ENERGY AND POWER DATA TRANSMISSION THROUGH DOMESTIC POWER LINES

Christeena Joseph ,P.C.Kishoreraja, C. Subesikaran, J.Naveen Kumar

Abstract-In the present scenario data transformation and voice communication is done in EHV transmission line through power line carrier communication system (PLCC) for the efficient production management and safe transmission and there is no perfect tool or monitoring system available for distribution management. In this paper design and implementation of a smart power monitoring distribution system is discussed .The proposed method deals with data transformation regarding power consumption through existing low voltage distribution power lines using SCADA Technique. The advantage of using SCADA technique is that it improves the data transformation rate compared to the previous system and also is used to find out power theft.

Keywords: Power monitoring distribution system, power line carrier communication(PLCC), SCADA, Power theft, data transformation

1.Introduction

In power system, communication regarding operation is very critical and vital. For efficient operation of the grid, communication between sub-stations and the load dispatch center is a must. Similarly for better operation the load dispatcher requires real time data of various generating stations and the sub-stations for which good communication link is very important. As the generating stations such as hydro and sub-stations is generally located in the remote areas, to have normal P&T telecommunication systems will be very difficult, costly and is not much reliable. This resulted in the development of a new concept called PLCC using the high voltage and extra high voltage transmission lines such as 110 kV, 220 kV, 400 kV which acts as a medium for sending the carrier signals by super imposing on the electrical power signals and transmitting on the power line with necessary equipments. The power lines are originally intended for transmission of AC power in conventional use. Now days these power lines are used for sending and receiving information between two sub stations or two subscribers etc.

The paper is divided into the following sections. Section I introduces the importance of data transmission through the power lines.

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Section II provides the problem with the existing and how the proposed system tackles the barriers of existing system. Section III provides the literature review of some of the existing systems of PLCC system. And also the methods and technologies used in these systems. Section IV introduces the model and concept of the power line carrier communication system (PLCC) Section V describes the design adopted for the system to make it efficient in various aspects. Section VI provides the information about the implementation of the system architecture. Section VII gives the conclusion and section VIII details the future work.

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2. Problem Definition

Though we produce large amount of power, at a very high cost, we do not have effective technology to control and monitor the losses .The losses pose a major threat in the development of power sector. Power Thefts have a greater share in the losses and it takes place in each and every sector of distribution and consumption such as industrial, domestic and commercial. This is because of improper monitoring of power consumption. The proposed system uses SCADA which has the ability to monitor an entire system in real time. This is facilitated by data acquisitions including meter reading, checking status of sensors, etc that are

communicated at regular intervals depending on the system.

3. Literature Review

Power line communication (PLC) has become an important network access technology to conveniently and effectively provide various useful services such as remote meter reading, broadband Internet access, and home networking services.[1] This paper presents two novel contributions. The first one is a new methodology developed for smart metering PLC network monitoring and analysis. It can be used to obtain relevant information from the grid, thus adding value to existing smart metering deployments and facilitating utility operational activities. A second contribution describes grid conditioning used to obtain LV feeder and phase identification of all connected smart electric meters. [2] An overview of PLC network technology and described a trial PLC network and its deployment in Korea. The experience on the deployment and management of the trial PLC network is also presented.

4. Existing Method

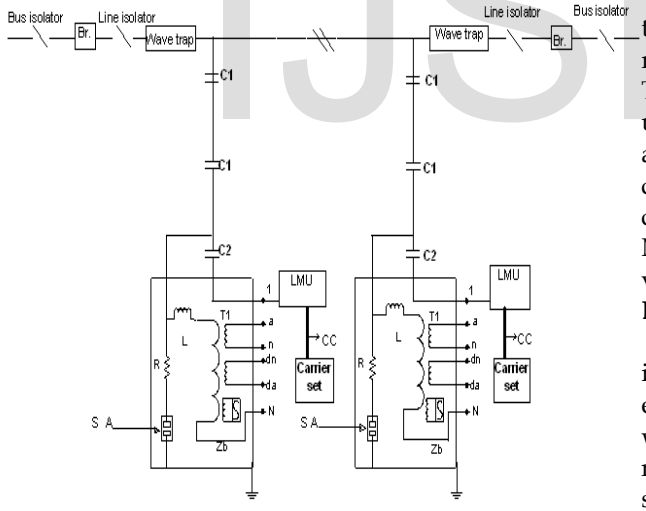

Fig 1

PLCC:

The PLC Modem is a dedicated device(Fig 1) for transferring data over low voltage power line. The PLC modems are used in the power line cable as communication medium. It is convenient as it eliminates the need to lay additional cables. The modem at the transmission end modulates the signal from data terminal through RS-232 interface onto the carrier signal in the power line. At the receiving end, the modem recovers the data from the power line carrier signal by demodulation and sends the data to data terminals through RS-232 interface.

