RESEARCH ARTICLE OPEN ACCESS

A Brief Review on Wireless Sensor Network Technologies

D.L.Mythri ,Jogi Naidu Kuriti
[1,2]Assistant Professor, Department of Electronics and Communication Engineering, Dadi Institute of Engineering and Technology, Anakapalli, Jawaharlal Nehru Technological University Kakinada.

ABSTRACT
As wireless sensor technology improves; an increasing number of organizations are using it for a wide range of purposes. ZigBee technology is a new standard in wireless personal garea after Bluetooth. After an introduction to this technology, a new wireless meter-reading system based on ZigBee protocol has evolved. This system, which is comprised of ZigBee network and database management system, has many important advantages such as low cost, low power consumption, and low date rate. Wireless Sensor Network based on ZigBee technology is a wireless network which is composed of many nodes of ZigBee RF chip, sensor and MCU, especially suitable for application of the remote monitoring system in flammable and explosive environment. Fusion of RFID and Zigbee is also possible which turn out to be boon for wireless sensor network technology. A complete overview of wireless sensor network technology is given in this paper. Wireless sensor network technology has become one of technological basic needs of us.

Keywords: Bluetooth, Wireless Sensor Networks, Networks, Protocol, RFID.

Date of Submission: 02-12-2017 Date of acceptance: 08-01-2018

I. INTRODUCTION

With the development of network and communication technology, the inconvenience of wiring is solved with WSN into people's life; especially it has wide perspective and practicability in the area of remote sensing, industrial automation control, and domestic appliance and so on. WSNhas good functions of data collection, transmission, and processing. It has many advantages compared to traditional wired network, for example, convenient organizing network, small influence to environment, low power dissipation, low cost, etc. At present, near field wireless communication technology has been used widely, especially Bluetooth, wireless local area network (WLAN), infrared, etc. But, they have a number of disadvantages, for example, complexity, large power dissipation, short distance, networking in small scale. In order to satisfy the demand of low power dissipation and low speed among wireless communication devices, a new type of wireless net technology-Zigbee emerges as the times require. In this paper, we will introduce the networking technology and application of Zigbee. How Zigbee & RFID combination can be used in applications. In this paper first Zigbee is explained, then its advantages application and finally its fusion with RFID along with applications is discussed.

ZigBee is new wireless communication technology with Short distance, low complexity, low energy consumption, slow data rate and low cost, and it is based on IEEE 802. 15.4 Standard with the capacity of coordinating mutual communication among thousands of tiny sensors [1]. Through the radio waves, these sensors can transmit the data from one sensor to another with small energy cost and high efficiency. Compared with various existing wireless communication technology, ZigBee technology has the lowest energy consumption and cost. Because of the slow data rate and the small range of communication, ZigBee technology is extremely suitable for agricultural field which has small amount of data flows. The technical features of this technology also make it the best choice for wireless sensor networks. Therefore, it has the practical significance when applied in the crop environmental monitoring system [1], [2].

II. BACKGROUND:

2.1. Bluetooth: Bluetooth is an open wireless technology standard for transmitting fixed and mobile electronic device data over short distances. ... A variety of digital devices use Bluetooth, including MP3 players, mobile and peripheral devices and personal computers.

2.2. Wireless Sensor Networks: It is spatially distributed autonomous sensors to *monitor* phys ical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to main locations.

2.3. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

2.4. Networking Protocol: Network protocols are formal standards and policies comprised of rules, procedures and formats that define communication between two or more devices over a network. Network protocols govern the end-to-end processes of timely, secure and managed data or network communication.

2.5. RFID: Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked.

III. RELATED WORK

Literature Survey:

ZigBee has the following features. ZigBee uses a variety of power-saving modes to guarantee that it could be used for at least six months to two years powered by two AA batteries. ZigBee uses the avoidance collision mechanism in CSMACA and pre-set a prior particular time slot for a fixed bandwidth communications service in order to avoid competition and conflict when sending data. MAC layer adopts a fully confirmed data transport mechanism, and each packet sent by the receiver must wait for confirmation [3]. Zigbee has self-organizing features that one node can sense other ones without any human interventions, and connect with each other automatically to create a completed network. It also obtains self-recovery function that the network can repair itself when a node is added or deleted, the position of a node is changed, or a breakdown occurred. It also can adjust the topology structure to ensure that the whole system can work normally without any human interventions.

