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Design and Implementation of Dual-Mode Wireless Video Monitoring System

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Abstract: Dual-mode wireless video transmission has two major problems. Firstly, one is time delay difference bringing about asynchronous reception decoding frame error phenomenon; secondly, dual-mode network bandwidth inconformity causes scheduling problem. In order to solve above two problems, a kind of TD-SCDMA/CDMA20001x dual-mode wireless video transmission design method is proposed. For the solution of decoding frame error phenomenon, the design puts forward adding frame identification and packet preprocessing at the sending and synchronizing combination at the receiving end. For the solution of scheduling problem, the wireless communication channel cooperative work and video data transmission scheduling management algorithm is proposed in the design. *Copyright © 2014 IFSA Publishing, S. L.*

Keywords: Dual-mode transmission, Time delay, Scheduling, Video monitoring, Frame identification.

1. Introduction

Video monitoring has been widely used in all walks of life. With the emergency monitoring, mobile monitoring demand growth and the limitation of the cable video monitoring system in the wiring (factors such as geographical environment and project cycle), the demand for wireless video monitoring system has become more and more urgent.

Comparing with the traditional video monitoring system based on wireless transmission technology, dual-mode wireless video monitoring system made up for the shortcomings of single mode video transmission. It has high transmission speed, small dependence on a single network and high stability, and can be trace monitoring for mobile observation. But it also brings some problems: using two different networks with time delay is different, this led to receive asynchronous, so it must be conducted frame synchronization at the receiving end , and which can correctly display video frames; Rate of wireless channel network also brings problems: due to the performance of the mobile communication network and wireless resources and environment change over time, so the monitoring terminal need according to the data transmission effect, increase the wireless resource environment good amount of data transmission, and improve the performance of the system. This paper thus put forward an effective improvement of TD-SCDMA and CDMA20001x dual-mode video transmission effect of the method. The algorithm is to solve the TD-SCDMA and CDMA20001x dual mode of video transmission video frame synchronization of combination and scheduling problem. The method is based on the current wireless video monitoring system, using the new protocol standards and transmission way to

realize the dual-mode wireless network video surveillance, the performance of video transmission system is better. The method includes video data adding frame identification and packet preprocessing when sending, using the receive buffer to realize synchronization combination and efficient scheduling algorithms when receiving. The former can solve the problem of dual mode of asynchronous receive, which greatly improved the availability of the network. The former can solve the problem of dual-mode asynchronous receive. The latter greatly improved the availability of the network.

2. System Structure and Function

2.1. System Overall Composition

Terminal system overall architecture is shown in Fig. 1, the system consists of OMAP3530 embedded chip and its peripheral chips. It mainly can be divided into five parts: network, a video capture, video compression, local storage and peripheral control [2].

Network part consists of 1 block of CDMA module and 1 block of TD-SCDMA. When system is working, it can use routing load balancing strategy in the Linux system and dual-mode scheduling algorithm control sending rate of two modules.

Local storage part consists of 1 piece of mobile hard disk. Responsible for uncompressed video data or compressed video data is stored locally, and it stores uncompressed video data or compressed video data according to the determined by the users themselves.

Peripheral control part consists of 1 piece of CPLD. It can control the external set of power supply, camera, and light.

The thread synchronization is initialized by Rendezvous program module. The module using POSIX condition realizes synchronizing threads initialized. Each thread performs its initialization, since the end of the object to be notified of Rendezvous. All the threads after initialization, unlock at the same time, and began to implement the main loop [3].

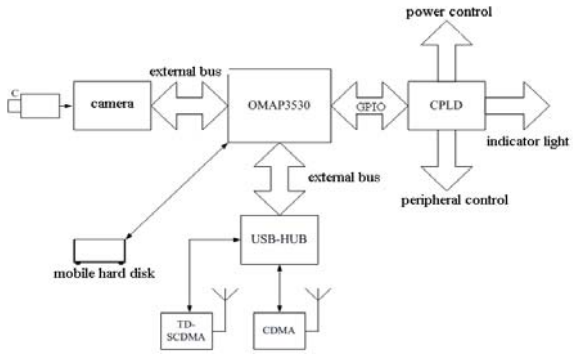

Fig. 1. Dual-mode video terminal system hardware structure.

