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Design of a Home Surveillance System Based on the Android Platform

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Abstract - *We have designed a video surveillance system based on the smart Android terminal equipment. This system consists of two parts, including the server and the client. The server is responsible for the video acquisition and the H.264 video encoding. The video transmission uses RTP protocol. The client is responsible for receiving data, and completing the decoding and playback. Because of the limited storage capacity of mobile devices, the server implements the face detection function, which only stores the critical information. This monitoring system is applied to Android phones which are used for the elderly. With the arrival of the social trend of population, customers can get information about the old people at home by using this monitoring system. It can provide emergency alert about emergency situations. This system has a good mobile performance and transmission stability. It is intelligent, convenient and practical.*

***Key Words*: Android phones, Home monitoring, H.264, Real-time transport protocol.**

1.INTRODUCTION

In the development of human society, the issue of people's living and residential security has been a topic of concern. The social security monitoring can manage and maintain the public order more efficiently. It is better to see for oneself rather than to hear for many times. Images and videos can provide visual, specific and rich content information. Since the video surveillance is brought to the market, it has received the unprecedented expectation and is promising to be applied to all areas of the national economy. With the development of computer technology, communication technology and Internet technology, the video surveillance technology has experienced three stages of development: analog video surveillance, digital video surveillance, and network video surveillance.

The traditional video surveillance is usually based on PC to implement the monitoring system. However the mobility of PC is poor. It needs someone to guard in front of the monitoring equipment, which often brings a lot inconvenience to the monitoring. In order to meet the demand of market, mobile, high definition, and intelligent will be the future development trend of the surveillance technology. With the enhancement of the performance of intelligent machines, as well as the rapid development of Wi-Fi technology, the boom of mobile Internet has arrived. The video surveillance technology encounters a new development opportunity.

Our country is a populous country. According to statistics, in 2013, our elderly population (60 years and older) is more than two hundred million. With the arrival of the aging population of our society, the demand for home monitoring products is more and more urgent. Therefore, in this article, we will implement the application of home monitoring on the platform of Android mobile phone. This system is divided into two parts, including the server-side and the client-side. It uses the wireless network to transmit data. This system has better mobility, and it responds to emergency situations more timely.

2. THE OVERALL FRAMEWORK OF HOME MONITORING SYSTEM

A typical video surveillance system includes a series of process like video capturing, encoding and decoding, data transmission and video playback, and so on. Based on this the paper designed the overall structure, which is shown in Fig. 1. The camera at front end is responsible for video data acquisition, thus we can obtain the original video data information. Because the video has not been compressed, the data size is very large. In order to facilitate the subsequent storage and transmission, we need the video encoder to encode and compress the original video data. Then the data packets will be released to the network. At the far end, the user can view the surveillance video images through the terminal equipment such as PC, tablet or smart phone which has connected to the network.

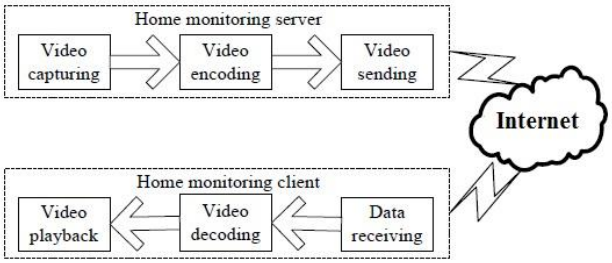

Fig-1: The overall framework of home monitoring system.

3. THE DESIGN OF HOME MONITORING SERVER

The server-side program of this monitoring system is divided into several functional modules according to the need, as shown in Fig. 2. These functional modules complete the task of video capture, encoding and transmission collaboratively.

The server captures the data of real-time images through the camera of Android device and creates a Sever Socket object at the server side program to monitor the connection request from a client. When the server receives the connection request from a client, it begins to compress the raw data using the H.264 encoding, followed by delivering to the transport layer protocol by the RTP packet, and then packages and sends through UDP protocol. In this process, the RTSP streaming media module controls the transmission.

