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SMART HOME CONTROL SYSTEM USING PLCC AND ZIGBEE

S. Ravi[1], R. Ganga[2], K. Gayathri[2], K. Suganya[2], A. Hema[2]

[1]*(Assistant Professor, ECE, The Kavery Engineering College, Salem, India)*

[2]*(Final Year ECE, The Kavery Engineering College, Salem, India)*

ABSTRACT

This paper focuses on design of smart home control system based on power line carrier communication (PLCC). PLCC technology is proved to be useful for control applications. It is most commonly used in home automation, automotive and internet access applications. The aim of the project is to design a PLCC modem circuit to monitor and control the appliances in home. The control messages for home appliances will be directly transferred using both PLCC and ZigBee technology. Experimental tests demonstrate that the proposed system for smart home control networks is practically convenient and performs well.

I. INTRODUCTION

A smart home is said to be a room which is has with the ability to get adapted by itself to certain situations to make the occupants feel comfortable [1]. A Power Line carrier Communication System is a system whereby communication signals were sent and received on 50Hz current-bearing power line. Power Line Carrier Communication has become a popular technology for automated appliance control in home and in industries as well. It is because power line is relatively cheaper and more robust communication channel used throughout the world other than the wireless channel. It is most widely used than any other communication channel. A simple digital communication system consists of an encoding circuit and a modulation circuit at the transmitting side, and a decoding and a demodulation circuit at the receiving side. A power line modem is a device which consists of an encoding, a decoding, a modulation, and a demodulation circuits. As the current bearing. The design is based on ZigBee module that uses the IEEE 802.15.4 networking protocol for high speed point-to-multipoint networking [2]. It gives users a cost effective and convenient installation process [3].

II. MOTIVATION

The aim of the project is to design a smart home control system based on power line carrier communication and ZigBee. ZigBee is useful for controlling appliances without wired connections. It is a hybrid control system having both wired and wireless medium for controlling appliances. The goal is to reduce the usage of wired connection and reduce unnecessary energy consumptions.

III. EXISTING SYSTEM

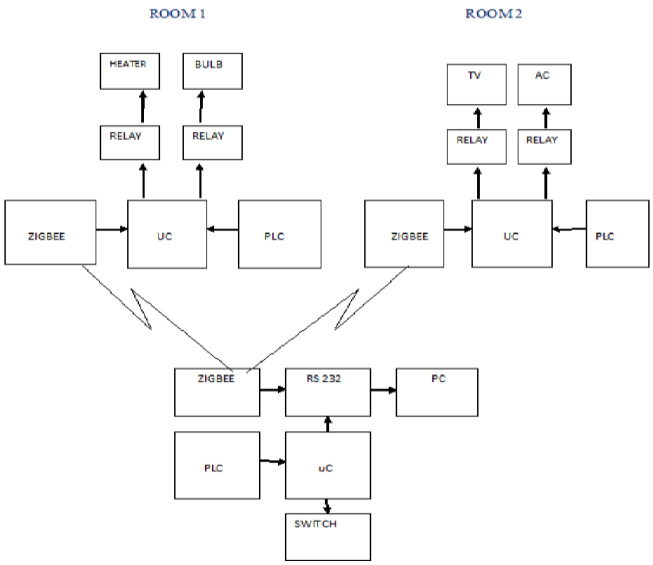

Fig.1 Existing system

An isolated WSN with one coordinator that has been integrated into the PLC transceiver, is established in each rooms of the home or office. The coordinator takes the responsibility of transferring environmental parameters obtained by WSNs to the management station through PLCs. The control messages to home appliances are transferred using PLCs rather than WSNs. Another PLC-based Home Energy Management System that combines a home network and the Internet was proposed [4].

IV. PROPOSED SYSTEM

The Home automation is becoming a trend in recent technologies. This system is proposed to reduce the Man power as well as to improve the energy efficiency. It does not need any additional wiring since it uses the existing power line in home and industries.

