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The Multi-channel Embedded Video Surveillance Alarm System

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Abstract

The system is used to measure temperatures and monitor by videos in multi-channels. For example, it can be used to care for babies in home while parents go to work. Each room has a baby's body wireless temperature sensor to measure his or her temperature and a webcam. The temperature sensors can transmit the babies' temperatures to the gateway by the wireless multi-channel network. The linux operating system is installed on the gateway. The data base saves each baby's temperature. And the developed software can display all the temperatures on one screen in the form of split-screen or on one's own. In addition, each WIFI wireless camera system is also fixed in the corresponding crib. The camera catches the video and transmits it via the 3g module through the wireless multi-channel network. The H.264 coded video is transmitted to the gateway through the RTP protocol. The collected multi-channel videos are also displayed on the screen of the gateway respectively or simultaneously. In the gateway, the video is captured using FFMPEG solution through the H.264 decoding and the RTP protocol. Each mother can view what the baby is doing and her baby's body temperature by her mobile phone through the WIFI in her company at any time. When the baby is in the abnormal situation, the alarm system is activated automatically. The system can also apply widely in other aspects.

Keywords*: multi-channel video stream; FFMPEG; RTP; H.264*

1. Introduction

The P2P systems are the most popular resource sharing system now. Transmitting the real-time multi-channel multimedia data stream is one of the main characteristics of streaming media technology. But the general internet protocol is not able to implement it. The real-time transfer protocol (RTP) can transmit the real-time multimedia data which made by Internet Expert Task Force (IETF)[1-3]. In addition, it can solve the synchronous problems of video data. Some researches and projects have been implemented based on it. The research on RTP protocol becomes the key to the streaming media technology [4-5]. The FFmpeg is an open source free database [6-10]. It provides the function of recording, converting and completing the audio and video streaming. It contains a very advanced audio / video codec library libavcodec in order to ensure high portability and codec quality. The system uses the Real-time Streaming Protocol (RTSP) to transmit the videos. Some study aims to take a brief look at augmented reality technology, and proposes the new experimental model and expressive techniques for cultural-art organizations' promotional video, which set the experiential learning environment, and enables consumers to take contents actively [11]. Some paper focused on the image input color, the morphological algorithms, the moving objection detection to remove the shadow of the video [12]. Network-based intelligent surveillance is becoming more popular, and remote monitoring platforms using web cameras with mobile robots can be used as child monitoring platforms in infant caring facilities. The paper presents cooperative server-client control scheme as a next-generation intelligent surveillance system for child monitoring. In order to achieve this, a is developed that has multiple users and a remote robot that utilizes an appropriate communication method [13].

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2. The Hardware of the System

The system includes the wireless temperature sensor, the WIFI camera, the infrared, the gateway and the 3G module. The user can view the video and the wireless temperature sensor by the 3G module through multi-channel. In the gateway, there is an alarm program to set security zone to stimulate the infrared sensor. The guards can work according to the instructions.

Figure 1. The Hardware Structure of the System

The gateway is using the Cortex-A9 core board as shown in the Figure 1. It aims to alarm and monitor. It uses the high-performance Exynos4412 Samsung quad-core processor. The system uses the Qt software platform. The version of Qt in this system is 4.7.2. After cross-compiler in the QT platform, the software is ported to the ARM development board. The DDR3 RAM of the cortex-A9 is 1G. It has the 7-inch SD LCD with the 800*480 resolution. The system uses its high precision and accurate line resistive touch screen. The light of the background is LED and adjustable. The linux operating system is installed. The Dimensions are 180x130 with the millimeters for the unit. The supply voltage is 5V. The work electric current is 2A. The Cortex-A9 multicore processor is used as the ARM processor for the scalability. It provides the Accelerator Coherence Port (ACP) to improve system performance and reduce system power consumption. The Advanced Bus Interface Unit implements low latency through the high bandwidth devices.

The system uses the cs-c1-11pfr HaiKang 3G wireless camera shown in the Figure 1. The system sets its maximum resolution up to 1280 × 960. And at the resolution, it can output the image real-timely. It supports the local storage of the Micro SD / SDHC card which is up to 32G. It captures the moving images without saw tooth. The ICR infrared filter can switch automatically for the surveillance all day and night. It supports PIR human to detect the body. It can send and receive wireless information. And it supports the wireless sound and light alarm, the wireless door sensor, wireless remote keyless entry and the wireless remote arm and disarm function. In this system, this camera with the gateway implements the wireless surveillance and alarm at the Internet by the intelligent phones in the form of the video. It works in the WIFI.

