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# Receiver Module of Smart power monitoring and metering distribution system using Domestic power line data transfer

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***Abstract:*** *In the current situation all the communication is very much important and faster range but the usage of the power should be less in order to reduce the power and the usage of the sources we are going for this data transmission through the power lines which is common and much feasible since power line is used at all homes. In this paper we have concentrated much in the receiver module where the receiver receives the data through the power lines through which we can know the readings of amount of usage of power at each homes and also the power theft if it occurs anywhere.by this way we no need to generate any particular infrastructure for transmitting an d receiving instead we can use the power line itself.This is the work done in NLC,TAMILNADU india which is very less explained in this paper.*

***Keywords:*** *Receiver Module, Data Transformation, Power monitoring distribution system, power line carrier communication (PLCC), SCADA, Power Theft.*

## I. INTRODUCTION

In this system of power , operation communication is a very critical and vital area. For good operation of the grid, communication between sub-stations and the load dispatch center is a must. Similarly for better operation the load dispatcher shall get real time data of various generating stations and the sub-stations for which good communication links 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 not much reliability. 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 is acting as a medium for sending the carrier signals by super imposing on the Electrical power signals and transmitting on the power line with necessary equipment's. The power lines are originally intended for transmission of AC power in conventional use. But these power lines are used for sending and receiving information between two sub stations (or) two subscribers etc.

This project is done in an electricity mine which is located in Tamilnadu. Neyveli is situated in the Cuddalore District of Tamilnadu about 200 Kms. South of Chennai. The Existence of Lignite in this area is known since 1870. However during 1934, the existence of Lignite was first encountered while drilling a bore well for agricultural purpose at Jambulinga Mudaliar's land. While drilling, lignite gushed out what appeared as "Black clay" from the bore well and later it was identified as lignite.

Later Neyveli, home of Neyveli Lignite Corporation limited is today India Energy Bridge to the 21st century & fulfillment of Pandit Nehru's launched the mining operation in May 1957. NLC has achieved the objectives it has set for itself, fulfilling its corporate mission to be the leader in the industry, with 2 mines& 2 thermal power stations. NLC contributes a total power about 2490MW to national grid.

**NlC Telecommunication Division**

NLC Telecommunication division was established during 1986 to provide effective communications facility within NLC complex. Earlier all communications was provided through telephones operated by erstwhile P&T department (Now BSNL) using old type electromechanical exchanges. With the expansion of NLC operations with new Thermal stations and Mine, BSNL was unable to satisfy the growing communication requirements. Hence a new telecommunication division was established under the control of GM/Electrical Services. The unit was renamed as Electrical Services & Communication (ES&C).

Under consultation with M/s TCIL (Telecommunication Consultant of India Ltd. ) a new telecom system was established. Accordingly 4 analog exchanges were installed in Township and 6 Exchanges in various production units. Later more exchanges were introduced in accordance with the growing demands.

The analog EPABX-200 exchanges of the initial project were supplied by M/s ITI Ltd. These exchanges were having ultimate capacity of 200 lines. In accordance with the communication requirements during the initial project, exchanges were installed in 10 locations later 3 more locations were added to the network to meet additional requirements in township (Block 21) and new projects like TPS-I Expansion and Mine-IA. The latest addition to this network is TPS-II Expansion.

The NLC telecom network is spread over a wide area across NLC campus and exchanges are located in the following places.

1. TPS-I 8. Corporate Office
2. TPS-I Expn. 9. New Service Unit
3. TPS-II 10. Block-26
4. TPS-II Expn. 11. Block-16
5. Mine- I 12. General Hospital
6. Mine- IA 13. Block-21
7. Mine- II 14. TA Exchange

With the growth of new ISDN and VOIP technologies and in order to meet the ever growing requirement of telephone connections new IP enabled ISDN exchanges were installed in all locations one by one.

