

# Design of Narrowband PLC for Power Distribution System with Automated Billing Generation through GSM Network

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**Abstract-** The advancement of the Electricity Boards in the Metropolitan area, Such as implementing energy meter, current leakage sensing parameters and reached success in it, but still now a major advancement have not achieved in this department. Though, the monthly bill and usage of current units are noted by a person and later it entered into the Electricity Board. This paper proposes the most reliable and effective automated Bill generation using PLC Modem through GSM Network for each individual home or person, and to provide the facility to monitor and control the each and every household from the Electricity department Board.

**Index Term** - PLC modem, GSM, Energy meter.

## 1 INTRODUCTION

The technology uses advanced modulation technology which super imposes the data signal of high frequency over the low frequency power signal. There is no additional cost to install other dozens of meters of wires, there is not the necessity to break the walls and to do building works at home, there are no interferences with other devices (like in the radio communication case). There is no need to have an extra power source (usually, in a bus cable domotic system, there is a direct voltage generated by a power supply and distributed on the whole domotic net). This fast system enables transmission in the form of voice and other data as well it has wide implications. Since most forms of communication today require separate hard wiring it is convenient to use PLC which can employ the pre-existing power cables within the house.

This paper presents a feasible Home Automation System scenario based on a very cheap distributed microcontroller architecture, rather than one devices interconnected by an expensive commercial bus. The means used for data communication is the home power line, so that the system doesn't require placing other cables in addition to standard electrical facilities. Power line carrier systems have long been a favorite at many utilities because it allows them to reliably move data over an infra structure that they control. Now we discuss briefly:

Section [2] Related works  
Section [3] proposed System  
Section [4] System Requirements  
Section [5] LabVIEW Implementation  
Section [6] Conclusion

## 2. RELATED WORKS

Existing electricity consumption billing process seems in India to be very obsolete and does not meet the latest technology available. Recent development of sending the total EB power usage per month using GSM based network have succeed. The prevailing manual system requires lot of human workforce and also needs the customer attendance at home when they take readings. Some of the related works are Prototype of a PLC Based communication System for Residential Electrical Consumption Measurement- Jhon Edison Rodriguez Castellanos, Jonathan Bustos Herrera, Andres Leonardo Jutinico Alarcon, Robinson Jimenez Moreno

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describes a system capable of individualizing electrical consumption measurements obtained for each one of the MTUs. The measurements are sent from a module adapted to the electrical appliance to a data hub which compiles and stores the data. The Impact Of The CFL Lamps On The Power-Line Communications Channel- A.Emleh, A.S.de Beer, H.C. Ferreira, analyze the harmonic impact of large scale in-building loads, such as compact fluorescent lamp interference on the wiring system of power line communication channel.

### 3. PROPOSED SYSTEM

PLC is one of the technologies used for automatic meter reading. Both one-way and two-way systems have been successfully used for decades. PLC is one of the technologies being used in Advanced Metering Infrastructure (AMI) systems. This system automatically send the meter readings from Home to EB office through power line communication using PLC modem and also generating EB bill automatically, and sending the bill directly to owner's mobile. In addition to this, when the consumer did not pay the bill within the due date, the system automatically disconnects the EB power of the particular consumer automatically from the EB office itself. The PLC based system will use the Existing EB power line for communication and don't have any interference with other communication devices such as the radio communication. The system establishes a Proper communication between the user and EB office, with less maintenance. Usage of power can be effectively managed by the method of calculating the individual power consumption by the devices.

### 4. SYSTEM REQUIREMENTS

The hardware and software components used in the project listed below,

#### 4.1 HARDWARE REQUIREMENTS:

- PLC modem: ST7540
- Voltage Sensor,
- Current Sensor,
- Energy Meter: AC Static KWh Meter
- Microcontroller: PIC16F877A

### 4.2 SOFTWARE REQUIREMENTS

- MPLAB IDE v8.53
- HITECH-C Compiler
- Embedded C Language
- LABVIEW v13.0

### PLC TECHNOLOGY

Power Line Communication is a fairly recent technology which is used to transfer data and establish means of communication at broadband speeds over transmission lines. The technology uses advanced modulation technology which super imposes the data signal of high frequency over the low frequency power signal. At the same time, the modem control/retrieve data from it in a half-duplex manner. In this technique, a high frequency carrier is injected onto the power line and the data to be sending is modulated. It has a wide range of application possibilities. As PLC signals can carry long distances (several 100 kilometers), such facilities only exist on very long power lines using PLC equipment. For the purpose of understanding, PLC can be broadly viewed as:

1. Narrowband PLC
2. Broadband PLC

Narrowband PLC works at lower frequencies (3-500 kHz), lower data rates (up to 100s of kbps), and has longer range (up to several kilometers), which can be extended using repeaters. Broadband PLC works at higher frequencies (1.8-250 MHz), high data rates (up to 100s of Mbps) and is used in shorter-range applications. Recently, narrowband Power Line Communication has been receiving widespread attention due to its applications in the Smart Grid.

