

Automation focused on Power line Communications and the Internet of Things



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Abstract: Power line carrier is available in every home for power supply. However instead of inserting optical fibre and ethernet for communication medium, the power line carrier can be utilized. The aim of this study is to implement the low-cost home automation by integrating the GSM/GPRS modem and PLCC modem. With the assistance of these two modems, the home automation can be implemented from any location. Blynk application is been implemented in this study for controlling the home appliance like fan, bulb and AC.

Keywords: PLCC, IoT, GSM, Automation, Blynk

I. INTRODUCTION

Nowadays wide variety of communication technologies are being implemented for transmitting the information from transmitter end to receiver end. However existing communication technologies like ethernet, satellite transmission, and fibre optics are bit expensive for installation in any building or home. In order to overcome this challenge, there is requirement of transmission medium that is not only speed but also low cost. PLCC (Power Line Carrier Communication) is one of the technologies that satisfy the above requirements. PLCC is a technology which utilizes the existing power lines as a medium for transmission of information. Nowadays as every house is facilitated with proper installation of electricity lines, so by taking it as advantage we can bind the house easily with a high-speed network access point and due to this infrastructure cost is avoided. Internet of Things is an emerging area where we can control and monitor any home appliance and any other devices via internet from any remote location [4, 5, 6]. With the availability of power lines in the home, it is easy for the implementation of power line communication for communicating the data. From this study, it is addressed that power line communication can generate high data rate during transmission of the data [7]. Nowadays home automation is emerging field for controlling completely home with internet. Implementation of home automation aims to provide a system where the utilization of the electricity can be reduced.

Integration of Power Line Carrier (PLC) on home automation enhances the existing communication technology in home automation system. Address the advanced home automation system and discuss the features like web-based control and data-logging facility [8]. In home automation system, a local network or cloud server is established with the assistance of the wi-fi router for controlling the home appliances. The appliances are controlled by using smart phone and through voice command with the assistance of alexa. For a establishing communication between the appliances and gateway, power line communication can be employed as transmission medium [9]. For initiating the interface between the smart meter and concentration point, a communication technology is necessary one and they are mobile telephony, power line communication and radio frequency. After evaluating with the assistance of standard dominance factors, the results show that power line communication is advance and reliable technology for communication interface in between smart meters and concentration point [10]. With the assistance of internet of things, home automation can be implemented easily. The main advantages of home automation are Affordable, Easy to use and safe. In terms of affordable, due to the presence of power lines, it is easy to implement, in terms of easy to use, due to the presence of internet of things, it is easy for user to control the home automation from any location, in terms of safe, as the home automation is controlled by authorized centralized control unit, it doesn't create any privacy and security issues.

II. BLOCK DIAGRAM

A system is proposed for the implementation of power line carrier communication is shown in Fig.1 and Fig.2. The system comprises of transmitter section and receiver section. The transmitter section is an end for triggering and giving the command for controlling the home appliance. The transmitter section comprises of micro controller unit, display unit, GSM/GPRS modem, and PLCC (Power Line Carrier Communication) modem. GSM/ GPRS gives access to give command to the home appliance via PLCC modem with the assistance of mobile.

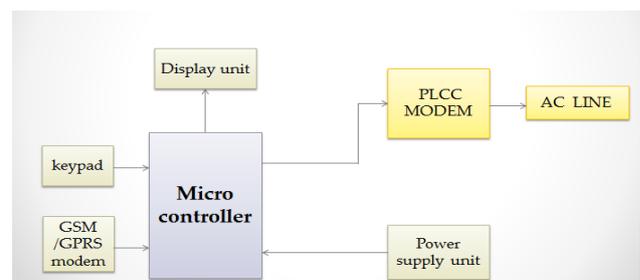


Fig.1. Transmitter section

Revised Manuscript Received on May 30, 2020.