**Networking Of Exchanges:**

The exchanges located at these 13 sites are interconnected throughout the Tandem exchanges at Block 26. Alternatively the exchanges are interconnected two nearby exchanges on both sites so as to have alternate connectivity during failure of main link.

Normally a call from one exchange to the other is routed through Tandem exchange. In case of failure of the link between the exchange and Tandem exchange, available alternate route is chosen automatically and call is routed through the neighbor exchange. Number of connectivity between any two exchanges is established based on the capacity of the exchange and practical call flow as per studies conducted. The links are established through latest ISDN technology called PRI. Each PRI provides 30 voice links. For small exchanges one PRI to the Tandem exchange and one PRI each to the adjacent exchange is provided. For high capacity exchanges the Tandem exchange connectivity is increased to 2 or more PRI as per the call flow study.

**Telecom Cable Network:**

NLC Telecom Network was a combination of state of the art of technologies at that time and commissioned at the fag end of 1986 to fulfill the communication requirements of the vast NLC Complex. We were one of the first in India to introduce Polythene Insulated Jelly Filled (PIJF) cables in our complex.

We have been using underground PIJF cables right from the exchanges to the subscriber's ends without going for overhead lines in any section. This ensures reliability of the communication network. As these cables are jelly filled, they are moisture resistant and working satisfactorily throughout the year including rainy seasons.So far, 600Kms of different sizes of distribution and junction cables have been laid and are in service. This network also consists of 230Kms of internal wiring, 4200Nos distribution points (DPs) for providing the total of around 5500Nos Telephone connections.

Every year around 150-200 new connections are being provided in addition to the maintenance and operation of existing Telecom Network using annual maintenance contracts for about 10Kms trenching and 5Kms of wiring.

**Telephone Instruments Lab:**

In Telephone instruments lab at Block-26 Tandem Exchange, all the repairing and testing of various makes and various types of telephone instruments like pushbutton, Main and Extension, Cordless telephones, Executive Secretary plan 1+1 telephones and Eliminators are carried out. Around 6000Nos of various make telephone instruments, 150Nos of mini exchanges connected in residential, plants and office areas connected through satellite Exchanges are maintained.

Any fault occurs in telephone connected in sites are replaced by good working telephones through satellite Exchanges. The faulty telephones removed from sites are transported to telephone instruments lab for repair. The repairing of telephones by replacing the faulty parts by spare parts and testing are carried out in telephones instruments lab. Daily, around 25Nos of telephone instruments are repaired, tested and transported to the satellite exchanges for replacing faulty telephone instruments.

**The parameters being measured in our project are as follows:**

1) Voltage
2) Current
3) Power supply
4) Real power
5) Active power
6) Reactive power
7) Power factor

**Fault detection**

There are many cases were fault are very frequent in any distribution system, so theses also can cause loss in distribution system and these faults can be easily located and isolated.

**Power theft**

Power theft is also very common in distribution system culprits are there many in number who gets illegal connections to them. These also easily determined and punished.

**SPECIAL FACILITIES:**

**I. NlC Automated Complaint Registration System**

1. Features available:
   - Complaint registration NLC Automated Complaint Registration System
   - Complaint status enquiry
2. To access the facility dial 198 from any telephone and follow the 'voice guidance' provided from the system.

Note: Remember the 'complaint number' allotted by the system for complaint status enquiry.

**II. Voice Mail System**

1. Leaving a 'Voice Mail Message'

   When you make a call, the call is automatically forwarded to the voice mail system after approximately 10-13 rings (only if the called party telephone is provided with voice mail facility)

   To record your message follow the voice guidance provided by system.

2. Message retrieving:

   2.1 Block-26 and Block-16 Exchanges.

   From own Telephone

   Dial 1222 from your own telephone and follow the instructions provided by voice guidance.

   From any NLC phone

   Dial 3900 for Bl-26 Exchange
   Dial 7600 for Bl-16 Exchange

   and follow the instructions of voice guidance system.

