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Research on Image Transmission System Based on 3G Communication Platform

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Abstract: A wireless image real-time transmission system is designed by using 3G wireless communication platform and ARM + DSP embedded system. In the environment of 3G networks, the embedded equipment has realized the functions of coding, acquisition, network transmission, decoding and playing. It is realized for real-time video of intelligent control and video compression, storage and playback in the 3G embedded image transmission system. It is especially suitable for remote location or irregular cable network transmission conditions applications. It is shown that in the 3G network video files are transferred quickly. The real-time transmission of H.264 video is broadcasted smoothly, and color distortion is less. The server can control client by remote intelligent units. *Copyright © 2014 IFSA Publishing, S. L.*

Keywords: 3G wireless communication system, Wireless video real-time transmission system, ARM embedded system, DSP, Linux.

1. Introduction

Recently, with development of wireless communication technology, digital audio and video technology, and digital processing device technology, especially with the development of video compression coding technology and the wireless network technology, image transmission has become an important business for the wireless network. Especially, the wireless network video real-time transmission system based on the 3G communication platform can overcome the limitations of cable transmission, such as wiring cumbersome, poor flexibility, high cost and other disadvantages. Compared to the video communication with the wired channel, there are advantages of its unique and irreplaceable of wireless video communication:

1) Small size, low power, good scalability, and network maintenance;

2) Easy networking, unattended without hand, strong in real time and high stability;

3) Widely applications for domestic long distance, round-the-clock, and harsh environment in the 3G wireless network existed.

It can widely be used for public transportation, remote medicine and education, multimedia information publishing, and buildings and outdoor advertising [1].

Image transmission system devices on the domestic market have been all over the country, the reasons are as follows: on the one hand the rapid development of national economy improves the business, and consumer demand for the development of streaming media equipment provides the opportunity; On the other hand a decline in hardware cost and the rapid development of embedded computing technology improve the speed of equipment replacement of the image transmission system.

With the popularity of the third generation mobile communication technology and the mature of embedded computing technology and the rapid development of high performance embedded processors, we can fully take the advantage of 3G wireless network transmission rate, and the system with carrying ARM of the embedded platform, so the image transmission is not subject to regional restriction, can transfer quickly and efficiently. At the same time, the production of high-performance processor OMAP3530 from TI Company, is able to be very good deal with audio and video, and fully reads and writes large capacity SD card [2, 3].

This paper designed a novel image transmission system based on 3 G mobile network technology and advanced microprocessor (ARM+DSP), combined with the far transmission distance, low cost, and convenient access of the 3 G wireless transmission technology, and small size, low power consumption, and high performance of embedded computing system, the image transmission system can quickly, high efficiency transport image files of high-capacity storage and realize playback function in real-time.

The research object in this paper combines three contents together, including 3G networks, embedded system and multimedia. In the environment of 3G networks, the embedded equipment has realized the functions of coding, acquisition, network transmission, decoding and playing. And thus, embedded image transmission system based on the 3G communication platform has been realized, and has a high practical value.

2. The Overall System Design

2.1. General Design of Video Transmission System Based on 3G Network

In this article, the embedded Linux OS is transplanted to the ARM+DSP dual-core micro-processor platform with the server/client model [4-6]. Take the advantage of 3G communication platform to complete tasks such as video compression, transmission, playing and intelligent control. Overall system block diagram is shown in Fig. 1.

In Fig. 1, the server-side is consisting of server management system, real time video memory, remote intelligent controller, the client viewer and some other components. Real time video memory and remote intelligent controller are controlled by server management system to achieve real time information. Server management system can also view the contents of any client information through the client viewer at any time. Client is consisting of ARM+DSP dual-core processor, 3G network card with USB port, LCD display module, memory unit, audio interfaces and etc. The information flow is sent from the server-side to the client through the 3G network card, and displays in real time on the LCD module after decoded by the ARM+DSP dual-core processor or stored by the memory unit.

2.2. Main Thread of the Server-side

Main thread of the server-side is mainly responsible for the creation of user threads. The tasks of server-side are monitoring in real-time playing, controlling the content that client is playing and etc. It is shown in Fig. 2.

Firstly the server side establishes the Internet Protocol Server and the client monitoring Internet Protocol Server port [7, 8].

It will create a user thread if there is a user connection. The user thread has the main function of sending file transfer commands, client communication commands, and after a user accepts the file, displays the file on the LCD module. After the creation of user threads is done, and there are choices of the types of play. Either real-time play or play the content which already exists in the client's memory.

