

## A Wireless Approach for Automation Using Zigbee Communication Technique

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### Abstract

*Technology has now advanced to the point at which we wish to take an integrated approach to home automation, allowing appliances to communicate with each other and to be controlled in flexible ways. With the development of industrial automation technology, the limitation of traditional cable control network has become increasingly prominent. Consequently, establishing a reliable data transmission network becomes a critical demand in industry. Increasingly, companies developing monitoring and control applications in industrial and commercial building environments are looking to wireless technologies like ZigBee to save the cost of wiring and installation and also to allow more flexible deployment of systems.*

*A wireless network approach to this communication and control provides an easy, cost-effective and scalable solution to home automation. The home automation systems provide mutual interoperability between various electronic, electrical, and power devices as well as interactive interface for people to control their operation. This paper illustrates that the ZigBee wireless technology can perform well in industrial environments in terms of performance and reliabilities.*

### INTRODUCTION

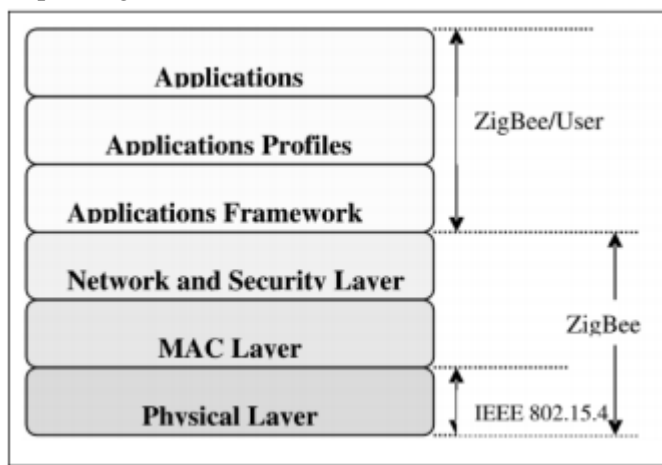
Older people are incapable to control home appliances by moving all over their house especially if double story house. Definitely they will suffer to control their home appliances if the control of the appliances is by switches [1-3]. This kind of problem can be solved by developing a system which can control home appliances by a PC, because PC is becoming a product which is necessary to

our daily life style nowadays. With the rapid development of automation and measuring techniques, automatic recording of the data in the meter reading instrument has gradually become the target of people whose working, living, and home conditions are of increasingly high level of intelligence. Home automation systems are developed in recent years that make use of emerging technologies for the development [4]. Home automation has become a one of the upcoming field that introduces many technologies for making the automation easy and with good performance. Most of the system makes use of a web server and mobile communication for controlling the home appliances. ZigBee is developed in recent years, a short-range wireless communications technology, with low power, low data rate, short distance, low cost, safe and reliable. Wired networks are very reliable and stable communication systems for instruments and controls. However, the cabling engineering necessary is very costly. Therefore, recently costless wireless networks are more and more strongly required by customers [5-6]. Many domestic and foreign companies and research institutions start to study how to formulate industrial wireless measure and control systems. ZigBee, the short-range wireless data transmission technology, for its safe, reliable, simple and flexible, low cost, long battery life and other advantages, has shown strong potential and been the research hotspot in recent years in industrial control field. Having proposed ZigBee as the wireless technology to replace wire harnesses in any sensing and control application that uses wired signal and data communication.

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**Zigbee Protocol:**

The complete ZigBee protocol specifications were ratified in December 2004, involving the collaboration of about 70 firms (over 200 firms are currently participating in the consortium). The aim was to develop a low-cost, low consumption wireless communication system with an average data transfer rate, for use in consumer electronics, computers and peripherals, control of residential lighting systems, industrial control, automatic construction systems and monitoring of medical variables, etc [7-10]. In comparison with other wireless communication systems, the ZigBee stack (fig.1) can be considered to be small: 4 Kb for the simplest nodes and 32 KB for the complete stack. ZigBee offers a layered architecture based on the MAC and physical layers of the IEEE 802.15.4 standard. This design offers low power consumption and guarantees a longer battery life, which is one of the most important issues of wireless networks. Since ZigBee is based on IEEE 802.15.4 it inherits a low data rate, and a reception distance of about 100 meters (depending on environmental conditions).



