Chapter 2
The Research on Wireless Positioning Base on ZigBee

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Abstract With the development of modern sensor and wireless communication technology, the content networking technology has begun to enter the people daily life. RFID, ZigBee technology and NFC communication technology in near field, as a representative of the content networking applications, became the direction of research and development innovation, among many enterprises, universities and so on. Combinated with the application of the CC2530 wireless chip based on ZigBee technology in coal mine, the principle and method of ZigBee positioning was introduced.

Keywords Zigbee • Positioning • Wireless communication

2.1 Introduction

With the deepening of China's economic reform and modernization process continues to accelerate, increasing national attention on mine safety, regulatory efforts have been strengthened, small and medium-sized coal mines and large towns have a lot of equipment, mine safety monitoring system, effectively controlling the major gas explosion the accident. However, the lack of information on the location of underground personnel monitoring, is still widespread well into the personnel management difficulties, Inoue it difficult to promptly and accurately the distribution of underground personnel and operating conditions, in the event of an accident, disaster relief, security aid is inefficient, especially accident after the rescue

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personnel on the mine location of the lack of reliable information, severely restricted the efficiency of disaster relief, to save the most precious time lost. Safety is the core of human security. Therefore, the coal mine on the use of appropriate personnel tracking and locating equipment, all-weather mine into the well of real-time automated tracking and staff attendance, keep track of each employee's position and activities in the underground track, the location of all mine personnel distribution and other urgent needs [1].

Location of underground personnel monitoring and management system is a set of underground staff attendance, tracking and positioning, disaster first aid, equal to the daily management of integrated applications [2]. The scientific and technological achievements of the implementation of corporate security for coal production and daily management level, to bring reliable emergency incident command basis.

2.2 The Components of ZigBee Wireless Location System

Mine personnel positioning system uses the world's latest wireless RF technology, data processing, data communication technology and geographical information systems, combined with the latest wireless network transmission technology ZigBee, proprietary positioning technology and patented coal mine communications base stations, at home and abroad for the first time economic and practical way to realize the precise positioning of underground personnel needs (mobile communications, gas, the actual data transmission, wireless video surveillance). Can provide a wealth of data, graphics, information, real-time monitoring from the ground, underground personnel, equipment, current location, walking paths, and the statistical distribution of the number of underground workers, according to the actual situation of coal mines to provide time and attendance functions, which, before the accident, safety monitoring center, you can keep track of the location of all underground safety of different elements [3]. To take effective preventive measures; after the accident, the accident was quickly retrieved, even after the accident for quite some time, the specific distribution of underground staff position to develop timely and effective rescue measures and implementation of effective on-site rescue command,

First, the need for staff to track the underground area and the roadway in accordance with site specific needs for a certain number of intrinsically safe mining sub-station/base station (this sub-station multi-functional communication sub-station, belong to the same personnel positioning system for mining and mining wireless communication systems. the sub-station communication base stations and network switches with dual function, so that underground mining is no longer used switches and repeaters, while the layout of the line is also a significant reduction in

the use of fiber optic cable). Typically placed every 500 m of a sub-station, network coverage can ensure precise positioning of personnel within the mobile phone and mobile phone. Roadway in good condition, its wireless communication range is greater than 1 km, this time the distance between the two widening sub-station, and in the conditions were very poor, may be appropriate to shorten the distance between the sub-station, so that the two sub-station communication distance and communication conditions to adjust to the best.

Then as the need for personnel tracking and locating of personnel to wear to go down a mine locator card with intrinsically safe, when people enter the mine after mine, as long as the underground network coverage, any point at any time, sub-stations can be sensitive to the signal, and information uploaded to the workstation, through software, and come to the specific information (such as: Who, in which position, specific time), while it could be dynamic display (real time) in the monitoring center or computer on the big screen, and for a good backup. Inoue staff can keep abreast of the status of mine workers.

