

QT-Based Monitoring System of Multi-Functional Laboratory

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Abstract: Regarding the embedded processor as the core, this study utilizes various cutting-edge technologies such as wireless LAN, USB interface, Bluetooth, multimedia, etc., to propose the design program of QT-based security monitoring system. Taking the lab environment in school as an example, this system has achieved the security monitoring, information transmission and control of certain equipment. Besides, it has cut the Linux kernel module reasonably and explored the touch screen, serial port, wireless LAN, Bluetooth, USB and other resources, thus realizing various functions, such as collection and processing of audio, video and security information and wireless communication. Thereby, users can carry out real-time monitoring for multiple locations through the wireless LAN.

Keywords: Bluetooth, linux, monitor, QT, wireless communication

INTRODUCTION

The development of traditional image monitoring system is accompanied by the emergence of the cameras and televisions. However, some defects inevitably exist; its application is restricted in small-scale regional monitoring and the system's poor scalability makes it fail to form an effective alarm linkage. Due to the impetus of the social wave of informatization and digitization, the convenient and efficient remote monitoring with high-capacity and low-cost is becoming increasingly important. This system can reasonably cut the Linux kernel module and explore S3C2410AL resources of touch screen, serial port, USB Host, etc., to achieve the functions of wireless communication, Bluetooth communication and automatic control and so on Miao and Liang (2011), Wilander (2005) and Wu and Xiao (2008). In addition, the entertainment function of this device can extricate staff from the tedious work environment to a large extent, for the rest and relaxation in their spare time can thereby improve the work efficiency.

In this study, we achieve the security function, remote management function, emergency alarm, entertainment and some other auxiliary functions coupled with the remote management. In addition, our system could be used to monitor the security and video of several rooms simultaneously, which has prevented the tedious wiring and released the staff from staying in the monitoring room to watch the display screens all

day long. Meanwhile, the realization of entertainment contributes to work efficiency increases. The stepper motor can be used to control the windows and curtains, simplifying the manual operation. Therefore, this system has integrated the wireless monitoring and entertainment, so it can satisfy the actual demands of the laboratory.

PRINCIPLES OF THIS SYSTEM

The UP-NETARM2410-S-based embedded system utilizes a powerful processor S3C2410AL to collect luxuriant hardware resources (Wang *et al.*, 2011; Zhao *et al.*, 2011; Chen and Gao, 2010), which is conducive for the environment video acquisition and remote transmission. So based on the powerful functions, wireless communication network, camera monitoring and Bluetooth of UP-NETARM2410-S, this study designs an embedded remote monitoring system and aims to achieve the information transfer and control functions by the two major wireless networks, 802.11bWLAN and Bluetooth, as well as the large control room server and the user's mobile phones.

The system conducts the development on the UP-NETARM2410-S platform (Ren *et al.*, 2006; Yang and Li, 1994; Malone and Corwstone, 1994). The wireless LAN card on the monitoring terminal is in line with the 802.11b communication protocol, so it can carry out the network communication at the maximum transmission rate of 11 Mbps. As an access point, the embedded

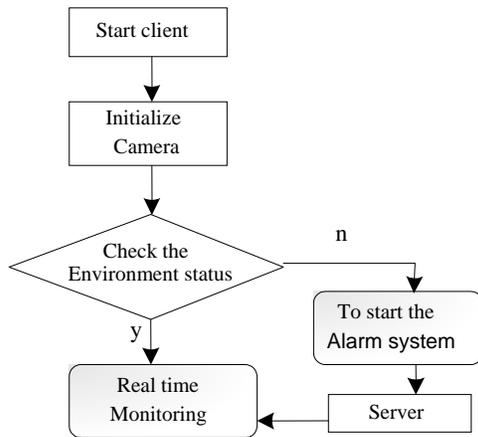


Fig. 1: The flowchart of the server

monitoring terminal can be connected to the LAN to receive a variety of video stream, audio stream, etc., from the network and it can also be access to the Internet. Serial port is in monitoring state, once receiving the abnormal signal from the front-terminal; it will raise the alarm and send alert messages to the host via the wireless network card. At this moment, this thread with the highest priority will block other threads.

This system conducts monitoring for the environment based on video monitoring, alarm and wireless management and supplemented by the expansion capabilities such as Bluetooth technology, room management, etc. Under the video monitoring environment, the system will send data to the host, if any anomalies emerge, raise the alarm to the embedded system which then should send the alarm information to the PC in the monitoring center. Data transmission is based on the wireless network, by which the wireless network environment can be established. In addition, Bluetooth can also be regarded as the auxiliary of data transmission.

