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Design and Implementation of Secured Power Line Communication with Enhanced Rfid Applications

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Abstract
Evaluation of any communication technology is only relevant in the context of the operating environment. This seemingly obvious point, frequently bypassed in general analysis, cannot be overlooked in the field of power line communications. The conditions required for superposition to be applicable (i.e., linearity and time invariance) are not met for the majority of power line networks. In this project, current meter reading along with appliance information will be sent to RFID and power cables. Appliance information is collected by RFID tags and it will be forwarded to power station through PLC.
Keywords: PLC (Power Line Communication), Radio Frequency Identification (RFID), Broad band communication, Transducer, Invariance.

I. INTRODUCTION

Power Line Communications (PLC), also known as Broadband Power Line Access (BPL), is the latest technology to provide broadband Internet access through existing house wiring. Every outlet in the home becomes a high-speed Internet access point. Access from the in-home network. Long-haul networks can be established with other devices or facilities, such as wireless (Wi-Fi) and digital subscriber loop (DSL). This technology has the potential to offer benefits relative to regular cable, DSL or wireless connections.

Power line communication systems: Power line communication is the usage of electrical power supply networks for communication purposes. The main idea behind PLC is the reduction of cost and expenditure in the realization of in-home PLC networks. Power Supply Networks High Voltage (110-380kV) networks. Connect the power stations with large supply regions or big customers. Long Distances, power exchange with in a continent. Overhead supply cables. Medium Voltage (10-30kV) networks supplies larger areas, cities and big industrial or commercial customers. Overhead supply cables and underground networks. Low-Voltage (230V in Germany) networks. Supply the end users either as individual customers or ass single users of a bigger customer. Overhead and underground cables.

Background: Only when our electricity is gone do we realize how dependent on it we actually are. Power is the backbone of modern society. Power is a crucial ingredient for economic growth and prosperity for every nation and the people it supports. Electricity is consumed in everything we do and it has become synonymous with life in the industrialized world. Our communications, transport, food supplies, and most amenities of homes, offices and factories depend on a reliable supply of electrical power. However, despite the technology and engineering that has gone into building the power grid infrastructure, today's technologies have placed even greater demands on already strained systems, leading to expensive outages that can cost millions of dollars, There are two obvious ways to decrease the strain on the power line infrastructure: build more grids, or make the grids more efficient. In our opinion the latter is a better option because building more inefficient grids will not decrease the problems that we are faced with. How do we achieve more efficiency in the power grids? The answer that we believe is the key to this question is Power Line Data Transmission (PLDT). PLDT can ease the congestion and load on the power lines, and also, give the electric companies the chance to offer new services such as broadband internet access and Power-on- Demand. In this project, we focus on the application of PLDT to Power-on- Demand.

II. WORKING PRINCIPLE

Plc Basic Network Elements The communication signal has to be converted into a form that allows the transmission via electrical networks. The main task of the basic elements is signal preparation and conversion for its transmission over power lines as well as signal reception. Following two devices exits in every PLC access network. PLC modem, PLC Base Station.

PLC Modem: A PLC modem connects standard communication equipment, used by the subscribers, to a power line transmission medium. Functionality of the physical layer i.e. Modulation and Coding. Functionality of the Data Link Layer including MAC and LLC.
PLC Base/Master station: A PLC base station connects a PLC access system to its backbone network. Provides

multiple network communication interfaces, such as xDSL, Synchronous Digital Hierarchy (SDH) for connection with a high-speed network, WLL for wireless interconnection and so on. Coupling The coupling has to ensure a safe galvanic separation and act as a high pass filter dividing the communication signal above 9 kHz from the electrical power(50 or 60Hz).

A microphone amplifier that may be used with either Electrets Condenser Microphone (ECM) inserts or dynamic inserts, made with discrete components. Both transistors should be low noise types. In the original circuit, I used BC650C which is an ultra low noise device. These transistors are now hard to find but BC549C or BC109C are a good replacement. The circuit is self biasing and will set its quiescent point at roughly half the supply voltage at the emitter of the last transistor. The electrets condenser microphone (ECM) contains a very sensitive microphone element and an internal FET preamp, a power supply in the range 2 to 10 volts DC is therefore necessary.

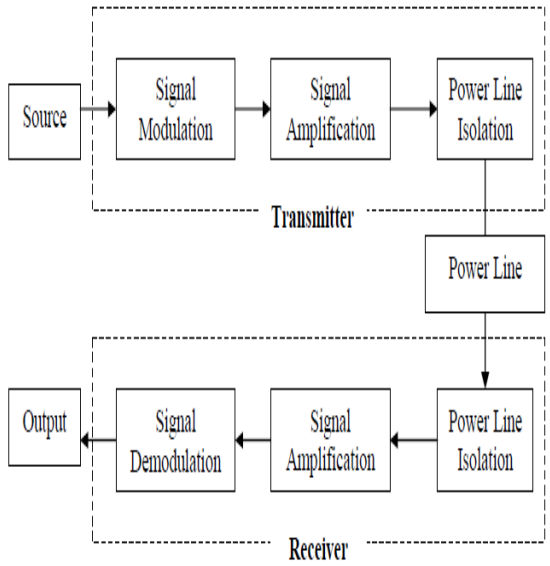


Figure1: System Functional Block Diagram

Power Line Data Transmission:

PLDT is the art of sending data through power lines. The basic process
Involves three steps:
1. Modulate the data so that it can be sent over the transmission Medium.
2. Transmit the signal in such a manner to reduce signal distortion.
3. Receive and demodulate the signal to extract the data.