In this system, the maximum image size in the transmission is 1280 × 960. The image's brightness, contrast, saturation and sharpness are adjustable by the client or the IE browser. It supports protocols TCP / IP, HTTP, DHCP, DNS, DDNS, RTP, RTSP, PPPoE, SMTP, NTP, and so on. The interface protocol includes the ONVIF, PSIA and CGI. The communication interface includes one RJ45 and the 10M / 100M adaptive Ethernet port. The alarm interface includes the 8-channel wireless input port and one channel wireless

output port with the 433MHz wireless transceiver. It supports for the Wi-Fi. The wireless standard uses the IEEE802.11b, 802.11g and 802.11n Draft. The range of the frequency is from 2.4 GHz to 2.4835 GHz. The bandwidth of the Channel supports 20 / 40MHz.

The Wireless frequency of the wireless temperature sensor is 433M. The temperature sensor communicates with the gateway in the distance of 200 meters. The baud rate of the serial port is 9600. The wireless temperature sensor supports two ways of the serial communication. One is that it sends the value of the temperature at intervals of about 0.5S continuously. The other is that the computer sends instructions to read the temperature and the wireless temperature module return temperature. The working voltage is DC 5V. It uses the 232 serial communications. It can combine the chip of USB to 232. It is convenient to do the secondary development with communication protocols.

3. The Software of the System

The data flow of the system is as follows in the Figure 2. The video and the temperature have been transmitted to the gateway through the wireless multi-channels in the RTP protocol. This system uses the FFMPEG solution and the H.264 decoding. This system uses the corresponding functions in the FFMPEG, such as libavformat, libavcodec, libavutil, libswscale, libpostproc, ffmpeg, ffsever, ffplay, and so on.

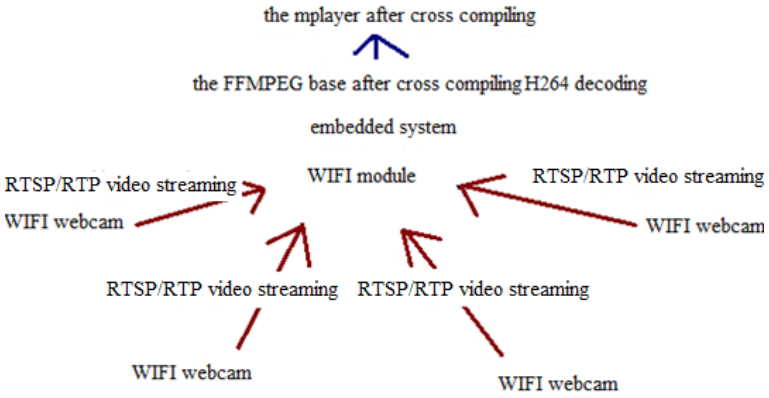

Figure 2. The Data Flow of the System

The system uses the H.264 decoder part. The entropy decoder paraphrases the transform coefficients, motion vectors and the macro-block header information from the compression bit stream. The transform domain macro-block X is quantized after the reverse run-level encoding and sorting. The X is transformed into the residual D'_n after the rescaling and IDCT. The 16 × 16 matching area from the last reconstructed reference frame F'_{n-1} is used as the motion-compensated prediction P in the decoder according to the decoded motion vector. The residuals D'_n added by P is the reconstruction macro-block. The reconstructed frame F'_n is got from all rebuilt macro-blocks. It can be used to show and also is used as the reference frame of the next frame
F'_{n+1}. The H.264 decoder includes predictions of the intra frames.

The system includes the login module, the main interface, event records, alarm records, the video records, the real-time monitoring, system operation, system settings and the system description. The login module includes the username and password. When the user inputs the text, the keyboard will pop automatically. After the user inputs the correct user name and password, the interface jumps to the main interface. Then the main modules of the system are displayed. They are the event recording, the alarm recording, the video recording, the real-time monitoring, the system operating, the system settings and the system descriptions. The event recording records the events that happen in the baby ward.

The alarm recording records the alarming time, the number of the baby crib and the result. The operations include returning to the main interface, deleting records, jumping to the previous page or the next page. The gateway can play many babies' cases in the same screen simultaneously which are monitored by the WIFI cameras. Of course, it can also record all the videos and save them in the data base. When one video is clicked in the serial twice times by the mouse, it can also play in full screen individually. In this system, the gateway can implement the HD resolution viewing and recording.