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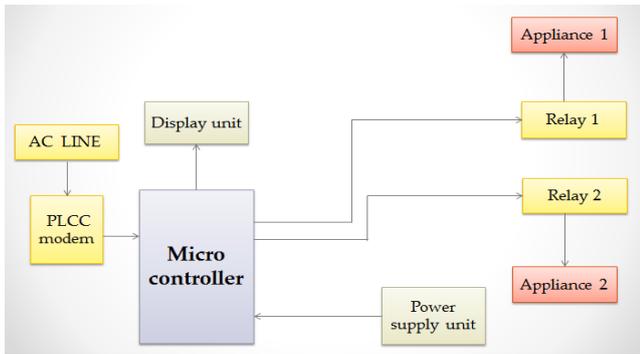


Fig.2. Receiver section

The keypad is provided additional for giving command as we give command through GSM/GPRS. PLCC modem communicates the command to the receiver end via ac power line. The receiver section is for receiving the command and controlling the home appliance. The receiver section comprises of micro controller unit, display unit and PLCC (Power Line Carrier Communication) modem. Through the ac line, the PLCC modem receives the command from the transmitter section and it will send to microcontroller unit for controlling the appliance through relays. LCD is useful for displaying the status of the appliances.

III. COMPONENT DESCRIPTION

A. Arduino Uno

Arduino Uno microcontroller belongs to the family of Atmega 328 microcontroller unit and it is shown in Fig.3. It comprises of 14 I/O pins, 6 analog pins, usb jack, ICSP header and power supply jack. This microcontroller board is different from the existing boards which generally use FTDI USB to serial driver chip. Operating external power supply is in between 6 to 20 V. This board is easy and flexible for programming through Arduino IDE for any kind of application.



Fig.3. Arduino Uno board

B. Power Line Carrier Communication Modem (PLCC)

Power line modem transmits and receives the serial data over AC line of the building. Power line modem is ready to use circuit which is shown in fig.4 and fig.5. As the size of circuit, it is easy for installation in the home for initiating data communication system [1].



Fig.4. Front View of the Modem

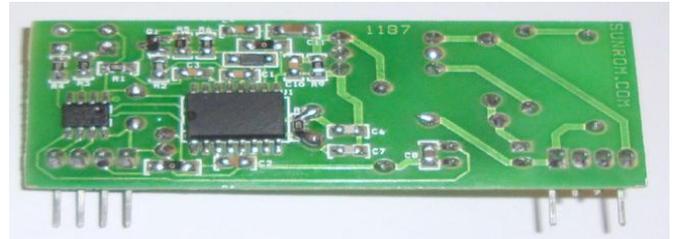


Fig.5. Back View of the Modem

This module is capable of bi-directional half-duplex communication within the frequency of 50Hz or 60 Hz. From the fig.4, the modem comprises of four different pins, TX-OUT, RX-IN, +5 V voltage and GND. With RX-IN pin, the module sends the serial data over the power line. The TXD of microcontroller connects to RX-IN of PLC modem. The RXD of microcontroller connects to TX-OUT of PLC modem. Red LED in the fig.4 indicates the transmission of the data and green LED indicates the receiving of the data from TX-OUT pin. The transmission bit rate of this modem is byte by byte and time duration for transmission of byte is 500 ms. With this transmission bit rate, it is challenging for sending the large amount of data. However, this modem is helpful for sending the sensory data and remote control. The application of this modem can be seen in Fig.6, we can see it clearly how the PLCC modem is implemented for application purpose in controlling the appliance. The specifications of the PLCC modem are shown in the Table.1.

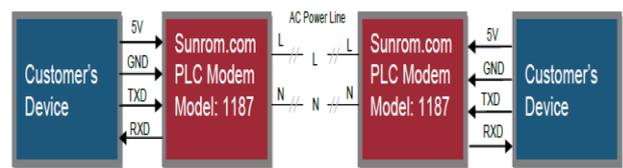


Fig.6. Application based PLCC modem

Table.1. Interfacing Pin Details

Pin	Pin Name	Details
RX-IN	Receive Input	Input serial data of 5V logic level. Usually connected to TXD pin of microcontrollers.
TX-OUT	Transmit Output	Output serial data of 5V logic level. Usually connected to RXD pin of microcontrollers.

+5V	Power Supply	Regulated 5V supply input.
GND	Ground	Ground level of power supply. Must be common ground with microcontroller.

C. GSM/GPRS TTL UART MODEM-SIM900A

GSM/GPRS TTL UART modem works on the frequency band of 900/1800MHz and it is show in Fig.7. The operating voltage of the modem is 5V & 3V. Due to presence of TCP/IP stack, the GSM/GPRS modem can send the SMS and voice message in machine-to-machine interface [3]. This modem facilitates with audio calls, SMS and internet via AT commands. Because of small size, this modem can be utilized in customer application for implementing cost effective solution.