   2.2 GH, Block-21 and Chemical unit exchanges.

   From own Telephone

   Dial 1222 from your own telephone and follow the instructions provided by voice guidance.

   From any NLC phone

   Dial 2800 for GH Exchange
   Dial 8600 for Bl-21 Exchange

Dial 6200 for Chemical Units Exchange and follow the instructions of voice guidance system.

**III. Other Facilities**

In Block-26, Block-16 and CO Exchanges

Automatic call back of busy telephones.

When called phones is busy, dial flash & 9 and replace handset, exchange gives ring when both phones become free.

**Call transfer**

Dial flash and phone number to which call is to be transferred and replace your handset.

**Reminder call**

Dial 9211 & time in 12 hour format & AM/PM code (AM-2, PM-7) and replace handset (eg. For reminder call at 5.40 AM dial 921105402). The phone gives you a ring at the registered time.

**In Block-21 & Chemical Unit Exchange**

**Automatic call back of busy telephones.**

When called phones is busy, dial 91 and replace handset gives ring when both phones become free.

**Call transfer**

Dial flash and phone number to which call is to be transferred and replace your handset.

**Reminder call**

Dial 92 & time in 24 hour format and replace handset (eg. For reminder call at 5.40 PM dial 921740). The phone gives you a ring at the registered time.

**TELE-FACILITIES**

**I. MPLS Voice Connectivity Between Regional Projects:**

1.0 The Regional office Chennai, Barsingsar project and Neyveli are connected with MPLS (**M**ulti **P**rotocol **L**abel **S**witching) connectivity for voice connectivity between the exchanges at these sites.

2.0 By dialing the following access codes, the voice connectivity can be established between the above sites.

| STATION NAME | OLD CODE | NEW CODE |
|---|---|---|
| From Barsingsar to Neyveli | 02 | 81 |
| From Chennai to Neyveli | - | 81 |
| From Neyveli to Barsingsar | 02 | 82 |
| From Chennai to Barsingsar | - | 82 |

3.0 For Example:

1. To contact Chennai Regional Office from Barsingsar and Neyveli
Dial 84 + 3 digit intercom number. ( eg : 84 100)
2. To contact Barsingsar from Chennai Regional Office and Neyveli
Dial 82 + 4 digit number. ( eg : 82 6200)
3. To contact Neyveli from Barsingsar and Chennai Regional Office
Dial 81 + 5 digit number. ( eg ; 81 73200)

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From own Telephone

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From any NLC phone

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Dial 8600 for Bl-21 Exchange

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**IV Other facilities**

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## I. PLCC MODEM FOR TRANSFERRING DATA

The PLC Modem is a device which is used for transferring data over low voltage power line. The PLC modems are used in the power line cable as communication medium. It is very efficient as it eliminates the need to lay additional cables.. 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.

