

Wireless Remote Intelligent Home System Based On ZigBee

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ABSTRACT: Wireless home automation system has been drawn considerable attention of the researchers today. The major technologies can be used in these system is Wi-Fi, ZigBee, Bluetooth. From these technologies the ZigBee based system has become very popular because of its low power consumption and low cost. As Bluetooth is suitable for high data rate transmission but for automation system we need 24 hour monitoring which takes high power consumption so for this reason ZigBee is more suitable for home automation system than any other technology. In this paper ZigBee based wireless home automation system has been focus. There is brief description of ZigBee technology and also wireless remote intelligent system. The aim of this paper is apply these technologies on smart devices having android app, which allow controlling of devices using interactive GUI which can be easily used by any average user. It changes the living style of the human.

KEYWORDS: WSN, ZigBee, PAN, WI-FI

I. INTRODUCTION

As wireless transmission technology in automation system, the most important problem to concern is power consumption, cost, network capacity and security. The home automation system integrates electrical devices in a house with each other, coordinates lighting, temperatures, audio/video automatically for safety, and security energy savings, and convenience. Automatically changing lights and heating and cooling set points when you are away from home at any location so this can greatly reduce energy time and costs. Remote access of your home can lets you view security video on a laptop or web-enabled cell phone also you can interact with your home appliances through a mobile phone. Adding GSM technology to the system increase the options to communicate with your home via SMS so that in absence of internet an alert message can be send to the user and from user to home network. To achieve the low cost and low power consumption system we use ZigBee in this system.

Many automations system have been build but it is not popular and even doesn't used by at least 60% to 40% of the population. it means there is some weakness in the Build system. So here we are trying to remove that weaknesses and make the product cheaper and energy efficient so that most of the people can used the system.

II. ZIGBEE TECHNOLOGY

The description of ZigBee protocol in detail can found in literatures [1, 2]. We have presented only a partial description of ZigBee protocol in this section.

The ZigBee is a communication technology and worldwide open standard for the monitoring and control fields which form an ad-hoc network to connect local area wireless nodes, which is low in complexity and low power consumption. It passes message from one node to the next. It has also low data rates as compare to other competing technologies such as Bluetooth, Wi-Fi. In this the nodes forms the network which away from the coordinator in one PAN, as the nodes distance increase from the coordinator the signal strength is decreases or getting weak due to insufficient use of network capacity. ZigBee can connect at least 65535 network nodes in a network so; we joint the nodes in such a way that network capacity can be optimized, by using mesh technology in a network. It is based on IEEE 802.15.4 standard. It is introduced by ZigBee alliance.

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Table 1
Features of Different Communication Technologies

Features	ZIGBEE	BLUETOOTH	WIFI
Distance	10-1600m	10m	50
Extension	Automatic	None	Depend on the existing network
Power supply	Years	Days	Hours
Complexity	Simple	Complicated	Very complicated
Transmission speed	250Kbps	1Mbps	1.54Mbps
Frequency range	2.4GHz	2.4GHz	2.4GHz
Network nodes	65535	8	50
Security	128bit AES	64bit ,128bit	SSID
Prime cost	Low	Low	Normal
Ease of use	Easy	Normal	Hard

Table 1 is differentiating the difference between the technologies, among all the technologies ZigBee is low power battery consumption. A ZigBee end device should operate for months or even Years without needing its battery replaced. It support large number of network nodes, Therefore ZigBee is suitable for home automation system.

- Data rates up to 20 Kbps to 250 Kbps for 2.4 GHz.
- It is secured by 128 bits symmetric encryption.
- 16 channels allocated in 2.4 GHz. Each channel is spaced 5 MHz apart through using only 2MHz of Bandwidth. It also uses DSSS coding.
- For Indoor applications transmission distance may 50-1600m.

III. LITRATURE SURVEY

There have been several commercial and research versions of smart home system introduced and built. Some are given below.-

[5] Proposed a remote control system of smart appliances based on wireless sensor network, the rapid development of mobile network and Internet to the field of remote control. They use a STM32 low-consuming chip as information processing centre, without the use of high-costing PC as a local server for the system. ZigBee technology is used to form household internal control network instead of the complex wiring. This method has a short installation period and is convenient to add and move network nodes. With the research of TCP/IP protocol, ZigBee protocol, and GSM communication technology, they design two types of remote methods for controlling the system using STM32 as the information processing centre and using ZigBee module to form household internal control network. Users can access the system by a webpage of LwIP TCP/IP protocol stack or GSM (Siemens TC35i) for SMS

[6] Proposed system based on the interfacing of various sensors with the PIC microcontroller. ZigBee is used for the transmission of data. Because PIC is rich in peripheral so if we need to connect multiple devices with the controller it will be the good solution. PIC is easy and cheap microcontroller. This controller used to send the sensor values to the PC with the help of ZigBee.

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[7] Proposed system in which design of wireless remote intelligent home system based on ZigBee and GPRS introduce a wireless home automation system. This system uses environment monitoring sensors and used a star topology to control intelligent appliances. The microprocessor used in the system is ARM39 chip STM32F103 has a 32bit based on:

- o ARM Cortex-M3 core,
- o 256 to 512k bytes of flash memory,
- o Up to 48k bytes of SRAM,
- o Supports SRAM, PSRAM, NOR, NAND memories.