A device that can achieve the above is called a Power Line modem. There are many types of modems in most homes today that allow us to communicate over the telephone and cable mediums. Modems are built specifically for their transmission medium, that is to say, a dial-up modem will not work on the cable (coax) medium. Each type of modem also employs some type of modulation/demodulation scheme, such as FSK, PSK, or ASK. The specifics of the project that we have created will be discussed later.

Power on Demand:

Power-on-Demand means exactly what it sounds like- distributing power dependent on the demand and need. Electricity providers are turning to power-on-demand technologies to relieve the stress on the exhausted power grids. Energy providers do not want to build more and more complex and expensive grids, instead, they would like to focus their time and money into more efficient and long-term solutions. Power-on-Demand (PoD) is the solution that the electrical utility sector has been longing for. PoD systems can be implemented to supply the consumers on the grid with the amount of energy that they need at any time, and this amount can be varied at any moment. PoD systems can also be used between many utility companies to sell and buy excess generated power when needed. Thus, PoD systems involve communication between two parties. Our project, Meter Man, is one implementation of a PoD system.

III. MOTIVATION

As technology advances and more technologies are developed and used by society, our demand for electricity will increase at unpredictable rates. In fact, on a daily basis power companies are faced with the challenge of distributing power through their power grids without disrupting the flow of electricity to other users. However, when there is a sudden increase in the demand for power in a part of the power grid then there can be disastrous effects. When the load is too great for a power grid there can be outages that can cost the economy millions of dollars and this is simply unacceptable. Many times it is not by fault of the power company that these outages occur, but mainly due to mechanical failures at certain nodes or unexpected increases in power consumption at particular nodes. Power on-Demand cannot decrease the occurrence of outages due to mechanical failures, but it can decrease the chances of outages occurring due to unexpected increases in demand for power. Power-on-Demand is gaining support because of the functionality it purports. Using this technology, power companies can communicate with their large industrial clients on an ongoing basis and be assured that their power demands will be met. This will decrease the probability of an outage being caused by those clients and increase the efficiency of the power network. The motivation is simple – create efficient power networks by communication. If companies are successful in implementing Power-on-Demand systems, then this technology can be further developed to offer other services using Power Line Data Transmission.

Problem Definition:

There is an opportunity to enhance the capabilities of the existing power line infrastructure using PLDT. This opportunity would lead to several positive outcomes:

• Efficient power distribution and network management
• Use the new technology to diversify the core practices by offering new Services such as broadband access
• Lower the probability of costly and inconvenient power outages

In this project, we want to build a system to send and receive messages through the power lines. The messages will be used between two parties to communicate the need for more power. To address this opportunity we developed the idea of Meter Man. Meter Man is a product that is based on the idea of PLDT. Meter Man uses communication techniques over power lines to communicate between two parties. We identified several requirements for this product, namely:

• Safely interface with power line
• Low bit error rate
• Low susceptibility to interference
• Frequency Shift Keying or Phase Shift Keying as modulation scheme
• Some kind of console to enter data and read data
• Isolate the power signal from the message signal

These requirements form the basis for the solution that we developed to address the problem of sending and receiving data over power lines.

IV. DESIGN METHODOLOGY

For this project we developed a high level idea and then worked down hierarchically to develop the individual pieces. The idea is simple – support communication through power lines by two parties. In Figure 1 we show the typical scenario of the Meter Man being used. We envision a system, where the consumer would go to Meter Man's interface and choose to increase or decrease his power consumption level, and Meter Man would send a signal to the electric company advising them of the change in demand. Overall, this implementation would be perfect for the distribution of power between two electric grids so that power outages could be avoided. For example, let us consider the case of a large car manufacturer that will be increasing output by 40% for five days. This would mean that the company would be using more power than usually expected. This increased usage would cause extra load on the power grid. Now, if several other manufacturers had similar demands then we would be in trouble. However, if the power company knew of the increased demand, then they could compensate for the extra demand ahead of time by ensuring that enough power is available.