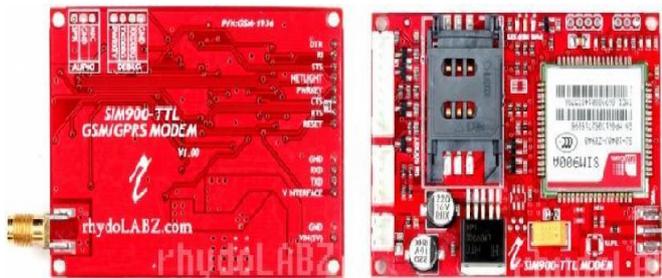


Fig.7. GSM/GPRS modem

D. 20x4 LCD Display

LCD (Liquid Crystal Display) is useful display the characters in digital form. Here 20*4 LCD display is implemented at both transmitter and receiver section. This LCD display 20 characters per line and it will display 20 characters in 4 line each and LCD display is shown in Fig.8. This display is green color backlight with MCU speed upto 2Mhz. and connecting of LCD display with Arduino controller is show in Fig.9.

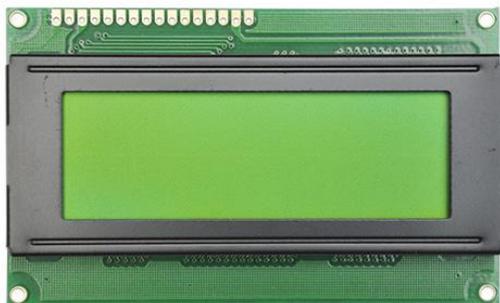


Fig.8. Liquid Crystal Display (LCD)

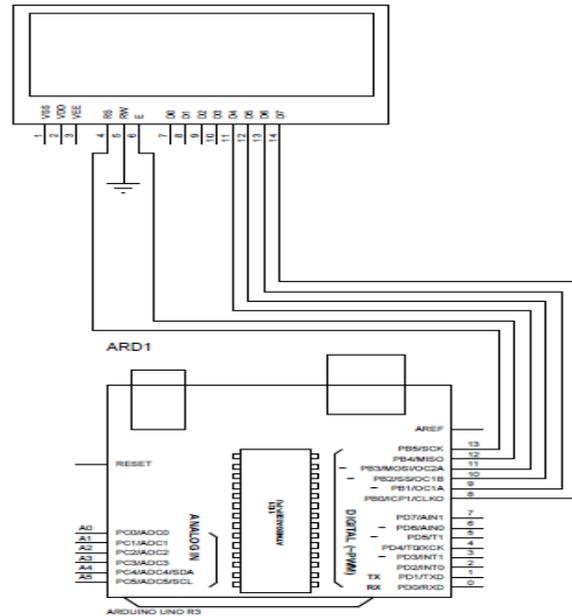


Fig.9. LCD connection with Arduino

E. Relay

As it is been discussed in the receiver section, the relay is embedded for controlling the home appliances where the current is large and the relay shown in fig.10 is 4 channel relay. The relay can control by the any microcontroller unit [2]. This relay can control with two different input like 12V and 5V. LED is available in the relay for displaying the output status.

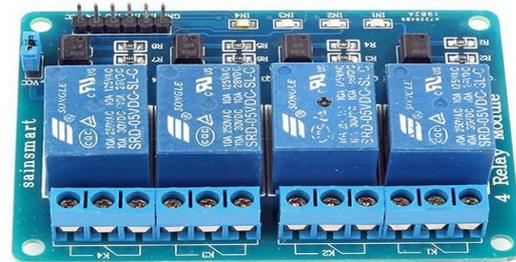


Fig.10. Channel relay

III. RESULTS

The main objective of our system is control the home appliance with PLCC communication medium. For showing it in GUI (Graphical User Interface), blynk application is being used. Blynk application is generally useful controlling the devices and displaying the sensory data through internet of things and Fig.11 reveals the controlling of appliance with the help of blynk application.