3.2 Video Capture and Compression

The Media Recorder class provided by the Android system can realize the control of collecting and the setting of coding. In order to save the traffic and for easy transmission, the videos need to be encoded after captured by Media Recorder class. The H.264 coding system is divided into two parts, including VCL (Video Coding Layer) and NAL (Network Abstraction Layer). The VCL layer performs the task of efficient coding; the NAL layer packages the video data appropriately to send them according to the need of the network. Therefore the H.264 can have a very good compression efficiency and network adaptability. The monitoring system uses the wireless network transmission and the bandwidth is limited, so we use the H.264 hard coding to improve the efficiency and compression ratio.

3.2 RTSP Server

The RTSP (Real-time Stream Protocol) is used to control the playback of the streaming media. After the implementation of this protocol at the monitoring server-side, the client can enter the URL to request for the streaming video. RTSP is a stateful protocol. For the OPTION request, the server side sends its usable state to the client; for the DESCRIBE request, the server sends the information of the type of the H.264 video stream to the client player. In order to enable the client to play the video properly, the server provides the SDP information in the DESCRIBE response, including the session information, the media information, SPS and PPS etc. Profile, SPS and PPS information is obtained through the following methods. When the server begins to work, record a short video in the local first, then parse and extract the profile, SPS and PPS information which is to be sent to the remote client end. After obtaining this information, the client player can correctly decode and broadcast when receiving the RTP stream. After the server receives the PLAY request, they begin to transmit video streams to the client.

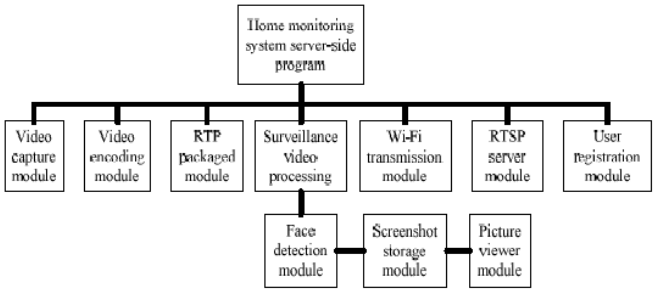

Fig- 2: Function structure of the home monitoring at the server side.

3.3 Video Transmission

The transmission of the real-time video data is greatly influenced by the network environment. A larger delay will result in a greater impact on the real-time, and the confusion of data packets during transmission will cause adverse effects on decoding and playing at the receiving end. So in order to protect the real-time transmission of monitor video and the restoring quality of data at the receiving end, we need to comply with related transport protocols. Here we use the RTP, UDP and IP together to protect the quality of transmission.

In this monitoring system, for the RTP packets of video data in the application layer, if the RTP packets are encapsulated in longer payload length, the IP layer will divide them themselves, before deliver them to the lower layer. Its processing is not controllable, and it will cause potential impact for decoding and playing at the receiving end. So after H.264 encoding, for each NALU, it needs the split processing, when the length is greater than the threshold. Since the RTP header information takes at least 12 bytes in length, while the UDP header is 8 bytes long, the IP packet header information will occupy 20 bytes in length. So in the bottom layer packet, just the header information occupies 40 bytes at least, leaving up to 1460 bytes to the part of the RTP payload length.

3.4 Face Detection

In the home monitoring, the home and property security of users is our top priority to consider. Since the mobile devices are small and their storage is limited, you cannot save a large segment of video data. Therefore, the monitoring system will process the video data, when it detects someone intrusion, it saves the screen shot to achieve retaining the critical video screen, which can be used for the later investigation.

In this issue, we use the face detection algorithm inside the OpenCV (Open Source Computer Vision Library) library to achieve the face detection, using the JNI (Java Native Interfere) technology to compile and load the dynamical shared library in the Java program. The OpenCV function library is implemented by C language. So to take advantage of this library, we need the JNI which is the interface between Java and other program languages. When the server detects that there is someone's face in the video screen, it grabs the video image and saves in the local SD card. User can also bind a phone number, when someone invasions, the system alarms or calls to users directly.

