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Design of ARM-Linux based Video Surveillance System

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Abstract:- In this paper, a solution about the design of Arm-Linux based Video surveillance system is introduced. The overall structure of the system and the hardware that capture the video is described. It is designed using ARM architecture based Samsung S3C2440 microprocessor and Linux operating system. It also describes both the hardware and the software modules used for video data collection, combined with V4L2 video interfacing and MPEG-4 video coding and decoding and video data transmission. Besides, the video data transmission flow diagram and the final encapsulation structure of the video data frames are shown in detail. It has the advantages of low cost, multi-client, cross platform and high performance operation.

Keywords: - ARM-Linux, S3C2440,V4L2, Video surveillance and DM9000.

I. INTRODUCTION

With the advancements in the IC technology, computer networking and communications technology, the video surveillance systems are playing a major role in this modern world, especially in the military, industrial and civilian security applications. These video surveillance systems are broadly classified into analog and digital video surveillance systems. The earlier or traditional video surveillance systems that are based on the coaxial cables as a transmission media are more complex, expensive and slow in speed of operation. But today in this digital world, the embedded video surveillance systems are more advantageous compared to the traditional surveillance systems, as it is provided at low cost with high performance and good stability. This paper puts forward a video surveillance system based on ARM9 architecture based S3C2440 controller which is and ARM-Linux platform. Video4Linux is used to get the camera video data, which is transferred to the widely used HTTP web server, and the data is displayed on the client browser in real time. The system can be applied in intelligent anti-theft, intelligent transportation, intelligent home, medical treatment, as well as in all kinds of video surveillance systems. Compared with video capture systems based on the digital signal processor (DSP), this system has the advantages of fewer modules, lower cost, higher intelligence, higher system stability and higher security.

II. FEATURES OF ARM BASED SAMSUNG S3C2440 PROCESSOR

In this paper the video surveillance system is designed using Samsung S3C2440 which adopts the ARM architecture. The ARM processor has been widely used in the wireless products, Bluetooth equipment and in many consumer electronics for its high performance. The Samsung S3C2440 features a ARM920T core, a 32-bit RISC microprocessor, to provide hand-held devices and general applications with cost-effective, low power and high performance microcontroller solution in a small form-factor. The S3C2440 includes a separate 16KB instruction and 16KB data cache, MMU to handle virtual memory management, LCD controller, 3-ch UART, 4-ch DMA, RTC, 8-ch 10-bit ADC and touch screen interface, camera interface, AC97 audio codec interface, IIC-BUS interface, IIS-BUS interface, USB host, USB device, SD host and multimedia card interface, 2-ch SPI, PLL for clock generation which best suited for this application.

III. OVERALL SYSTEM ARCHITECTURE

A. System hardware design

The overall architecture of the video surveillance system is comprises of two parts, the client and the server. The server and the client perform the different operations. Here at the client side, the video data is acquired, compressed and transferred. While at the server side, the transferred video data is received and reproduced. The overall system architecture is shown in Fig.1.

The server-side hardware comprises of Samsung S3C2440 processor, USB camera, DM9000 network card, and other peripheral devices which is based on the Linux operating system. The system application program comprises of two parts which are video data acquisition and network transmission program. The video data acquisition program can be able to not only access and control the USB cameras, but also get the data stream that the cameras capture through the V4L2(Video 4 Linux 2). Then, the network service program will encapsulate the video data stream into the frame and send the data to the client side with the communication protocol of http. The client receives the video data after establishing the connection between the server and the client. As the client is designed by the QT which is regard as a cross-platform, the client programs can be compiled and run on different operating system platforms.

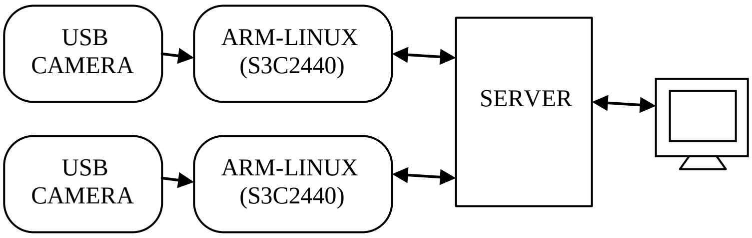

Fig.1 Overall system Architecture

B. Video data acquisition hardware design

The complete video data acquisition hardware design consists of S3C2440 one of the ARM920T processor core based 32-bit micro controller, the processor can reach the highest running frequency 400MHz, its low power consumption and lean and fully static design are particularly suitable for the application of sensitive to cost and power consumption. S3C2440 provides rich resources in chip, supports Linux, it is a suitable choice for this system. The S3C2440 is connected with the SDRAM (Synchronous Dynamic random access memory), NAND flash, network card DM9000, USB camera and cloud platform through the address bus, data bus and GPIO port that supports the embedded Linux operating system and network. Besides, the USB camera based on the ZC0301 chip of the company named VMICRO. For the Linux version with 2.6.16 kernel or above, the driver of the cameras is called GSPCA. And this system will select Linux with the 2.6.37 kernel. So, the driver for the camera can be implemented by burning the zImage file which is generated by compiling the kernel with the program of GSPCA into the NAND Flash. The video data acquisition hardware design is shown in Fig.2.

