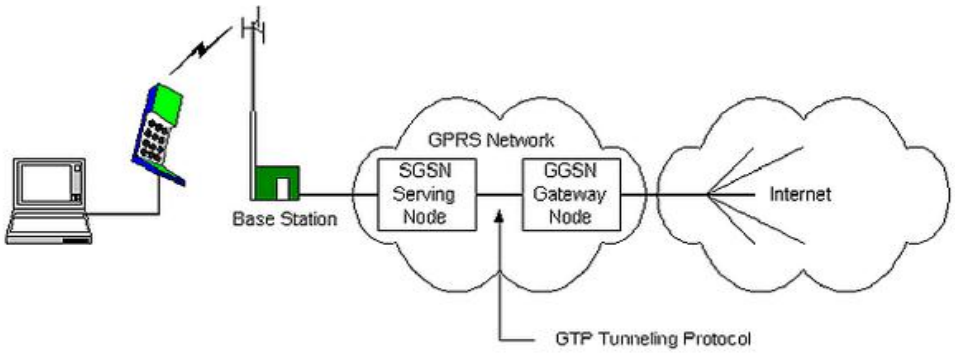

Figure.1 Schematic diagram of GPRS

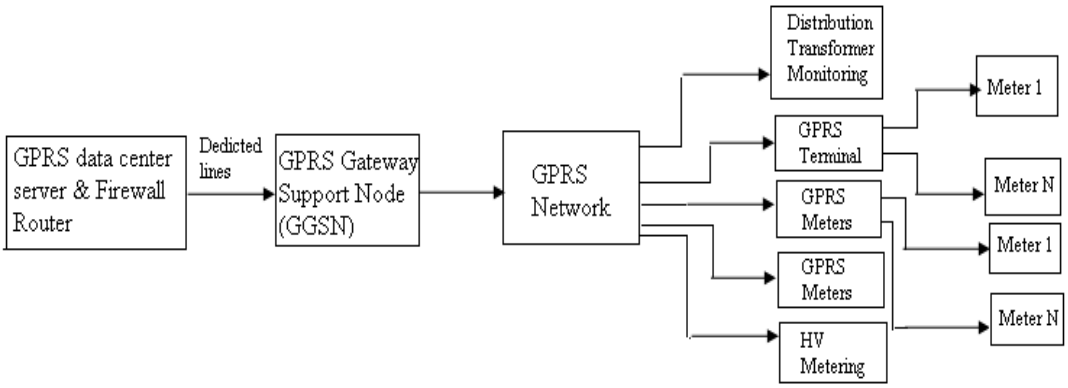

Figure.2 Architecture of GPRS system

To realize the online monitoring of the data, ATmega162 microcontroller which is shown in Figure.3 has been used to process the electrical data. Code is dumped on to the microcontroller (pin diagram shown in fig 3) to control the electrical data to be monitored such as current, voltage and KWh [4]. At the sending end and receiving end GPRS modem is established, and the monitored data is transmitted using GPRS at sending end and the same data is received at remote location by using GPRS at receiving end [5]. The proposed hardware model is shown in fig4. The module shown in fig4 is at sending and receiving end to transmit and receive the monitored data by the microcontroller.

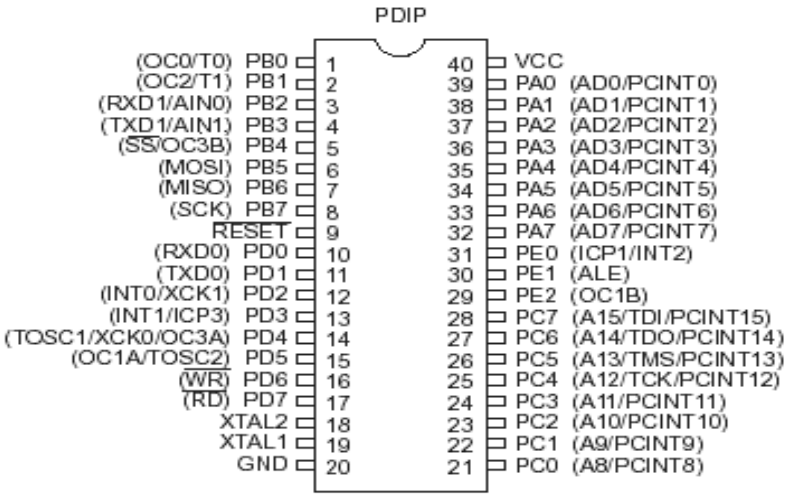

Figure.3 Pin diagram of ATmega162 Microcontroller

In the laboratory the module is tested for variable inductive load such that the corresponding data is received by the modem at receiving end which has been interfaced with PC for further analysis with Wavelet Transform in MATLAB environment**.**

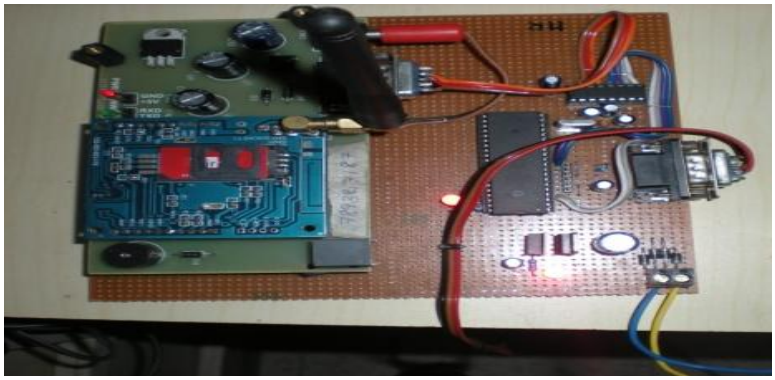

Figure.4 Hardware model for automated monitoring

As an illustration the observed data is given in the following table.
V=210 volt, Meter can measure up to 12A, KVA=2.0, R-L load