2.2. System Main Function

The system main function is image acquisition, its compression and real-time transmission to the monitoring center. On this basis, it also can realize video parameters modification, the modification of network transmission parameters, local storage, as well as the local power supply control.

2.3. System Working Process

The System overall flow is shown in Fig. 2. After powered on, firstly, the system is initialized, including hardware initialization, software initialization and interacts with the server process information, etc.

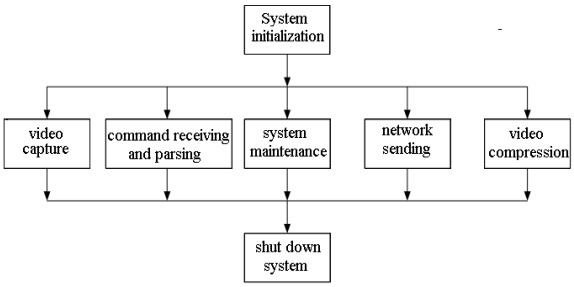

Fig. 2. System software overall flow chart.

Normal initialization is completed, the main thread will create video capture thread, video compression thread, command receiving and parsing thread, the network sending thread, system debugging thread. Video compression thread will create local storage thread, a total of five kinds of six threads (because of having 1 CDMA module and 1 TD-SCDMA module, so a total of 2 command receiving and parsing thread). Then the main thread blocking, waiting for the end of each thread, finally shutdown operation.

3. Dual Mode Video Transmission Scheduling Algorithm

3.1. System Sender Data Preprocessing

3.1.1. Packet Synchronization Combination Algorithm Target

Video transmission use TD-SCDMA and CDMA20001x 2 modules, and use the serial port using UDP protocol to send under Linux. With two different networks, delay differences lead to receive signal asynchronously, so the signal will be synchronously managed. For the monitoring center, it need to check every frame length parameters, determine whether within the normal range, then determine received correctly or not. If receiving is

normal, according to the data frame length, frame the order, the system repeated receiving video frame, and then each complete frame is decoded. Once errors, lost the front receiving incomplete frame data, and then set the frame in a check in the new received data, until it receives the fixed frame identification. At the same time, the monitoring center needs frame synchronization based on different channel transmission frame tagging, and completes the data combination [4].

3.1.2. Basic Principle of the Algorithm

The monitoring center receives the two modules of UDP packets, and deposited in the receive buffer, the receive buffer can adopt the circular queue data structure to achieve. Each data received frame of fixed frame marks is checked, if received fixed frame marks is the finishing marks of the each video complete frame, the video complete frames are searched in the receive buffer. Search method is to search the receive buffer frame of marks for the end frame, according to the frame to search the other parts of the entire frame, in order to improve the search efficiency. Here considering the same network may take a different route to send data, even if it is a module to send data, the order of receive data and the order of send data is always a possibility inconsistencies, the probability of the problem is not big, so not every receives a data frame to search, take the search algorithms mentioned above. If searching a complete frame, then each part of the complete frame will be deleted in the receive buffer; If it can't search complete the frame and the receive buffer is full, it will receive the packet to cyclic covering the original packet. It is necessary to reasonably set the receive buffer size, too long, the receive buffer will inevitably reduce search efficiency; Too short, the receive buffer may not receive a complete video frames because of the time delay difference bigger.

3.1.3. Synchronous Combination Algorithm Implementation

The sender increased frame identifier when sending, consider to use 4 bytes the type to identify TD-SCDMA module and CDMA20001x modules send data, and the position in the whole frame, whether for the end frame, etc.

Implementation of the algorithm and flow chart is shown in Fig. 3.

