

Material Handling System Based on ZigBee Wireless Remote Control Equipment Development

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Abstract

At present, in the industrial production and logistics and warehousing industries, the phenomenon of man-machine mixed operation is common in the handling of large materials, and safety risk accidents occur frequently. The development of a set of large material handling equipment that can keep the operators away from the handling site can effectively reduce the heavy physical labor of the employees, and improve their labor safety while also improving production efficiency, which is of great significance. ZigBee technology is a short-range wireless sensor network standard. Due to its low rate, low cost, low power consumption, low complexity and other characteristics [1], it also has the advantages of self-organization, strong self-healing ability, and high reliability. It is widely used in the field of close-range control equipment and the Internet of Things. This article takes the material handling system in a warehouse yard in Shanghai Port as the research object. Aiming at the unsafe factors of man-machine mixed operation in the handling of copper plate bundles in the warehouse yard, from the perspective of the actual function requirements of the system, fully consider the operation of the warehouse yard Environment, innovatively proposed a short-range wireless remote control solution based on ZigBee technology. This article mainly starts from the ZigBee technology, researches and analyzes the Z-Stack protocol stack, and then develops a set of large material handling wireless remote control equipment. After briefly introducing the relevant situation of the wireless sensor network, the CC2530 chip is selected as the hardware carrier of this system scheme by comprehensively considering the actual situation of various aspects, and the ZigBee/IEEE802.15.4 technology is explained in detail, and the ZigBee protocol stack Z- Stack made a preliminary design of the software part of this article, and realized it on the wireless remote control equipment of the large-piece material handling system. The system solves the problem of close contact between operators and materials at the work site, improves safety performance, realizes the separation of man and machine during handling operations, and greatly improves production efficiency and operator safety.

Keywords

Man-machine separation, Wireless sensor network, ZigBee, CC2530.

1. Introduction

With the increasing scale of industrial production and the improvement of automation, especially the continuous development of intelligent control and electronic technology, automatic control technology has been widely used, and some automatic material handling equipment will be used in industrial production. Increase. A high degree of intelligence and automation are gradually becoming a reality. Nowadays, operators face great safety risks when handling materials in hazardous operating

environments such as toxic, severe dust, high heat, and limited operating space. If the personnel working in such an environment do not take effective protective measures, the less serious His injuries are life-threatening. But from the perspective of the enterprise, it is also the inevitability of enterprise behavior to reduce production costs as much as possible and risk high-risk production in order to obtain the maximum benefit. In the face of these contradictions and problems, we need to learn from and use some mature technologies in other industries to solve the problems while reducing the risks faced by employees in material handling operations, improving operational efficiency, and reducing investment costs and increasing profits. Therefore, R&D A set of man-machine separation of large material handling equipment is particularly important.

With the rapid development of electronic technology, especially wireless sensor network technology, single-chip microcomputer has become an important tool and powerful carrier in the field of science and technology and industrial production, and its application is very wide. At present, the installed capacity of domestic single-chip microcomputers alone has reached more than 200 million, and it is still growing at a high speed. In addition, the single-chip microcomputer has very positive scientific research significance and practical value. In a sense, its appearance has accelerated the development process of human industrial control history.

ZigBee technology is a short-distance wireless sensor network technology that has developed rapidly in recent years. It has low price, low power consumption, and small space requirements. It has shown bright prospects and great value in many fields, and has become a very important wireless sensor network. One of the network of research value [2].

This article discusses an important application of single-chip microcomputer and ZigBee technology in intelligent control, which is to realize the separation of man-machine for material handling through single-chip microcomputer, use CC2530 single-chip microcomputer as hardware, adopt ZigBee technology and its compiled software as its software implementation platform, and develop a set of human A wireless remote control system for machine separation of large material handling equipment [3]. Hope this article can provide some enlightenment to other readers who are interested in MCU based on solving actual problems.

1.1 Overview of wireless sensor networks

Wireless sensor network technology is a brand-new information acquisition and processing technology. This wireless network obtains a variety of data and information in a variety of ways under the cooperation of many sensors, and then processes the information to obtain Accurate and huge information data, and send it to customers [4].

The Internet of Things (The Internet of Things) is a network that connects things to things and completes communication. It will become an emerging power to promote the rapid development of future science and technology [5]. As a branch of the Internet of Things, the wireless sensor network involves the perception layer and the transmission layer of the Internet of Things, which can obtain object information anytime and anywhere, and complete data information transmission. Therefore, the development of wireless sensor networks has a decisive impact on the future of the Internet of Things [6]. The wireless sensor network redefines the existing interconnection functions, improves people's ability to explore the physical world, and has attracted the attention of the whole society.

2. Hardware Design of Wireless Remote Control Equipment for Material Handling System Based on ZigBee

The design of the peripheral circuit of the remote control system is based on the CC2530 single-chip microcomputer. After fully understanding the structure, various technical indicators and characteristics of the chip, the CC2530 stable power supply circuit, the handheld button circuit and the indicator circuit, and the system are designed. The crystal oscillator circuit that provides the basic clock signal, the antenna and balun configuration circuit for the signal transmission and reception feedback of the handset.