The basic process involves three steps:

- Modulate the data so that it can be sent over transmission medium.
- Transmit the signal in such a manner to reduce signal distortion.
- Receive and demodulate the signal to extract the data.

Data Transformation

For transmission of real time data such as MW, MVAR, frequency, voltage and current of power system, RTUs are employed. All parameters are converted to voltage form and this will be fed to RTUs (Remote Terminal Unit). All the parameters converted in to digital form and stored in the RTU. Whenever request comes from the servers which are located at load dispatch centres the RTU will send its stored data to the modem. In the modem the digital data is transferred as frequency and transmitted through the carrier set .The frequency change will be reproduced in the receiver end and digital pulses are sent to a COM port of the computer and can be displayed on the screen.

Advantages of PLCC:

The reliability of transmission lines in terms of availability and mechanical strength is much higher than the telecommunication lines. The PLCC channels are solely used by the Electric utilities and not by general public, so the availability factor will be much higher. The capital cost of the PLCC equipment is considerably less compared to the VHF or Microwave equipment and also maintenance is very less.

Disadvantages of PLCC:

As the medium used for communication is high voltage the cost of insulation of the equipment is high. Because of corona, noise level will be high. High-speed data transmission is not possible and there is no proper isolation system

The following are the reasons why the existing system is inefficient:

1. outdated technology used in energy meter
2. social obligations
3. human errors
4. times consuming
5. errors in the meter

5. Proposed System

The existing system is modified with microcontroller based system through power lines with a proper isolation system. This

technology enables the electricity board to monitor the MW and MVAR consumption of any particular industrial, agricultural, domestic and or commercial concern at any desired time, accurately. A technology which would enable to monitor the MW and MVAR consumption through telemetry would remove the human intervention. Data transfer through domestic power lines is one such technology which would revolutionize the smart power monitoring and metering distribution system and it is used to find out the power theft.

The consumption at the user side is converted into the digital form by giving it to the microcontroller placed at the transformer. The modem at the transmission end modulates the signal from the microcontroller through MAX-232 interface onto the carrier set in the power line. This carrier signal passes through coupler. The low voltage concentrator picks up and enhances the signal. At the receiving end, the modem retrieves the data from the power line carrier signal by demodulation and sends the data to SCADA system. SCADA system is programmed to decode the user and the consumption details .The parameters monitored are voltage, current, frequency and energy. In the data transmission, the distribution transformer is completely bypassed to avoid the undesired influence of the device .The signal is generated in the data center and is sent through the power line to the receiver.Figure2 and Figure 3 represents the operation of users end and monitoring end respectively.

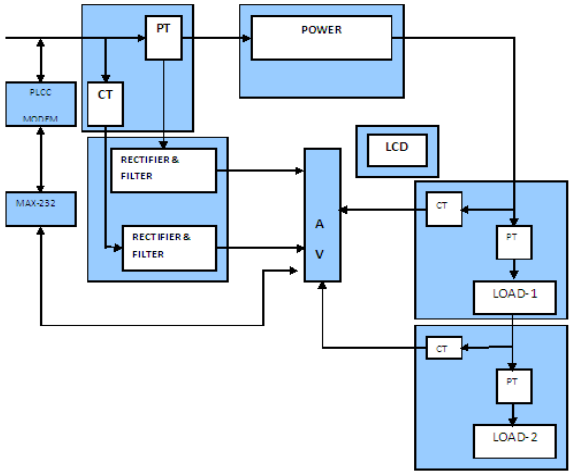

Figure 2

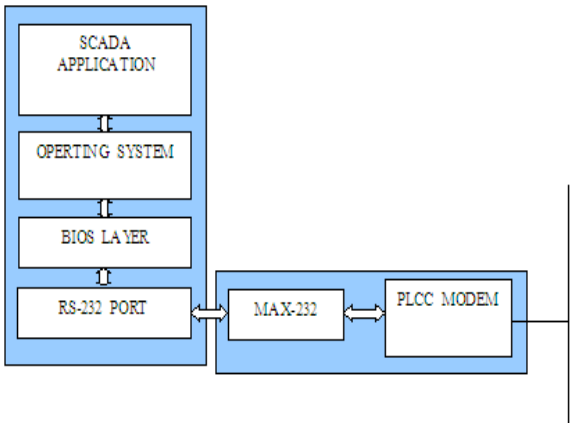

Figure 3

6. System Architecture

The Figure 4 shows the system architecture. The system uses SCADA technology along with PLC modem as the communication media for power monitoring. The computer is connected directly to the PLC modems.

The PLC modems use spread spectrum (SS) technology – CE bus. The spread spectrum technology is referred as the method of signal modulation where the transmitted signal occupies a bandwidth which is greater than the minimum necessary to send the information.