3.2. Dual Mode Video Transmission Scheduling Algorithm

3.2.1. Scheduling Algorithm Target

For wireless video transmission, due to the limited bandwidth of wireless channel has very instability, using a single module for video transmission prone to serious lost frames and time delay, and cannot achieve the ideal real-time monitoring effect. This project adopts multiple terminal modules for video transmission based on UDP/IP protocol, including a CDMA module and a TD-SCDMA module, but during transport multiple modules to prevent competition it is necessary to take effective scheduling algorithms, at the same time the scheduling algorithm can effectively utilize the limited wireless channel resources. On the basis of maximized data transmission, it achieves video data efficient and orderly sending in the sending end, and can complete real-time and correct receiving and broadcasting at the receiving end [5].

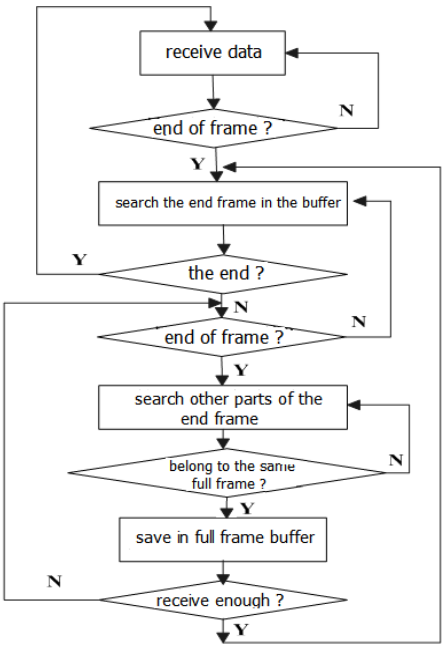

Fig. 3. Synchronous combination algorithm flow chart.

3.2.2. Basic Principles of Scheduling Algorithm

The monitoring center feedbacks two modules transmission rate to terminal in real time. The sender according to the feedback of the two modules of transmission rate in real time distribute the packets of two modules, bandwidth broad module sends more data, bandwidth small sends a small amount of data, set of TD module (hereinafter referred to as the T module) rate is R_T, the rate of CDMA module (hereinafter referred to as C module) rate is R_C, distribution ratio principle is $n=R_T: R_C$.

About packet retransmission, the monitoring center according to the received data packets feedback receives the information to the sender, too much feedback message increases the complexity of the system also increases the cost of the system. In order to reduce channel costs, on the premise of guarantee the quality of transmission, try to simplify the feedback information of the monitoring center.

Before image play in the receiving end, only to play image but there is no complete received frame retransmission packets.

3.2.3. Implementation of Scheduling Algorithm

The sender selects delivery module according to the monitoring center received feedback information: according to the feedback information, video packet sequence is divided; Monitoring center is statistics integrity of data packets received image frames, if there are packets of image frames are not complete, then send feedback to inform the sender to resend the lost packets. Specific solution flow chart is shown in Fig. 4.

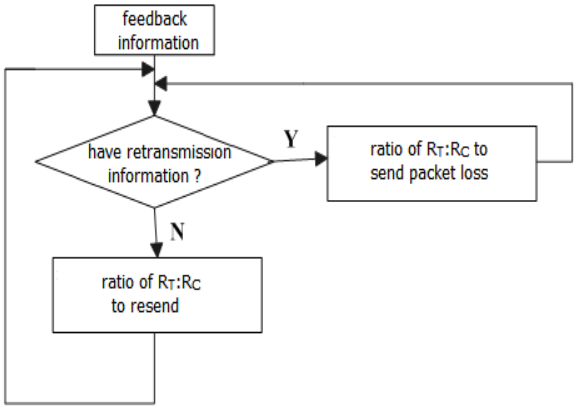

Fig. 4. Scheduling algorithm program flow chart.

Setting collection of data packets is M, M={D1,D2,D3…DN}.The ratio of 2 module of transmission rate is $n=R_T/R_C$. The algorithm steps are as follows.