It has quick interrupt response, high level of integration and also low power consumption. Time synchronization algorithm is used keep the power consumption low.

[8] The proposed intelligent home control system based on the android and ZigBee system presented the design of the hardware part and the software part. The forward are fixed in the variety of appliances based on CC2530 chip and sensors. The connection between different devices can be finished by the standard interfaces RS232 and RS485. The software can be installed in the tablet PC, the personal computer or smart telephones. It can be realized on the open Android platform or Eclipse.

[9] The proposed Speech Recognition Based Wireless Automation, they provide a solution for the physically challenged people by whom they can control their house alliances by giving voice commands through personal computer. This designed system gives accurate status of the signal when the circuit had gone fault state or the appliances are out of the range. For the security purpose RFID authentication is used, each appliance has 2 commands 'on' or 'off'. First user profile has been created then only system can recognize the voice command. The system has been tested by giving commands by various people.

[10] The proposed system based on the Realization of Intelligent Home by ZigBee Wireless Network Technology. AT89C51 is used in the RF node and ZigBee is used for the wireless communications transceiver modules CC2500 Chip. Between the control module and CC2500 Chip it use I/O port simulate SPI bus timing to achieve the data exchange, the send and receive data processing of node, and in accordance with communications data to complete the peripheral device control[10]. The main control switch circuit with SCM AT89C51, DTMF transceiver chip MT8880 and the composition of solid-state relay SSR action [10]. DTMF transceiver chip MT8880 can receive bus DTMF signal and demodulation of binary data. Software is the key of Singlechip Control System, the functions achievement and reliability of a single-chip control system determine to a large ext. on software [10]. The system software has two major components: one is ZigBee control (host) program, the other is each Intelligent Home (extension) program [10].

a) Limitations of The Existing System

- All the proposed systems have used star topology. This topology consists of a central node to which all other nodes are connected. But if the central node fails then the entire system is affected.
- PC is the remote monitoring station and microcontroller is the controlling device. Although one can monitor and control devices remotely from any part of the world provided internet access is available, this system incurs additional cost due to the requirement of a computer.
- Security is also a major concern in everywhere.
- Cost of the existing systems is expensive and can only own by rich family.
- Difficult to install because some expert professionals are needed to install the system.
- Difficult to use because the control interface has poor quality and they are not user friendly,
- Vendor dependency because need to use separate systems for different companies' appliances,
- Less functionality of the system because ,most of the system can either monitor or control the functions, and
- Not customized because most of the systems are not customized for the needs of the users.

IV. SYSTEM OVERVIEW

The objective is to make use of wireless sensor network and communication technologies like ZigBee to make smart home automation system can be developed in which all processing is handled by a controller.

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Here, micro controller is the AVR 32-bit RISC microcontroller offers a wide range of technical features. The AVR family is suited for battery-powered, portable consumer applications, board controller, remote controls, and human interface devices. It has some standard features such as on-chip 32K program ROM and 32 I/O pins. UART, USART, I2C, SPI (special purpose AVR support). ARM architecture is tough. With ARM architecture micro-controller, it is very difficult to get desired sample code for it in the internet. Unlike AVR whose code and tutorials are widely available. ARM is the higher end, while 8051 is a bit outdated, so AVR families are generally preferred for general purpose.

A. System design



Fig 1. Block Diagram of Working of System

In figure 1, R1 and R2 are two rooms, each room consists of relays and each room connected with the ZigBee nodes. A central controller ZigBee coordinator can communicate with the different nodes X1, X2 which is connected with the room. This logic implemented within some limited range, but it can also communicate with whom which are not in the range by routing protocol. Wi-Fi module connected with this so that monitoring and controlling can be done over the internet also.

V. INTERFACING DIAGRAM

The scenario describes a person who has installed a home automation system at his/her home, person can control his/her home light fan from his/her computer now. By giving the A, B, C, D commands from the XCTUW window. ZigBee is used to send control signal from laptop to Node 1.

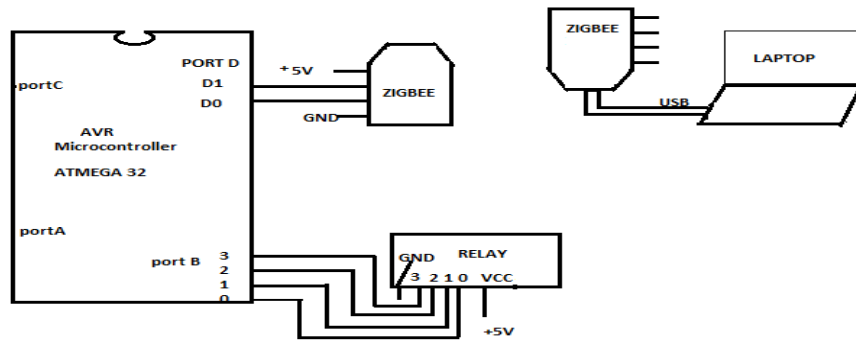


Fig 2. Interfacing Diagram Of ZigBee and relay with the atmega32

Figure 2 shows the interfacing diagram of ZigBee and relay with the AVR microcontroller. ZigBee is connected at port D pins D0 and D1, and +5v power supply is given to the ZigBee through AVR board and ground the ground pin of the ZigBee. Also interface the relay with the AVR controller, connect pins 3,2,1,0 pins to the port B pins 3,2,1,0 also connect relay ground and +5v to the board power supply pins and ground pin. After all that, give external power supply to the AVR board ,after that one attach one ZigBee module with the laptop so that one can acting as a node and other is acting as a coordinator.