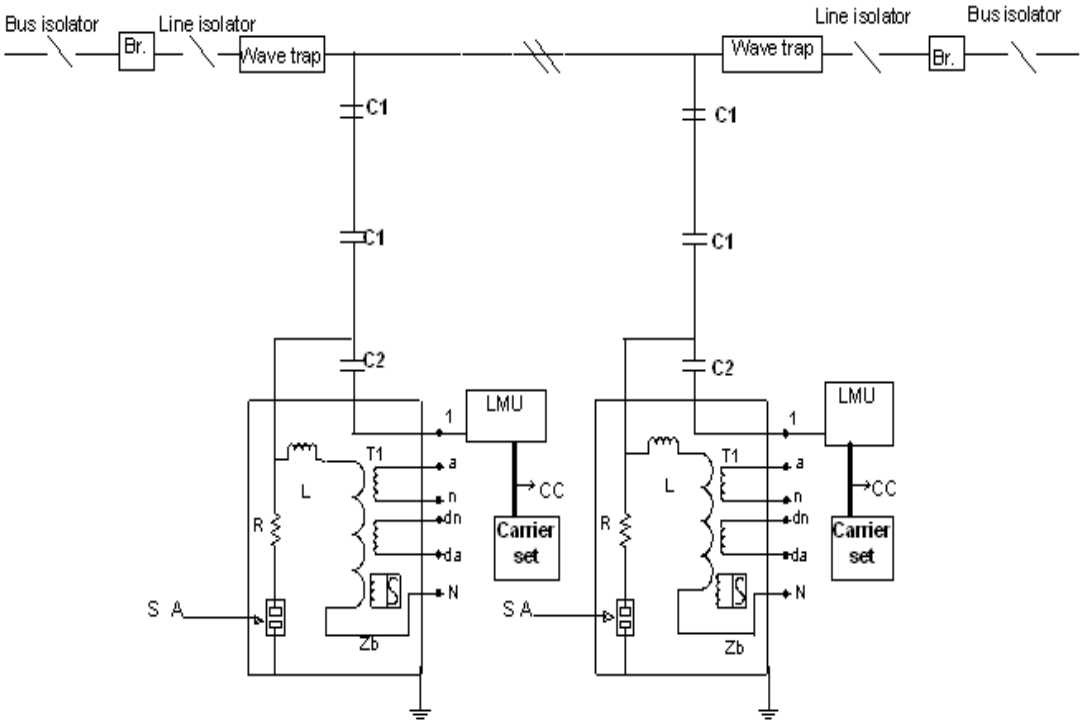
The basic process involves three steps

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

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




**Real time Data transmission**

For transmission of real time data such as MW, MVAR, Frequency, Voltage and currents etc. of power system RTUs are employed. All parameters are converted to voltage form and this will be fed to RTUs (Remote Terminal Unit). In that all the parameters converted in to digital form and stored. Whenever request come from the servers which are located at load dispatch center's the RTU will send its stored data to the modem. In modem the digital data transferred as frequency and transmit to 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.

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There are some reasons why the existing system is inefficient

1. The technology is outdated in energy meter
2. There are some Social obligations
3. Some Human errors
4. There are some Times consuming
5. Few Errors in the meter

**Proposed System**

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 existing system is modified with microcontroller based system through power lines with a proper isolation system. The need of the ours technology in which would enable the electricity board to monitor the MW and MVAR consumption of any particular industrial or 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.

