Plc Based Monitoring and Controlling System Using Wi-Fi Device

[1]Pavana H, [2]Radhika G, [3]Remya Ramesan
[1,2,3](ECE, MVJCE / VTU, INDIA)

 Abstract: *A system for controlling electrical appliances using power line communication and monitoring data. Control messages are sent over Wi-Fi network from Wi-Fi device to personal computer which then couples the message to power line using micro controller with serial port interface. Power lines which are present in all infrastructures are used as physical media to transmit data over 220/50Hz signal to control electrical appliances and to monitor. Here we are monitoring temperature. The data from the micro controller is coupled onto power line using power line communication modem and DSSS(direct sequence spread spectrum) modulation technique is employed to transmit data. The receiver unit consists of PLC modem, micro controller and can be connected in any power line network. The receiver unit controls the flow of electricity to the socket.*
Keywords: *PLC, DSSS, Wi-Fi, open source*

I. Introduction

Automation is the use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. Automation essentially involves leveraging the power of technology to reduce the dependency on human presence and decision making for any process.

Automation also helps reduce peak hour power consumption by enabling people to turn off appliances at will remotely. Automation greatly decreases the need for human sensory and mental requirements while increasing load capacity, speed and repeatability. Automation includes Home automation, industrial automation etc., Earlier systems are mainly based on the use of telephone lines, such as phone-based system for automation and control system using hardware remote controller and an intelligent system.

The technologies used in existing automation systems have number of limitations. Most of them require rewiring or connecting every appliance to central unit. These problems necessitate a solution based on already existing infrastructure, one of which is using ubiquitous power lines, to over come the limitations posed by the above technologies.

Aim of this system is to simplify the process of human-machine interaction through the use of a generic interaction system and make things around us smarter and interactive. The purpose of the system is to provide convenience to the user and also to reduce power consumption and save energy and to control device. This system requires no modification to the appliances, and it works for all appliances using electricity since electricity to the socket is controlled and not the appliance directly. The number of appliances needed to be controlled can be easily increased by increasing the range of addresses of the receiver units. Also the hardware and software used to build the system re licensed under open source license.
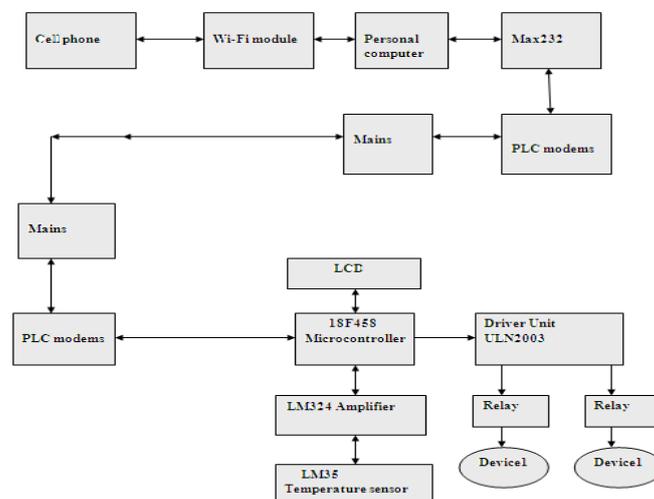
II. System Design

Figure 1: System Design

The experimental setup is as shown in the block diagram below. Control messages are sent over Wi-Fi network from a Wi-Fi device to the PC which then couples the messages to the power lines using the micro controller with the serial port interface. Ubiquitous power lines are used as physical media to transmit data over 220V/50Hz signal to control appliances/equipment and to monitor. Here we are monitoring the temperature and when this crosses the set limit the data is sent back to the PC and this will send the data to the cell phone and the user can get know temperature details.

The data from the microcontroller is coupled onto the power lines using a PLC (Power Line Communication) modem and DSSS modulation technique is employed to transmit data. The receiver unit consists of PLC modem plus microcontroller and can be connected anywhere in the power line network. The receivers have addresses assigned to them and only respond to the commands sent to them by the transmitter PLC modem. The receiver unit controls the flow of electricity to the socket.

2.1 Power line communication (PLC)

Power line communication (PLC) carries data on conductor that is also used simultaneously for Ac electric power transmission or electric power distribution to consumers. Power line communications systems operate by impressing a modulated carrier signal on the wiring system. It provides bi-directional half-duplex data communication over mains. It provides wire free solution as infrastructure has already been established.