1) According to the feedback information of 2 module transmission rate R_T,R_C calculate the n, the packet sequence M={D1,D2,D3…DN} is divided (T module) n:1(C module) proportion dividing group,

$$M = \{(D_1, D_2 \cdots D_n), D_{n+1}, (D_{n+2}, D_{n+3} \cdots D_{2n+1}), D_{2(n+1)}, \cdots, (D_{(k-1)(n+1)+1}, D_{(k-1)(n+1)+2} \cdots D_{(k-1)(n+1)+n}), D_{k(n+1)})\}$$

After redistribution the queue T module is to send packet queues:

$$M_T = \{(D_1, D_2 \cdots D_n), (D_{n+2}, D_{n+3} \cdots D_{2n+1}) \cdots (D_{(k-1)(n+1)+1}, D_{(k-1)(n+1)+2} \cdots D_{(k-1)(n+1)+n})\}$$

the queue C module is to send packet queues:

$$M_C = \{D_{n+1}, D_{2(n+1)}, \cdots, D_{k(n+1)}\}.$$

2) First of all determine whether receive the monitoring center the retransmission packets of information feedback. If resent the information, the sender need resend packet; If does not resend the information, data packets in the queue are sent according to the module (T) n:1 module (C) the proportion.

The algorithm flow chart is shown in Fig. 5.

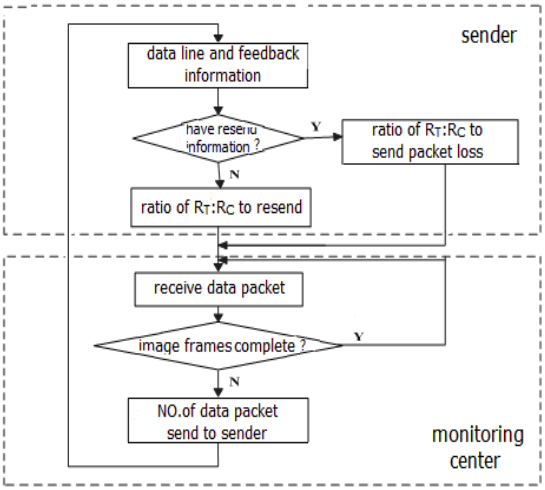

Fig. 5. Data send flow diagram.

4. Realization of Dual Mode Communication under Linux

4.1. TDM230 Module user Space Virtual Serial Port Communication Program

Virtual serial port to read and write program flow diagram is shown in Fig. 6.

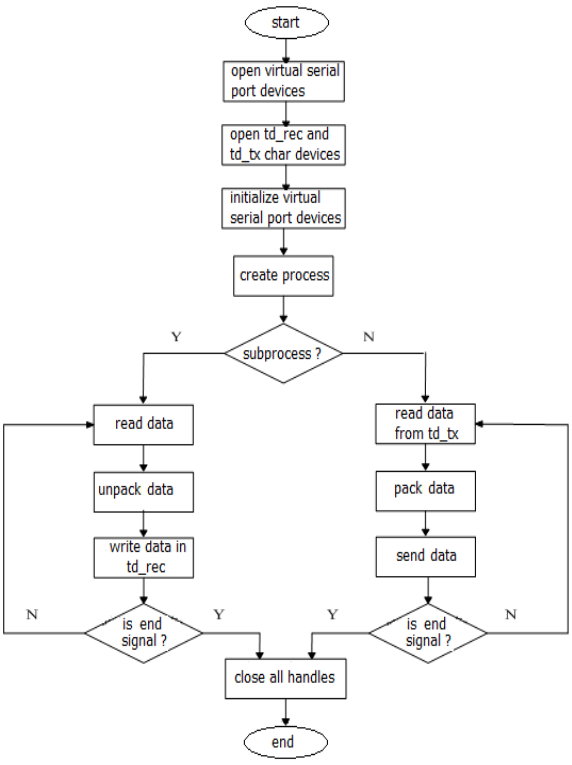

Fig. 6. User space virtual serial port communication program.

