

Research on Design and Implementation of Embedded Wireless Video Transmission System

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Abstract: The design flexibility of embedded system and the convenient access of wireless network bring new means for video transmission design, and also expands the application field of wireless network technology. This paper mainly designs a wireless video transmission system based on embedded technology. This paper adopts ARM processor and embedded Linux operating system as the hardware and software platform of the system, uses wireless network card and communication protocol to ensure fast and effective video data transmission, and designs and implements a wireless video transmission system.

1. Introduction

Video transmission can be divided into wired transmission and wireless transmission [1]. Traditional video transmission is mainly wired, but in recent years, the demand for wireless video transmission is increasing, and its importance is also increasing. Wireless video transmission can be applied to many special occasions where wired mode is not applicable because of its characteristics. Compared with other information, video information has a prominent feature that the amount of information is particularly large. Although the current network transmission bandwidth has greatly improved compared with the past, it still cannot meet the needs of high-definition video transmission. In order to solve the contradiction between a large number of video information and relatively narrow network bandwidth, it is necessary to use advanced video coding technology to encode and retransmit video, so as to improve the utilization of network bandwidth, which is also the basic way of video transmission at present. Because wireless video surveillance system has the characteristics of large amount of data and high real-time requirement, the previous wireless network does not have enough bandwidth to meet these requirements, so wireless video transmission has not been well popularized in the past. In recent years, with the development of multimedia technology, wireless communication technology and network technology, the demand for wireless video transmission applications is growing rapidly. In view of this, it is of great significance to study the wireless video information processing and transmission technology based on the new generation of mobile communications. With the rapid development of network technology, microprocessor technology and embedded system, new and better means and methods for video technology have been brought. Based on the application requirement of wireless video transmission, this paper combines wireless network technology with embedded system, and designs and implements an embedded wireless video transmission system on the basis of related technology research [2].

2. Overall Design of Embedded Wireless Video Transmission System

A complete embedded video transmission system consists of video capture module, video coding module, transmission control protocol processing module, communication network, video decoding module and display module. The structure diagram of video transmission system is shown in Figure 1.

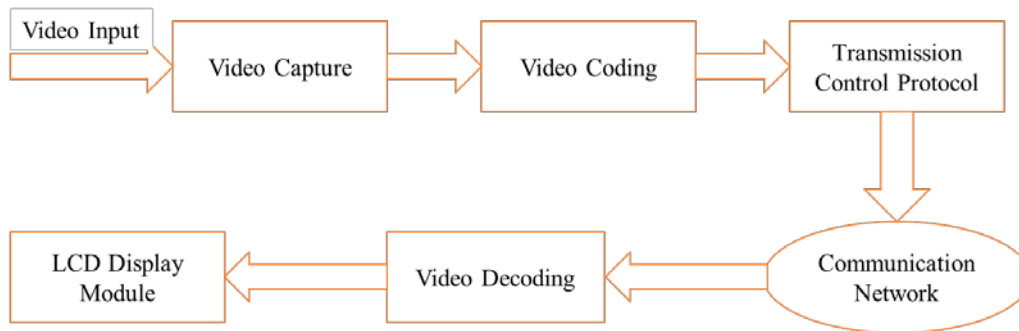


Figure 1. Structure diagram of video transmission system

Firstly, at the video transmitter, the system samples analog video, acquires digital video and encodes the digital video to generate video coding data stream suitable for transmission [3]. Then, according to the available communication resources and transmission control protocol of wireless network, the video data is transmitted wirelessly. Finally, the received video coding stream is decoded at the receiving end, the video signal is reconstructed, and feedback control information is sent to the sender. Embedded processor module is the core of the whole system. Receive the video data transmitted from the video acquisition module, trigger signals of peripherals and various control commands, and complete the operation, response and forwarding to various hardware devices according to these signals, complete the control and data transmission of various hardware devices, and collect various status information of each hardware device, so that each module can coordinate its work. Video acquisition module mainly completes the driving of camera, initialization of module and conversion of communication interface signal with system. Memory module is used to store program and acquire a large amount of video data. It is necessary to equip the embedded system with memory to temporarily store the collected image data, and as a transmission buffer of wireless transmission channels to provide sufficient storage resources for the operation of the system. The wireless transceiver module mainly realizes the establishment of wireless transmission channel and the wireless transmission of data. The display module mainly displays the collected or received video data on the screen. Expanding the interface is convenient to expand the peripheral circuit according to the demand of the system and complete the function upgrade of the system. The power module provides a stable power supply for the operation of the whole system.

