

The Research of Embedded Ships Video Wireless Transmission Control System

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Abstract: Through theory proof and practical test, put forward the scheme of multi-channel bundling transmission, the system uses the embedded routing controller as the main control model, and integrates with four CDMA 2000 1X channels, transmits video and audio signal as the same time, increases the bandwidth of communication channel, and controls the transmission of video and audio data stream by the method of multiplex polling redundancy, realize the transmission of huge video data, high-definition video images and real time audio in ships video monitoring system.

Keywords: ARM processor; embedded Linux OS; CDMA 2000 1X wireless network; multiplex polling redundancy

1 Introduction

In recent years, with the rapid convergence of embedded technologies, wireless communication technologies, image processing technologies and network technologies, ships video monitoring technologies has achieved great development. However, with the character of the special navigational condition, large video data quantity and the strong real time, the size of wireless communication channel bandwidth and the way of dealing with video data stream will decide the quality of the whole ships video monitoring system directly. The single road CDMA wireless channel can not satisfy the transmission of video data. It is thus clear that the wireless communication channel bandwidth becomes the bottleneck of the ships video monitoring system quality. Therefore, in Bohai area before the our country 3G network opened, put forward the scheme of multi-channel bundling wireless transmission, transmits video and audio signal as the same time, increases the bandwidth of communication channel, and controls the transmission of video and audio data stream by the method of multiplex polling redundancy, realize the transmission of huge video data, high-definition video images and real time audio in ships video monitoring system^[1,2].

2 The Embedded System Platform

2.1 The Structure of System

The work of this system mainly completes the wireless

transmission platform of video and audio data stream in ships video monitoring system. It can transmit video and audio data stream of Ethernet format form video encoder to Internet via CDMA 2000 1X wireless transmission channel, between the shipborne monitoring station and offshore-based monitor and command center^[3,4]. The structure of ships video wireless transmission control system is that such as the illustration (see Figure 1).

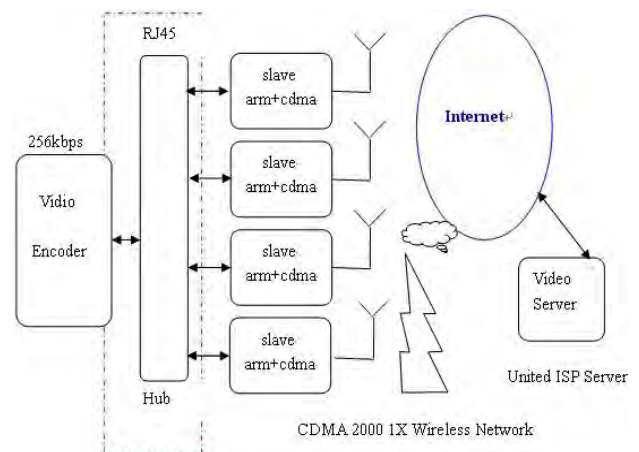


Figure 1. The whole structure of ships video wireless communication transmission control system

Each part of ships video wireless transmission control system has the same hardware structure designs completely. Each model chooses 32 bit low power ARM-920T-based microcontroller AT91RM9200 as the kernel

of hardware system, applies ANYDATA company’s DTU-800 as wireless communication model. In software, constructs embedded multiple task OS Linux as the software platform. Operate the application program of master and slave control function (master control program has the function of choosing the data packet channel), transmit video and audio data stream of Ethernet format form video encoder to Internet via CDMA 2000 1X wireless transmission channel, realizes the connection between the shipborne monitoring station and offshore-based monitor and command center. The system uses one controller as the main control model, others controllers as the slave control model, and integrates with four CDMA 2000 1X channels, its bandwidth equal to total of four channel bandwidths, controls the transmission of video and audio data stream by the method of multiplex polling redundancy, realize the transmission of huge video data, high-definition video images and real time audio in ships video monitoring system, that’s the scheme of multi-channel bundling transmission^[5].

2.2 The Hardware Structure of Control System

The system is designed with a modular structure, has the same hardware structure designs completely. The kernel of hardware system chooses 32 bit low power ARM920T-based microcontroller AT91RM9200. The peripheral circuit includes 8MB Flash memory, 32MB SDRAM, Ethernet interface circuit, RS-232 interface control circuit, I2C serial interface circuit, clock circuit, reset circuit, external circuit, power module, and so on. Wireless communication model applies ANYDATA Company’s DTU-800 as kernel model, its peripheral circuit includes RS-232 interface control circuit, UIM card interface circuit, power module^[6]. Its hardware structure is that such as the illustration (see Figure 2).

2.3 The Design of System Software Platform

Constructing the software platform of embedded multiple task OS Linux is a complex process. Because the embedded system is a system with limited resources, it is more difficult to compile software directly on the hardware platform of embedded system, and impossibly

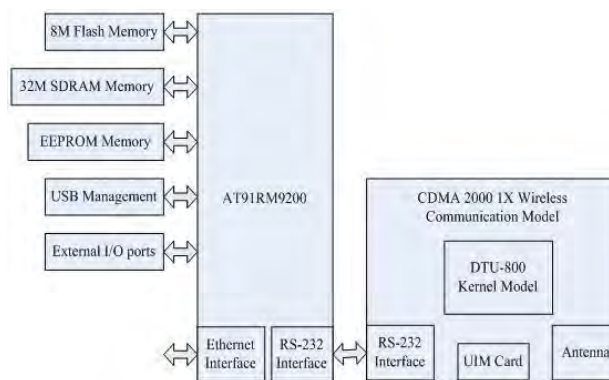


Figure 2. The system hardware structure

sometimes. Currently, the method of general adoption is that, first, builds cross-compiling development environment between host computer and target computer on general computer, finally downloads to the particular position of target platform and operates. For the transplanting of the whole embedded operating system, includes that creating cross-compiling development environment, developing and transplanting bootloader, transplanting Linux kernel, developing device driver, creating root file system, and compiling application software.

