

X-bee Based Spy Robot with Night Vision Camera

Ashish Zade, Priyanka Rahangdale, Akshay Giri

Abstract- Latest studies in the development of wireless sensor networks have achieved a significant attention on a world level. These consist of small sensors with limited power which consumes very less power and also require limited resources. One of these very well-known standards are ZigBee which has been developed to focus on low cost of deployment, low complexity and low power consumption. ZigBee defines the higher layer communication protocols built on IEEE 802.15.4 standards. This paper provides a review on ZigBee technology, its characteristics, its alliance, its access methods, devices and topologies supported by ZigBee. The most important part of this paper is the protocol architecture of ZigBee and its application in Spy Robot with night vision camera.

Its wireless sensor and actor network builds an information bridge for the components in the intelligent space, the spatially distributed devices are connected together seamlessly. With this network, robot can share the mass information in the intelligent space and improve its performance with “light-packs”, devices in intelligent space, in defense, spy robots with night vision camera etc.

Index Terms- Wireless sensor networks, ZigBee, Intelligent Space, Home Service Robot, Spy Robot, and Night Vision Camera.

I. INTRODUCTION

In this technology driven world every day we see a new technology taking birth and some innovating applications enabling the human life with lot of ease. This paper is basically to highlight the ZigBee technology which has got tremendous application in security applications in defense or commercial robots where a robotic vehicle is equipped with wireless camera with night vision capability. It can also be used for spying purposes. The camera is capable of storing or transmitting real time night video. In March 1999, IEEE establishes the 802.15 working group as a part of IEEE Computer Society’s 802 local and metropolitan Area Network Standards Committee. Motive of this group is to develop standards for short wireless network, known as Wireless Personal Area Network-WPAN.

IEEE devices are designed to support the physical and data link layer protocols and ZigBee defines the higher layer communication protocols built on IEEE 802.15.4 standards. The basic structure of ZigBee protocol stacks is shown in **figure 1**. ZigBee specification has network layer and the application layer and some where it has the security services too. It is different from other approaches, like Wi-Fi that

offers more bandwidth and consumes more power. The prominence is on low cost communication between the nearby devices having no infrastructure, aims to utilize this low power consumption.

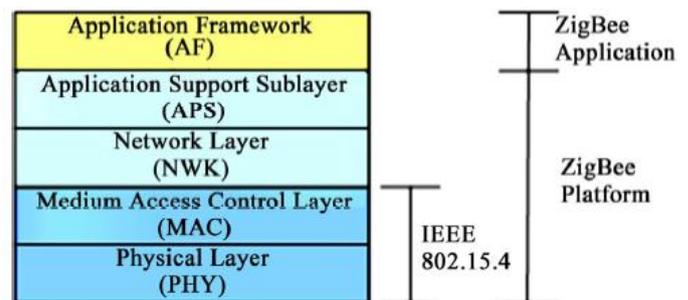


Figure1. Structure of ZigBee protocol stack

Wireless sensor network, the key point in information acquisition and command transmission, is one of the most important technology for intelligent space. It has attracted substantial attention. Distributed intelligent network device proposed by Hashimoto is one of the earliest network to implement an intelligent space using network devices. How to build a communication network which is high reliable and easy to be built is very important technology in the intelligent space oriented to home service robot. ZigBee technology has the characters of lower speed, lower power and less complexity, it is adopted to build wireless sensor and actor network to transfer the environmental sensor data, the intelligent space commands and their feedback, so that the intelligent space and service robots can be closely connected. In the **figure 2** it is illustrated that how an inner network is connected to external network through the server. This is the basic module which can be used in various applications in commercial as well as space or defense security.

II. ZIGBEE TECHNOLOGY

As far as wireless control and monitoring technology is concerned there are many technologies and their applications in home environments, for commercial purposes, industries and few has got very important role in space or defence industry. These applications needs lower data rates, longer battery life and lower complexity than the existing standards. For these type of wireless applications, a new standard has been developed by IEEE which is called ZigBee or IEEE 802.15.4. In order to fulfil the demand of consuming low power and low speed in wireless communication devices, a new wireless technology ZigBee comes as per the requirement of time. ZigBee is named for erratic zigzagging patterns of bees between flowers which symbolizes communication between nodes in a mesh network. Network components of ZigBee are analogous to queen bee, drones

Ashish Zade, Electronics Engineering, Priyadarshini College of Engineering, Nagpur, India

Priyanka Rahangdale, Electronics Engineering, Priyadarshini College of Engineering, Nagpur, India

Akshay Giri, Electronics Engineering, Priyadarshini College of Engineering, Nagpur, India

and worker bees. This communication dance (The ZigBee Principle) is what engineers are trying to emulate with this protocol a bunch of separate and simple organisms that join together to tackle complex tasks.

