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Performance Assessment of Zigbee basedHome Automation System.

Chaitanya R. Pandya,
Kashish A. Pandya
B.E. Student Dept. of Electronics Engineering K.J.Somaiya College of Engineering,Vidyavihar

Jash K. Doshi
Priyank J. Amlani
B.E. Student Dept. of Electronics Engineering K.J.Somaiya College of Engineering,Vidyavihar

M.G.Kulkarni, B. P. Khedkar
Assistant Professors
Dept. of Electronics Engineering K.J.Somaiya College of Engineering, Vidyavihar , Mumbai, India

ABSTRACT

This paper present a empirical comparison study of ZigBee and Bluetooth. The parameters investigated are power consumption and distance in different environments. This study shows the differences and similarities for the two different short rang radio technologies and results obtained for physical tests done for Zigbee.

Keywords

Distance, environmental, Wireless Sensor Network.

I. INTRODUCTION

This paper presents a comparison of the wireless communication standards Zigbee and Bluetooth 2.0.How distance affects the energy consumption is an issue concerning energy consumption for 2.4 GHz based radios.

Heinzelman et. al refers to both the free space propagation model and multi-path fading when presenting the LEACH energy model to describe the relation between distance and energy consumption in [1]. Whereas Macii et. al. states that the increased energy consumption depending of distance or transmission power can be neglected when transmitting in tens of meters in [2].

Lee et. al. has in [] conducted a broad comparitive study of Bluetooth, ulra wide-band (UWB), ZigBee and Wi-Fi with regards to their transmission time, data coding efficiency, and power consumption. In [], Siekkinen et. al. investigates Bluetooth Low Energy with regards of power consumption and compares it to Zigbee.

The power consumption for Bluetooth modules has been investigated by Negri et. al. in [3] and Ekström et. al. in [4]. Hajian et. el. states that one of the main sources of energy waste are retransmission due to injury in [5]. This study aim to investigate how much distance influence the transmissions/retransmissions in terms of energy consumption as well as the additional time each transmission/retransmission will cause and also the effect of indoor urban environment and addiotionally with effect of interference caused by other ISM using protocol “WiFi”.

This paper presents the behaviour of and a Chipcon Products Texas Instruments ZigBee module depending on the transmission distance and environmental settings. A better understanding of how these parameters effects the transmissions\retransmissions and the overall energy consumption for the radio can simplify the implementations of wireless systems in real life applications.

II. BLUETOOTH BASICS

The Bluetooth system provides point-to-point connection or point-to-multipoint connections as described in [6]. Two or more devices sharing the same physical channel form an adhoc network or piconet.

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With one device acting as a master, up to seven other devices or slaves can be actively operating in the piconet. All devices in the piconet are synchronized to a common clock reference and frequency hop pattern, provided by the master. Bluetooth devices may operate in two or more overlapping piconets creating what is referred to as a scatternet. Figure 1 shows the network topology for a scatternet consisting of two separate piconets. A device can act as a master in one piconet and a slave in another or have duplicate slave roles for two different piconets. A single device may not operate as a master in more than one piconet as this would imply synchronization between the separate piconets, however a slave may act as slaves for two different piconets.

As stated in the Bluetooth specification version 2 + EDR each piconet is required to operate independently using a distinct hop pattern and master clock. Bluetooth is a technology that is suitable for short range, up to around 100 meters when using Class 1 modules, wireless sensor network applications were low power consumption is important, and where it at the same time is able to support relatively high data transfer rates up to 3 Mbit/s [7].