Among them, bootloader uses the U-Boot 1.1.2 which is developed by Germanic DENX team. The system needs the option of network file system and root file system, configuring the kernel that supports PPP protocol and Netfilter function, root file system uses Ramdisk file system based on memory mode which is very fast. Iptables is the carrier as the rule of Netfilter system supported by Linux os. It’s same as a application program, and can configure the Netfilter(includes filter rules, net, and so on). The system utilizes the structure of Linux Netfilter, transplants Iptables application software, configures its rules, realizes Information packet filter. The script file of Iptables is different between the main control mode and the slave control model. The main control mode needs to intercept the data packets of UDP video and audio information which are sent by encoder. It only allows the data packets of TCP control information and UDP data packets of 5510 port to pass. And that the slave control models are configured a transparent wireless transmission channel, allows all the IP data packets to pass^[7].

3 The Design of Video Wireless Transmission Control Program

During the process of video and audio data packets transmission and the interaction of TCP connection is keeping all the time, so it is important to ensure that connecting the encoder with the server is keeping any time. According to the normal condition (that is, system is normal, connects four wireless transmission channels with the internet), the main control model takes charge of four TCP connections, so this model needs confirm that the CDMA 2000 1X wireless transmission channel is expedite. For the four channels of video and audio data packets, it depends on the quality of every wireless channel, gets the speed relative ratio of every channel, then the main control model distributes every channel's corresponding quantity data packets according to this ratio. In this way, the channel which has higher network signal intensity will get more data packets, the other way round, the channel which has weaker network signal intensity will get less data packets. If the main control model has weaker network signal intensity, the system will reduce quantity of the channel's video and audio data packets, when the condition change badly, also change the TCP connection. When the whole wireless links are worse, in the case that video server receives less data packets and other data packets loss, we can use the method of redundancy transmission, the multiple of redundancy transmission is according to the frame rate which is set by video server. The flow chart of system control program is such as the illustration (see Figure 3).

If the system appears abnormal condition, it divides into two types: a kind of abnormal condition is that, the wireless channel of the main control model interrupts chaining; the other abnormal condition is that, three wireless channels of the slave control model interrupts chaining. If the first case, the main control model estimates the state of three wireless channels of the slave control model all long, and then appoints a wireless channel that has higher network signal as the network gateway, the TCP connections will transmit data packets through the channel which is appointed by the main

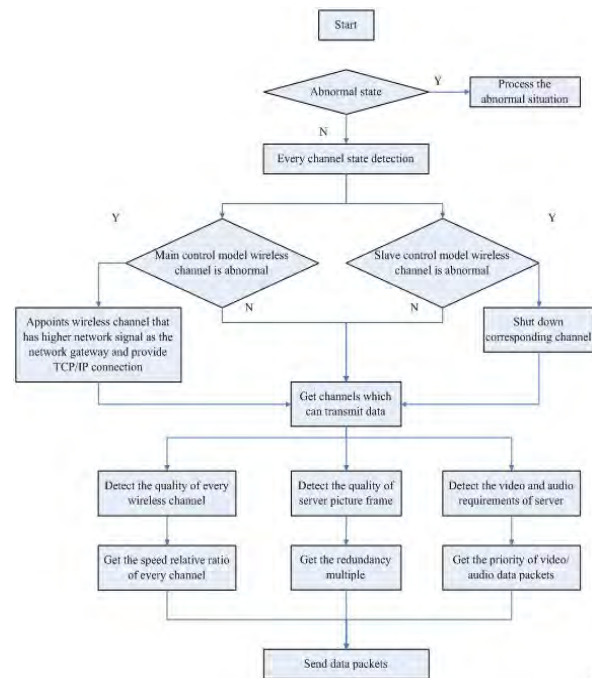


Figure 3. Flow chart of system control program

control model, the other channels transmit UDP video data packets. If this channel interrupts, and then will afresh poll, keeps on finding the conformable channel to establish connection. During this course, the system also keeps on searching the quality of the main control model wireless channel, if the main control model connects up once again, it will join in the transmission links. If the second case, it is more convenient, video and audio data packets are not distributed to this wireless channel. During this course, it still searches the quality of every model wireless channel, then distributes and controls.

During the ship navigation, in the normal condition, the system can shut down the audio signal. But in the special case, it need transmit the audio signal importantly, and ensure the quality of talking. This time, the system can control transmission data through distinguish the ports of video signal and audio signal, increase the redundancy quantity of audio data packets, reduce the redundancy multiple of video data packets^[8-10].

4 Conclusions

The system makes full use of existing wireless network, by means of convenient conditions that United CDMA

wireless network signal covers all of the route from Yantai to Dalian, put forward the scheme of multi-channel bundling transmission, the system uses the routing controller as the main control model, and integrates with four CDMA 2000 1X channels, transmits video and audio signal as the same time, increases the bandwidth of communication channel, realize wireless network transmission platform which has control function successfully.

Through proof and practical test, it can realize one of the methods that solve ships video communication bottleneck, led to the development of ships video monitoring system, improve the monitor ability and management of the coast and inland water ships aquatic traffic safety efficiently, offshore vessels will favor the decreasing of the occurrence of the sea traffic accidents and promote sea navigation safety.

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