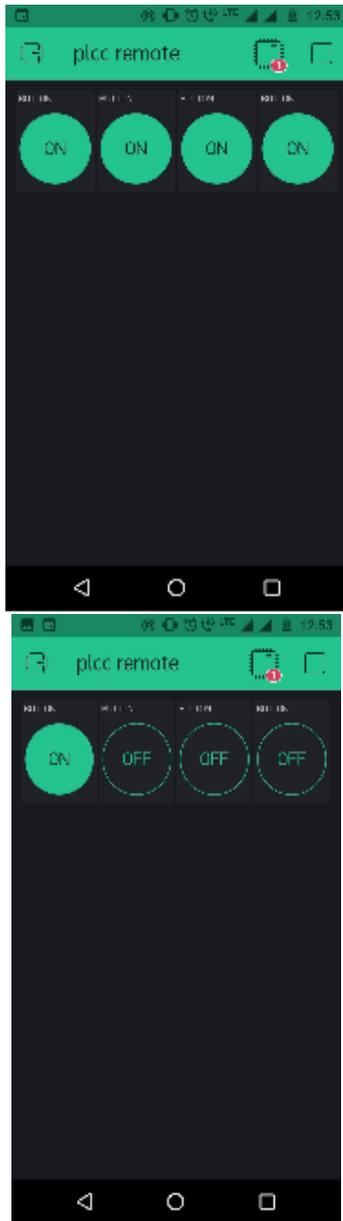


Fig.11. Blynk app-based controlling of appliance

IV. CONCLUSIONS AND FUTURE SCOPE

The proposed system which is integration of GSM/GPRS and PLCC for the implementation of home automation. The system is working efficiently without any interruption. The features of the system are controlling speed of fan, controlling room temperature, smoke detection and gas detection. With the help of power line in the, one utilize the resources for efficient implementation communication medium for home automation

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AUTHORS PROFILE



Dr. Rajesh Singh is currently associated with Lovely Professional University as a Professor with more than fifteen years of experience in academics. He has been awarded as the gold medalist in M.Tech and honors in his B.E. His area of expertise includes embedded systems, robotics, wireless sensor networks, and the Internet of Things. He has organized and conducted several workshops, summer internships, and expert lectures for students as well as faculty. He has twenty-three patents in his account. He has published around hundred research papers in refereed journals/conferences.

Under his mentorship students have participated in national/international competitions including Texas competition in Delhi and Laureate award of excellence in robotics engineering in Spain. Twice in the last four years, he has been awarded a "certificate of appreciation" and "Best Researcher award- 2017" from the University of Petroleum and Energy Studies for exemplary work. He got a "certificate of appreciation" for mentoring the projects submitted to Texas Instruments Innovation challenge India design contest, from Texas Instruments, in 2015. He has been honored with the young investigator award at the International Conference on Science and Information in 2012. He has published ten books in the area of Embedded Systems and Internet of Things with reputed publishers like CRC/Taylor & Francis, Narosa, GBS, IRP, NIPA, and RI publication. He is an editor of a special issue published by the AISC book series, Springer with the title "Intelligent Communication, Control, and Devices"-2017 & 2018.



Dr. Anita Gehlot is associated with Lovely Professional University as an Associate Professor with more than ten years of experience in academics. She has twenty patents in her account. She has published more than fifty research papers in refereed journals and conferences. She has organized several workshops, summer internships, and expert lectures for students. She has been awarded a "certificate of appreciation" from the University of Petroleum and Energy Studies for exemplary work. She has published ten books in the area of Embedded Systems and Internet of Things with reputed publishers like CRC/Taylor & Francis, Narosa, GBS, IRP, NIPA, and RI publication. She is an editor of a special issue published by the AISC book series, Springer with the title "Intelligent Communication, Control, and Devices-2018".



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Shaik Vaseem Akram is pursuing a Ph.D. in embedded systems from Lovely Professional University, Punjab, India. His area of research is on waste management using the internet of things and blockchain.



Prabin Kumar Das is currently pursuing his Bachelor's degree at Lovely Professional University. He has good experience in building real-life projects based on Wireless Sensor Networks and the Internet of Things. He has participated and has secured positions at various zonal and national level competitions. He has 17 patents in his account. He has published 2 research papers under Springer Publications and has attended 2 International Conferences.

He leads a team of 7 enthusiastic members. With the hardworking and talented team, they have won various competitions at zonal and national levels. One of his projects was selected for the Student-Project of the Year award 2019 by the Institute of Scholars. He has published 2 book chapters in the area of Embedded Systems and Internet of Things with a reputed publisher named Nova Science.

Prabin is also involved in projects like “KAWACH” and “Ally” which are exclusively covered by the media during the COVID19 lockdown as preventive and protective measures for the society.