Once the emergency situation occurs underground, underground personnel can be carried by the positioning device (identification card) issued a warning. As long as by underground personnel locator alarm button on the alarm. Inoue control room in the dynamic display interface will immediately pop up a red warning signal. Carried by underground personnel locator can also receive information in the event of danger, Inoue control room can be issued to all personnel underground in case the alarm signal for the mine workers provide an important prerequisite for the first time to escape.

Managers can always watch the big screen or computer personnel and equipment on the underground activities, and view any area, any team/personal information on the situation, and to print reports, historical data query, bringing great convenience for the management.

2.3 The Working Principle of CC2530 Radio Chip

TI's new CC2530 is a true for IEEE 802.15.4, ZigBee, ZigBee RF4CE applications and wireless location system on a chip solutions. With up to 256 KB of large capacity flash memory, CC2530 ZigBee is ideal for positioning applications. 64 K and later will support new ZigBee RF4CE for RemoTI™ stack, which is in line with the industry's first ZigBee RF4CE protocol stack, and will allow more memory to support on-chip system-air re-programming. In addition, CC2530 also incorporates a fully integrated high-performance RF transceiver with 8051 MCU, 8 KB RAM, 32/64/128/256 KB strong support for flash memory and other functions and peripherals, the work in the free 2.4 G ISM band, CC2530 internal structure shown in Fig. 2.1.

