International Journal of Computing Academic Research (IJCAR)
ISSN 2305-9184 Volume 2, Number 2 (April 2013), pp. 50-56

http://www.meacse.org/ijcar

Design of Remote Security System Using Embedded Linux Based Video Streaming

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Abstract

This paper presents a design and realization method for remote video monitoring system based on embedded Linux and wireless technology network. Monitor terminal hardware takes ARM9 S3C2440 processor and ARM higher version for centralization, in virtue of SDRAM, USB etc. Software system adopts embedded Linux, the main function realized by C programming to achieve real-time camera data acquisition, image compression and network transmission through Wi-Fi module. Monitoring center receives image data and displays after connects with the terminal.

It is easier to be used in windows system. Image data can be transmitted to the monitoring center in3-6 seconds after JPEG compression. The results showed that the monitoring system has the advantage of high reliability, high efficiency and low cost with ARM9 and wireless network, and it provides a feasible method for remote video monitoring.

Aim at the environment for the lack of power, the paper adopts S3C2440 to design emergency remote security monitoring and control system based on ARM processor, and introduces detailed hardware structure and software design. The system encodes the video of client by H.264.

In this paper the design and implementation of security system by using Wireless Technology based video streaming is proposed. The realization of both wired Ethernet and the wireless accesses of internet are implemented. In this project one can monitor a particular place from any remote location by using the Wireless network.

Keywords: ARM9-S3C2440, MINI 2440, MJPG-streamer, JPG, IP address

I. INTRODUCTION

In the existing system is designed as a system which is used to monitor the movements inside the area in this system to monitor the conditions CC camera is used where the distance of monitoring the movement will be limited and to monitor we require a TV which will be placed inside a control room. To monitor the conditions person should be present inside the control room but it is impossible to monitor movement in TV for each and every second. Web based video surveillance has been envisioned in the literature as either classical video streaming with an extension over wireless networks, with no processing at remote side but only remote control by a human operator, or as a special case of distributed wireless sensor networks in which one type of sensors corresponds to video sensors [8].Video surveillance system has gone through three stages including Simulation Monitoring System, Digital Monitoring System and Network Monitoring System which is the most popular, most widely used. Wireless Internet monitoring system which is based on GPRS (General Packet Radio Service) or CDMA (Code Division Multiple Access) is born when wireless communication service providers start to provide data communications services. Whether

it is CDMA or GPRS network, the supreme bandwidth is less than 100kbps. Usually transmitting the acquisition time interval of a few seconds of images, image continuity is poor and cannot transfer real-time coherent picture [9]. The 3G (3rd-generation) is able to provide diversified, high-quality multimedia services, to achieve Seamless global coverage, global roaming capability. In the quasi-static conditions, the rate of 2 Mbps can be achieved, even in high-speed train; the data rate is up to 144kbps, to support multimedia services such as audio or video.

II. OVERALL SYSTEM ARCHITECTURE

Nowadays, controlling a system via PC is very common. A web base control and monitoring system can make us control a system without distance. So developing a cost effective, programmable and high efficiency controller webpage is necessary for the world competition.
The purpose of this paper is to build a remote control system through a webpage. And this system is controlled through local area network by using an embedded ARM S3C2440. The ARM9 is chosen because of have easy Program download utility, ideal for network-enabling security and lots of storage.

This paper is divided to hardware and software part. The hardware part is building up an I/O that can connect to the ARM board. The connection between the Input/output is connected by a converter that can convert the hardware like sensor and motor signal for ARM9.
For the software part, webpage base embedded software will be build for enable personal computer to communicate with ARM by using Dynamic C/C++. The changing in the I/O will be shown in the personal computer by accessing the webpage.

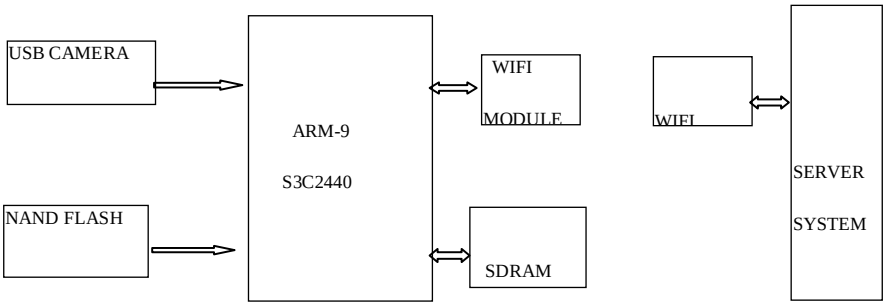

Figure 1. Overall System Architecture

The system structure shown in figure 1, the system consists of three parts: server, mobile terminal, network transmission. The main function of the server application program is that controls the every terminal to open the video surveillance or close the video surveillance throughout the internet, and received the video information from the terminal, and displays the screen real-time. The mobile terminal's main function is monitor the controlled object real-time, and deliver the information to the server.
The system work flow is

- The server send the video open signal to the terminal;
- The terminal received the signals, and captures the video information, compress the video information, and transmit them to the server;
- The server receives the information, and display to the screen, and save them to the disk.

