Abstract—We are in an era where the need for wireless communication in home is increasing day by day and technologies are getting discovered by the minute. This project evinces a way for wireless controlling of appliances using a Computer. The Computer will communicate with the help of a zigbee module which consists of both transmitter and receiver. This project will be able to control electrical appliances such as fan, bulbs, doors etc by sending commands through the computer using software called hyperlink. Commands will be inputted on the computer and accordingly a device connected to the relay will be switched ON/OFF. Sensors have been attached to the rooms which will sense any movement and switch off lights if there are none thus saving electricity. An alternative method for controlling the appliances has also been made in this project. The appliances can be switched on and off using a remote which has 8 buttons, each for controlling the appliances attached to the relays.

I. INTRODUCTION

Home automation may be thought as a way of controlling home appliances with the help of a computer or a smart device. It is a combination of 1 or more computers and microcontrollers to control electric devices. We are in an age where an ample of technologies are being discovered by the minute. Such technologies are being discovered to make our lives easy and make things available at a much faster process, for example: Earlier people had to stand and watch when washing clothes in the washing machine but now automatic washing machines are there and there is no need to stand around to see if the clothes are getting washed or not. Similarly home automation will also help and provide a breakthrough to an easier lifestyle. In this project we have used a computer to control electronic devices with the help of ZigBee as communication medium. There are a number of devices that are used for wireless communication such as ZigBee, Bluetooth, RF, GPRS etc. ZigBee is used for short distance communication. In this project the commands will be written on a software called hyperlink terminal and then sent over through ZigBee to the Arduino board which will then decode the command and switch on/off the appliances connected to the relays. ZigBee, a wireless medium which has been established as an axiom for low power, low cost, M2M wireless network and belongs to IEEE 802.15.4 standard and operates in the unlicensed band: 868 MHZ, 915MHZ and 2.4GHZ. Zigbee device communicates in the frequency of 2.4 ghz at the speed of 250 kbps and has a data rates of 20 kbps and 40 kbps at frequencies 868MHZ and 915MHZ. ZigBee can communicate up to 50 meters in a typical environment. The distance is maximum in ideal conditions. When the duty cycle is low, ZigBee would have a data rate that is high. Considering all these features it can be said that ZigBee is ideal for home automation, industrial automation and all places where sensors and control devices are used.

II. MODES OF OPERATION OF ZIGBEE:

- Idle mode: This is usually the mode in which the ZigBee is switched on and the commands are going to be inputted shortly.
- Transmit mode: This is the mode in which the ZigBee is transmitting the commands received from the computer to receiver.
- Command mode: Commands are being inputted on to the computer in this mode. The commands are then sent to the zigbee. A ping is sent to the ZigBee before commands are sent.
- Receiving mode: This is the mode in which the ZigBee receiver receives the commands that have been transmitted from the ZigBee transmitter.
- Sleep mode: When no commands are being sent and it remains idle for more than 4 mins then the ZigBee module goes in to sleep mode. It switches on when commands are to be inputted.
III. BLOCK DIAGRAM:

The given block diagram shows a circuit that is used to control electrical appliances with a computer device. All the appliances are connected to the relays. The commands are given on the computer using software called hyper terminal. The circuit is divided into 3 parts: the ZigBee transmitter connected to the computer, the ZigBee transmitter connected to the microcontroller and remote and finally the ZigBee receiver connected to Arduino module which acts as the motherboard of the circuit. The relays are connected to the Arduino through a relay master which amplifies the signal and sends the inputs from the Arduino to the relays which then switches ON or OFF of the electrical appliances. For eg : Suppose command 1 is given at the computer then the Arduino module switches ON relay 1 and if command Q is given it switches OFF relay 1. A remote has also been introduced to the circuit. This remote consists of 8 switches, pair of which is used to switch ON and OFF the relays. The input reaches the microcontroller by the remote. The microcontroller sends the input to the ZigBee transmitter and vice versa.

The hardware consideration for this embedded system is the use of computer to give commands. Sensors are used in this project. The sensors are placed in room’s so that it can sense any movement and accordingly switch OFF the appliance if not in use. When the relays switch ON, the sensors sense if any movement is there and accordingly after a short duration switch OFF the appliance. Electricity is thus saved.

TRANSMITTER SIDE:

The transmitter side consists of the computer device, ZigBee transmitter and the remote. The appliances can be controlled by anyone of the two. First let us look into the computer through which the commands are inputted. When the commands are inputted on the computer, it is carried through the RS232 wire to level translator. It converts the RS232 signal into TTL signal and regulates the voltage supply to the ZigBee transmitter i.e. it converts 5V into 3V. The ZigBee transmitter works only when 3V is supplied to it, if voltage supplied is more than that then it gets damaged and doesn’t work. We have attached a Zener diode next to the ZigBee transmitter so that the voltage is limited before it enters the ZigBee. The Zener diode in turn protects the ZigBee transmitter from high voltages and avoid getting it damaged. There is also a crystal oscillator whose function is to generate the baud rate. Frequency input required can only be done after baud rate is set. The crystal oscillator also sets the clock cycle. Only after this process the signal is transmitted from the ZigBee transmitter.

