

Controlling Switches Wirelessly Using Zigbee Technology

Nusrat Jahan Nitol¹, Thamina Toma²

Electrical and Electronic Engineering, American International University, Bangladesh

Abstract: *Wireless local area network (WLAN) and wireless personal area network (WPAN) technologies are rising highly with their technological development. Bluetooth was very much used for short range communications. Now, ZigBee is becoming as an alternative to Bluetooth for devices with low power consumption and for low data rate applications and for long distance transmission which is approximately around 100m. We used this technology for data transmission and controlled switches from far.*

Keywords: ZigBee, Wireless communication, Data Transmission, Transmitter, Receiver, Switching, Arduino UNO

1. Introduction

While Bluetooth focuses on connectivity between large packet user devices, such as laptops, phones, and major peripherals, ZigBee is designed to provide highly efficient connectivity between small packet devices. As a result of its simplified operations, which are one to two full orders of magnitude less complex than a comparable Bluetooth device, pricing for these devices is extremely competitive, with full nodes available for a fraction of the cost of a Bluetooth node. They are also actively limited to a throughput of 250 Kbps, compared to the much larger pipeline of 1 Mbps for Bluetooth, and operate on the 2.4 GHz ISM band, which is available throughout most of the world. The ZigBee standard has adopted IEEE 802.15.4 as its Physical Layer (PHY) and Medium Access Control (MAC) protocols.[1] Therefore, a ZigBee compliant device is compliant with the IEEE 802.15.4 standard. In our project we are using this network for transmitting data. By using that data we are controlling switches. So, we can control any kind of switching process from 100m distance.[1]

2. Objective of this Work

The main objective of the project is to transmit and receive data using Zigbee technology. After receiving the data we can control switches. So, overall we can say the objective of our project is to control switches far from that place.

3. ZigBee Specification

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.[2]

ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20

kilobits/second in the 868 MHz frequency band to 250 kilobits/second in the 2.4 GHz frequency band. [1]

The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level.[1][2][6]

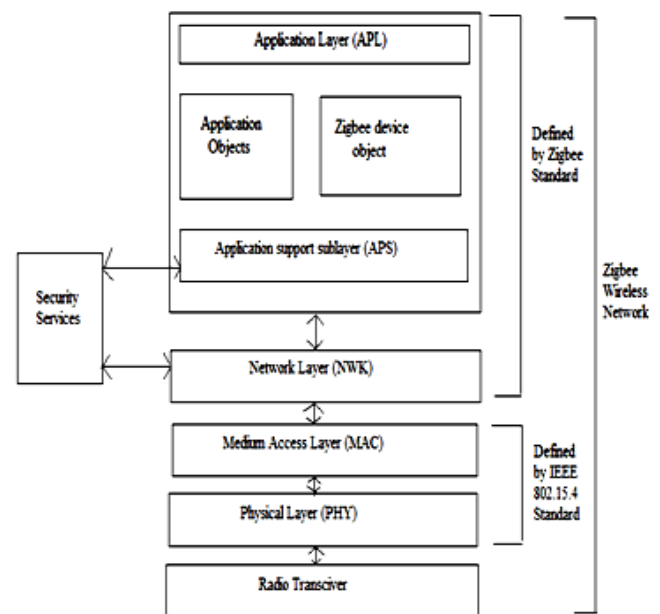


Figure 1: Zigbee wireless networking protocol layers [2]

Table 1: Specifications of Zigbee Technology [2]

Parameter	Specification
Data rate	250 kbps
No of channels	16
Operating frequency	2.4GHz
Channel spacing	5MHz
Spread spectrum	Direct Sequence Spread Spectrum
Chip rate	2 Mega chips per second
Modulation	OQPSK with half sine pulse shaping

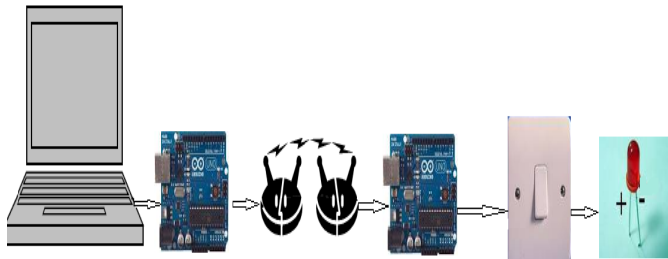
4. Introduction to this Project

Step1: Upload programs in Arduino Board using Arduino software for preparing the transmitting and receiving side to transmit and receive data.

Step 2: Install programs in ZigBee transmitter and receiver for differentiating, which one is transmitter and which one is receiver.

Step 3: C# programming for sending characters from laptop to Arduino via USB.

Step 4: Connecting LEDs with the Arduino at the receiveing side.



Laptop->Arduino Uno->ZigBee Network->Arduino Uno->Switch->LED

Figure 2: Project Demo

4.1 Data Transmission

From the laptop characters are sent using visual studio software. An Arduino Uno was connected with the laptop via USB. On the Arduino Uno microcontroller ATmega328 is connected. By using Arduino software the microcontroller was being programmed. When the characters were pressed they pass through microcontroller to ZigBee transmitter. The procedure is shown in figure 3.[7]

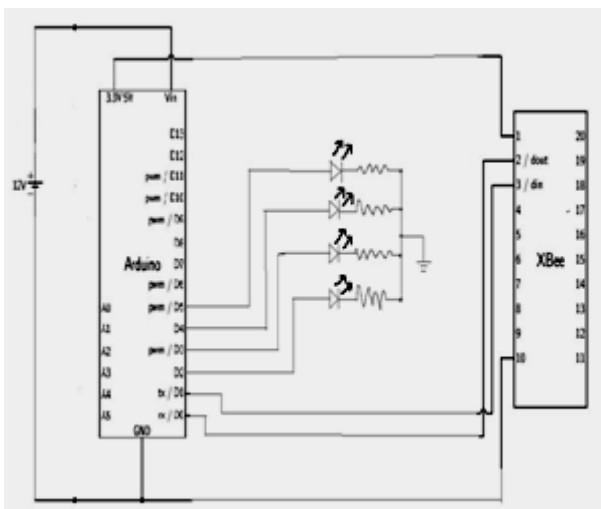


Figure 3: Schematic Diagram of Transmitting side

4.2 Data Receiving

At the receiving side ZigBee receiver receives the characters and pass it to the Arduino Uno. Then according to programming the switching take place and thus we can lighten up LEDs. The whole procedure is shown in figure 4.