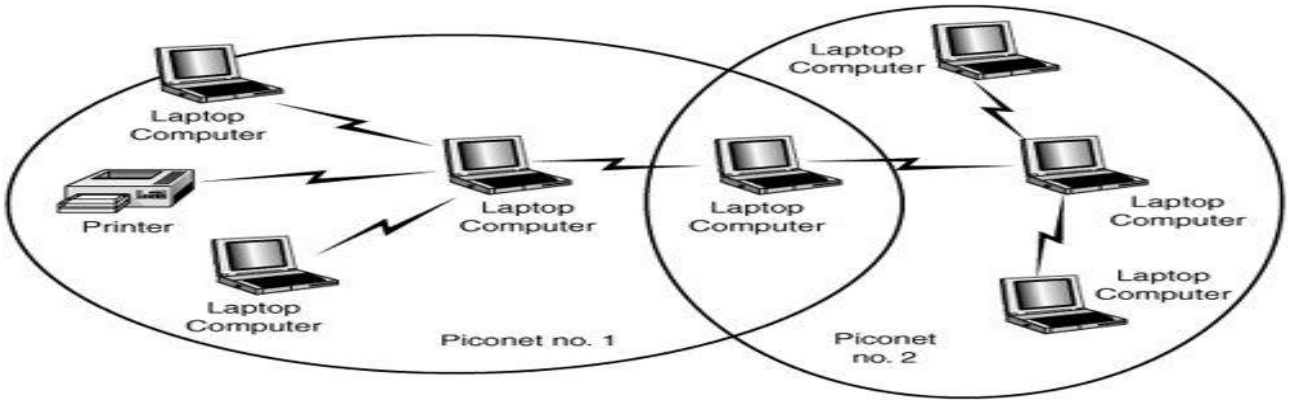

Fig. 1. Wireless Sensor Network Using Bluetooth

For class 1 devices it is mandotary to implement a power control scheme for transmission power over 4 dBm. The scheme contains a radio power table with discrete transmission power levels. If a receiving device received signal strength is to low or to high it sends a request to the device it communicates with to increase or decrease its transmission power one step in the power table. Bluetooth utilizes frequency hopping on 79 channels 1 MHz wide in 2.45 GHz band. The hop rate is 1600 hops per second. Devices has the possibility to use an adopted frequency hopping pattern where occupied freqeuncies may be excluded.

A. Sniff mode

Being a technology optimized for portable devices with constrained power resources, Bluetooth offers various power saving modes which are used to reduce the duty cycle of devices: hold, park and sniff mode. In this study the Sniff mode has been used for its low energy and wireless sensor network capabilities. The basic idea of sniff mode is to reduce the duty cycle on a link between two devices by negotiating specific slots (sniff slots) where communication between devices can begin. If no communication takes place at these slots, thedevices may spend the time until the next sniff slot in a low power mode. In case of communication activity, the communication period (sniff event) can be extended dynamically until one of the devices decides to end the communication. The other device aborts the communication if it does not receive anything on the link for a configurable amount of slots. In fact, this behaviour is specified only for the slave. However, if a master does not receive anything from a slave for some time (e.g. due to transmission errors), it has to assume that theslave has already gone back to low power state. The sniff slots are determined by the user who is able tochange the interval between the start of each sniff event or sniff peak. The interval setting is given in number of time slots. Each time slot is 625 _seconds long. Each sniff peak in this study is able to allow 1 to 5

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attempts to transmit and/or receive data. These settings can be determined by the user to adapt the radio for the specific application.

III. ZIGBEE BASICS

ZigBee is a standard based technology, not a standard itself, aimed towards low-cost, low-power sensor- and controlnetworks. The specification aim for easy implementation and self-organizing networks. The ZigBee Alliance has developed the ZigBee specification since 2002 is aimed to enhance the IEEE 802.15.4 standard by adding network, security layers and a application framework. ZigBee is build upon the PHY and MAC as it defined in the IEEE Standard 802.15.4 in 2003 [8]. The main characteristics for the ZigBee specification is:

- ZigBee uses DSSS and OQPSK with carrier sense multiple access with collision avoidance in 1 channel in 868 MHz (Europe), 10 channels in the 915MHz band (USA and Australia) and 16 channels in the 2.4GHz ISM band according to IEEE 802.15.4 [9].
- Power saving mechanisms for all device classes
- Security key generation mechanism and utilizes industry standard AES-128 security scheme
- Zigbee network layer supports multiple Star topology, Tree and generic Mesh networks.

IV. ENVIRONMENTS

The investigated environments ranges from indoors, outdoors in urban environment and outdoors on grass field. The indoor measurements were performed in two different corridors in an college space with measurements as 200 meters long and 1.8 meters wide and second residential space with 15.24 meters long and 3.81 meters wide respectively also performed were multiple floor level tests and the play ground test for length with 90 meters open space with no natural or artificial obstruction.

V. EXPERIMENTAL SETUP

This section will present the most important part of the experimental setup with Figure 2, including the parameters that influence the measurements, the environmental differences for the various setups, what parameters that will be measured and the ambient radio levels. The different settings that will have an effect on the overall power consumptionof the radio are Interval, Role and Number of attempts.

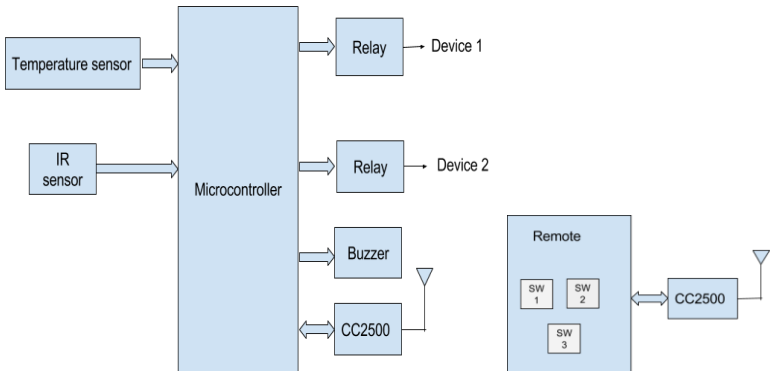

Figure 2

A. Parameters

During the experiment there are two parameters that influence the measurements and will the altered throughout the experiment. These are as follows.