A. PLCC Transmitter & receiver:-

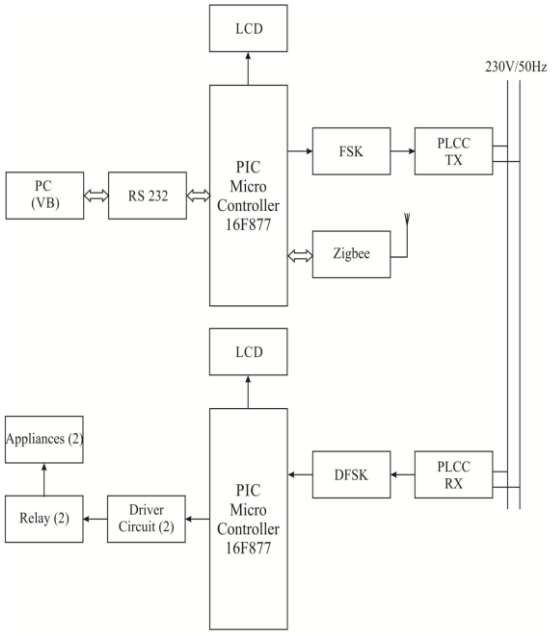

Fig.2 Block diagram of PLCC Transmitter and Receiver

Figure 2 shows the transmitter and receiver used in PLCC technique. PIC microcontroller is the heart of both transmitter and receiver system. Here the appliances are controlled through the normal existing power line. In this system, visual basics tool (VB) is used to give input signals to the transmitter circuit. The signal from the system is given to the PIC microcontroller through the RS232 cable.

B. POWER LINE CARRIER COMMUNICATION

Power line carrier communication (PLCC), also known as Power line Digital Subscriber Line (PDSL), power line telecom (PLT), power line networking (PLN), or Broadband over Power Lines (BPL) are systems that carries data on a conductor also used for transmission of electric power. Electrical power is transmitted over high voltage transmission lines, distributed over a medium voltage, and then used inside buildings at lower voltages. Power line carrier communications can be applied at all stages. Network architecture for home energy management system using power line carrier communication (PLCC) was proposed [5]. All power line carrier communications systems transferring a modulated carrier signal on the wiring system. Data rates over a power line carrier communication system may vary widely.

Low-frequency (about 100-200 kHz) carriers are transferred on high-voltage transmission lines carries one or two analog voice circuits, telemetry and control circuits. These circuits have an equivalent data rate of a few hundred bits per second. These circuits may be many miles long. Higher data rates can be generally used in shorter ranges. A local area network that operates at millions of bits per second may cover only one floor of an office building, but it eliminates installing dedicated network cables. The highest information rate transmissions over power line use RF through microwave frequencies transmitted through a transverse mode surface wave propagation mechanism. Such kind of mechanisms requires only a single conductor. The implementation of this technology called E-Line has been demonstrated using a single power line conductor. High frequency communication may (re)use large portions of the radio spectrum for communication, or may use select band(s), depending on the technology. The embedded remote monitoring and controlling power socket was developed for automatic and power management of home appliances [6]. Power line carrier communication systems has become a convenient one because it supports a reliable movement of data over an infrastructure which has to be controlled.

C. FSK (FREQUNCY SHIFT KEYING)

Frequency-shift keying (FSK) is the modulation scheme used in this system. In FSK, a frequency modulation scheme in which digital information is transmitted through discrete frequency changes in a carrier wave [7]. The binary FSK (BFSK) is simplest FSK. BFSK involves using a pair of discrete frequencies to transmit binary (0s and 1s) information [8]. With this scheme, the "1" is called the mark frequency and the "0" is called the space frequency. Audio frequency-shift keying (AFSK) is a modulation technique by which digital data is represented by changes in the frequency (pitch) in an audio tone, that gives an encoded signal that is suitable for transmission through a radio or telephone. Normally, the transmitted audio signal alternates between two tones: Binary one is represented by the "mark". The Binary zero is represented by "space". AFSK differs from regular frequency-shift keying in performing the modulation at baseband frequencies. AFSK is not always employed for high-speed data communication applications, because when compared with the other modulation schemes it is far less efficient in both power and bandwidth. In addition to its simplicity, however, AFSK has an advantage, the encoded signals will pass through AC-coupled links and it includes most equipment which designed to carry music or speech. The early telephone-line modems used audio frequency-shift keying to send and receive data, in which the bit rate ranges up to rates of about 300 bits per second.

D. PIC MICROCONTROLLER

The PIC microcontroller is used in this project. PIC microcontroller is the first RISC based microcontroller. It is fabricated using CMOS (complementary metal oxide semiconductor).PIC uses separate bus for instruction and data which allows access of program and data memory simultaneous. The CMOS has become a greater advantage as it shows more immunity towards noise. Various microcontrollers has different kinds of memories such as EEPROM, EPROM, FLASH etc. FLASH is

the most recently developed technology that is used in pic16F877. So that data is retained even when the power is switched off. Other features of PIC 16F877 includes easy Programming and Erasing. Some pins for these I/O ports are multiplexed with a special function for the peripheral features in the device. In general, when a peripheral device is enabled, that pin cannot be used as a general purpose I/O pin. There are three memory blocks in each of the PIC16F877 MUC's [9].