The spread spectrum techniques that have been applied to the PLC systems use chirping method. Chirping method uses its entire allocated bandwidth to broadcast a signal, making it robust to channel noise. Further, because the chirps utilize a broad band of the spectrum, chirp spread spectrum is also resistant to multi-path fading even when operating at very low power. In the CE bus standard the frequency range of the chirping method is from 100 kHz to 400 kHz over a 100microseconds .In CE bus protocol, the data is transmitted in short frames. The PLC target modem will answer back to the source PLC modem when it receives a request.

SCADA as a System:

The main parts of a working SCADA system generally includes signal hardware (input and output), controllers, networks, user interface (HMI), communications equipment and software. The central system mainly monitors data from various sensors that are either in close ranges (sometimes miles away).

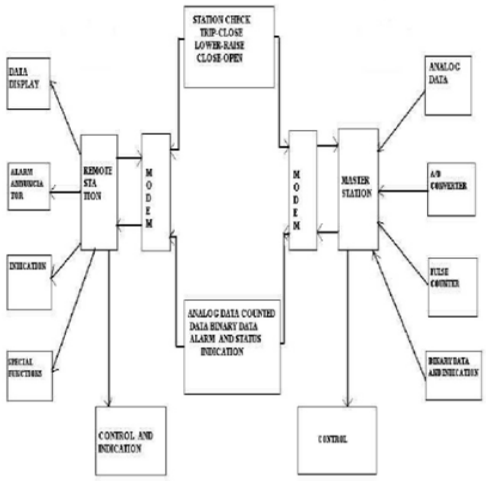

Figure 4

SCADA is more efficient in monitoring an entire real time system. This is facilitated by data procurements including meter readings, checking status of sensors that are transferred at regular intervals depending on the system. In addition the data used by the consumer is also displayed to monitoring person.

Visual Basic Front End:

Visual Basics is used for program interfacing. Visual Basic (VB) is the third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model. Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using Data Access Objects, Remote Data Objects, or ActiveX Data Objects, and creation of ActiveX controls and objects. Figure 4 represents the output of the monitored power consumption.

System Output of Monitoring Power:

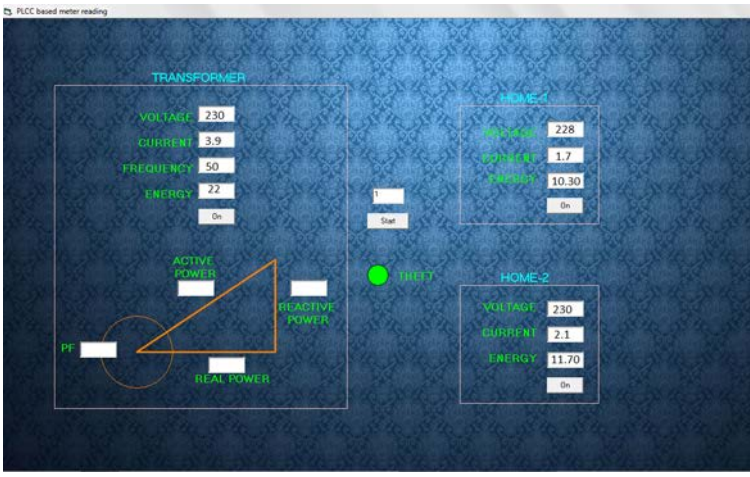

Figure 4

Voltage : 230
Current: 3.9
Frequency: 50
Energy: 22
MERITS:

- The reliability of system is high.
- Mechanical strength of PLCC is high.
- Maintenance is very less.
- Capital cost of the PLCC equipment is less.
- It saves a lot of time by collecting many readings in few minutes time.
- This technology has high accuracy in data transmission and no data loss.
- Power theft is identified and minimized.
- A voltage trip can be given to a particular housing unit if the bill is not paid within the expected duration.

7.Conclusion

The power sector in India is expanding exponentially and so are the losses which include power theft. The existing system of power consumption monitoring is very obsolete and does not prove to be of great use for consumption monitoring of rapidly expanding power sector. To effectively monitor the consumption of industrial domestic and commercial power utilization, our project energy and power data transfer through the domestic power lines is the best for power consumption monitoring system. This technology has some salient features like Capital cost of the PLCC equipment is less, it saves a lot of time by collecting many readings in few minutes time, this technology has high accuracy in data transmission and no data loss.

Data transfer through medium or low voltage power line helps in monitoring the load pattern, MVAR consumption, voltage variation, power theft, distribution losses etc. This project is

an important tool for detecting theft and maintaining power consumption discipline. This technology would save the power sector from crumbling clutches of losses and theft and paves way for a new trend in peak demand and load management in distribution system.

8.Future Work

This project deals with data transmission through existing low/medium voltage domestic distribution power lines and the real time information provided by PLC based smart monitoring Systems .Perhaps there is more potential for PLCC to succeed in the home networking area due to the fact that electrical wiring is available in most homes, and various home application devices (such as PCs, audio, video, camera, home appliances, etc.) can be easily networked. By suitable enhancement of hardware and software the power consumption on a daily basis can be displayed at the user's end.

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