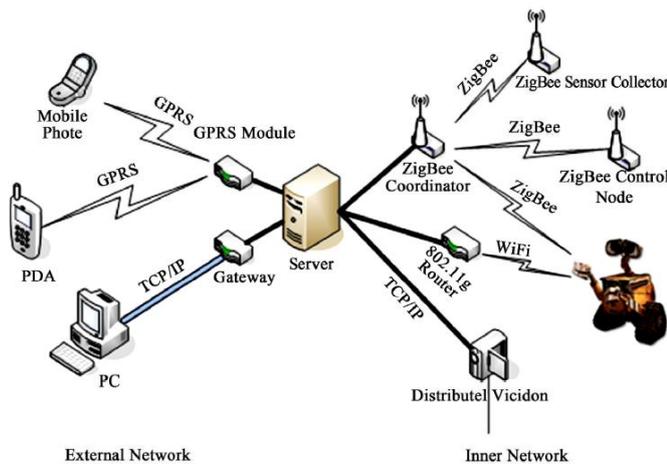


Figure 2. Heterogeneous network in intelligent space system.

III. TECHNOLOGY INTERFACE

A. Microcontroller ATmega16

Standard for a microcontroller based low cost platform. It consists of an Atmel ATmega16 is a low power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU) allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Selectable power saving modes, the idle mode stops the CPU while allowing the USART, two wire interface, A/D converter, SRAM, timer/counters, SPI port and interrupt system to continue functioning. The specific applications of war field spying robots may use AT89S52. It is an 8-bit microcontroller of 8051 series with 8K bites of In-system programming flash memory.

B. Fusion of RFID and ZigBee

One of the main tasks of service robot is to provide different kinds of services to persons in complex indoor environment, such as delivering water or medicine. So the robot must have the ability to search the target and recognize the target autonomously. In intelligent space, robot can finished the task successfully with the help of distributed intelligent device in the space and on-board sensor of the robot. RFID (Radio Frequency Identification) and ZigBee technology are very important for the actuating of the task. The principle of object search for the robot based on the fusion of RFID and ZigBee is shown as **Figure 3**.

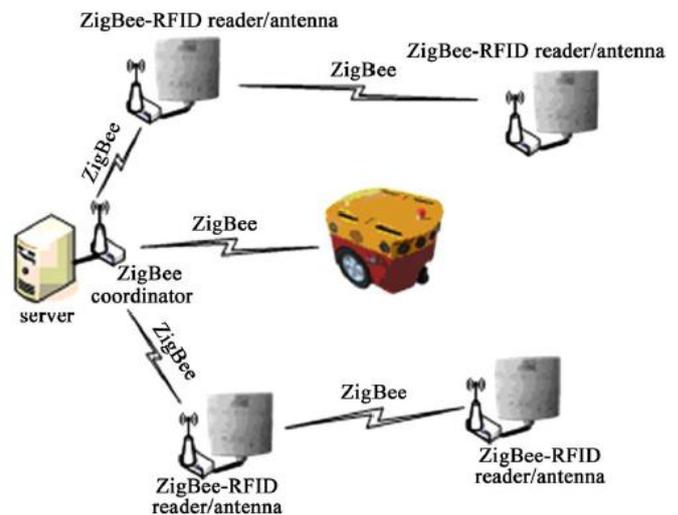


Figure 3. Object Search Based on ZigBee-RFID

The robot will send control command to the server in the intelligent space when it needs to search and locate an object. Sever will look for the ZigBee nodes which connect with the RFID reader and send the command to these nodes, then the ZigBee terminal node will control to turn on the RFID reader and RFID antenna. When RFID antenna finds the tag which is attached on the object, RFID reader will send the RFID tag information to the ZigBee terminal node through serial port. ZigBee terminal node will add its physical address to the RFID tag information, and transfer this information to sever by ZigBee wireless sensor network and server will transfer this information to the robot. Robot can complete the object search according to the information. The program flowchart is show in **Figure 4**.