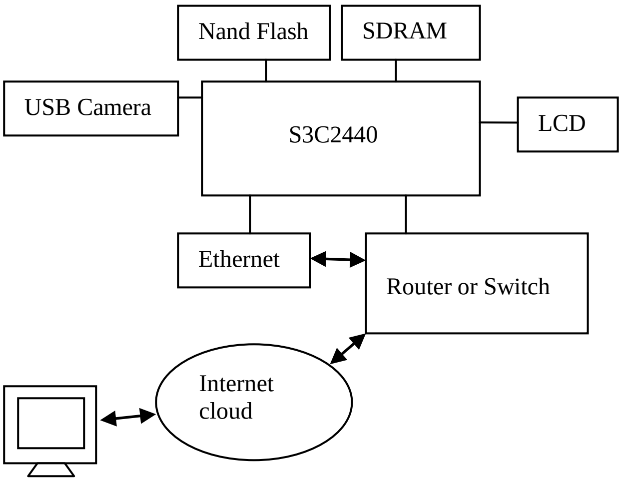

Fig.2 Video data acquisition hardware structure

IV. SERVER SIDE SOFTWARE DESIGN

A. Video Data Collection

In view of the open source code, Linux operating system is the best choice in the field of embedded systems, and many microprocessor systems has been transplanted into the Linux operating system. In this paper, the system will transplant Linux operating system into S3C2440. Linux operating system has number of advantages such as open source, Powerful kernel, supports multiple users, multithreading, good real-time, powerful stability function, Size function customizable, Supports multiple system structure. Constructing embedded Linux development platform needs to construct cross-compiling environment first, a set of complete cross-compiling environment includes host and the target machine.The drivers of audio and video capture devices are developed using a set of specifications V4L2 for Linux kernel, which provide a clear model and uniform interface of API for the driver’s development. It is mainly used to perform some video equipment operations such as setup, collection, close and some other operations. When a USB camera is connected to the system after transplanting the camera drivers, the Linux generates a device file automatically under the directory: /dev/video0. Then it is easy to operate and access the video device. The flow diagram of video data acquisition is shown in Figure.3.

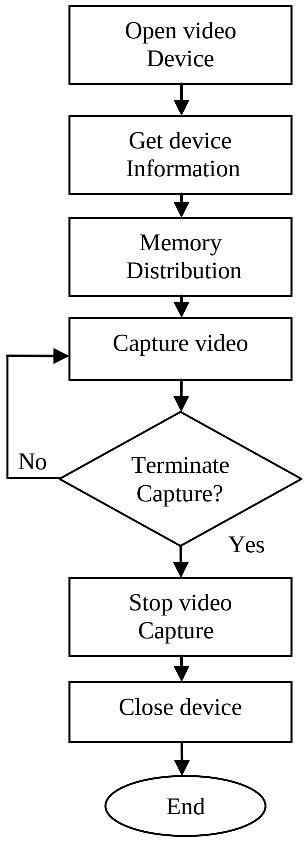

Fig.3 Video data acquisition flow diagram

B. Network Transmission Design

The network transmission program sends real-time video data stream to different clients using multiple threads. The server communicates with the client after building the socket through the listening port that is bind to the socket. When a client request for a connection with the server, the server detects the request and opens a sub-thread to encapsulate the video data and then send the data packages to the client. In addition, the main thread continues to monitor the port for other client requests. The data transmission is based on the http protocol. The network transmission flow diagram is shown in Figure.4.