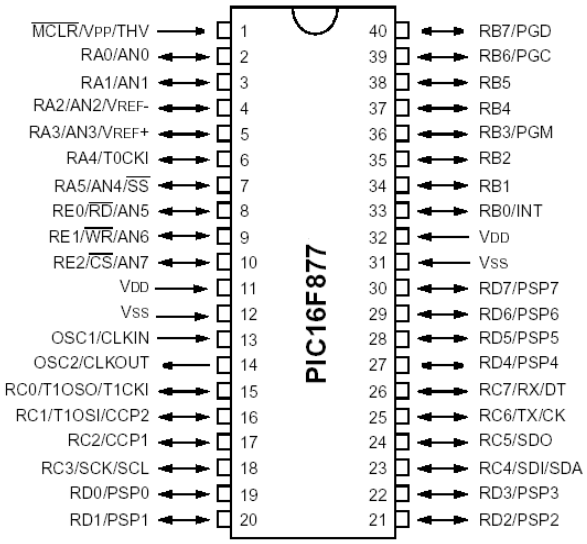

Fig.3 Pin diagram of PIC Microcontroller

The program memory and Data Memory have separate buses. So the concurrent access is possible. The PIC16F877 devices have a 13-bit program counter. It is capable of addressing 8K *14 words of FLASH program memory. Accessing a location above the physically implemented address will lead to wrap around. The data memory is divided into multiple banks that contain the General Purpose Registers and the special functions Registers. The lower locations of all the bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers used as static RAM. Some frequently used special function registers from one bank may be duplicated in another bank for reduction of code and quicker access.

E. RELAY

A relay is device to receive, reinforce, and retransmit a radio or television signal. Current that flows through the coil of the relay creates a magnetic field that attracts a lever and changes the contacts of the switch. The coil current can be on or off. So relays have two switch positions and so they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be entirely separate from the first. Most ICs (chips) will not provide this current and a transistor is used to amplify the small IC current to a larger value required for relay coil [10]. The maximum output current

for the 555 timer IC is 200mA. So these devices can supply relay coils directly without any amplification.

Fig.4 Relay

Relays are usually SPDT or DPDT switches but they can have many more sets of switch contacts. Most relays are designed for PCB mounting. The below picture shows a working relay with its coil and switch contacts. A lever that lies on the left being attracted by magnetism when the coil is switched ON. This lever moves the contacts of the switch. There is one set of contacts (SPDT) in the foreground and another behind them, which makes the relay DPDT. Solid state relays (SSR) are relays based on semiconductor technology with electrical isolation between control circuit and load circuit [11].

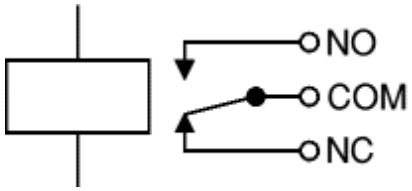

Fig.5 Relay circuit

The connections of relay switch are usually labelled COM, NC and NO:

COM which means Common, it is the moving part of the switch.
NC which means Normally Closed, COM is connected to NC when the relay coil is off.
NO which means Normally Open, COM is connected to NO when the relay coil is on.

F. ZIGBEE

ZigBee is a high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects that needs wireless connections. The ZigBee specification is a combination of the 802.15.4 specification and Home RF Lite. The spec operates in the 2.4GHz (ISM) radio band - the same band as 802.11b standard, Bluetooth, RF and some other devices. It is capable of connecting up to 255 devices per network. ZigBee presents itself as a much better performance when compared with UWB, Wi-Fi, and Bluetooth [12]. The specification supports rate of data transmission up to 250 Kbps at a range of up to 30 meters. ZigBee's technology has a speed lesser

than 802.11b (11 Mbps) and Bluetooth (1 Mbps) but it consumes less power. The ZigBee technology is used due to its low-cost and low-power characteristics [13]. ."Wireless Home Automation System Using ZigBee" and "Research on home networking with ZigBee" are research papers based on ZigBee, a standard that provides a set of communication protocols for low data-rate and short-range wireless networking [14] [15].