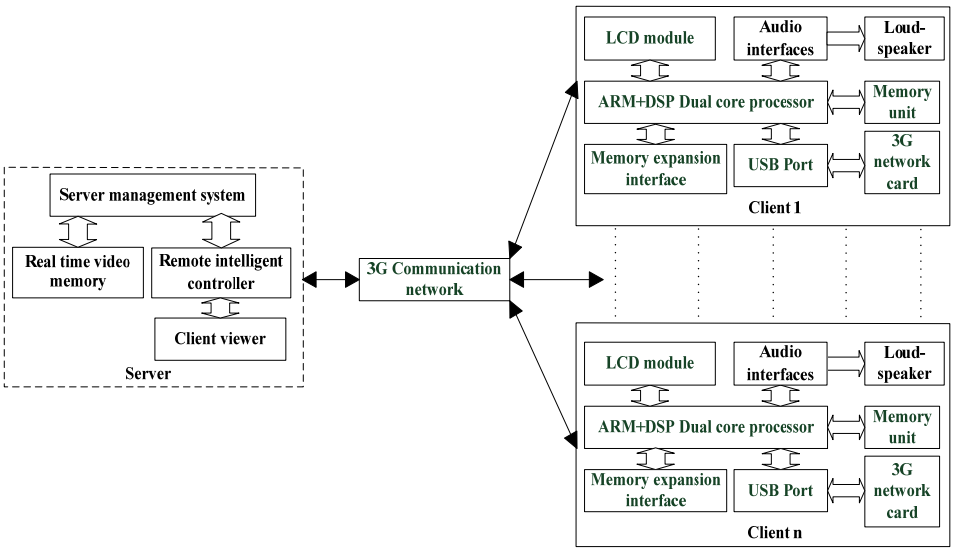

Fig. 1. Diagram of image transmission system based on 3G network.

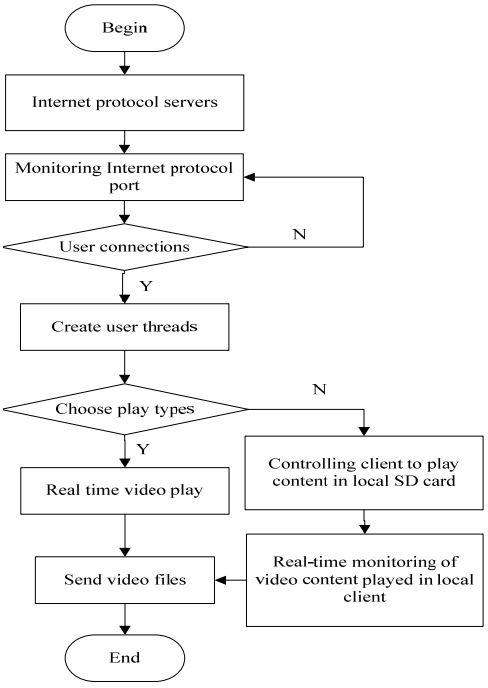

Fig. 2. Flowchart of the server's main thread.

The user thread will close after the end of play. Considering of the connection lost may occur during data transmission, there is a necessary of taking measures such as broken-point continuingly-transferring and timeout-retransmission in the program to ensure the reliable transmission of data.

3. Transplantation of the Linux in Client

3.1. Construction of Cross-compilation Environment

Building a cross-compilation environment is a prerequisite for further development, and cross-compilation of GNU GCC mode is used in this paper [9]. The executable files are cross-compiled, debugged on the host, and run on the target system through the download mode. The system in client uses Redhat 9.0 Linux software as host OS and chooses 'Cross_2.95.3.tar.bz2' with Utopias as the tool chain. The system also implements NFS to sharing files between the host and terminal. The installation steps are as follows:

1) Create the new arm directory in the/usr/local directory.

2) Enter and copy 'cross_2.95.3.tar.bz2' to the directory. Use the following command to complete the extraction.

Tar jxvf cross_2.95.3.tar.bz2

After the command executed, 'folder 2.95.3' will appears in 'arm directory 'where is the location of the cross-compiler.

3) Add the compiler path and use the 'export' command to add 'environment variable':

Export PATH=$PATH:/usr/local/arm/2.95.3/bin

The crosscompilation environment is established.

3.2. Download the Boot-loader with JTAG

By modifying VIVI, the system uses boot-loader mode to send copies of Linux kernel files, root system files, and startup parameter files into SDRAM. Then skip to the first address of the Linux kernel in SDRAM and start running Linux. Download the kernel Linux-2.6.28 and the file system by NFS server, and choose Ext2 RAM Disk type as the root file system type.

4. The Design of 3G Network Card Driver in Client

4.1. Hardware and Software Levels of Wireless Network on Linux in Client

USB bus is a connection between the host and peripheral, and just plays the role as the communication channel between devices and host controllers.

As USB wireless network card in the access system, firstly USB bus is seen from the embedded MMU, and then the card chip is seen. So the USB drive must be implemented before the net card driver [10, 11]. Hardware and software levels of wireless network on Linux are shown as Fig. 3.