4. THE DESIGN OF HOME MONITORING CLIENT

The client program of the monitoring system is divided into the user login module, the RTSP client module, the video receiver module, the video decoding module and the video playback display module according to our needs, which is shown in Fig. 5. In the monitoring system, if the server is set that it needs to log in to verify. Except the IP address of server, you also need to input a registered account name and password. The RTSP client module connects and exchanges information with the server based on the playback address inputted by users. After establishing proper connection, it will start the transmission of the video data. After the receiving module has received the data, it gives it to the decoding module to complete the H.264 decoding. Finally, we can play the remote video by the video display module.

4.1 Data Reception

At the monitoring client-side, after receiving the video data through the Socket, it needs to be unpacked to extract each NALU, and then we deliver them to the decoder to decode. For the NALU packet with different size, the treatment will be different, so the reception end needs to judge it. The processing flow is shown in Fig. 3. Remove the UDP header to extract the RTP package, when the client receives the UDP datagram through the Socket. Then obtain the load of RTP by taking out the bytes of the RTP header, from which we can get the type information of NALU unit encapsulated in the package. When the type field value is 1-23, it indicates that the NALU encapsulated in RTP packets is single packet encapsulation. For a single packet encapsulation NALU, it is simpler to deal with. When the Type field is 28, it indicates that the NALU encapsulated in RTP packets uses the way of slicing encapsulation. For the slicing encapsulation NALU, you need to take a combination of these fragments together to form a complete NALU, and then deliver it to the decoding module for decoding.

4.2 Video Decoding and Playback

In this paper, we use FFMPEG to decode the video. The FFMPEG is a free open-source and cross-platform video coding project with excellent performance. It supports the H.264 decoding well. There we still use the JNI mechanism to compile the dynamical shared library of decoding. After the Java layer gets the NALU, it delivers it to decoding module. Its internal decoding procedure is shown in Fig. 4. After obtaining the pixel data, we save it as a Bitmap. For the display interface, we use the Surface View class. And we draw the Bitmap on the canvas to achieve the playback function.

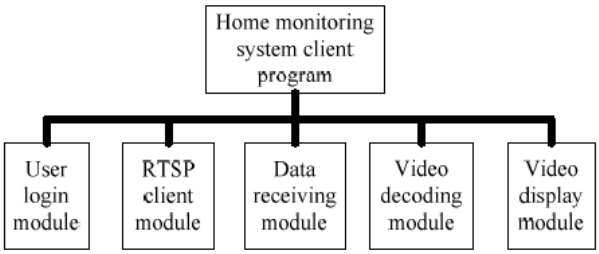

Fig- 3: Modules of the monitoring system at the client side.

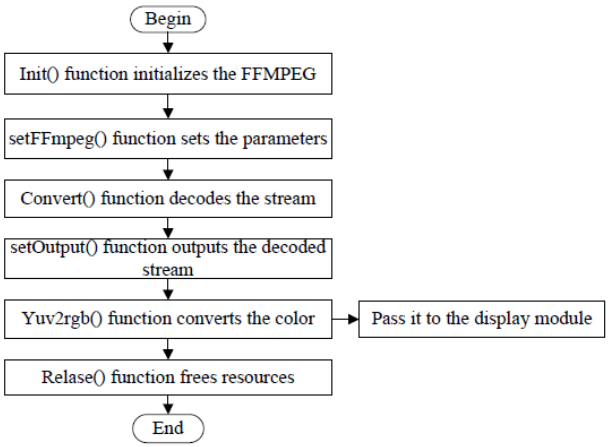

Fig-4: Video decoding process

5. CONCLUSION

With the aid of the Android mobile devices, the user can know the old man at home timely and dynamically at a remote place. The system can also provide emergency early warning. This system is of good performance and stable transmission. Simultaneously, it has a bit of intelligent ability. It is convenient and practical as well. What we have

studied can provide certain reference for solving the problem of the elderly care.

The video surveillance is of great value in use and vast potential for future development. A home monitoring system based on the Android mobile terminal is convenient, flexible and can provide more help for people's daily lives. This paper has realized the basic framework of the monitoring system. In the future it can be added more function on this basis.

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