Power line communication leverages the existing power line infrastructure and provides cost effective approach for introducing monitoring and control to many industrial applications. This makes PLC one of the leading technologies for smart grid applications ranging from smart metering, lighting control, security, home and industrial automation
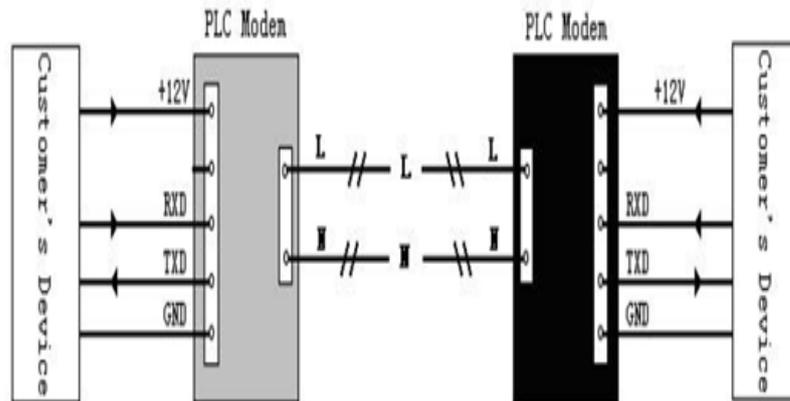

Figure 2: Application Diagram of PLC modem

The ATL90115 series embedded PLC modem is ready-to-go circuit module which is capable of transferring data over the power cable at the low voltage end of the power transformer of a 3-phase/4-wire distribution network.. The module provides bi-directional half- duplex data communication over the mains of any voltage up to 250V AC and for frequency of 50 or 60Hz. It does not require any protocol to function and therefore is protocol independent. A pair of embedded PLC modems connected on the power line can provide low speed bi-directional data communication at baud rate of 300bps.

2.2 Modulator

DSSS is a modulation technique in which the transmitted signal takes more bandwidth than the information signal that modulates the carrier frequency. DSSS phase modulates a sine wave pseudo randomly with a continues string of pseudo noise (PN) code symbols called "chips", each of which has a much shorter duration than an information bit. DSSS uses a signal structure in which the sequence of chips produced by the transmitter is already known by the receiver. The receiver can then use the same PN sequence to counteract the effect of PN sequence on the received signal in order to reconstruct the information signal.

2.3 Microcontroller

Microcontroller monitors, processes and controls the functions of the devices connected to it. PIC 18F458 microcontroller is used here. PICs are popular with industrial developers due to their low cost, wide availability large user base, extension collection of application notes, availability of low cost or free development tools, and serial programming capability.

2.4 Wi-Fi

Wi-Fi is a popular technology that allows an electronic device to exchange data wirelessly over a computer network, including high speed internet connections. . A device that can use Wi-Fi such as personal computer, smart phones, and tablet) can connect to network resource such as internet via a wireless network access point. Such an access point has a range of about 20meteres (65feet) indoors and great range outdoors. Wi-Fi is fast. Wi-Fi typically offers much faster internet access than cable and DSL connections. The coverage of one or more access points called hotspot can extend from an area as small a Wi-Fi in private homes, high street chains and independent businesses, as well as public places s few rooms to as large as many square miles. Here in this system battery powered routers are used, that include a cellular mobile internet radio modem and Wi-Fi access point. Many smart phones have a built-in capability of this sort, including those based on Android. Some laptops that have cellular modem card can also act as mobile internet Wi-Fi access points.

2.5 Mobile hotspot

Mobile Hotspot is an application which facilitates internet phone connection sharing either with Personal computer or tablet via a Wi-Fi connection, it is also known as tethering. Tethering refers to connecting one device to another. In context of mobile phones or internet tablets, tethering allows sharing the internet connection of the phone or tablet with other devices such as laptops. If tethering is done over Wi-Fi, the feature may be branded as a mobile hotspot. The internet-connected mobile device can thus act as portable wireless access points and router for devices connected to it.

One of the most important features of android mobile phone users is mobile hotspot. Android phones and tablets, starting with version 2.2 can be used as mobile hotspots or portable Wi-Fi hotspots, letting user share data connection on user android device wirelessly with up to 5 other devices, including other cell phones, tablets and computers.

2.6 Mobile Hotspot Implementation

Go to the settings screen on your android phone. You can get there pressing the menu button on your device when you are on the home screen then tapping "settings". At the setting screen, tap the "wireless & networks" option. You should see an option for "portable Wi-Fi hotspot". Click the check mark beside it to turn on the hotspot and your phone will start acting like a wireless access point. (You should see a message in the notification bar when it's activated. To adjust and check the settings for the hotspot, tap the aptly named "portable Wi-Fi hotspot settings" option. You will need to do this if you don't know the default password that ill be created for your hotspot so you can make a note of it for connecting your other devices. You can change the default password, security level, router name (SSID), and also manage users connected wirelessly to your phone in the Wi-Fi hotspot settings.