II. PROBLEM DEFINITION

Existing System

The terminal device of the traditional security monitoring systems adopts computers, the system will be paralyzed when the emergency leads to the power system outage, and the computer does not work.

Proposed System

So as to solve the problem of existing system, this project designs an emergency remote security monitoring and control system based on ARM.

The system adopts the S3C2440 embedded processor as a terminal CPU, which has the ARM architecture, its frequency is 400MHz, and its features are cost effective, low power consumption and high performance of application-oriented processors.

III. HARDWARE PART

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. ARM Company founded in 1990, as a IP suppliers, it does not produce the chips, but transfers the design permits only, and produce the variety features chips by the partners, including the chip manufacturers, semiconductor manufacturers, developers, real time operating systems, electronic design and development tool providers, application designers, etc.. They ensure that the ARM processor products make into the market quickly; the chips have the advantages of low power consumption, high performance, low price, to be used in the wireless communications, consumer electronics, auto electronics and other fields widely. The current ARM core processor has the following categories: ARM7, ARM9, ARM9E, ARM10, ARM11, Secure Core etc.

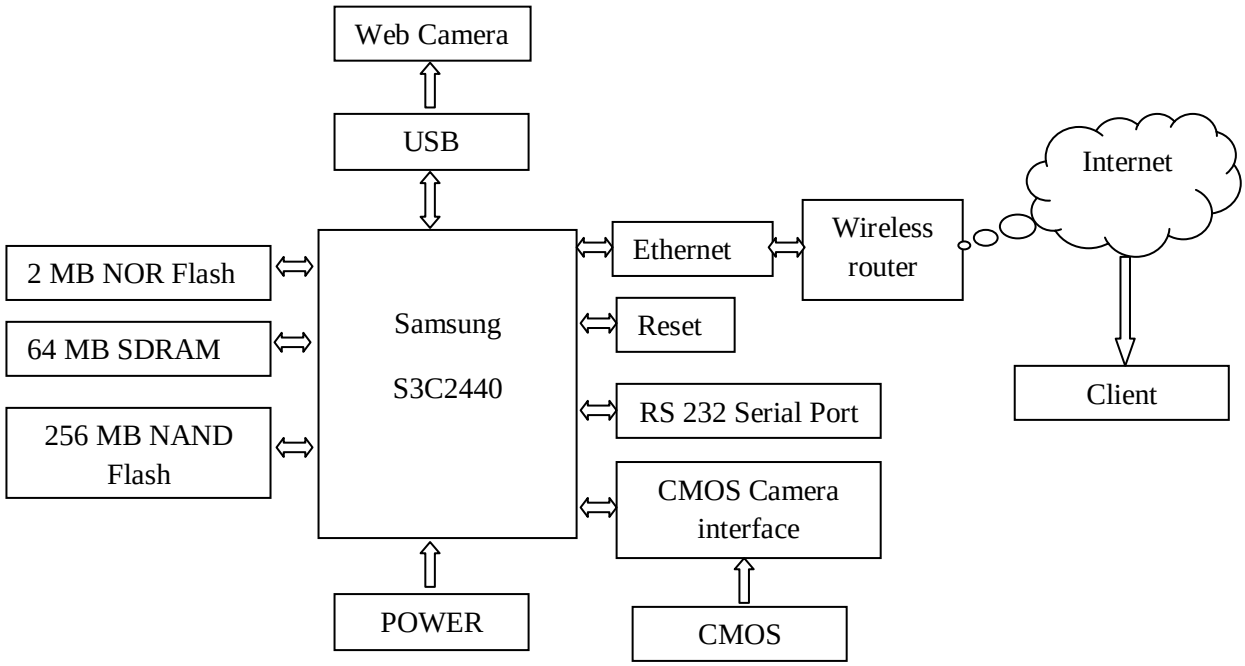

Figure 2. Block Diagram of Hardware System

S3C2440AL processor is used as core of the hardware platform in this paper. Figure 2 is the block diagram of hardware system. Include: serial port, Ethernet interface, JTAG port, storage systems and so on. The frequency Samsung S3C2440AL is 400 MHz and can up to 533MHz in the maximum. (According to its mode of internal circuit). 12MHz chosen for the crystal. JTAG (Joint Test Action Group) is an international test protocol standard, software simulation, single step debug and u-boot download can be carried out through the JTAG port, it's a simple and efficient means of developing and debugging embedded systems. The SDRAM capacity in the system is 64MB, working voltage is 3.3V, data bus is 32bit, clock frequency up to 100MHz, Auto-Refresh and Self-Refresh are both supported.
For supporting boot loader in the NAND Flash, a buffer named Steppingstone is equipped in SDRAM. When the system starting, the first 4Kbyte content in NAND Flash is load to the Steppingstone and is executed. When Startup code, the contents of the NAND Flash are copied to the SDRAM in general. The data's in NAND Flash are checked when ECC is used. The main program will be executed on the SDRAM based on the completion of copy [10]. S3C2440AL UART provides three serial I/O port, each port can operation on interrupt or DMA mode. UART can support a maximum baud rate of 115.2Kbps when using the system clock. Each UART channel for the receiver and transmitter includes two 64-bit FIFO.