3. Software Design of Wireless Remote Control Equipment for Material Handling System Based on ZigBee

As an emerging software development protocol, the Z-Stack protocol stack has many features and advantages, one of which is that it is very compatible and can support a variety of software development platforms and environments, such as system solutions based on CC2530. The program is developed using the ZigBee protocol. In addition, the protocol stack also has some new features. For example, in the ZigBee mesh network, node updates of the Z-Stack protocol stack can be easily downloaded.

This article is based on the ZigBee2007 protocol stack design, combined with the IAR software development environment, compiles the program and experiments, and finally achieves the software design purpose of this program.

4. Realization of Wireless Remote Control System

4.1 IAR EW8051 integrated development environment

The wireless sensor network node hardware combined with Z-Stack can run well, but the implementation of other functions such as compilation, debugging, analysis, and display also requires the help of the IAR EW8051 integrated development environment. This section will introduce it.

As a professional software development platform with good operability, easy to use and powerful functions, IAR Embedded Workbench is embedded with many secondary development tools. The software uses C/C++ as the programming language, which can provide software developers with a good software Integrated development environment [7].

The core principle of the wireless remote control system in this article is to realize the point-to-point command transmission and information feedback between the three CC2530 modules based on the protocol stack. Using the ZigBee protocol stack to implement a simple wireless communication generally requires three steps of networking, sending and receiving [8].

4.2 Description of the operation process of the wireless remote control system

1. The operator operates the handheld remotely, first long press the start button to start the handheld, after the system is initialized, the handheld red light is on for 1s, and the handheld is ready. After that, the operator can input instructions to execute the keyboard program according to the state of the material site at this time in the video surveillance. When the operator inputs the corresponding instruction, the handheld terminal transmits an operation signal to the driving end, the driving end recognizes and starts the driving end control program through the signal, drives the corresponding mechanism, and firstly moves the fixture to the cargo to be dispatched through the traveling mechanism of the large and small vehicles. Right above the crane, lower the clamp through the lifting mechanism of the crane to a position where the goods can be clamped autonomously; during this process, when the button is pressed, the red light of the handheld is on.
2. The operator presses the clamping button after the fixture reaches the target position, the key signal will be sent to the driving end, and the driving end will be forwarded to the fixture end to start the fixture motor; and after a certain period of time, the operator presses the fixture tightening button, The signal of holding the clamp tightening button is received by the clamp end after being forwarded by the driving, the clamp end control program is started and the clamp is continuously tightened to realize the complete clamping state of the goods; when the button is pressed, the LED indicator of the handheld is on. Until it goes out when you release it.
3. After the goods are clamped, the lifting, left and right, front and rear button commands will enable the goods to complete the lifting, left and right, front and rear transportation activities, until the goods are transported to the predetermined storage location and placed properly;
4. After receiving the button command from the handheld device to open the fixture, the driving end forwards it to the fixture end, and the control program drives the fixture to open. At the same time, it

also sends feedback information to the handheld, and then controls the fixture motor to close the fixture. The electric motor and the crane lifting mechanism raise the fixture again, and the operation cycle of transfer operation is now over. If you need to operate again, go back to step 1. When the handheld is not operating, the red light of the handheld is off. Long press the stop button to turn off the handheld.

5. Conclusion

This paper systematically explained the origin, development, principles and protocols of wireless sensor networks. Starting from the ZigBee protocol stack, a wireless remote control solution for handling bulky materials was designed, and the hardware and software of the wireless remote control system were designed. Preliminary experiments were conducted on the system. This article mainly carried out the following tasks:

1. Introduced wireless sensor network and ZigBee technology, which laid the foundation for the research and development of wireless remote control system.
2. On the basis of a deep understanding of the CC2530 chip, combined with the actual environment of a yard in Shanghai Port, the existing conditions on site and the actual needs of the operators, the hardware part of the equipment has been modified and designed, and the three components of the system The circuit was designed.
3. In-depth study of TI's Z-Stack protocol stack, combined with the results of the hardware design, formulated the network topology adopted by the three components of the system, and formulated the wireless communication protocol between the three; the program was carried out through the software development platform The preliminary development is explained, the design principle of each program module of the wireless remote control device is elaborated, and the solution is proposed.
4. On the basis of the preliminary research, preliminary tests were carried out on the spot to verify the feasibility of the scheme and provide direction and support for further improving the system.

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References

- [1] Wang Jiangfeng. Implementation of wireless sensor network based on ZigBee [D]. University of Jinan, 2010.
- [2] Peng Yong. Research on energy-efficient target tracking protocol in wireless sensor networks [D]. Central South University, 2009.
- [3] Zhang Jie. The development and application of material handling equipment[J]. Logistics Technology and Application, 2009, 14(1):50-56.,
- [4] Zhou Yiren, Ma Fuchang. Level monitoring system based on embedded wireless sensor network technology [C]// 2008 China Instrumentation and Measurement and Control Technology Report Conference. 2008.
- [5] Liu Fang. Analysis of my country's Internet of Things Industry Investment [D]. University of International Business and Economics, 2011.
- [6] Chen Long. Research on Wireless Sensor Network Attack Detection Technology Based on LEACH Protocol [D]. Harbin Institute of Technology, 2009.
- [7] Li Qiang. Discussion on the choice of computer software development language[J]. Electronic Production, 2013(9x): 67-67.
- [8] Yan Wei. Research and design of smart home system based on ARM[D]. Guilin University of Electronic Technology, 2014.