BASIC NETWORK STRUCTURES

Zigbee supports multiple network structures, which mainly include star, tree, and mesh network, shown in Fig. 1.They are composed of the Coordinator, the router, and the end device. The Coordinator and the router need full function (FFD), but the end device could select either full function device (FFD) or reduced function device (RFD). RFD is only used to acquire data information and transmit the information to its parent node; it is not used to finish the work such as data transmission, route discovery, and route maintenance [2].

The responsibility of RFD is used for building a new network, transmitting network beacon, managing nodes in the network, and storing network information, etc. Star network is composed of a Coordinator and an end device or multiple end devices, the end device could only communicate with Coordinator, it cannot communicate with end device, so star network is called single-hop network. The tree network and mesh network have routing function, so they are called multi-hop network.

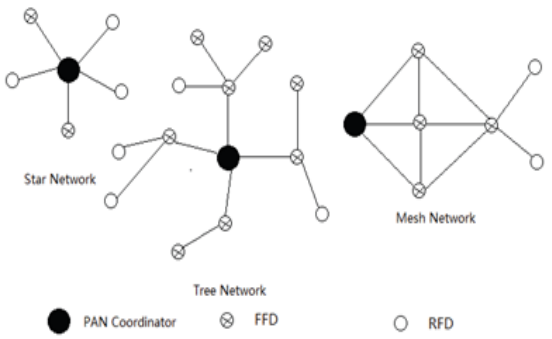


Figure 1. The architecture of Zigbee network.

ZigBee Protocol Suite

ZigBee standard uses hierarchically structured. ZigBee does not exactly fit the OSI 7-layer networking model, but it does have some of the same elements, including the PHY (physical), MAC (link layer), and NWK (network) layers. The Alliance focuses on the specification of the upper layers of the protocol stack (from network to the application layer), as the IEEE 802.15.4 protocol specifies the Medium Access Control (MAC) sub-layer and physical layer for LRWPAN [4]. Fig. 2 shows the frame structure adopted by the alliance.

IV. ENVIRONMENT REMOTE MONITORING SYSTEM ARCHITECTURE

System structure shown in Fig. 3, the entire system by monitoring the host, GPRS module (or, a ZigBee coordinator node, a number of ZigBee routers, ZigBee node and a number of nodes of terminal equipment. This is a cluster tree network structure is conducive to the number of network nodes and the physical expansion of the scope, complex, multi-node wireless network communication system is also an important reference value. Fig. 3 Structure of the framework of remote monitoring system. The coordination of the network nodes, network management functions, the receiving terminal device node for the data upload, and transfer through the GPRS network to the monitoring center. Router nodes for routing of

information, transmitted, allowing other nodes join the network.

Node device to the network coordinator from time to tim collect information to send and receive commands from the monitoring host. ZigBee module used for GPRS networks and Internet networks, the Internet (also available in other ways), the realization of ZigBee network data to monitor the upload and download the host commands. Host real-time monitoring of the collection, storage, monitoring and processing equipment from a remote terminal nodes of information, and can overrun the police at any time, such as setting parameters for the production environment to achieve effective monitoring and management, its functions are divided into two major parts, Data Monitoring: to receive from the ZigBee network information collected, the corresponding data into the database; to receive instructions from the managers, and command frame format in accordance with the configuration commands, GPRS module through the command issued to the ZigBee network and do the action[3], [4].

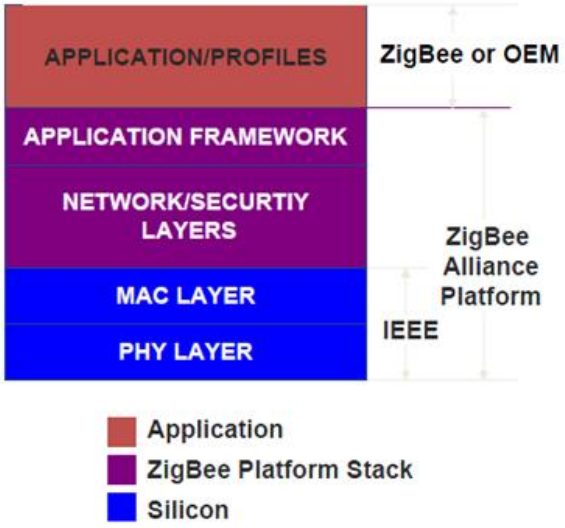
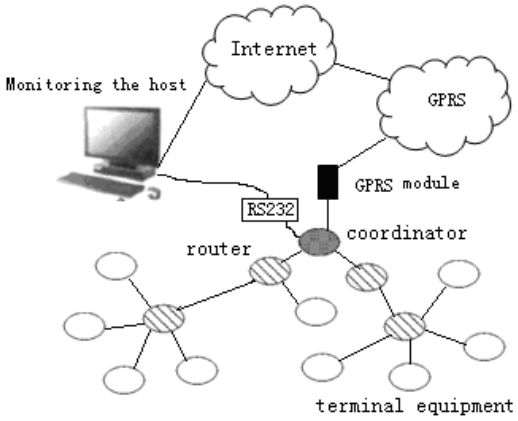