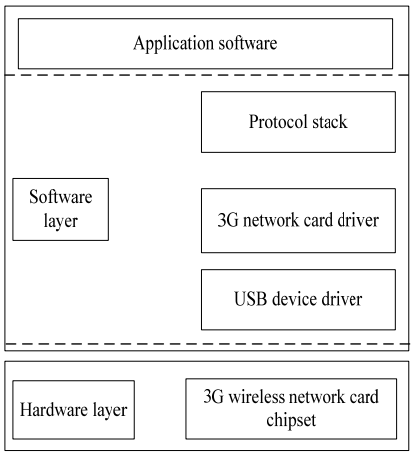

Fig. 3. Hardware and software levels of wireless net-work on Linux.

4.2. Realization of the 3G Network Card Driver

The 3G network card sends and receives data through wireless network using the 'net_device' structure. Key fields of 'net_device' are initialized as follows:

```
netdev –> open=usb_rlusb_open;
// Setting the open function
netdev –>hard_start_xmit=RTMPacket;
// Setting the send function
netdev –> stop=usb_rlusb_close;
```

// Setting the close function
netdev –> priv=pAd;
//Setting RTMP_ADATTER as the private data.

The initialization, configuration, and setting of the parameters, and closing of the wireless network card are achieved through the appropriate function to assign the register [12, 13]. Approach 'open' is implemented mainly by using a function 'static intusb rlusb_open'. Identify if the return value of function 'insmod' is existed, then initialize data structures and registers. The flowchart is shown in Fig. 4.

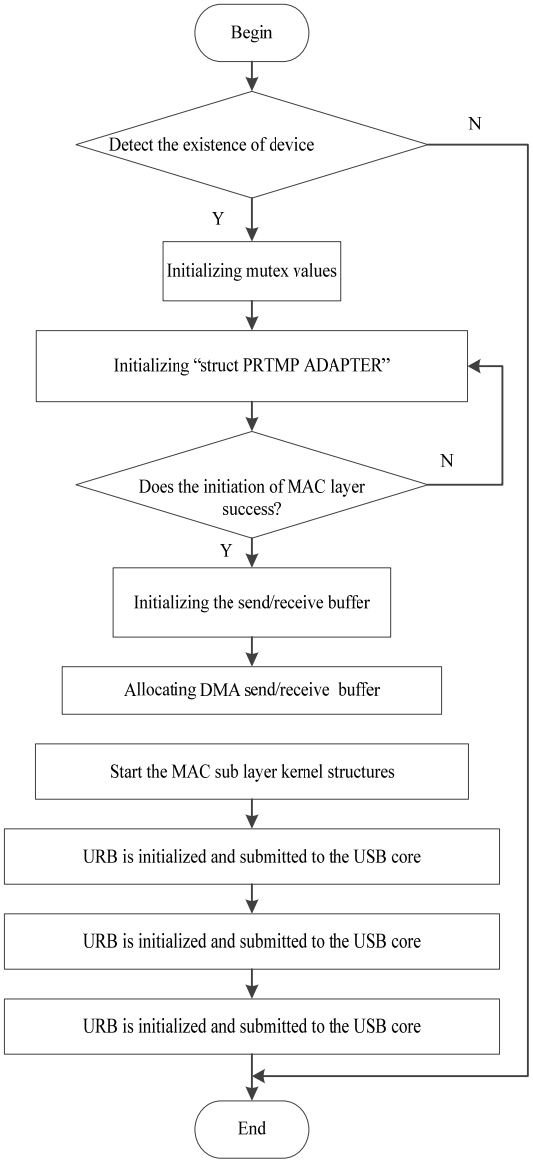

Fig. 4. Flowchart of 3G network driver program.

5. Analysis of Experimental Results

5.1. 3G Network Card Driver Testing

At first the kernel is compiled on the host, together with providing the support for PPP dial-up. It is shown in Fig. 5.

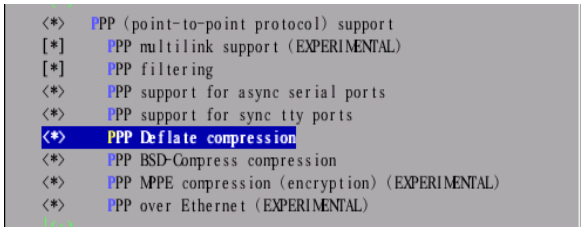

Fig. 5. Options of PPP dial-up.