5. Transmission Effect Test and Analysis of Dual Mode Video Scheduling Algorithm

After testing, performance results are shown in Table 1. Through it, you can see that under the condition of monitoring terminal video image acquisition frame rate same, TD-SCDMA and CDMA20001x modules than single CDMA module transmission video data is much faster.

Table 1. Single mode and dual mode video comparison.

	Single mode CDMA	Dual mode before optimize	Dual mode after optimize
Acquisition frame rate after compression/fps	25	25	25
Server display frame rate/fps	6-10	6-25	15-25
Correctness of frame/fps	90	40	90
Available bandwidth of network/kb	64	64+128	64+128
System time delay/s	5	7	7

Dual-mode system makes full use of the TD-SCDMA and CDMA20001x transmission bandwidth, compared with the single mode video transmission system effectively improve the video transmission bandwidth. This is because in the monitoring terminal through the scheduling algorithm, make full use of the two modules of the wireless channel resources, make the data transfer rate maximize. Before without using optimization algorithm, dual mode of video transmission system receives the frame it is difficult to form a complete video frame, frame rate only a few, after using optimization algorithm, dual mode video transmission system can already close to the ideal level. Dual-mode terminal video monitoring system which using dual mode video transmission algorithm sends video signal, the monitoring center receives signal as shown in Fig. 7.

6. Conclusions

We put forward a kind of effective two-mode video transmission algorithm. In wireless video data transmission, comprehensive utilization synchronous combination and effective scheduling algorithm solved video transmission delay difference and two-mode receive asynchronous solution frame errors occur. The algorithm can make full use of network resources and improved the quality of video transmission.

Completed the software overall architecture of the dual-mode video transmission system, the system main function is image acquisition, compression and real-time transmission to the monitoring center, also can realize the modification of video parameters , the modification of network transmission parameters, local storage, as well as the local power supply control.

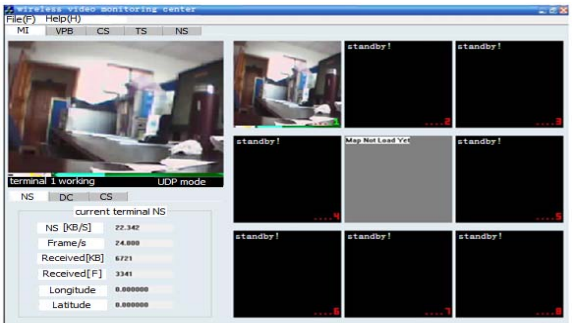

Fig. 7. Wireless video monitoring center.

Acknowledgements

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References

[1]. F. F. Yan, S. F. Gao, and X. L. Liu, Safety and Reliability Research of the Remote Video Monitoring System, *Computer Engineering and Design*, Vol. 26, Issue 9, 2007, pp. 2494-2496.

[2]. Z. S. Tian, Q. J. Li, and W. He, An Improvement Approach of TD - SCDMACDMA20001x Dual-Mode Video Transmission Effective, *Journal of Chongqing University of Posts and Telecommunications*, Vol. 22, Issue 1, 2010, pp. 37-40.

[3]. J. M. Sohn, S. H. Baek, and J. D. Huh, Design Issues towards a High Performance Wireless USB Device, *IEEE International Conference on ICUWB 2008*, Ultra- Wideband, 10-14 March 2008, pp. 109-112.

[4]. M. F. Liao, L. Zhao, and J. W. Mo, The Design of Embedded Video Acquisition System Based on CMOS Image Sensor, *Computer System Application*, Vol. 5, Issue 18, 2009, pp. 194-197.

[5]. Y. Y. Xu, S. J. Bao, Dual-Mode Wireless Video Monitoring System Design and Implementation Based on OMAP3530, *Video Engineering*, Vol. 35, Issue 1, 2011, pp. 115-118.