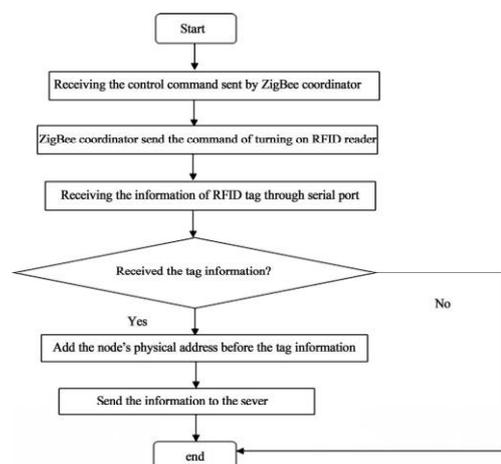


Figure 4. Flowchart of program.

IV. NIGHT VISION WIRELESS CAMERA

We are using a wireless CCD camera, which are commonly available in the market. This camera works on 12 volts DC supply. The camera has a receiver, which is placed in the remote station. Its output are in the form of audio and video signals. These signals are directly sent to a television or a computer through a tuner card. This CCD camera is placed on the robot. The camera captures the audio and video signals and sends those signals to the remote station and with the help of the camera receiver which is connected to the television or

a computer through we will be able to see the captured signals. This is a mini wireless monitoring video camera and wireless receiver set for home and small business surveillance, security and is used by us for demonstration purpose. We need to install the wireless camera in the room where we want to monitor and set the wireless receiver in the next room (up to 15 meters away) and hook it up to a TV or DVR to watch the action or record the footage for the security purpose. Here we are placing this wireless camera in the combat robot which would be present in the war field.

adding effects such as normalizing, trimming fading in and fading out.

V. RESULT

1. Import Audio

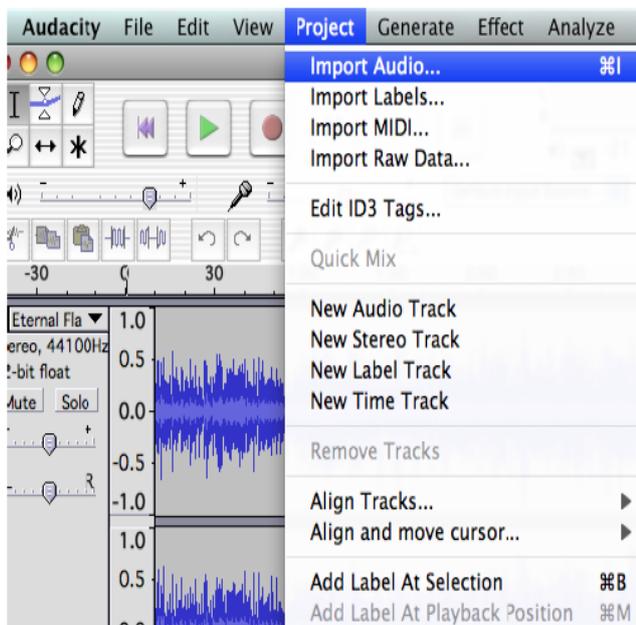


Figure 5. Importing Audio

2. Isolate the quiet moments

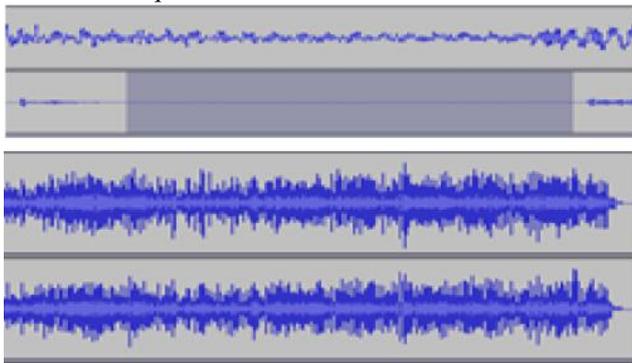


Figure 6. Isolating quiet moments

3. Get Noise Profile

With the help of this we targeted the accuracy and it has been achieved. Our design has not caused any sort of disturbances and worked as it meant for. This robot will move based on the motor direction depending upon the input given through command via remote section unit. With the help of camera it can view the things that are happening in the war field where the robot is hidden. The importing and exporting features of 'AUDACITY' in this project have helped to remove the unwanted audio signals. By using this software we can post process all type audio including broadcast by