Then to compile the kernel, execute 'make zImage'. After successful compile, copy the kernel to the target panel, turn on the system and 3G network card can be found and recognized on the target plate successfully. It is shown in Fig. 6.

```
option 1-1:1.1: GSM modem (1-port) converter detected
usb 1-1: GSM modem (1-port) converter now attached to ttyUSB0
option 1-1:1.2: GSM modem (1-port) converter detected
usb 1-1: GSM modem (1-port) converter now attached to ttyUSB1
option 1-1:1.3: GSM modem (1-port) converter detected
usb 1-1: GSM modem (1-port) converter now attached to ttyUSB2
option 1-1:1.4: GSM modem (1-port) converter detected
```

Fig. 6. Recognition of 3G network card on the target board.

Write the scripts 'evdo' and 'evdo-connect-chat'. Execute './pppd call evdo' at last, then ppp0 will appear in ifconfig. Execute 'ping 202.108.33.73'. It is shown in the Fig. 7. The 3G network card is driven successfully on the target board, if the order 'ping 202.108.33.73' is passed.

```
# ping 202.108.33.73
PING 202.108.33.73 (202.108.33.73): 56 data bytes
64 bytes from 202.108.33.73: seq=0 ttl=52 time=505.7 ms
64 bytes from 202.108.33.73: seq=1 ttl=52 time=118.4 ms
64 bytes from 202.108.33.73: seq=2 ttl=52 time=115.6 ms
64 bytes from 202.108.33.73: seq=3 ttl=52 time=108.5 ms
64 bytes from 202.108.33.73: seq=4 ttl=52 time=98.6 ms
64 bytes from 202.108.33.73: seq=5 ttl=52 time=186.5 ms
64 bytes from 202.108.33.73: seq=6 ttl=52 time=107.6 ms
```

Fig. 7. Connection of the network.

5.2. Joint Testing of Server-side and Client

There are some options in the form such as remote connection port of 'IP address', 'send the file', 'delete the file', 'read the terminal', 'file information', 'transport progress' and 'the local state information' in the management software of server-side in 3G image real-time transmission [14]. It is shown in Fig. 8.

Server-side is capable of transmitting large video files in real-time mode and controls to playing the files on the display terminal in the client. It can also read the playing video content in the client smartly and play it on the server-side monitor. Fig. 9 is showing the interface that the server-side send video files to the client. Fig. 10 is a screenshot of the server-side read the client's content in real time.

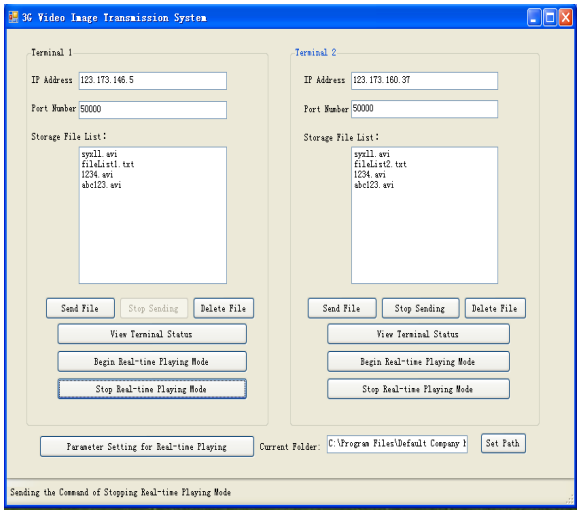

Fig. 8. Software interface of 3G image transmission system.

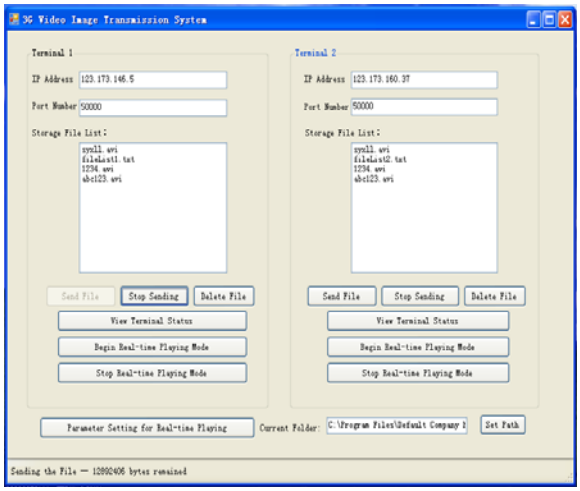

Fig. 9. Sending files from server to client.

Fig. 10. Screenshot of the server read client's content in real-time mode.

6. Conclusions

The system uses a server/client model. Under the control of the server management system, the server sends video files to the client and plays in the real-time mode or read the content that the client plays through the 3G communication network based on Internet protocol. The design of server-side software, Linux OS transplant and the design of 3G network card driver on the ARM+DSP board are completed. The system test is well in actual test. With the 3G network coverage and technology promotion the video transmission system based on 3G communication framework will be applied to all areas of information society.

Acknowledgements

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