### POWER LINE COMMUNICATION MODEM

The AC-PLM (ST7540) is a digital modem implementing a half-duplex transmitter/receiver for power line communications (PLC). Designed as an ASIC, the device is a very efficient solution for cost sensitive, medium data rate applications. The PLM uses a narrowband FSK (*Frequency-Shift Keying*) modulation technique. The information is encoded by shifting the frequency of the carrier signal between two discrete values in a very narrow range.

## 5. GENEREL BLOCK DIAGRAM

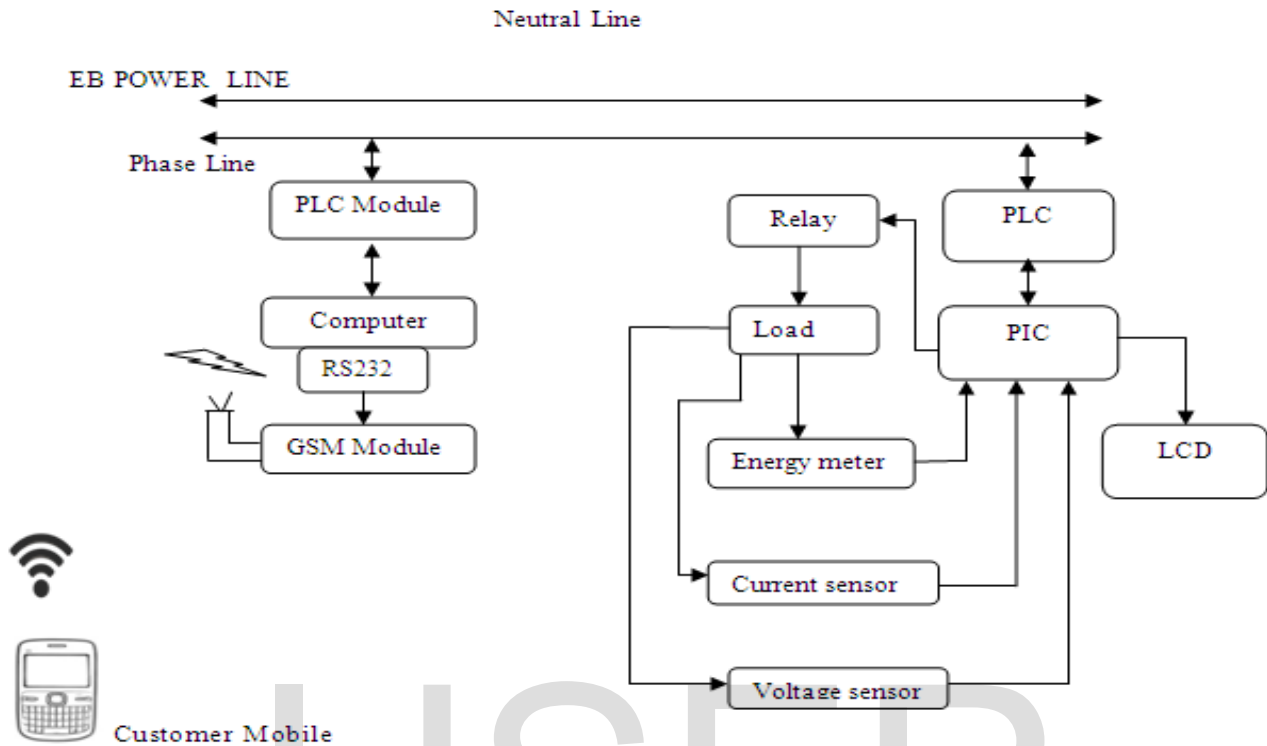


Fig 1 GENERAL BLOCK DIAGRAM

### PLM INTERFACING WITH COMPUTER AND MICROCONTROLLER

PLM provides two types of communication with the external Host: serial (SPI) and parallel, depends on the circuit design, as well as the capabilities of the Computer. In both cases, a master-slave design is used, in which the PLM acts as a slave. The PORTSEL pin enables the selection of the interface. The PLM modem connected to microcontroller using rs232 male connector both the end. The data are transmitted and received serially bit by bit continuously. The PLM offers the following interfacing features

- Serial and parallel mode
- Programmable clock polarity for serial mode
- Programmable Chip Select (CS) polarity
- Port and line status monitoring

### GSM MODULE

GSM (Global System for Mobile Communication) module (SIM900) The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design. GSM module that monthly sends a message to the consumer about the EB power usage with due date to each individual home or person. The text message consist of meter id, power usage in units, bill amount of the particular month and also

another text message to indicate power disconnection due to nonpayment of the bill within the due date.