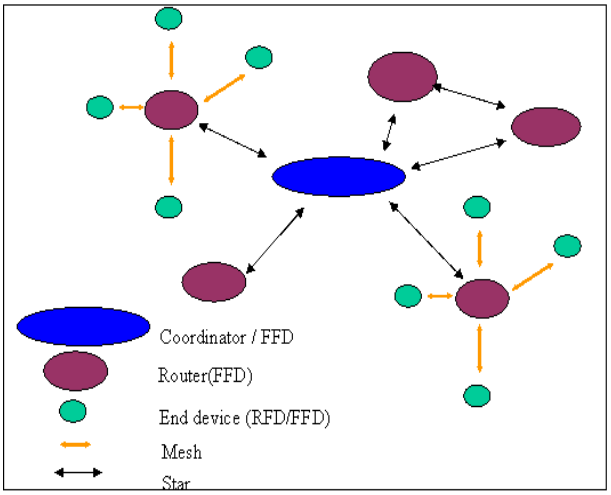

Fig 6. ZigBee Network Model

G. ZIGBEE RECIVER:-

The zig bee receiver consists of a zig bee receiver module, a pic microcontroller, a LCD display, diver circuit and relays that are connected to the appliances which has to be controlled.

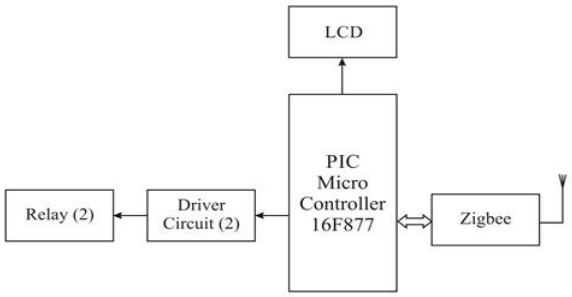

Fig 7. ZigBee Receiver

V. RESULT

This work contributes towards the development of home automation system. Energy savings and user convenience are two major design considerations for these systems. PLCC transceiver is used to control a building using the existing power line without any extra wirings. The ZigBee transceiver is used to control the appliances without any wired connections. Figure 8 shows the experimental result obtained through the proposed system. Four loads have been considered, with two loads are controlled by PLLC technique and the remaining two loads are controlled by Zig-Bee network. It is observed from the results that the effect of wireless interference on the proposed smart home control network is largely reduced.

Fig 8. Output

VI. CONCLUSION

The aim of automation is from Home Automated Living (HAL). Home automation can provide significant cost savings in a home environment, and it provides a great level of control for the building administrators and good comfort for the occupants [16]. As a part of future work, power line carrier communication will be applied with more number of applications and the security features are also to be included.

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AUTHOR'S DETAILS

S. Ravi, received his ME degree from Vel Tech Engineering College, under Anna University, Chennai, Tamilnadu, India, in 2007, and his BE degree from Karunya Institute of technology, under Bharathiyar University, Coimbatore, Tamilnadu, India, in 2004. He is currently working as an Assistant professor in the ECE department of The Kavery Engineering College, Salem, and Tamilnadu, India. His research interests include Digital system design and Testing, CAD for VLSI, Low power VLSI, and Advanced Microprocessors and Microcontrollers. He is currently pursuing his PhD degree at Anna University, Chennai, in the area of CAD for VLSI.

K. Gayathri is Pursuing BE Final year in the department of ECE in The Kavery Engineering College, under Anna University, Chennai, Tamilnadu, India, during 2016-17. She has presented paper in various national level conferences. Her areas of interest are Electronic circuits, Digital Electronics, Digital Signal Processing and RF and Microwave Engineering. She is a Member of Indian Society of Technical Education (ISTE).

R. Ganga is pursuing BE Final year in the department of ECE in The Kavery Engineering College, under Anna University, Chennai, Tamilnadu, India, during 2016-17. She has presented paper in various national level conferences. Her areas of interest are Signals and systems, Digital signal processing and RF and Microwave Engineering. She is a Member of Indian Society of Technical Education (ISTE).

K. Suganya is pursuing BE Final year in the department of ECE in The Kavery Engineering College, under Anna University, Chennai, Tamilnadu, India, during 2016-17. She has presented paper in various national level conferences. Her areas of interest are Electronic devices and circuits, Digital signal processing and Microprocessor and microcontroller. Previously done a project in VLSI domain.

A. Hema is pursuing BE Final year in the department of ECE in The Kavery Engineering College, under Anna University, Chennai, Tamilnadu, India, during 2016-17. She has presented paper in various national level conferences. Her areas of interest are Signals and Systems, Digital Electronics and RF and Microwave Engineering. She is a member of Indian Society of Technical Education (ISTE).