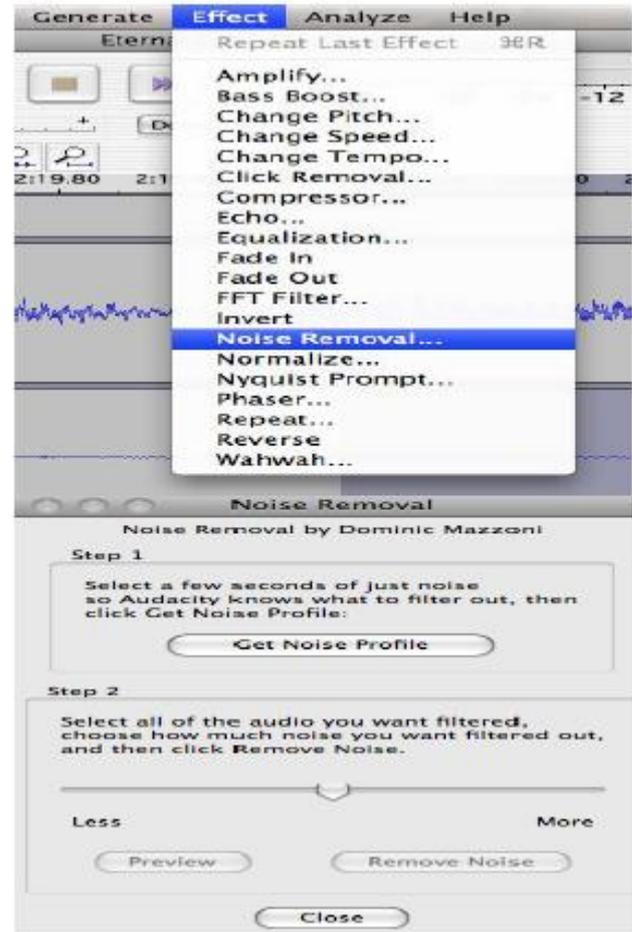


Figure 7. Noise Profile

VI. ADVANTAGES AND APPLICATIONS

Spy Robots can be used for space aircrafts, spying on people in a ways where normal humans can't reach, going far down into the unknown waters where humans would be crushed etc. They can be used to get crucial, confidential information that humans couldn't get. Very important and interesting part is they work at places 24*7 without any salary and food where don't get bored. They can capture moments just too fast for the human eye to get.

Because of efficient throughput of ZigBee and the rate of data transfer which is about 250 Kbps, it is used in wide range of applications like;

- Home automation and control.
- Automatic meter reading.
- Building automation.
- Personal health care.
- Fitness monitoring.
- Home gym.
- Hospital and industrial.
- Patient monitoring.
- Cable replacements.
- Status monitoring
- Telecom services.

- ZigBee based multilevel parking vacancy monitoring system.
- Design of intelligent warehouse measure and control system based on ZigBee based wireless sensor networks.
- Design of greenhouse monitoring and control system based on ZigBee based wireless sensor networks.
- Application of ZigBee based wireless sensor networks in environmental monitoring.
- Vehicle control; vehicular and entertainment.
- Residential and commercial utility system.

VII. FUTURE SCOPE OF SPY ROBOT

The military forces always tried to use new gadgets and weapons for reducing the risk of their casualties and to defeat their enemies. With the development of sophisticated technology, it mostly relies on the high tech weapons or machinery being used. Robotics is one of the hot fields of modern age in which the nations are concentrating upon for military purposes in the state of war and peace. They have been in use for some time for demining and rescue operations but now they are under research for combat or spy missions. Today's modern military forces are using different kinds of robots for different applications ranging from mine detection, surveillance, logistics and rescue operations. In the future they will be used for reconnaissance and surveillance, logistics and support, communications infrastructure, forward-deployed offensive operations, and as tactical decoys to conceal maneuver by manned assets. In order to make robots for the unpredicted cluttered environment of the battlefield, research on different aspects of robots is under investigation in laboratories to be able to do its job autonomously, as efficiently as a human operated machine can do. Latest techniques are being investigated to have advanced and intelligent robots for different operations. The robots that are under investigation in laboratories for future military operations. These robots are under investigation for autonomous and cooperative environment. We focus our attention on the uses of robots in war and peace as well as their impact on society.