## 5. LABVIEW IMPLEMENTATION

LabVIEW is a highly useful development environment for creating custom applications that interact with real-world data or signals in fields such as science and engineering. LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications

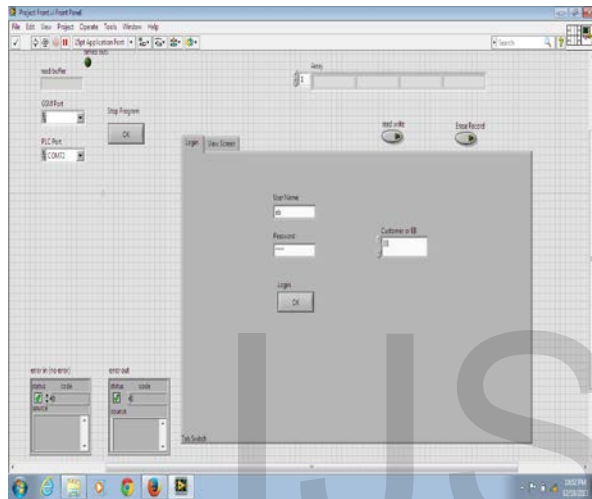


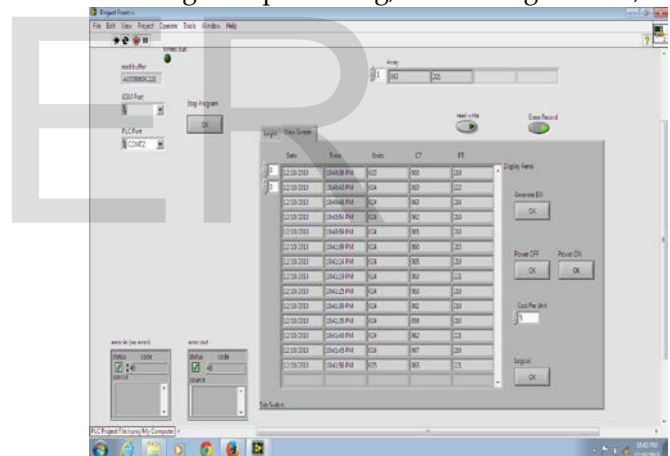
Fig 2 FRONT PANEL EB OFFICE LOGIN

In contrast to text-based Programming languages, where instructions determine program execution, LabVIEW uses dataflow programming, where the flow of data determines execution. The LabVIEW build a user interface with a set of tools and objects. The user interface is coded using graphical representations of functions to control the front panel objects. In some ways, the block diagram resembles a flow chart You can purchase several add-on software toolsets for developing specialized applications. All the toolsets integrate seamlessly in LabVIEW. Refer to the National

Instruments Web site at ni.com for more information about these toolsets.

LabVIEW makes the process of integrating hardware much easier by using a consistent programming approach no matter what hardware you are using. The same initialize-configure-read/write-close pattern is repeated for a wide variety of hardware devices, data is always returned in a format compatible with the analysis and reporting functions. In this project, the LabVIEW front end collects the values of current sensor, voltage sensor, energy meter unit through USB to RS232 converter. The values are updated continuously for the user reference and the end of the day and they are moved to EPROM memory. In addition to the standard programming language constructs, LabVIEW contains functions for

- String, array, and waveform manipulation
- Signal processing, including filters,



windowing, spectral analysis, and transforms

Fig 3 FRONT PANEL EB READINGS UPDATE

- Mathematical analysis, including curve fitting, statistics, differential equations, linear algebra, and interpolation



- Communication, including high-level communication protocols, HTTP, SMTP, FTP, TCP, UDP, Serial, and Bluetooth

To access the EB side LabVIEW front end panel, the user name and password information should be provided. There are two different panels one is home side and another for EB side, both protected by password.

## 6. CONCLUSION

This paper proposes the idea of automatic billing from EB office to Home through GSM with the help of power line communication network. The system automatically generates the EB bill for every month, if the consumer did not pay the bill within the grace period, then the system will automatically disconnect the EB power of the particular consumer through a relay control and the system include a GSM module (SIM900) that monthly sends a message to the consumer about the EB power usage and the bill amount with due date. All these processes controlled and monitored through LabVIEW. Furthermore, work of this project will be extended to voice communication with help of DSP processors.



Fig 4 HOME SIDE VIEW

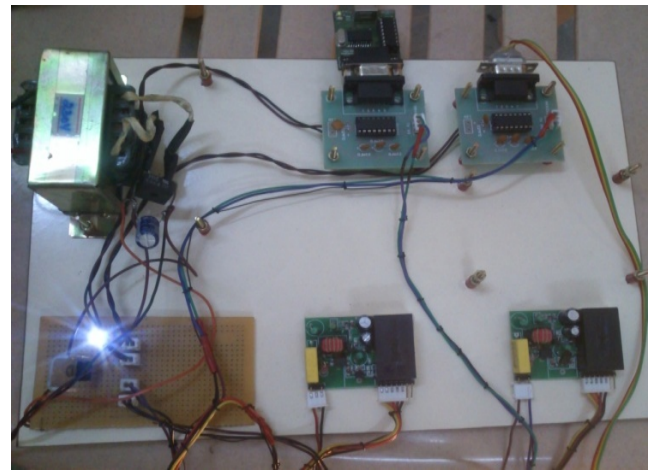


Fig 5 PLC MODEM COMMUNICATION

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