3. Hardware Design of Embedded Wireless Video Transmission System

Embedded microprocessors are based on general-purpose computers. In order to meet the special requirements of embedded applications, although embedded microprocessors are basically the same as standard microprocessors in function, they have been enhanced in working temperature, anti-electromagnetic interference, reliability and so on. Embedded microprocessor has the advantages of small size, light weight, low cost and high reliability. Considering the functional requirements of video transmission system, it is more appropriate to use ARM processor. Because the biggest advantage is high performance, low power consumption, low price, and the company's technological development makes its partners not only the world's top semiconductor companies, but also a variety of small and medium-sized companies. With the increase of partners, processors can also get more third-party tools, manufacturing and software support, which also reduces the cost of the whole system, shortens the development cycle, and thus has a greater competitive advantage. In addition, the processor has abundant documents, and most embedded software supports ARM processor, which has been widely used. The most concerned technical index of camera in people's daily life is resolution and clarity. The resolution is very important to the performance of the system. The higher the resolution, the clearer the image will be. However, the performance of processor is required for high-definition image compression processing. The image with high definition will reduce the performance of the whole embedded system, and the price factor is also the choice of camera. First of all, the price of high-resolution cameras is bound to be very high. Resolution cannot be too low, otherwise the collected image will be blurred and lose the meaning of use. Considering the quality of

collected video, the performance and price of embedded system, the video acquisition module of this system adopts Logitech's C525 high-definition camera. C525 can capture 720p resolution video with autofocus function and support V4L2 video capture framework [4].

4. Software Design of Embedded Wireless Video Transmission System

4.1 Video Acquisition Module.

The initialization of the whole video acquisition module is mainly accomplished by module `int()` function. The main function of the video capture module is to take in the analog signal of each image point of the camera, convert or format the digital signal at the same time, and transmit it to the video data processing module for further data processing. The hardware of video acquisition module includes camera, digital-to-analog converter of video data and interface connected to processor. Therefore. The driver design of video capture module involves the initialization of camera, camera and interface. Initialization image sensor mainly sets the working mode, various parameters, allocation of continuous memory space, capacity and the number of dot matrix of the image acquisition through the bus. In this configuration, relevant data is transmitted through the industrial bus. Initialization work mainly includes the definition of bus operation, bus read and write operation, and the setting of internal registers. For the direct setting of internal registers, read and write operations of the bus are needed, and these read and write operations are accomplished by using the basic operation functions of the industrial bus mentioned above. Driver is located in the kernel. On the one hand, it completes the control of the underlying hardware, on the other hand, it provides these functions to the upper application in the way of standard file access. Therefore, in Linux, each device is a file for the upper application, which can access the device control function in the kernel through the standard interface function of the file. The main body of the driver is a function that controls and accesses hardware devices. In order to better manage these device drivers, each device defines a structure variable in the kernel to describe it.

4.2 Video Processing Module.

We choose i. Max 21 as the main processor. An important reason why i. Max 21 is chosen as the main processor in this system design is that it has a multimedia accelerator embedded. It mainly consists of video preprocessor module, encoder module, decoder module and video postprocessor module. Multimedia accelerator is realized by hardware circuit. Each module can work independently, so it can reduce the burden of processing video image operations and realize the acceleration function of video. The preprocessing module can work in either single frame mode or cyclic frame mode. Single frame mode is mainly suitable for static image processing and display or other very low frame rate operation cyclic frame mode to process image frame data transmitted from work. There are two output channels. The output of the channel is mainly used for image display. The output of the channel is mainly used for image processing such as hardware encoder input or software coding. At the same time, the input image frame data can be adjusted by image size and color space conversion. Because of the large amount of video data, it is necessary to compress the captured video frame data. According to the content discussed above, the compression standard adopted by this system. On the platform of serial processors, it is convenient to choose hardware or software to implement MPEG-4 encoding mode. Considering the limited performance of the embedded system and the embedded codec, which supports multimedia acceleration, the system adopts hardware coding and decoding to realize video data encoding. Because the data we collected is in YUV format, in order to make the collected video data display on LCD screen, we need to convert the format to RGB format. There is a special color space conversion module in the PrP module, which can also set the value of the relevant registers through programming mode to meet various needs. The conversion mode of CSC is determined by six matrix_coefficients and video_range domains of MPEG-4 coding bits.