Fig. 2. IEEE820.15.4/ZigBee protocol stack architecture

Data Management: The database can be found, query data from the current ZigBee network information, such as: the production of the ambient temperature, pressure, overrun alarm, such as the peak period. ZigBee end-node using the occasional wake-up call from time to time work, time to wake up from hibernation to start data acquisition, ZigBee routing node to send a message, send completed and then enter hibernation. ZigBee routing nodes will collect the data sent to the ZigBee coordinator node, gateway GPRS module through the data uploaded to the remote monitoring center.



THE FUSION OF RFID AND ZIGBEE

RFID is a non-contact automatic identification technology that uses radio frequency signals automatic recognizes target and access to relevant data. The identification work does not require human interference and can work in variety of harsh environments. But if there is no network to transmit data, it will be difficult to play its advantage. Under the influence of environmental conditions, the traditional wired network may not be a better way to achieve.

The feature of wireless sensor network is no center and self-organize, it is a powerful complement of RFID, and can solve the drawback of poor anti- interference, the effective transmission distance short. Based on the ZigBee technology and the RFID technology of information-fusion technology: the former used to monitor the target environment conditions, the latter used to identify target objects. Complementary and interdependent of the technology can effectively solve the problem of RFID data transmit in the mine and can also better perceive the safety hazard exists in coal mine **[4], [5].**

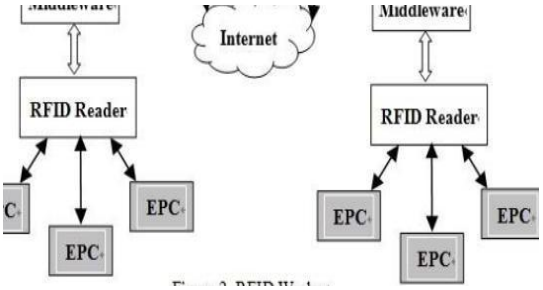


Fig. 4. The fusion technology of wsn and RFID

Base on the Integration of WSN and RFID Technology to Solve the Problem of Mine Safe

The combination of ZigBee wireless sensor networks and RFID technology, make up for the drawback of short transmission distance of the RFID which can also solve some of the following problems.

1) **RFID data transmission problem**: GIS and RFID to achieve the separate wiring problem of personnel location under the traditional way; Because of geographical complexity of the mine, bad environment, wired connections will cause the data route in the mine complex and redundant and data lines will be influenced by poor environments to rotten skin, breaking leading to data transfer instability.; and effective data are collected precisely to ensure personnel safety of important security; relying on wireless sensor networks to transmit data, security, high reliability and eliminating the need for separate wiring problems, reducing input costs.

2) **Personnel positioning problem**: The combination of RFID technology and GIS, can solve based on ZigBee technology the personnel positioning inaccuracy of the problem; Under the ZigBee technology to realize personnel positioning mode, Personnel to wear the positioning of a ZigBee module which regularly sent the existed information, the sensor node which distributed in mine roadway to receive this signal, according to signal strength to determine its location ;

When the mine tunnel barrier is greater, the existed signal attenuation occurs during transmission, detection accuracy of sensor nodes will be reduced or even fail. And when the network transmission links due to the malfunctioning of a node failure, the data will not reach the ground control center. Using RFID technology, Anti-pollution features of the electronic tag and the reader transmission and the diffraction function, to minimize the environmental impact of geography; with GIS analysis of the surrounding environment, truly accurate personnel positioning. And when the mine accidents occur, RFID tag will bring help to rescue; use of handheld devices that have targeted the location of facilities, staff side edge detection rescue, relief to improve greatly [6].