**Fig.1: Zigbee protocol stack**

For the upper layers one of the most important characteristics of ZigBee is the possibility of using one of two types of routings: mesh and tree. This gives the application designer much more freedom to get the maximum gain out of each option depending on the very own needs of the solution they develop. The protocol also offers a framework application to make easier and faster the development of simple standard applications.

Also, in order to promote the reuse of already existing functionalities, libraries and profiles have been created to facilitate the construction of the most frequently needed devices within the application environments that ZigBee has been created for.

This paper present a home automation system based on ZigBee technology. The Central Processing Unit for the proposed system is developed using the 8051 based microcontroller which is a low cost and efficient controller used in many applications. Here combine embedded system technology with the wireless technology.

**EXISTING SYSTEM**

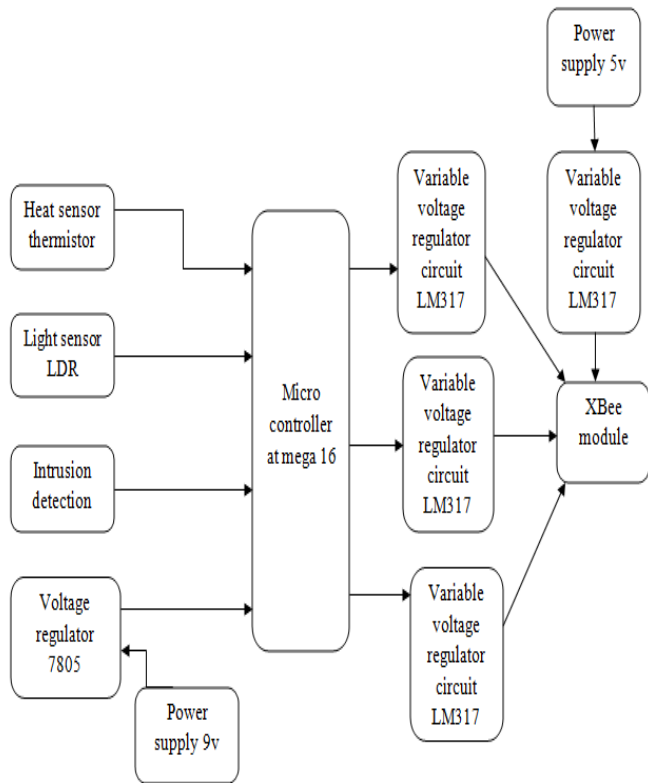
A phone based remote controller for home automation system. In this system all the communications occur by a fixed telephone line and the system can be controlled by using any telephone that supports the dual tone multiple frequency (DTMF). This system has some disadvantages: in the users are not provided with a graphical user interface (GUI), users have to especially remember an access code, and they also have to remember which buttons to press for the control of connected devices of the system.

A control network by using hand gestures. A glove is used by the controller to relay hand gestures of the system. The disadvantage of this system is the inaccuracy of hand gestures with the potential of the normal arm movements being inaccurately interpreted as commands. There is also a risk of the user fatigue if repetitive hand gestures are required.

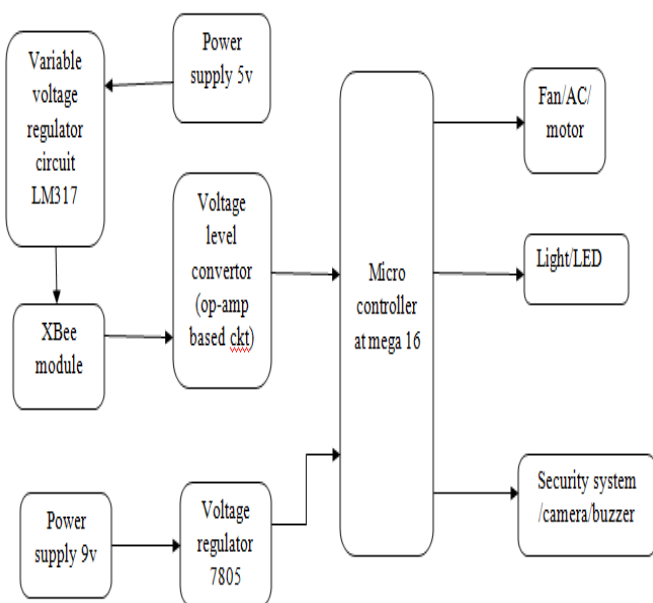
**PROPOSED SYSTEM**

This research paper presents low cost and flexible ZigBee based home automation and security system. The objective behind this automation system is to reduce the system complexity, lower fiscal costs and can the waste of electricity, saves human energy, and makes human life easier and simple. The goal of the is to continue monitoring of the devices, to change the status of devices conveniently and remotely access the home appliances.