Now let us talk about the second method of controlling the appliances which is the remote. The remote is attached to a microcontroller (89C2051) which has 20 pins. Since the requirement was of less I/O and less Ram we have chosen this. It has a requirement of 8bits. This remote can be called ubiquitous as it is easy to use. When the buttons are pressed on the remote, the command is sent to the microcontroller which then
sends a signal to the ZigBee. Before the signal reaches ZigBee it has to go through the level translator which converts the -12V into 5 V. After this, it works in the same way as the computer device.

RECEIVER SIDE:
The data is received at the ZigBee receiver and inputted to Arduino board serially. The Arduino board recognizes the signal according to the way it has been programmed and accordingly switches on/off the relays as per the command. It makes a parallel output compared to a serial output of ZigBee. Before the relays are switched on the signal from Arduino goes into the relay driver IC ULN 2003. This relay driver is used to drive the relays connected to the board. It amplifies the signal from the Arduino and sends it to the relays which then switch on. We have used a total of 4 relay so any or all of them can be turned on/off. When the devices are switched ‘ON’ the PIR sensor senses if there is any movement in the room. If there is no movement it switches ‘OFF’ the light thus saving electricity. This could be said as a small step to smart homes where sensors are used to sense any movement is there or not.

IV. HYPER TERMINAL
This software is used to write commands on the computer. Hyper terminal offers a way for controlling devices by sending text based commands. It is an interface which makes possible for communication to be sent serially. In this project when we write a command 1 on the hyper terminal then relay 1 switches ON and when we write ‘Q’ then relay 1 switches OFF.

V. COMMANDS AND OUTPUT GENERATED

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Connected to Relay</th>
<th>Serial Communication data command for ON/OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAN</td>
<td>Relay 1</td>
<td>1: On Q: Off</td>
</tr>
<tr>
<td>BULB 1</td>
<td>Relay 2</td>
<td>2: On W: Off</td>
</tr>
<tr>
<td>BULB 2</td>
<td>Relay 3</td>
<td>3: On E: Off</td>
</tr>
<tr>
<td>Motor</td>
<td>Relay 4</td>
<td>4: On R: Off</td>
</tr>
</tbody>
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VI. APPLICATIONS
HOSPITAL MONITORING: There are lots of applications such as
1. Heart Rate Monitoring
2. Temperature Monitoring
3. Personal Equipment Control

ELECTRONICS: They are as follows
1. Remote Control
2. PC peripheral
3. Control of window roll/shades
SECURITY SYSTEMS

VII. ADVANTAGE AND LIMITATION
The advantage of Zigbee home automation is,
- Uses less power so can be called a low power consumption device
• The time taken to finish a task through home automation is less thus can be called a time saving device.
• Zigbee provides a range of 100 feet to 300 feet and compared to other systems it’s cost is also low thus a power saving device.
• The cost is dependent on advancement of system.

The limitation of the ZigBee home automation is
• If any wire is ruptured then the entire system crashes.
• It can be prone to interference thus causing problems to the user.
• If the size of the home is big then a number of ZigBee devices need to be kept due to small range.

VIII. RESULT
The project is able to switch on/off the devices as per the commands given by the user successfully. The project gives us an understanding of Zigbee communication and also a deep knowledge of the working of microcontrollers.

IX. CONCLUSION AND FUTURE SCOPE
In this project we were able to successfully implement the control system in which electrical appliances can be controlled with the help of a computer device and a remote. We were able to gain a deep understanding of network topologies and also the working of zigbee module. In this project we had to first learn about the architecture of zigbee and how to send commands through it, for this we had to learn the AT commands and also use some C coding. We were able to successfully configure the zigbee module and the commands could be sent. The coding for Arduino had to be learnt which was important for the progress of our project. The coding had to be done using Arduino software and important parameters had to be defined in this coding so that the commands could be successfully sent to the relays. Special attention had to be paid to the Arduino connections so that proper voltage was supplied to all points to avoid damage to the board. An additional knowledge of sensors was also required for this project so as to decide the best sensor that could be used for the circuit and accordingly the coding also had to be changed. Finally the commands could be sent and the appliances could be switched ‘ON’ and ‘OFF’ using a computer. An additional way for controlling the device was added to the project. A remote having 8 buttons was attached to a microcontroller which could also switch ‘ON’ and ‘OFF’ the device as required. From this project we can conclude that home automation is indeed possible and can lead to an easy lifestyle. This is an era of technology and we believe that home automation is the next technology to revolutionize the technological world and this project gives us a basic understanding of what smart homes could look like.

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REFERENCES