S.No	Voltage	Load current in AMPS
1	209	1
2	209	2
3	209	3
4	209	4
5	209	5
6	209	6
7	208	7
8	208	8
9	208	9

S.No	Time in Minutes	KWh Measured from Energy meter
1	5	0.142
2	10	0.200
3	15	0.424
4	20	0.546
5	25	0.723
6	30	0.788
7	35	0.967
8	40	1.116
9	45	1.266
10	50	1.417
11	55	1.554
12	60	1.698

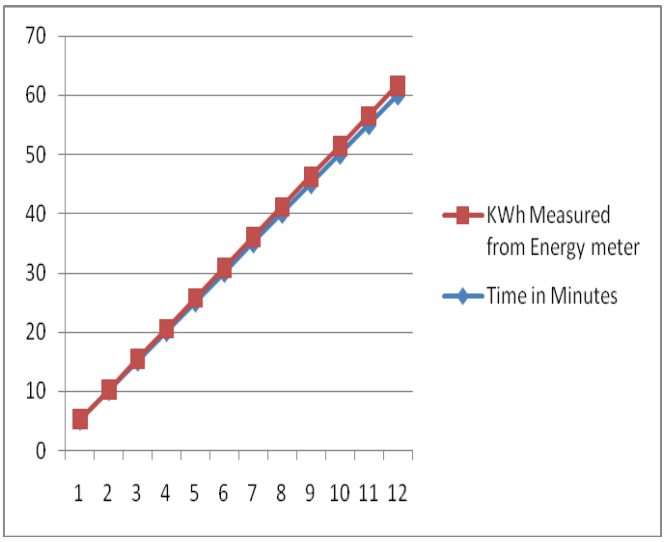

Figure.5 Load variation with corresponding kWh

III. Wavelet Multi Resolution Analysis

The main idea of wavelet multi-resolution analysis is that any function f(t) can be approximated step by step and the approximation of each step is just to smooth f(t) by a lower-pass function φ(t) which will also expand or contract according to the step. f (t) is approximated in different precision in different steps. Mallet algorithm is adopted to decompose the signal. The signal to be analyzed is to decompose at different dilations and shifted till in-depth resolution of the signal is achieved. Firstly the high-pass filters h[n] and low pass filter g[n] the load signal s can be decomposed into two sub serials c1 [n] and d1 [n].The transform is an orthogonal decomposition of the signal [6]. The c1 [n], named the approximation of signal s contains the low frequency component of the signal s and d1 [n] is the detail of the signal is associated with the high frequency component of the signal s. The further step by expanding the scale function φ (t) the approximation c1 [n] is again decomposed into c2[n] and d2[n] . By using the Wavelet analysis in the PC, the monitored data is analyzed to observe the discontinuities in the observed data. While applying wavelet transform ,detailed and approximate coefficients are obtained and these values provides information regarding any sort of anomalies in the observed data shown in fig 6.

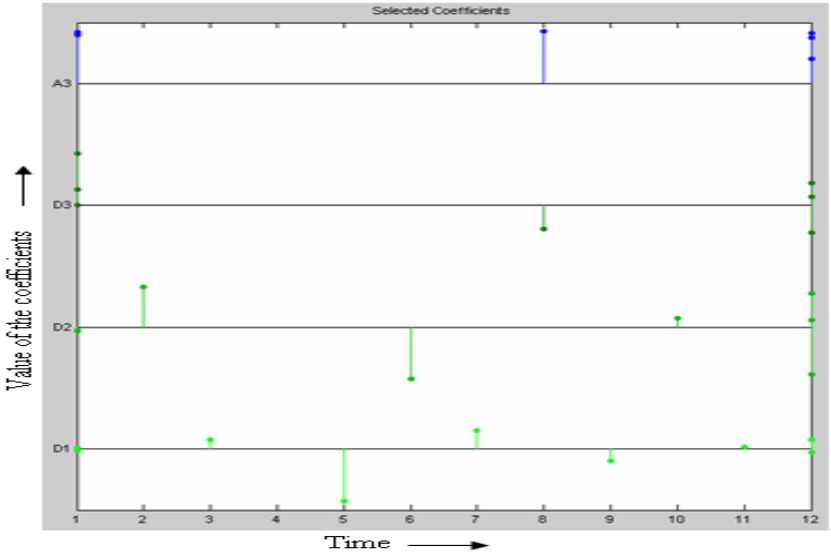

Figure.6 Selected coefficients

This concept can be extended even to monitor the condition monitoring of the power transformer with respect to temparature,voltage,and overload condition.

IV. Conclusion

A real time energy monitoring system for simple load is proposed and developed and its automation closer to real time is realized with microcontroller based GPRS system. The developed approach is low and able to identify anomalies in monitored data with the help of approximate and detailed coefficients as the receiving end GPRS system is interfaced with PC by RS232 port. The developed system is tested in laboratory with variable resistive and inductive load.

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