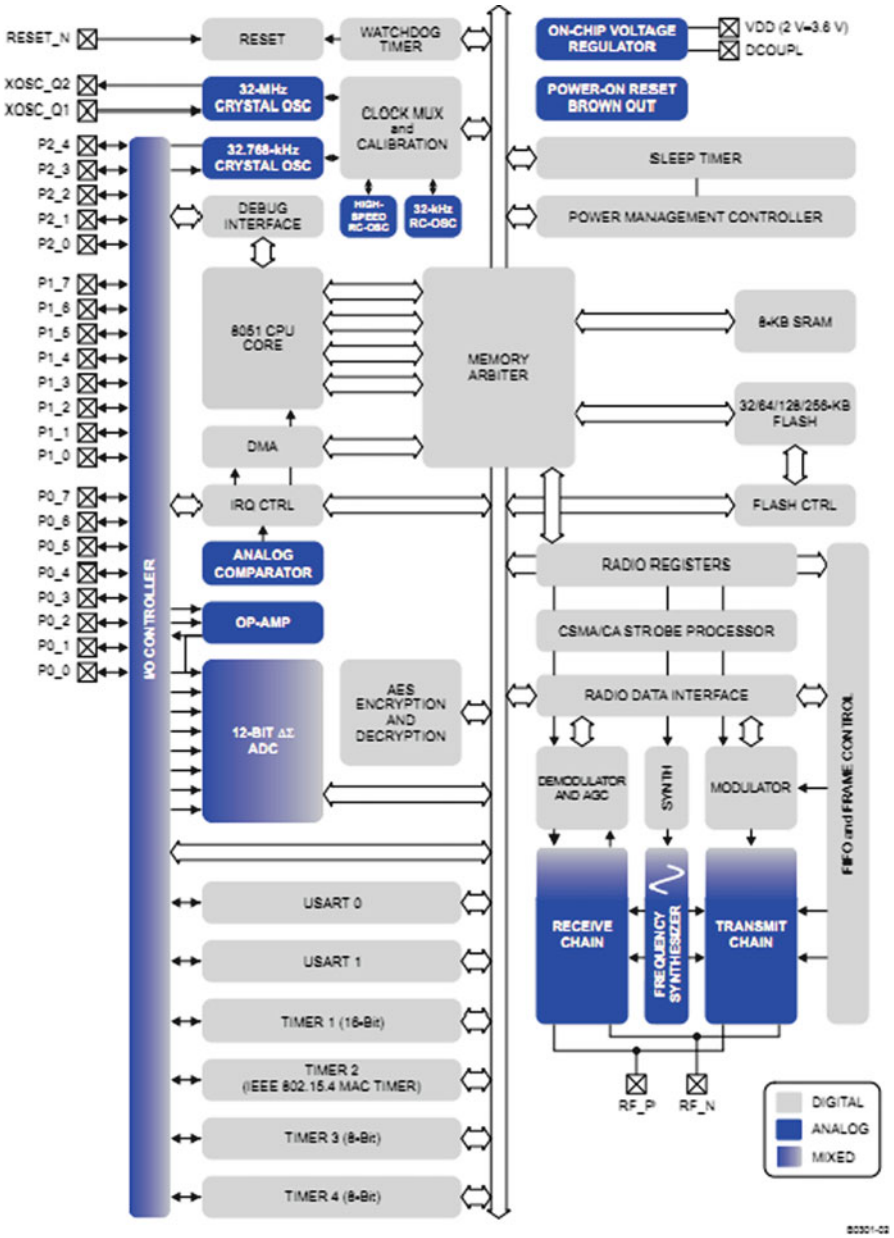

Fig. 2.1 CC2530 internal structure

2.4 The Hardware Design of CC2530 Wireless Microcontroller

CC2530 radio chip to improve the stability of the system, CC2530 radio chip platform designed to improve copper PCB board jamming capability, an external antenna is also designed to improve the CC2530 radio chip platform system signal strength. Each site are install a CC2530 radio chip module, the module automatically from the network between the collection personnel location information. Human-computer interaction using a PC interface, real-time display of ZigBee network topology maps and location information. CC2530 radio chip JTAG download port set aside to facilitate the users are interested in learning a second development, the equivalent of a small microcontroller development board.

2.5 The Software Functions and Features of Zigbee Wireless Positioning System

2.5.1 System Function

Underground tunnel work surface to achieve the precise positioning of the staff, to provide timely and accurate personnel mine the number, location, distribution and location of each person's activities and the time path for incident handling and provide reliable relief data based on disaster relief and security to ensure the efficient operation of the rescue work.

Provides an intuitive roadway map at any time convenient to observe the distribution of underground personnel working status of equipment and systems, to simple and fast data processing and query tools to help improve the efficiency of the rescue work.

Mine moving targets real-time monitoring and on-screen display: system program by monitoring machine screen display and communication sub-station tunnel diagram, showing the mobile communications sub-stations around the target information.

Display the communications sub-stand distribution of roadway within the communications sub-station and the state;
The staff show a large lane numbers and their current location;
Show the distribution of personnel form the work surface;

The achievement of departmental staff time and attendance functions, departments and individuals can issue a variety of comprehensive, detailed attendance reports for the management of the production sector and provide the basis for assessing the individual's work.

Fixed to achieve underground attendance functions, a special department to help staff monitor whether the specified time and place to work, in order to achieve the purpose of strengthening the management of underground work.

Information storage and playback of historical data: The system has a data storage and playback. System can store 1 week distribution of staff. Dispatchers can always play back any of this time period of the distribution of staff in order to provide the basis for the accident analysis.

Alarm emergency situations, mine workers encounter unexpected situations (such as fire, gas explosion, roof fall, flooding, etc.) can be positioned mine intrinsically safe alarm button on the card to the police.

Alarm information function, Inoue personnel know dangers occur once, immediately notify all personnel mine as long as they are with a positioning system (identification card), provide valuable time to escape.

Abnormal data automatic alarm functions, such as restricted areas and long time to go down to the police.

Man–machine dialogue: dialogue employing machine called a variety of menu, press the menu prompts to select the input function.

Self-diagnosis: detection of the communication sub-station on the network is working properly.

Printing: according to the requirements of printing history.

2.5.2 System Features

GIS-based geographic information display, query system

Cover a wide range of underground

High precision, low error rate

Comply with the AQ6210-2007 standard

Fiber-optic and wireless integrated layout, fiber optic ring network provides a highly reliable system

All the safety equipment (compared with explosion-proof equipment, the advantages of nature), when power is sustainable for more than 2 h of work.

2.6 Conclusion

ZigBee wireless location technology is wireless technology is a major highlight of the mine to reduce the high probability of occurrence of a few days ago to improve safety, protect life and property of the people has an important meaning.

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