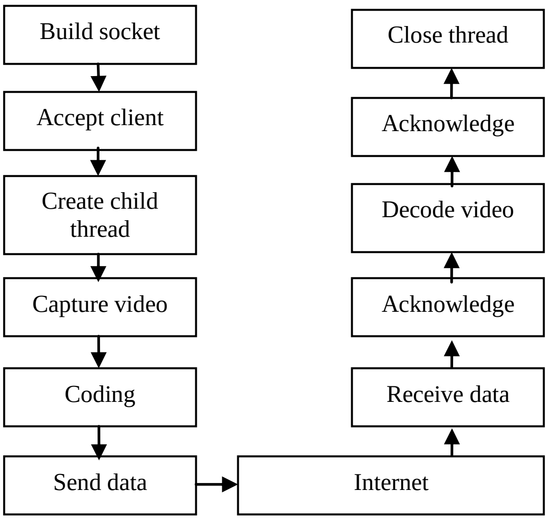

Fig.4 Network transmission flow diagram

When the server accepts the client request, a child thread is created at which one connection could be established after the three necessary handshaking signals between the server and the client. Then the server can respond to the client's request through the child thread. After receiving the client's request, the server generates some kind of messages like status messages, message header and other related messages. The server sends the video data which is stored in the data buffers by push operation, if the client response is successful. If the video data transmission is completed, the server is disconnected with the client and stops transmitting the video data to the client. When the connection is disconnected, the server kills the child thread, which is built before transmission and the system resources are recycled for further video data transmission. When the video is captured the data frames generated are encapsulated and transferred to the client in the form of http files through the Ethernet. The encapsulated data frame structure is shown in the Figure.5.

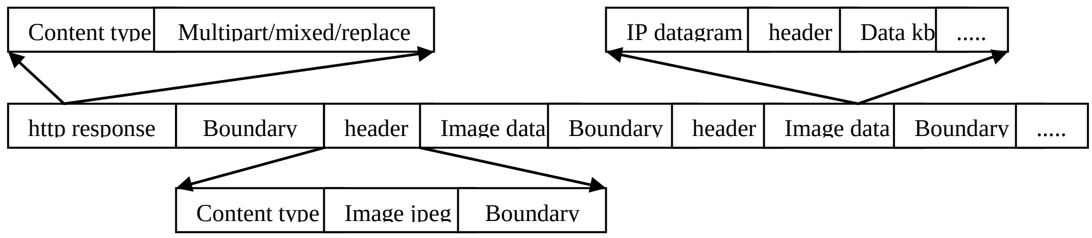

Fig.5 Data frame structure

V. CLIENT DESIGN

In this system, the client programs are written in such a way that they can be easily encapsulated, compiled and run anywhere. Besides, the system not only supports most operating systems like windows, Mac, etc but also supports the other embedded operating systems like Android and Symbian, etc. The system QT client uses the multi-thread approach. The video data reception and video data decoding from the network is done by creating a dedicated thread, which is a GUI thread that ensure real time response of the graphical user interface. When a client request for video data using a trigger signal creates a socket with the server, establishes a connection with the server side equipment by some necessary handshaking signals. The client sends the header of the message request and creates a dedicated thread to communicate with the server.

VI. CLOUD PLATFORM CONTROL AND CLIENT IMAGES

In this system, the cloud platform is rotated in two dimensional direction by using two steering engines controlled by a PWM signal generated by the S3C2440 processor. The S3C2440 processor generates the PWM signal through the TOUT0 and TOUT1 to control the steering gear; while the timer is used to adjust the duty cycle of the PWM signal. The duty cycle of PWM signal is adjusted by the timer according to the control information received by listening to the control port of S3C2440. Therefore the client can easily monitor the real time videos by moving the USB camera in all the directions. In practice, the time period of the PWM signal is of 20ms and the pulse width changes from 0.5ms-2.5ms.The final results shows that the cloud platform under the control of client rotates between 0-180 degrees turn, with good control accuracy. By employing a stepper motor, the precise steering control of the system can be obtained. The performance of the system is tested in Linux, windows and android mobile phones. With 320 x 240 resolution, the rate of video frames are 24 frames/sec and at 640 x 480 resolution the rate of video frames are 18 frames/sec. These two resolutions can meet around five client request.

VII. CONCLUSION

This paper proposes a design of ARM-Linux based video surveillance system that captures the real-time videos. This system can perform well in most of the operating systems like Windows, Linux, and Mac. Besides, it can also perform in the embedded operating systems like Android and Symbian systems etc. This video surveillance system has many advantages compared to the traditional monitoring systems in terms of low cost, performance stability, speed, cross-plat form, real-time and easy installation. In practice, the system provides the images at the rate of 18 frames/sec with 640 x 480 resolution that can meet the industrial and civilian security markets. Finally, I strongly believe that this paper will be helpful in developing more advanced video surveillance systems.

REFERENCES

[1]. Wayne Wolf. Computers as Components Principles of Embedded Computing System Design [M), Beijing: Publishing House of Machinery Industry. 2002, 10-70.
[2]. Analog Devices, Inc. Blackfin Embedded Symmetric Multi-Processor. Norwood, USA: Analog Devices,2004:1-52.
[3]. Weihua Ma. Embedded Systems Principles and Applications[M]. Beijing University of Posts and Telecommunications Press, 2006.
[4]. Sarkar. A Concurrent Multipart TCP and Its Markov Model[C].Communications, 2006 IEEE International Conference on Volume2, June 2006:615-620.