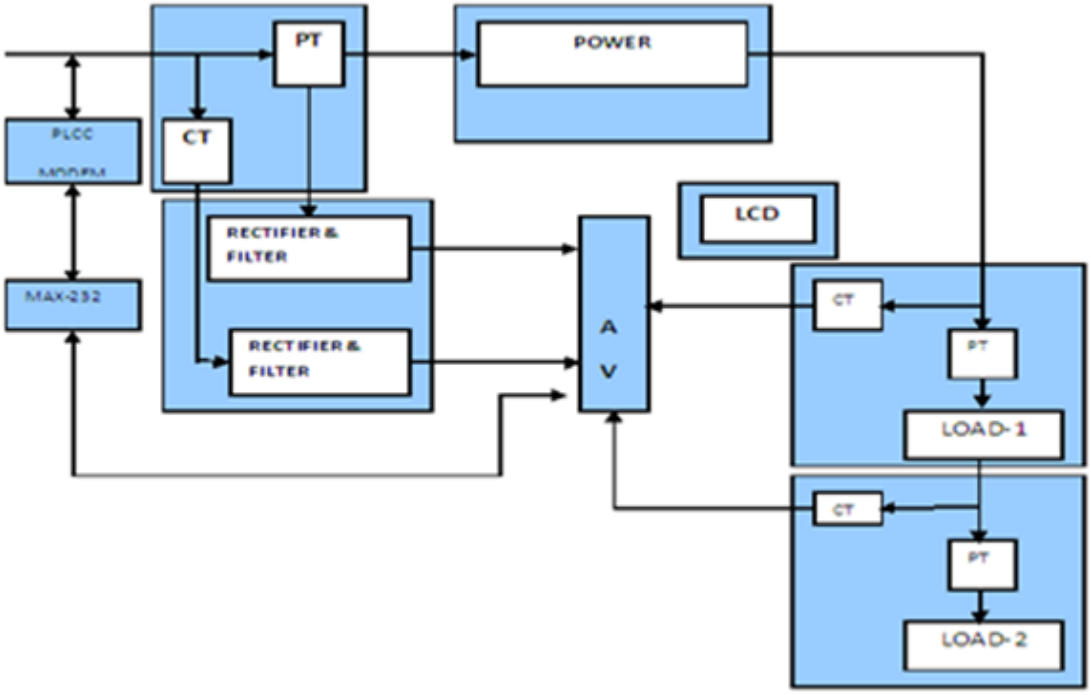
**MAX 232- RECEIVER**

**FEATURES:**

- ✓ Operate With Single 5-V Power Supply
- ✓ Operate Up to 120 kbit/s
- ✓ Two Drivers and Two Receivers
- ✓ ±30-V Input Levels
- ✓ Low Supply Current . . . 8 mA Typical
- ✓ Designed to be Interchangeable With Maxim MAX232
- ✓ ESD Protection Exceeds JESD 22
- ✓ 2000-V Human-Body Model (A114-A)

**System Architecture.**

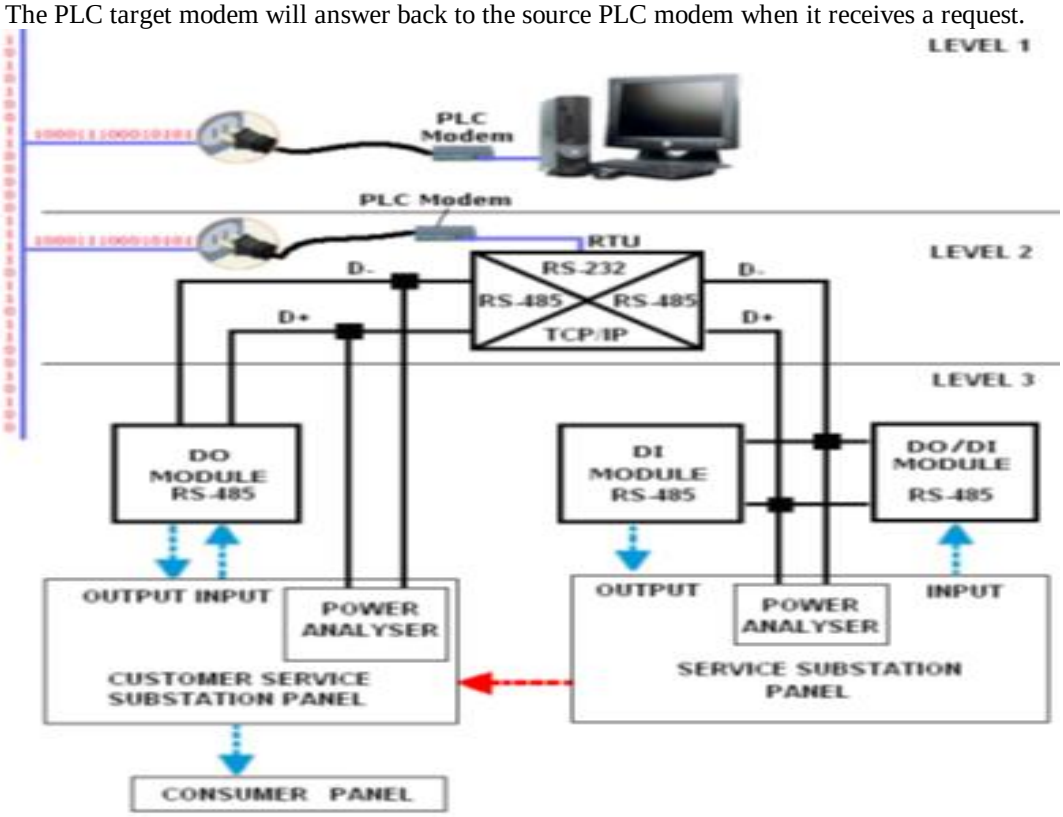
The following figure shows the system architecture of SCADA for DAS that is used PLC modem as the communication media. The Embedded Ethernet RTU and computer are connected directly to the PLC modems. The PLC modems use spread spectrum (SS) technology – CE bus. The SS technology is referred as the method of signal modulation where the transmitted signal occupies a bandwidth which is greater than the minimum necessary to send the information. The PLC modems use spread spectrum (SS) technology - CEbus. The SS technology is referred as the method of signal modulation where the transmitted signal occupies a bandwidth which is greater than the minimum. The spread spectrum techniques that have been applied to the PLC systems use chirping method. Figure shows the carrier chirp waveform measured from the PLC systems. In the CE bus standard the frequency range of the chirping method is to send the information.