VIII. CONCLUSION

The IEEE 802.15.4/ZigBee protocol stack gives a practical application solution for low data rate, low cost and low power dissipation characteristics of WSNs. This paper gives all over details of the ZigBee technology. ZigBee is a technology designed by ZigBee alliance which offers various characteristics like low power consumption, advanced security services, full mesh networking etc. ZigBee offers two types of access methods; beacon enabled and non-beacon enabled and supports three types of ZigBee devices. It supports three network topologies. Protocol stack of ZigBee is given in this paper with sufficient details. ZigBee has its applications in various fields which require low data rate and low power consumption. The prominence of this technology is on low cost communication between the nearby devices having a little or no infrastructure, aims to utilize this low power consumption. In terms of the application where we did study we have been able to view the things accurately, the design has not caused any sort of disturbances. The robot

moved depending on the motor direction based upon the input given through command by remote section unit. With the help of the camera we could see the things that are happening in the surrounding area where the robot is hidden. By keeping the circuit easy and simple, most users will be able to use it easily. The demo robot couldn't be used for long range applications but yes the technology interface between ZigBee and Wireless camera can be used in wide range of applications as mentioned.

IX. ACKNOWLEDGEMENT

The authors wish to thank the faculty from the Electronics Engineering department at Priyadarshini College of Engineering, Nagpur for their continued support and feedback. The authors are thankful to Department of Electronics Engineering for technical help in doing this work.

REFERENCES

- [1] Aamir Shaikh and Siraj Pathan, "Research on Wireless Sensor Network Technology," International Journal of Information and Education Technology, Vol. 2, No. 5, October 2012.
- [2] Nisha Ashok Somani and Yask Patel, "ZIGBEE: A LOW POWER WIRELESS TECHNOLOGY FOR INDUSTRIAL APPLICATIONS," International Journal of Control Theory and Computer Modelling (IJCTCM) Vol.2, No.3, May 2012.
- [3] Patrick Kinney, "Communications Design Conference," October 2003.
- [4] Yi Sun, Yue Sun, Peng Xu, Haocheng Liu, "Performance Analysis of Wireless Sensor Network Based on OPNET," Communications and Network, vol. 5, pp. 512-516, 2013.
- [5] Kuldeep Vats, Puneet jain, Lovish jaiswal, sumer singh, "ZigBeebased WSN Topology Simulation Investigation and Performance Analysis using OPNET", International journal of advanced scientific research and technology, vol. 3, issue 2, ISSN 2249-9954, 2012.
- [6] Yasvinder Rana¹, Vikram Nanda², Kuldeep Vats³, Ravinder Kumar, "IEEE 802.15.4 based Investigation and Simulation Evaluation of ZigBee Tree and Mesh Topology using Different QoS", International Journal of Computer Science and Mobile Computing, vol. 6, pp. 922-932, 2014.
- [7] Mr Lokesh Mehta, Mr. Pawan Sharma "Spy Night Vision Robot with Moving Wireless Video Camera". International journal of research in engineering technology and management (IJRET), 2014.
- [8] IEEE xplore <http://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=spyrobot&x=0&y=0>.
- [9] J.-S. Lee, Y.-W. Su and C.-C. Shen, "A Comparative Study of Wireless Protocols: Bluetooth, UWB, ZigBee, and Wi-Fi," *Proceedings of 33rd Annual Conference of the IEEE Industrial Electronics Society*, Taipei, 5-8 November 2007, pp. 46-51.
- [10] D. Y. He, "The ZigBee Wireless Sensor Network in Medical Care Application," *International Conference on Computer, Mechatronics, Control and Electronic Engineering*, Changchun, 24-26 August 2010, pp. 497-500.
- [11] E. Callaway, P. Gorday, L. Hester, *et al.*, "Home Networking with IEEE 802.15.4 Developing Standard for Low-Rate Wireless Personal Area Networks," *IEEE Communications Magazine*, Vol. 40, No. 8, 2002, pp. 70-77. doi:10.1109/MCOM.2002.1024418
- [12] K. Gill, S.-H. Yang, F. Yao and X. Lu, "A ZigBee-Based Home Automation System," *IEEE Transactions on Consumer Electronics*, Vol. 55, No. 2, 2009, pp. 422-430. doi:10.1109/TCE.2009.5174403

Ashish Zade – Professor in Priyadaeshini College of Engineering, Nagpur (Electronics Branch)

Priyanka Rahangdale- Final Year student from Priyadarshini College of Engineering, Nagpur (Electronics Branch)

Akshay Giri-- Final Year student from Priyadarshini College of Engineering, Nagpur (Electronics Branch)