4.3 Video Transmission Module.

The framework of the whole network interface driver can be divided into network protocol interface layer, network device interface layer, device driver function layer providing practical functions, network device and network media, etc. The framework has been built in the core network module. When designing the network driver, the main task is to complete the function of device driver according to the net-device structure defined by the interface layer of the upper network device and the specific hardware characteristics of the bottom layer. The data structure net-device is the center of the whole framework. There are two ways to load network device drivers in Linux. One is that when the system starts, it is automatically detected by the kernel and loaded statically, which is called start-up initialization method; the other is that it is loaded dynamically according to the needs of users or system processes in the process of system operation through modularization mechanism, which is called module initialization method. Because the network card we choose already has drivers under Linux system, we adopt modular initialization to complete the porting and loading of the driver of the wireless network card. Module design is a unique technology in Linux, which makes the Linux kernel function easier to expand. The process of module initialization is to insert the network device driver into the kernel through module loading command insmod. Then insmod will call `int_module ()` function to initialize the int function pointer of the network device first, then register the network device in the Linux system by calling `register_netdev ()` function. If it is successful, it will call the network device initialization function indicated by the int function pointer to initialize the device, and insert the device data structure of the device into the end of the `dev_base` list. Finally, the `cleanup-module ()` function in the network driver can be called by executing the module uninstall command `rmmod` to uninstall the network driver modules. In order to ensure reliable transmission quality, the real-time transmission protocol is adopted in the network transmission part. This protocol is based on the traditional industrial protocol, which can provide efficient data transmission of streaming media. It also supports the establishment of multi-user connections, real-time detection of network conditions, user management, network exception handling and so on.

5. Implementation of Embedded Wireless Video Transmission System

In the experiment, the USB interface of the computer is connected with the USB serial port line, and the development board is debugged by the serial port tool. Connect the embedded terminal to USB camera, wireless network card, power module, and then start the development board to start the BOA server through the encrypted WPA2 network. Then it opens its desktop shortcut, enters the landing interface, and manually enters the monitoring point IP in the IP text window. Because it is set up to connect automatically, but the first landing does not record the IP, it will show that the connection failed, but when the input successfully logs in, the IP can be recorded. The next time you log in, the IP you logged in before will be displayed in the IP drop-down menu. Click the login button below to login to the mobile client for video surveillance and photography. In addition, in the main interface of video display, you can click the Photo button of the bottom menu to take real-time photos, which will be automatically saved to the mobile phone. When you click the photo view button, you can view the photos or delete the photos. In order to facilitate the operation, a batch deletion button is set, which can be used to delete photos in batches. It can also select a number of photos to be deleted at the same time and delete them together after ticking. When logged out, the system retains the successful IP, which can be seen in the drop-down menu. In addition, click the full-screen button, you can display the full-screen. The system can support real-time video surveillance of mobile APP and computer client at the same time. Finally, click the return button of the mobile phone to exit the video surveillance APP. A prompt dialog box is set here to indicate whether to exit the wireless video stream surveillance to prevent mistakenly touching and click to exit.

6. Conclusion

In the information society, how to acquire high-quality images and transmit them effectively is a

core research field. The main purpose of this paper is to solve some practical needs of video transmission in daily life by integrating embedded system and computer network technology. This paper designs and implements an embedded wireless video transmission system. In order to ensure reliable transmission quality, the real-time transmission protocol is adopted in the network transmission part, which can provide efficient transmission of streaming media data.

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