1.) Distance: The distance will range from 1 meter to the maximum distance that the environment or radio allows.

2.) Effect of Wifi Hotspot : For second indoor tests the wifi hotspot is turned ON and OFF for each test with exact same parameters.

B. Measured parameters

1. Power and time characteristics for transmission
2. Distance of transmission

VI. EXPERIMENTAL RESULTS

The follow section will present the results for the different measurements described in V for all environments presented in IV

A. Corridor 1

In this section the measurement results for Corridor 1 is presented. Here as we go on increasing the distance from 1 meters upto 10 meters we obtain an error free instant exchange of data. After which obstacles such as closed doors and window glass were used as obstacles to achieve the same upto 10 meters; beyond which communication was not possible as only one Zigbee node was used to communicate with the FFD device. As the distance increased beyond 10 meters the communication was not possible.

B. Corridor 2

In this section the measurement results for Corridor 2 is presented. Here in these corridor multiple tests were carried out such as wall mounted zigbee device receiver connected exactly next to WiFI Hotspot device by TP Link TL-WR740N 150Mbps Wireless N Router with 5dBi external antenna (which was turned ON and OFF to get the results with and without WiFI interference which operates in the same ISM band of 2.4 Ghz). Again we obtained the same results but with escalated distance upto 14 meters with multiple wall and wodden obstructions also tested with transmitter and receiver on different floors (with Transmitter on floor two and Receiver on floor three).

C. Outdoors

In these scenario the distance upto 20 meters were covered by Zigbee Tx. And Rx. Placed at Line Of sight to eachother.

VII. CONCLUSION

Comparing the two different environments. The indoors measurements for the ZigBee module resulted in that no packet-errors were detected. This means that the there is no change in power consumption due to distance for the ZigBee module. The ambient noise interference for both corridors is similar with a pectrum analysis that could be explained with the WLAN traffic. The outdoor measurements for the Zigbee module show that the maximum range differs for the different environments. The open playground field has a maximum of 13 meters whereas the urban environment has a range of 15 meters. For both Bluetooth and ZigBee modules in this study the distance itselfhave no influence of the power consumption. However theretransmission rate and packet-error-rate have a large influenceon the power consumption. This study have shown that theenvironments have a great impact on the range of the radiomodules and the behaviour concerning the retransmission rate.

REFERENCES

[1] W.B. Heinzelman, A.P. Chandrakasan, and H. Balakrishnan. An application-specific protocol architecture for wireless microsensor networks. Wireless Communications, IEEE Transactions on, 1(4):660–670, Oct 2002.

[2] D. Macii, A. Ageev, and L. Abeni. An energy saving criterion for wireless sensor networks with time synchronization requirements. In Industrial Embedded Systems (SIES), 2010 International Symposium on, pages 166 –173, july 2010.

[3] L. Negri, J. Beutel, and M. Dyer. The power consumption of Bluetooth scatternets. In Consumer Communications and Networking Conference, 2006. CCNC 2006. 3rd IEEE, volume 1, pages 519–523, Jan. 2006.
[4] M.C. Ekstrom, M. Bergblomma, M. Linden, M. Bjorkman, and M. Ekstrom. A bluetooth radio energy consumption model for low-duty-cycle applications. Instrumentation and Measurement, IEEE Transactions on, 61(3):609 –617, march 2012.
[5] Elham Hajian, Kamal Jamshidi, and Ali Bohlooli. Improve energy efficiency routing in wsn by using automata, june 2010.
[6] Cambridge Silicon Radio. Bluecore scatternet support, 2006. http://www.CSR.org.
[7] Bluetooth SIG. Bluetooth specification version 2.0 + enhanced data rate, 2006.
[8] ZigBee Alliance. Zigbee technology. http://www.zigbee.org/ About/AboutTechnology/ZigBeeTechnology.aspx. Online; accessed 6- October-2012].
[9] Ieee standard for information technology - telecommunications and information exchange between systems - local and metropolitan area networks specific requirements part 15.4: wireless medium access control (mac) and physical layer (phy) specifications for low-rate wireless personal area networks (lr-wpans), 2003.