Low Power, Wireless Home Automation System

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Abstract- **The proposed system discussed here is a robust security control giving a comfort position to speaker in a seminar hall or to a person watching a movie. The work emphasizes on the control of various lights and other electrical and electronic gadgets viz., air conditioner, lights in reference to the utility of the projector. The automatic control of the lights and air conditioners in the room/hall accounts to the conservation of energy. Depending on the perimeter of control two kinds of wireless techniques are employed; viz., Zigbee and Wi-Fi. To facilitate the customized control of the devices, two kinds of software interfaces, one for desktop application and the second for android based mobile application are designed.**

Energy Conserving: A human presence sensor, IR detector is employed to sense the presence of human in the theatre/hall, facilitating the control on a time lag of 3 seconds, enabling the conservation of energy.

Keywords: Zigbee, wi-fi, controlling devices.

1. INTRODUCTION

Home automation technologies have been greatly getting attentions, because they provide residents with a lot of convenience and completeness by controlling the home appliances in the house. Home network has become the network of consumer related electronics for various useful applications such as entertainments, telecommunications, automation systems, and remote control and monitoring systems. Controlling the appliances is the essential technique in the home automation, and communication between the residential gateway and appliances is essentials of controlling electric appliances. That is, one of the most important technology in home networking.

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory.

WiFi is a popular technology that allows an electronic device to exchange data or connect to the internet wirelessly using radio waves. Many devices can use Wi-Fi, e.g. personal computers, video-game consoles, smartphones, some digital cameras, tablet computers and digital audio players. These can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (65 feet) indoors and a greater range outdoors.

2. OVERVIEW OF ZIGBEE TECHNOLOGY

Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide range controlling applications and to replace the existing non-standard technologies. It currently operates in 868 MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps. It is used to verify whether user's truncation is possible or not. One of the main advantages of this ZIGBEE communication is that it provides a noise free communication, the amount of noise added in this type of communication is very less compared to the other wireless communications.

ZigBee is used in applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth or Wi-Fi. Fig.1 shows home automation using Zigbee.
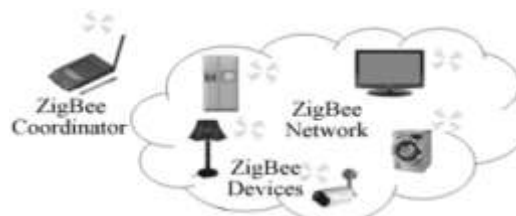

Figure 1 Home Automation using Zigbee

The ZigBee home automation network consists of a coordinator, routers and several end devices. The coordinator is responsible for starting the ZigBee network. During the network initialisation phase, the coordinator scans the available radio channels to find the most suitable.

Normally this will be the channel with the least activity, in order to reduce the level of interference. It is possible to limit the channels scanned, for example excluding those frequencies ranges used by the Wi-Fi network included in the proposed architecture.

Only those devices that are in possession of the correct private key can successfully connect to the home network. The devices that are permitted to join the network are recorded in the device database and stored on the network coordinator. A partially connected mesh topology was adopted for the ZigBee home automation network. Due to the nature of the home environment where communication interference is constantly fluctuating, the advantage of increased communication routes available through the adoption of a mesh topology outweighs the added routing complexity.[1]

3. PROPOSED SYSTEM DESIGN

The proposed system consists of transmitter and receiver sections shown in fig.2. Here one Zigbee transmitter series2 and microcontroller lpc2148 are placed in the switch board and another Zigbee receiver series2 is placed at the projector of the room. The switches are connected to the microcontroller which turns on and off the various electrical devices present in the room (say lights, fans, projector etc.).