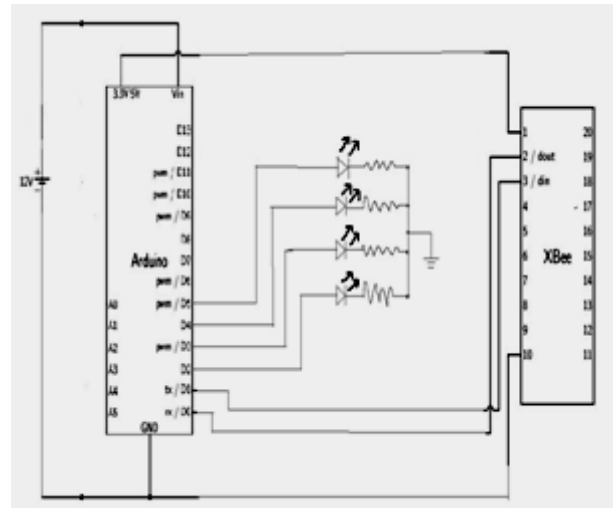


Figure 4: Schematic Diagram of Receiving Side

5. Programming

In this project we have used two types of programming. One is C# and another one is Arduino. C# is our main program. By using the C# program we send characters. When we run the C# program in the laptop, a screen appears like figure 5. From that screen we click buttons. If we click ON button then the corresponding LED glows. And when we click the button OFF then the corresponding LED becomes OFF. [7]



Figure 5: Output of the C# programming

6. Hardware Implementation

Figure 6 shows the whole set up of the project where we transmits the characters and receives them through the ZigBee network and use them for controlling switches. The left one is the transmitter which is connected to the laptop through the USB. And the other part which is connected with the bread board is the receiver. By receiving the data the microcontroller is lighten up all the four LEDs in the figure 6.

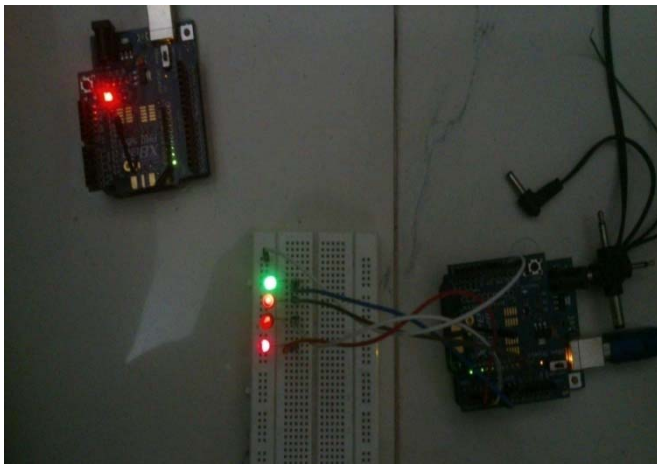


Figure 6: Physical setup

7. Future Work and Conclusion

Whenever we go for digitization we need switching. If we can control switches we can control many things. Moreover, in our project we can control switches wirelessly from far away. Thus we can control any kind of machine's switch wirelessly. So, it can be very much helpful for future advancement. As ZigBee modules are very cost effective, long lasting and gives security protection than other wireless modules so, our project can give a great advantage if we can apply this technology in industries and companies as well as home appliances.

References

- [1] "ZigBee Specification FAQ". *Zigbee Alliance*. Retrieved 14 June 2013.
- [2] ZigBee Alliance. (2006, December) ZigBee Specification.
- [3] Chi-Chun Huang, Chih-Yi Chong and Chih-Peng Li Chua-Chin Wang, "ZigBee 868/915-MHz Modulator/Demodulator for wireless Personal Area Network, "IEEE transactions on Very Large Scale Integration (VLSI) systems, vol.46.
- [4] Gronemeyer S and McBride A, "MSK & Offset QPSK modulation, "IEEE transactions on communications, vol.24, no.8 pp.809-820, August 1976.
- [5] Ali Abuelmaatti, Iain Thyne and Steve Reaumont, "A new approach to QPSK: Mechanism and implementation," in IEEE Wireless Communications and Networking Conference, 2007, pp. 2393-2398
- [6] Ravnikanth Kanna, Sarat Kumar Patra, Kiran Kumar Gurralla, Badugu Suresh, V V Satyanarayan, "Design of ZigBee transmitter using MATLAB/Simulink", International journal of systems simulation, pp.23-28, March 2011.
- [7] Dave Auld, "Arduino Platform-Working with Shift Registers", 10Jan, 2011.

Author Profile



Nusrat Jahan Nitol received B.Sc. degree in Electrical and Electronic Engineering from American International University-Bangladesh (AIUB) in 2014. She is Cisco verified CCNA and member of Cisco Network. Her research interest includes Wireless Communication, Networking and Signal Processing.

Thamina Toma received B. Sc. Degree in Electrical and Electronic Engineering from American International University-Bangladesh, India