III. System Implementation And Design

Microcontroller will continuously monitor the temperature of the device connected to it. LCD is used to display the status of the device temperature.Once the temperature crosses the threshold limit that the data is sent to user. The temperature detail is coupled to power lines using PLC modem. The data sent through power lines is received by PLC modem at the receiver. The data is then sent to Laptop/PC having Wi-Fi. The temperature crossed details is encrypted as letter 'A'. Once the PC/Laptop receives 'A', it in turns sends Temperature crossed message to Cell phone. User can switch off the device by using android cell phone. Device is switched off using relay. Microcontroller when receives the 'off' command from the user, it passes the data toULN2003 driver. As relay is electromechanical device it is driven by ULN2003 IC. Relay will turn off the device.
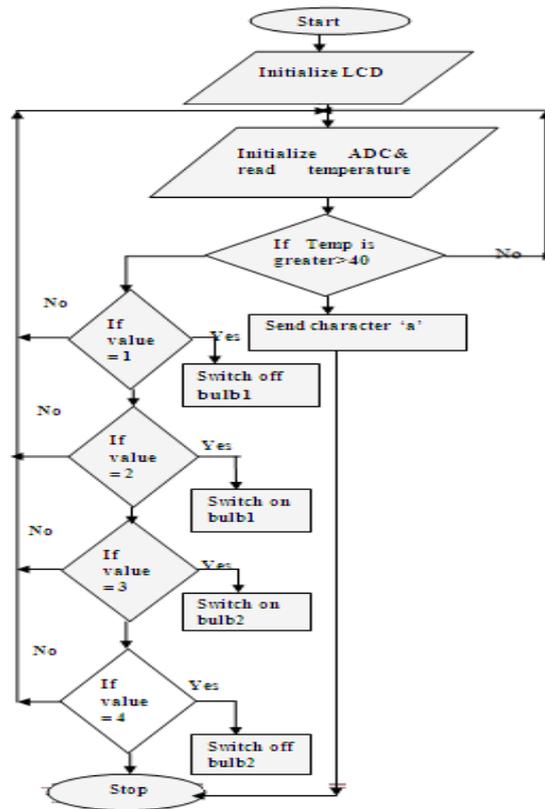
Figure 3: Flow chart

Figure 4: Transmitter Set up

Figure 4: Receiver Set up

IV.   Result

Tera term is a free software implemented and terminal emulator (communication program). Tera term is used set baud rate to 300bps and to select the COM port used by personal computer or laptop for serial communication.

Figure 6: Temperature>40

The is switched on. The temperature is normal and is displayed in LCD.

Figure 7: LCD Display

When temperature crosses 40 degree it is displayed in LCD and message is passed to cell phone via personal computer or laptop.

Personal computer or laptop receives letter "A" when temperature is crossed above 40 degree and this can be seen in tera term. Personal computer or laptop then transmits temperature crossed message to cell phone using Wi-Fi and then by running java applications

Figure 8: Temp crossed received in cell phone

"Temperature crossed" message is received in cell phone.

Figure 9: Device switched off

After receiving temperature crossed message on cell phone , the device is switched using cell phone.

V. Conclusion

The system was tested for conditions such as AC power. The system uses power line as a physical media for communication in spite no activity in the power line data was being transferred reliably. Hence as the temperature crossing a specified threshold the information is passed to mobile phone, using the existing alternating current wires. Control messages are sent back to one or more devices using Wi-Fi technology and devices are controlled.

5.1. Future Enhancement

- Implementation of PLC Zigbee hybrid combination could further enhance the functionality of the system.
- The transmitter unit can be made portable and compact by incorporating a battery back up and Wi-Fi interfaced card can be used.
- Advanced communication interface like GPRS can be used for extended range of control.
- The entire setup could be miniaturized using SMD components and multiple layer PCBs. The resulting size will be small enough to be fixed inside the switch board.
- High speed power line modems can be used for last mile broad band connectivity.

References

[1]. Karthik Shivaram;Nikhil Rajendra;Kavi Mahesh,;Balasubramanya murthy K N;,"power line communication based automation system using handheld Wi-Fi device." Consumer Electronics (ISCE), IEEE 2012,doi:10.1109/ISCE.2012.6241707

[2]. Wong,E.M.C "A phone-based remote controller for home and office automation" consumer electronics , IEEE transactions on, vol.40, no.1 pp.28-34, February 1994.doi:10.1109/30.273654

[3]. Coskun,I; Ardam,H; "A remote controller for home and office appliances by telephone" consumer electronics , IEEE transactions on, vol.44,no.4,pp-1291-1297 November 1998.doi: 10.1109/30.735829

[4]. Koyuncu ,B; "PC remote control of appliances by using telephone lines" consumer electronics , IEEE transactions on, vol.41, no.1 pp.201-209,February1995.doi: 10.1109/30.370328

[5]. Zhang X; Sun J; Zhou L; "Development of an internet Home Automation system using Java and Dynamic DNS service" Sixth international conference on parallel and distributed computing, applications and technology.0-7695-2405-2/05.

[6]. Rosendahl, A; Hampe, J; Felix and botterweck, g; "Mobile home automation-merging mobile value added services and home automation technologies" Sixth international conference on the management of mobile business January (ICMB 2007) 0-760695-2803-1/07

[7]. Srikanthan N.; Tam F; Karande A; "blue tooth based home automation system" Microprocessor and Microsystems 26 2002.pp 281-289.

[8]. Poole I "what exactly is Zigbee" communication engineer vol.2 issue 4, August-September 2004.pp 44-45.

[9]. Shwehdi M.H; Khan A.Z; "power line communication interface using spread spectrum technology in home automation" power delivery, IEEE Transactions on Vol.11 no.3,pp.1232-1237 July 1996.doi: 10.1109/61.517476.

[10]. Raphaeli,D; "spread spectrum communication utilizing differential code shift keying.",Itran communications,Isreal.

[11]. Yitran IT800D power line communication modem data sheets.