The architecture of a low cost and flexible automation system is given in this section. The system consists of two sections first is transmitter section and second is receiver section.



**Fig. 1(a): Block Diagram of the transmitter**



**Fig.1 (b): Block diagram of the receiver**

**Atmega 16 Microcontroller**

ATmega16 is an 8-bit high performance microcontroller of Atmel’s Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz. ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.

**Heat sensor thermostat**

A thermistor is a type of resistor whose resistance is dependent on temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistor are widely used as inrush current limiter, temperature sensors (Negative Temperature Coefficient or NTC type typically), self-resetting over current protectors, and self-regulating heating elements (Positive Temperature Coefficient or PTC type typically).

**Light sensor (LDR)**

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

**Zigbee Module**

The XBee RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band. It

operates over a range of 100-200 meters. The receiver module consists of an Xbee RF module which is connected to another controller through MAX232.

### WORKING DESCRIPTION

The methodology of this project design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the main controller, sensor network and the smart automation network. On the other hand, the software implementation focuses on the programming of the microcontroller using AVR studios and configuration and programming of ZigBee modules using X-CTU. The methodology of this project design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the main controller, sensor nodes and the smart home sensor network while the software implementation focuses on the programming of the microcontroller using Embedded C.

The two ZigBee modules are used in the proposed system that is one at the transmitter section and other at the receiver section. Both of these are connected with the microcontroller by UART Max 232 IC. At one end, there are buttons to control the devices. At the other end, there is a relay card of relays connected with the microcontroller. The microcontroller can switch on/off devices with the help of relay card, according to the command given at the transmitter. As the user press any key at the transmitter end, a proper data is sent to the ZigBee of the remote end. The ZigBee at the transmitter side will communicate to the ZigBee connected to the other side i.e. at the receiver device end. At the device end, the Zigbee will receive the data and feed it to the microcontroller. The microcontroller will check the data and turn on/off the proper device with help of a relay connected at this end.

### RESULTS

Finalized hardware is shown in figure 2. The microcontroller is interfaced with zigbee modules and sensors.



**Fig.2: Experimental hardware setup**

The loads are connected using driver circuits to operate from different voltage levels which are arranged at the receiver. These loads can be used as home appliances or industrial loads which are controlled based on the status of the sensors at the transmitter.

### CONCLUSION

Wireless communication technologies can often be useful within industrial applications. An advantage of using ZigBee radio technology in the implementation of measuring and monitoring systems is represented by flexibility in topology of the sensor network. This offers the possibility to reorganize very rapidly the systems. Also the components of the ZigBee mesh networks can operate over extended periods of time, even years, without changing the original battery. ZigBee is necessary if you need to use repeating or mesh networking functionality in your system.

ZigBee technology together with other wireless technologies will profoundly and completely change the aspect of the industrial automation system.

This paper describes the ZigBee communication protocol and presents its potential deployment in the smart home environment. This paper has reviewed the existing state of the home automation and security systems, and identified and discussed the areas that have hindered the consumer adoption of such technologies. The areas include the complexity and expense of the architectures adopted by the existing systems and safety and security.

A novel architecture for a home automation and security system is proposed and implemented, using the relatively new communication technology ZigBee. This proposed system remote access to home appliances is possible, status of devices can be easily monitored by remote (transmitter) user and security agent. The use of ZigBee communication technology helps to lower the expense of the system and the intrusiveness of the respective system installation. In future many more features can be added in it like home automation through voice call by implementing more secure and efficient techniques. Moreover, its specification, which is based on IEEE 802.15.4 wireless protocols, promises complete interoperability

#### **FUTURE WORK**

The future scope of the Zigbee based home automation and security system can be broadly divided into two categories. In an appliance control, the various home appliances can be controlled with the help of this zigbee technology. The various types of devices that includes temperature controlling devices, humidity controlling devices, bulbs, fans and the various other home appliances. For Security Purpose, this includes controlling of the various security purpose devices according to the feedback received. As this project is a wireless and based on Zigbee technology one can insure the security of his/her home in spite of being present there. The system can also be used for in the industries.

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