VI. WORKING OF THE SYSTEM

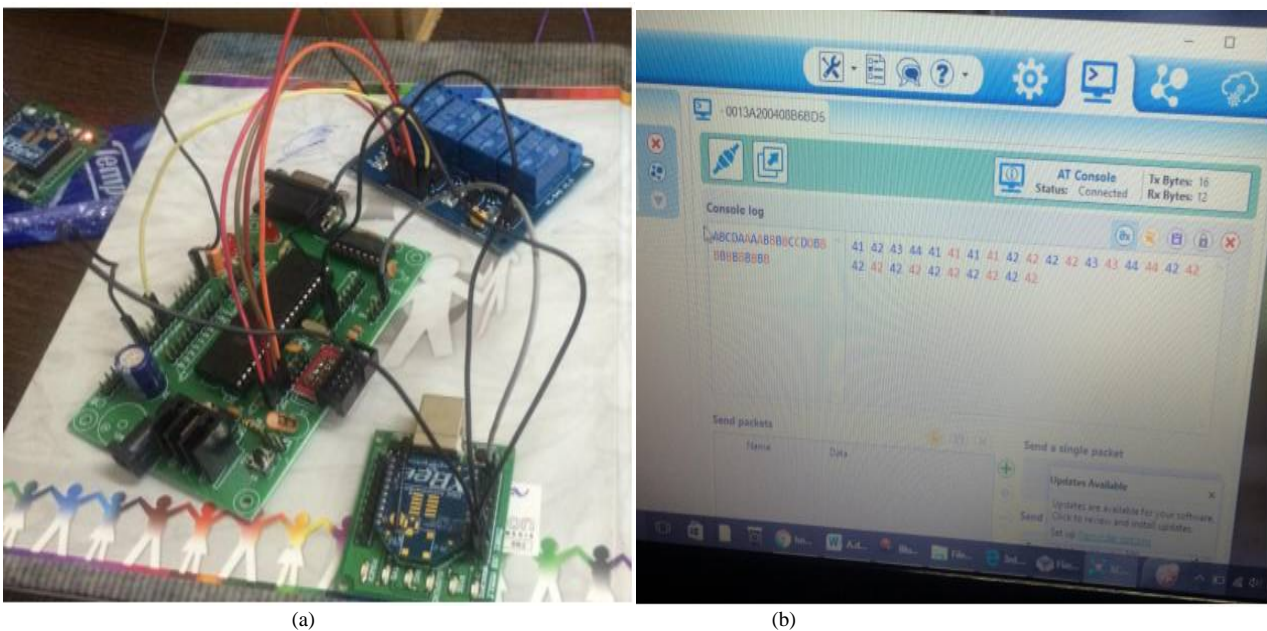


Figure 3.(a) Interfacing of ZigBee and ATMEGA 32 with AVR microcontroller (b) Console window at XCTU Software

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Figure 3(a) shows the interfacing of ZigBee with AVR controller. AVR board having a 32 bit processor in which code of the overall programming of the system is burned with the help of the AVR Program Loader. Then connections are to be made with the relay and ZigBee module.

We used XCTU Figure 3(b) software in the laptop and one ZigBee is connected with the laptop and another one is with the AVR board which is also connected with the relay. First, we made connection from one ZigBee to another through XCTU and then pass signals from the laptop. When we press A then led 1 will glow, for B led 2 will glow so on the relay. We can connect relay with the circuit board present in the room. So when we press A then connected appliance with the led 1 side will start. We can connect bulb, fan, and any other appliance with the relay.

VI. CONCLUSION

Currently, the transmission is happening between two ZigBee modules one is acting as a master node and another one is acting as a node. In this we use laptop on which software is installed XCTUW. We are communicating with node through the software now.

VII. FUTURE WORK

In further work, following points are to be covered:

1. A network of at least four nodes will be created.
2. Each node will be having 4 relays to power up 4 high voltage devices as shown in figure 5.
3. A master controller will manage all the communication with the four nodes.
4. To power on or off the specific device from the remote system or laptop or remote a specific command in terms of 4-8 bytes of frame will be sent to the master controller.



5. Master controller will process the data bytes received and then route the data to its specific targeted node and activate or deactivate the relay.
6. After processing the command node will generate the feedback command back to the master node to indicate the status.
7. We will also interface GSM module to microcontroller so that in the absence of internet, the appliances can be controlled through SMS or call.
8. Any android supported device can be used to install the smart home app and control and monitor the smart home environment. A cost smart home system can be developed in which all processing is handled by microcontroller.

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