## II. ARCHITECTURE

The following figure shows the system architecture of SCADA for DAS that is used PLC modem as the communication media. The Embedded Ethernet RTU and computer are connected directly to the PLC modems. The system architecture using PLC is given as follows:

The PLC modems use spread spectrum (SS) technology - CEbus. The SS 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. Figure shows the carrier chirp waveform measured from the PLC systems. In the CEbus standard the frequency range of the chirping method is from 100 kHz to 400 kHz over a 100_s meaning a Unity Symbol Time (UST). In CEbus protocol, the data is transmitted in short frame as shown in figure. The PLC target modem will answer back to the source PLC modem when it receives a request.




## III. SCADA SYSTEM

There are many parts of a working SCADA system. A SCADA system usually includes signal hardware (input and output), controllers, networks, user interface (HMI), communications equipment and software. All together, the term SCADA refers to the entire central system. The central system usually monitors data from various sensors that are either in close proximity or off site (sometimes miles away).

For the most part, the brains of a SCADA system are performed by the Remote Terminal Units (sometimes referred to as the RTU). The Remote Terminal Units consists of a programmable logic converter. The RTU are usually set to specific requirements, however, most RTU allow human intervention, for instance, in a factory setting, the RTU might control the setting of a conveyer belt, and the speed can be changed or overridden at any time by human intervention.

One of key processes of SCADA is the ability to monitor an entire system in real time. This is facilitated by data acquisitions including meter reading, checking statuses of sensors, etc that are communicated at regular intervals depending on the system. Besides the data being used by the RTU, it is also displayed to a human that is able to interface with the system to override settings or make changes when necessary.

## IV. VISUAL BASIC FRONT END

Visual Basic (VB) is the third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model. VB is also considered a

relatively easy to learn and use programming language, because of its graphical development features and BASIC heritage. 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. Scripting languages such as VBA and VBScript are syntactically similar to Visual Basic, but perform differently. The language not only allows programmers to create simple GUI applications, but can also develop complex applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions of those components, and writing additional lines of code for more functionality.

**FEATURES:**

The language not only allows programmers to create simple GUI applications, but can also develop complex applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions of those components, and writing additional lines of code for more functionality.