SYSTEM DESIGN

At both the client-end and server-end of the embedded system, the Linux operating system is adopted, coupled with the Qt platform. Besides, common Client-Server mode is also used to achieve the wireless monitoring. And Bluetooth module is used at the client of embedded system to realize the image transmission with users' mobile phone.

The system consists of a client with S3C2410AL processor and a PC-based server which is placed in the control room (Fig. 1). It can achieve the video streams

transmission over the wireless network and realize the communication with users' mobile phones by the Bluetooth technology.

Hardware design: The system utilizes the hardware interface of S3C2410AL to complete the access of peripheral devices and the USB camera is access to S3C2410AL through USB Host interface; wireless card also achieves the 802.11bWLAN access by the USB Host; server establishes a dedicated wireless, information channel to the S3C2410AL by AP and builds the hardware architecture for the system.

Software design: The application software of this system is based on the Qt/Embedded writing and owns good user interface. The software is divided into the camera module, the wireless transmission module and auxiliary module. The wireless transmission software module consists of the client and server. The client program of the embedded system regards embedded Linux operating system as a platform, while the server-end program is based on the RedhatLinux 9 operating system.

The software includes the PC server in the monitoring center and the client of ARM embedded system. The former is achieved on the PC, while the latter is released on the ARM embedded development board.

Design process of the server software: This software locates at the server-end of the monitoring center with the major functions shown as follows: open monitoring system, security functions according to the video surveillance and alarm system and so on. The integrated layout of its interface is QTabWidget class and QDialog class in Qt, while its data transmission is achieved by the QDataStreamclass.

In addition, there is another function about the security of the entire software, that is, the account management. The account is registered by users and the first registrant is the manager by default who has permission to operate the entire software, while others are regarded as the guest accounts. Taking into account safety factors, the operation authority of guest accounts would be restricted only to check out some relevant information.

Design process of client software: The QT writing-based client software is transferred into the embedded system by QT/E after being successfully written using Linux.

Table 1: The MP3 compression test results

Function times	Alarm module	Video monitoring module	Communication module	Information display of monitoring host	Video recording and compression
1-10 times	Raise the alarm for the abnormal situation and the host can successfully receive the alarm information.	Clear image and slight delay	Proper information transmission of wireless network and bluetooth	Successful display	Conduct recording and compression successfully, and it can play normally

Table 2: The MP3 compression test results

MP3 compression	

(Sampling rate = 44, 1000 Hz, recording time mono)	
Size of the original file	6875812 Byte
Size of the compressed file	286492 Byte
Compression ratio	1:24
Frame number	2984
Compression time	37.60s
Rate of compression frame	81.3872fps

Analysis on the test results of security and remote management: Test for 10 times and the results analysis is shown as Table 1 follows:

Data and results analysis of reaching test: The test results are shown as Table 2 follows:

Test has achieved the recording and compression of audio, which can satisfy the requirements of the performance index.

SYSTEM TEST

Take the test on security function and remote management, as well as the teaching management test as examples. Due to the first two functions are closely linked, so they are integrated together in the test.

The test program: The test program of security and monitoring functions is shown as follows:

Install two cameras in one room at different positions or in different rooms, turn on the monitor function to view the video streams of video 1 and then switch to video 2 to test whether the video image is clear and smooth:

- Test whether it can start the camera monitoring function automatically and then issue the appropriate alarm when the abnormal situation occurs.
- play the video file
- Take photographs, record a video and then return to play the video picture
- set the system and view the message
- Manual alarm
- Start the monitoring function at the server-end of monitoring center to detect whether it can receive alarm information normally
- Stop monitoring to test whether the turning off is successful.

The test program of teaching management is shown as follows:

Play music using computer for one minute, record it by the embedded monitoring system with the sampling rate of 44100 HZ and then compress the original file. Test the compression time, compression frame number and rate.

CONCLUSION

The security function, remote management function, emergency alarm, entertainment and some other auxiliary functions can all be achieved by this system, coupled with the remote management. In addition, it can monitor the security and video of several rooms simultaneously, which has prevented the tedious wiring and released the staff from staying in the monitoring room to watch the display screens all day long. Meanwhile, the realization of entertainment contributes to work efficiency increases. The stepper motor can be used to control the windows and curtains, simplifying the manual operation. Therefore, this system has integrated the wireless monitoring and entertainment, so it can satisfy the actual demands of the laboratory.

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