3) **Under the mine the personal safety of staff problem**: Implantation of clothes in the wireless data receiver can be realized well into the double protection of personnel; it apart from the ground control center received a warning message sent over in addition to the autonomy of the receiving sensor node detection data; when the data transmission is not stability or failure of data link control center to send the correct data can't be reached, it still can be achieved well into the safety of the personnel on alert [7].

V. APPLICATIONS OF WSN

Zigbee wireless communication technology has wide perspective, Zigbee will be used in a couple of years in the area of industry control, industrial wireless location, home network, building automation, medical equipment control, mine safety, etc, especially home automation and industry control will be the main application fields. Zigbee wireless communication is applied in families.

With the development of people's life, the concept of smart home and home automation is well known, but it must relate to the transmission of information and signal if it comes true, so it is troublesome to wire cables. Zigbee is a new short-range technology for wireless communication, it is specially designed for applications of wireless communication of low speed and low power dissipation, and it is ideally suited for establishing family wireless net.

It is effortless to realize home temperature regulation, remote control of interior lighting systems, and automatic adjustment of curtain. Zigbee wireless communication technology is applied in meter reading system in the monitoring center just needs to analyze and calculate data acquired from users and obtain electricity consumption of users. After that, electric charge of the month is deducted from electricity account of users, the workers who is obliged to read the meter in user's home, the thing that users are not at home when workers are to read the meter is avoided[8].

Compared to working expediently for workers, it is the most important to be used in safety. introduces an experimental home security monitoring and alarming system based on Zigbee technology, it is capable of monitoring door and window magnetic contact, smoke, gas leak, water flooding, providing simple controls such as turning off the valves, and sending the alarms to the residential area security network, etc. Zigbee wireless communication technology is applied in factories or enterprises. It is applied in information system of coal preparation enterprises in, all kinds of disadvantages of traditional cable network system are avoided by coal preparation enterprises, it highly improves the level of information automatic, automation, and management[9].

Zigbee wireless communication technology is applied in ARM NC system network in Experimental results showed that the improved method can guarantee the processing efficiency of NC system with satisfied accuracy and data transmission speed. Aiming at substation perimeter safety, a novel laser alarm system based on Zigbee is proposed in. It consists of laser railing security subsystem and data central monitoring subsystem, the communication between the two subsystems is realized by Zigbee wireless technology, a real-time

human-machine interface can be provided for worker.

Zigbee wireless communication is applied in mine. Aiming at improving safety of production and staff safety, Zigbee technology is applied in the Miner's Lamp Monitoring in.This system can realize underground staff orientation and achieve monitoring and control of the state of charge on the miner's lamp, and the high effective control and management on use of miner's lamp [10]. Utilizing the underground existing net and the extension Zigbee nodes, the system also can be more easily increased the humidity, gas and other sensors, to achieve mine environmental monitoring, ensure safety in production, the improved method has been researched in Zigbee has been widely used in many areas due to the advantage of low power consumption and low cost, it is good for wide-scale application.

But there are some problems now, the coordinator carry too much nodes, especially in the large scale wireless sensor network, it is necessary to result in bad real-time, data packet loss, and stability decrease; also, there are some places where it is difficult for humans to change the batteries of nodes, or there is a fairly large number of nodes which is troublesome to change presents an improved design, the coordinator only deal with the task on the Zigbee network, the rest tasks will be processed by another processor. Prolonging the lifetime of the Zigbee network is the important goal of designing the Zigbee routing protocol. An energy-aware routing mechanism EA-AODV is presented in it can save energy and improve the performance of Zigbee network.

Zigbee wireless communication technology is applied in container Information system in the paper presents the strategy of networking and routing in order to keep energy load balancing between network nodes, prolonged the lifetime of node and network effectively. It is highly necessary to research these respects. ZigBee technology is a new standard in wireless personal area after Bluetooth. After an introduction to this technology, a new wireless meter- reading system based on ZigBee protocol is possible. This system, which is comprised of ZigBee network and database management system, has many important advantages such as low cost, low power consumption, and low date rate [9], [10].