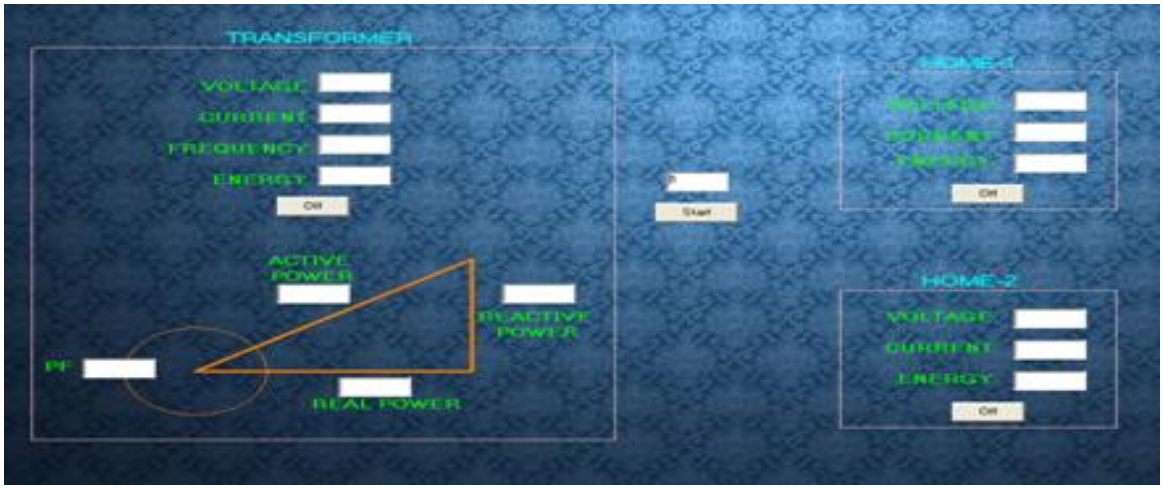
Since default attributes and actions are defined for the components, a simple program can be created without the programmer having to write many lines of code. Forms are created using drag-and-drop techniques. A tool is used to place controls (e.g., text boxes, buttons, etc.) on the form (window). Controls have attributes and event handlers associated with them. Default values are provided when the control is created, but may be changed by the programmer.

Visual Basic can create executables (EXE files), ActiveX controls, or DLL files, but is primarily used to develop Windows applications and to interface database systems. Dialog boxes with less functionality can be used to provide pop-up capabilities. Controls provide the basic functionality of the application, while programmers can insert additional logic within the appropriate event handlers.

Alternatively, a Visual Basic component can have no user interface, and instead provide ActiveX objects to other programs via Component Object Model (COM).

Unlike many other programming languages, Visual Basic is generally not case sensitive, although it will transform keywords into a standard case configuration and force the case of variable names to conform to the case of the entry within the symbol table.

**BACK END**




## V. CONCLUSION

In India the power sector is expanding vastly 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 monitor the consumption of industrial domestic and commercial power utilization. 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. This project paves a way for a new trend in peak demand and load management in distribution system.

## VI. FUTURE ASSESMENT

At present we concentrate only on the power usage of homes category all the other high voltage usage of the power in industries tanneries and other vast areas we can implement in the future projects so that it will be very efficient in finding the limitations of the power and the theft if any.

## REFERENCES

[1]. Archnet, "Embedded Power Line Carrier Modem", available online http//www.archnetco.com/english/product/ATL90.htm.

[2]. CIRED, "Distribution Utility Telecommunication Interfaces, Protocols and Architectures", Final Report of the CIRED Working Group WG06, September 2003. pp.52

[3] Customized Non-interruptible Distribution Automation System, Short Term Project No. PJP/2006/FKE (1), UTeM, 2005-2006

[4] K Dostert, 1997, Telecommunications over the Power Distribution Grid- Possibilities and Limitations Proc 1997 Internet. Symp. On Power Line Comms and its Applications pp1-9

[5] Intelligent Distribution Automation System Customized SCADA Based Rtu for Distribution Automation System, M.Sc. Research Project, UTeM, 2005-2007.

[6] K.W. Louie, A. Wang, Wilson, and Buchanan, "Discussion on Power Line Carrier Applications", Manitoba HVDC Research Centre, IEEE, 2006, pp.655

[7] K.W. Louie, A. Wang, Wilson, and Buchanan, "Discussion on Power Line Carrier Applications", Manitoba HVDC Research Centre, IEEE, 2006, pp.656

[8] Miriam P. Sanders and Roger E. Ray, "Power Line Carrier Channel & Application Considerations for Transmission Line Relaying", Pulsar Document Number C045-P05967, 2000.