When the projector switch is turned on from the switch board the Zigbee transmitter sends acknowledgement to the Zigbee receiver placed at the projector. Thus after delay of 3 seconds (can be changed) turns on the projector and other electrical devices like lights fans (and other connected devices) turns off. This reduces manual work. The microcontroller also senses presence in the room (if sensors placed) which turns off the connected electrical devices when no presence is felt in the room and in turn energy is conserved.
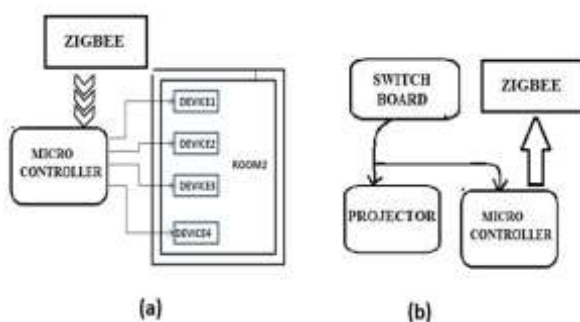

Figure 2 (a) Transmitter (b) Receiver

3.1 Microcontroller

The proposed system uses LPC2148 Microcontroller. The LPC2141/2/4/6/8 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

3.2 Zigbee series 2 module

XBee ZB modules can be used in many different ways. They also provide lots of configuration parameters. Zigbee is a standard for low-power, short range wireless devices based on an IEEE 802 standard for personal area networks (PAN). Zigbee modules work in unlisenced ISM (industrial Scientific Medical) band [2].

Zigbee devices are capable of peer-to-peer, point-to-multipoint and mesh communication. They offer convenient low power wireless solution for embedded systems where power consumption is a critical factor. A Zigbee network consists of three different types of ZigBee devices: coordinator, router, end-device. Each network has a 16bit PAN ID. All devices in a Zigbee network are assigned a single PAN ID [3]. Fig.3 shows Zigbee series 2 module

Figure 3 Zigbee series 2 module

4 WIRELESS TRANSMISSION

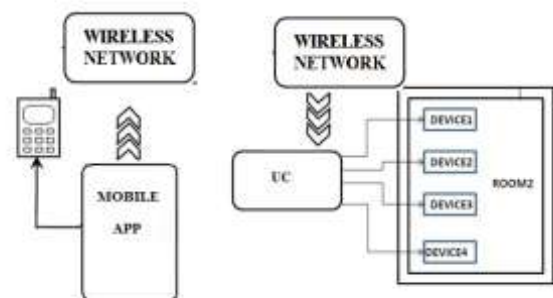The proposed system uses wireless transmission using wi-fi shown in fig.4.

Figure 4 wireless transmission

Figure shown above is block diagram of the components connected through wi-fi. There is a mobile application to be prepared (android or iphone) based which when connected through wifi network can control electrical devices of the room as shown in figure 4.

The microcontroller present in the switch board of the room is conneted to the wi-fi network available in the room and a mobile application is prepared for such. Using that

application one can control the switching of the electrical devices of the room [4]. The application is connected to the microcontroller lpc2148 which follows command given from mobile phone.

5. SOFTWARE DESIGN

The proposed system consists of X-CTU as software.
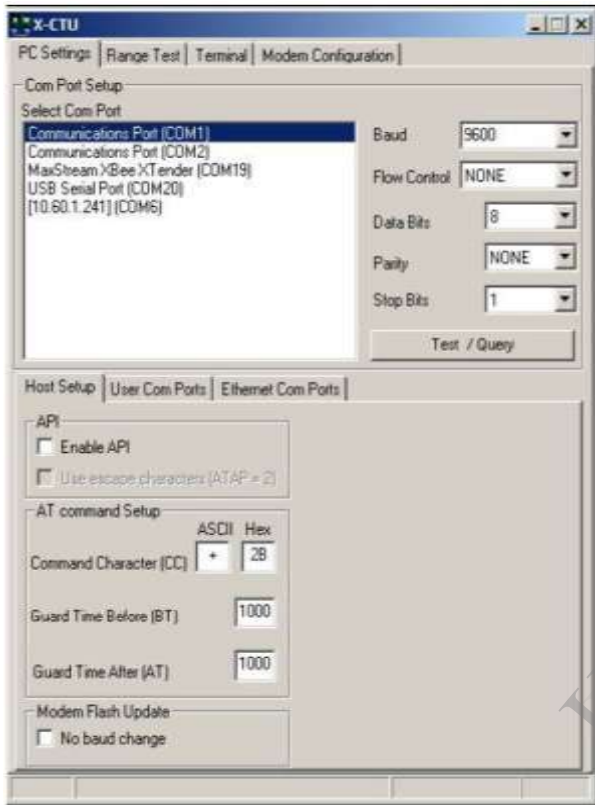It's the software available which is used for configuration of Zigbee.