VI. CONCLUSION AND FUTURE WORK

As a new wireless protocol in personal area, ZigBee has its unique characteristics including low cost, low data rate, and low power consumption which corresponds to a large market. This paper provides an application in the field of building automation. The fusion of two emerging technologies -- WSN and RFID that can give full play to the advantages of both technologies complement each other. It provides more reliable technique protection on the coal mine environmental monitoring and has great significance in China Mine safety.In this paper wireless sensor network technology is dicussed along with application and it is clear that WSN proves to be emerging technology.

REFERENCES

[1] D. Cox, E. Jovanov, and A. Milenkovic, "Time synchronization for ZigBee networks," in *Proc. of the Thirty-Seventh Southeastern Symposium, System Theory,* pp. 135-138, 2005.

[2] *Wireless Medium Access Control (MAC) and Physical Layer Specifications for Low Rate Wireless Personal Area Networks (LR-WPANS),* IEEE standard for Information Technology-Part 802.15.4- 2003.

[3] *Wireless Medium AccessControl (MAC)and Physical Layer (PHY) Specifications for Low–Rate Wireless Personal Area Net2 works (LR- WPANs),* IEEE Standards 802.15.4TM-2003.

[4] *Wireless Medium Access Control (MAC) and Physical Layer(PHY) specifications for low———Rate Wireless Personal Area Networks (LR - WPANs),* IEEE 802. 15. 4.

[5] W. LI, et al, *Introductory and actual combat of Zigbee wireless networks*, Beijing University of Aeronautics And Astronautics Press, April 2007.

[6] *Zigbee Specification,* Zigbee Alliance, June, 2005.

[7] J. Shen and L. Hao, *Zigbee MCU Principal and Application based on STM32W Radio Frequency*, Beijing University of Aeronautics And Astronautics Press, September 2010.

[8] W. Zhang, L. Feng, and Z. Wen, "Research on home networking with Zigbee," *Journal of Hefei University of Technology*, vol. 28, pp. 755- 759, 2005.

[9] Y. Wang and G. Shen, "ZigbeeWireless Sensor Network Technology and Application," *Ship Electronic Engineering*, 10th ed, vol. 28, pp. 32-34, 2008.

[10] Y. PENG, LI Yingli et al, "Method for Saving Energy in Zigbee Network," WiCom' 09. 5th International Conference on, pp. 1-3, 2009.

Author Profiles:

D.L.MYTHRI working with Dadi Institute of Engineering & Technology (DIET) - Anakapalli, affiliated with Jawaharlal Nehru Technological University-Kakinada. She is completed Bachelor of Technology in ECE from JNT University, Kakinada. She is completed in Master Degree in ECE from JNT University, Kakinada, and Andhra Pradesh, India.

She has 5 years good teaching experience with taught various subjects on good knowledge on EDC,OC,Pulse and Digital Circuits(PDC), Embedded Systems(ES), Microprocessors and Microcontrollers(MP &MC), Cellular And Mobile Communications, VLSI and along with ECE subjects and published 3 research papers in reputed International and national level conferences\Journals\Magazines, She attended 2 conferences, 4 workshops. She is Participated and active member in academic, curriculum and administrative works in existing resources Organization.

JOGI NAIDU KURITI working with Dadi Institute of Engineering & Technology (DIET) - Anakapalli, affiliated with Jawaharlal Nehru Technological University-Kakinada. He is completed Bachelor of Technology in ECE from Biju Patnaik University, Odisha. He is completed in Master Degree in ECE from Sathyabama University, India.

He has 9 years good teaching experience with taught various subjects on good knowledge on VLSI design, IC applications, Digital communications, Satellite communication, Cellular mobile communication, Electronic devices and circuits, Low power VLSI design CPLD and FPGA, EDC, RVSP, and along with ECE subjects. He published 7 research papers in reputed International and national level conferences\Journals\Magazines, and attended and organized 2 FDP/ 3 Conferences, 2 workshops. He is Participated and active member in academic, curriculum and administrative works in various organizations.

International Journal of Engineering Research and Applications (IJERA) is **UGC approved** Journal with Sl. No. 4525, Journal no. 47088. Indexed in Cross Ref, Index Copernicus (ICV 80.82), NASA, Ads, Researcher Id Thomson Reuters, DOAJ.

D.L.Mythri "A Brief Review on Wireless Sensor Network Technologies." International Journal of Engineering Research and Applications (IJERA) , vol. 8, no. 1, 2018, pp. 88-93.