The Server application program has five functions:

- Manages the mobile terminal;
- Open the monitor function of the terminal;
- Close the monitor function of the terminal;
- Display the monitor information;
- Save the information in disk.

V. SOFTWARE PART

The terminal system software block diagram shown as in figure 3, and consists of four parts: Boot loader, Linux, root file system and application program. The boot loader is the first code to run that the system power-up, in the function, boot loader is used to complete before running the operating system initializes the hardware device, such as CPU, UART and USB etc., and creating a memory space mapping for running the operation system. In this paper, we adopts U-boot, developed by German DENX Software Engineering center, support Linux, Wince, Vxworks and other operating systems, support the PPC, ARM, X86 processors, characterized by high reliability and stability.

Linux [6] operating system is developed by Linus Torvalds in 1991. He opens his Linux source code in the Internet for people to free download, every can improve and develop variety of application, after ten years development, Linux operation system has become a mature, stable, powerful network operating system, and in various fields have been widely used. Linux operating system kernel is characterized by small, flexible, easy to cut, which makes it more suitable for embedded systems applications. In the paper, we use the Linux 2.6.28 operation system.

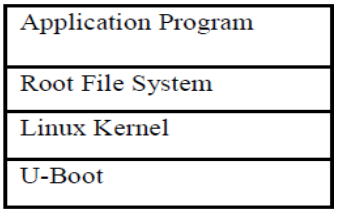

Figure 3. The software structure block diagram

In this paper, adopts the YAFFS file system designed for embedded systems flash device, it can read and write, it has a faster than jffs2 file system in boot speed, the better NAND Flash protection mechanisms. For support yaffs file system, the corresponding driver will be added into the kernel's fs / yaffs / directory, and modify the kernel configuration file. As the mobile terminal's main function is to transmit video images throughout the network, so the system does not require transplantation GUI.

Linux device driver development is an important and difficult part for embedded Linux development. In the Linux operating system, all hardware devices are seen as files and uniform managed by file systems. Device driver as the operating system kernel and the hardware interface between the hardware for the application details screen, the application can operate as an ordinary file, use the read, write, open, close, etc. system calls to operate on hardware devices. In this paper, we need to develop the wireless network card, sound card, MTD and other driver design divers. The terminal's application task is to accept the control signals from the Server, if it is to start monitoring, we wake up the camera, the camera receives the data, and compressed into H.264 format, sent through the UDP [7] protocol to the server. If the received control signals to stop monitoring, the application sleep cameras to reduce system power consumption.

The mobile terminal application's flow diagram shows in Figure 4.

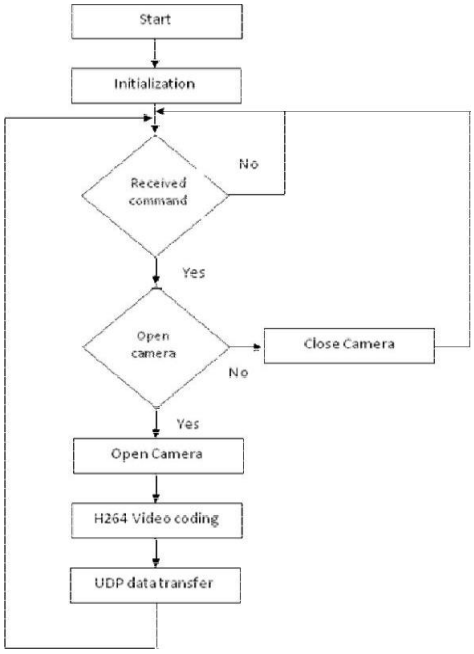

Figure 4. The application flow diagram of mobile terminal

VI. EXPERIMENTAL RESULTS

We load each driver and start the Web server on an already established experimental platform-S3C2440. In client browser, we input the corresponding IP address http://192.168.0.230/, and then the Web page is opened which is as shown in Fig.5.

Figure 5. Page where client web browser access to web server

VI. CONCLUSION

This embedded security system is a separate module which can provide a standard interface. With slight modifications it can be applied easily to embedded fields such as on-site AC servo system, industrial control, and intelligent appliances. Therefore, it has a wide range of application prospects and great promotion value. In this paper, ARM and embedded Linux OS are used as hardware and software platform, Boa is used as a Web server. Its unique approach and direct calls to connect the operating system's file read mode, which greatly improved the performance of the system. Compared to the Apache Web server working on Linux, Boa Web occupies less system resources, higher operating efficiency and responding more rapidly, Boa can stably run on the target board, easy to use and maintain. In addition, the solution based on "embedded remote video monitoring" is also easy to expand, conform to small client side requirements, good openness and portability, and is easy to maintain and upgrade. The Web server Boa selected in the present research requires small storage space and occupies less memory when it's running. It also ha more functions and supports CGI. Communication between external expansion applications and Web server can be achieved through CGI technology. This method can not only improve system security, but also make it possible to interact with users and create dynamic Web pages.

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