Figure 5 X-Ctu Setup

X-CTU is a Windows-based application. This program was designed to interact with the firmware files found on Digi"s RF products and to provide a simple-to-use graphical user interface to them . The X-CTU Setup window is as shown in figure 5 [5].
Channel number, and network ID etc. can be configure by sending the set of AT commands to the XBee Module using the X-CTU software. The Test / Query button is used to test the selected COM port and PC settings. The Host Setup tab allows the user to configure how the X-CTU program is to interface with a radio"s firmware. This includes determining whether API or AT command mode will be used to access the module"s firmware as well as the proper command mode character and sequence. A remote configuration window is as shown in figure 6.
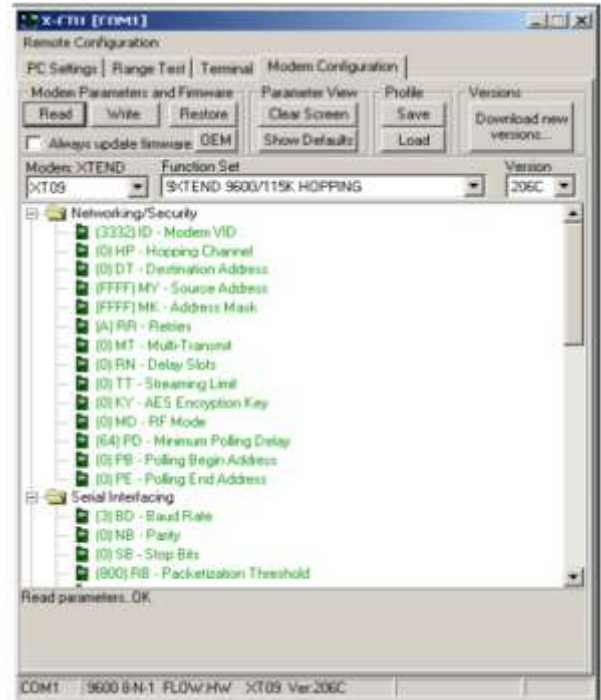

Figure 6 Remote Configuration on x-ctu software
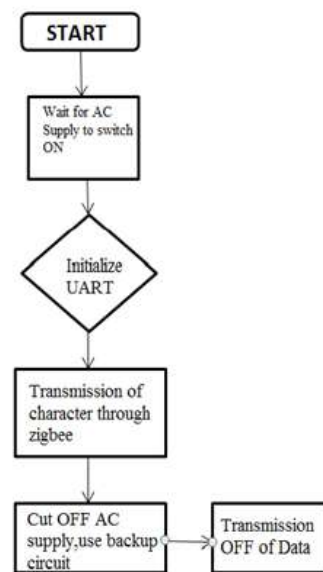
6. PROPOSED SYSTEM FLOW- CHART

Figure 7 Transmitter part

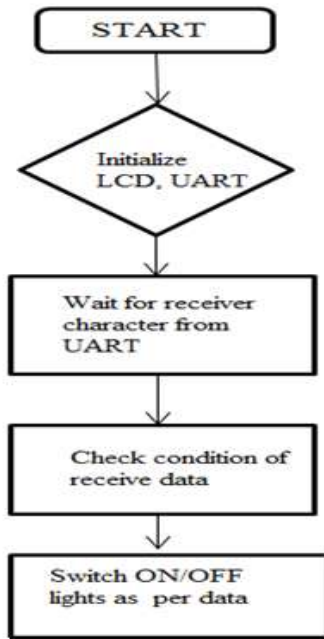Fig.7 shows flow chart of Transmitter part of the proposed system.

Figure 8 receiver part

Fig.8 shows flow chart of Receiver part of the proposed system.

7. CONCLUSION

It is easy to automate devices using Wi-Fi as it is widely used in todays world and it saves wiring cost and provides with more range. It becomes easy to integrate with mobile phone. When there is need of short range services zigbee is preferred. It has same application as Wi-Fi and consumes low power and low cost. Thus energy is also conserved. Both Wi-Fi and zigbee can be used as security purpose.

8. REFERENCES

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