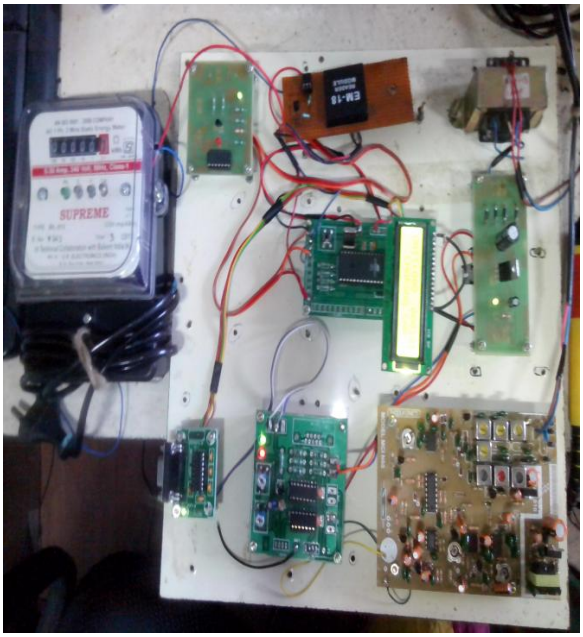


Figure2: Power Data Transmitter

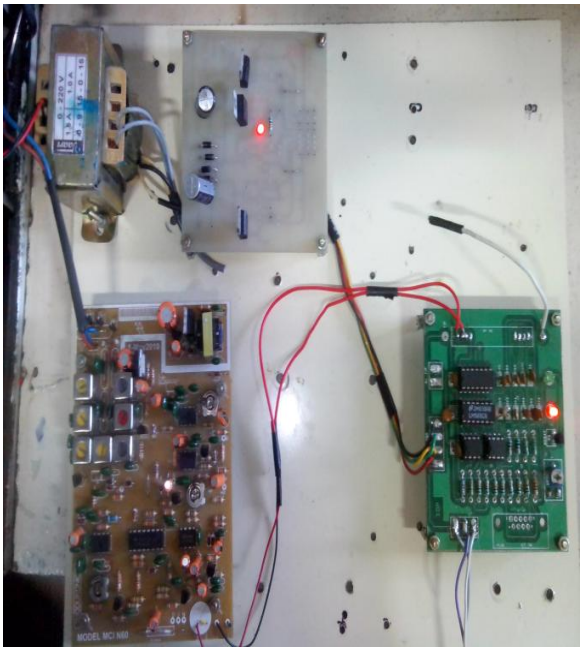
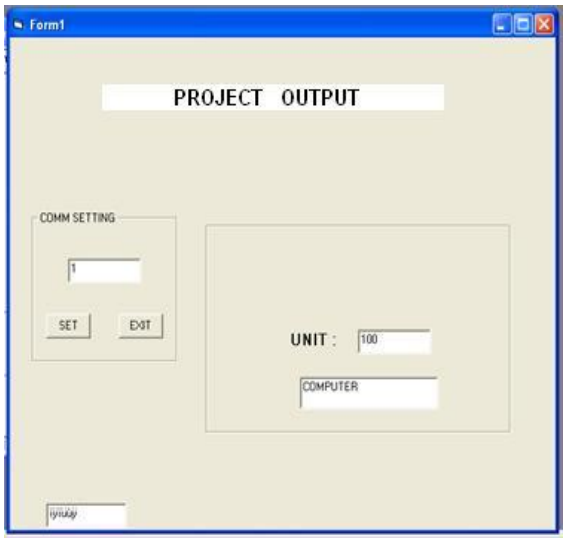


Figure3: Power Data Receiver

Above Figure shows the hardware design of the SIT. The SIT is equipped with an embedded board. Since the SITS provide all applications and services from the server, it does not need powerful computing ability on the SIT. For deploying an interactive environment, it is a solution to reduce hardware cost. The SIT has a touch screen and a RFID reader built in, and it sits in the tabletop. The number of touch screens and RFID readers are scalable which depends on the need. Hence it can be one for desk in the classroom, four for a dining table in the restaurant and six or more for a conference table in a conference room. Each of the screens processes independently in our SITS. The system identifies users by RFID. After the user contact his RFID card with a reader, his customized application

will show on the screen to continue the last time status of the system environment. Furthermore, the integration of PLC and Ethernet that provides the user a fast and stable way to connect to Internet for access and modification his personal information which store in the server.

V. RESULTS



The Appliance information is collected by RFID tags and it will be forwarded to power station through PLC, Power Line Communication transferring high frequency signals of RFID over power line to detect appliances as observed on the PC.

VI. APPLICATIONS

Earlier, we saw that PLC is widely used in the Smart Grid and in micro-inverters. As the market gets familiar with this technology, PLC should see wider adoption in other applications like lighting (e.g. traffic light control, LED dimming), industrial (e.g. UPS communicating to a network device, irrigation control), machine-to-machine (e.g. vending machines, a hotel's reception-to-room communication), telemetry (e.g. offshore oil rigs), transport (e.g. Electronics in cars, trains and airplanes) and indeed, applications of PLC are only limited by one's creativity. In this article, we will find out a little more about PLC in energy generation and conservation markets.

VII. CONCLUSION

A review of various technologies which can be applied to power line communication leads to the conclusion that the digital signal processing. It is key to overcoming the harsh conditions of the power line environment. DSP-based narrow band power line communication transceivers, DSP-based narrow band are a clear winner for most all power line applications. The only possible exception to this conclusion is a dedicated power line environment devoid of revealing each and every appliance usage with security.

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