The high-definition network camera can access the gateway. The gateway can browse the real-time high-definition video. It can record the consequent HD video for 24 hours of all HD network cameras at the same time. The gateway can access up to 16 network front end. It supports H.264 encoding and decoding. It can achieve the real-time video browsing and video at up to 1080p resolution. Also, every network front end can achieve dual-stream transmission. And the real-time view of the image can adjust the resolution automatically according to the network bandwidth and browsing pictures and other conditions.

The gateway picture style includes 4: 3 and 16: 9 to accommodate different proportions of the monitor. It can display in up to 16 screens (4: 3). The gateway operates in different segments. So it supports the access of the network front-end in different segments. The Figure 3 shows the debugging four videos in one surveillance screen.

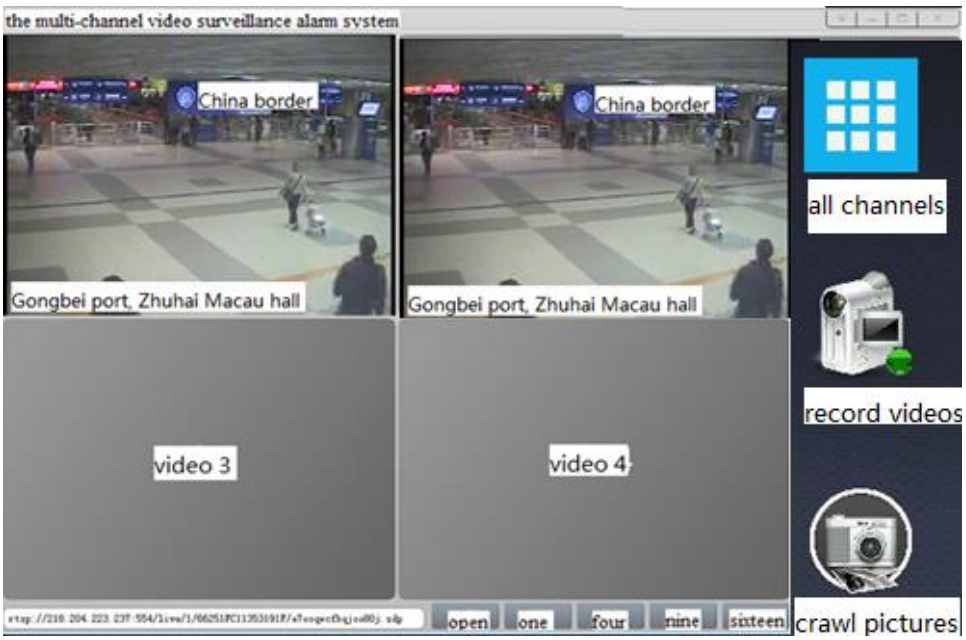

Figure 3. Four Videos in One Surveillance Screen

The software supports multiple pictures that are played in a screen simultaneously. The user views some picture in the full screen by the mouse double click. The system operation contains how to deploy security persons to guard some exit, how to withdraw the garrison, how to call the police automatically, how to open or close monitoring and returning to the main interface. The system settings include setting the time, the volume, arming zone, users' rights, the network, monitoring, timer, the serial port, general configurations and the returning function.

The system description contains elaborating system functions, system operation guide and system settings guide. The function of the intelligent Android telephone implements remote arm and disarm by the 3G module. The telephone can open or close the monitor. It can do real-time viewing through the single channel. The system implements to deploy security persons to guard some exit or withdraw the garrison remotely, to open or close the monitoring and to view the single-channel video real-timely.

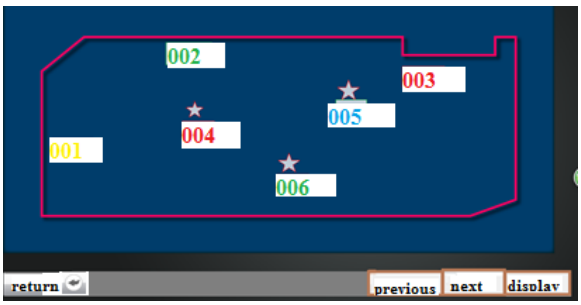

Figure 4. Setting Security Zone

The Figure 4 shows the map after setting the security zone. The function of the interior zone is as follows. The icon is displaying in a point which has notified to the relevant staff. The operator can edit, display or hidden, or modify the security zone number. It can view some region according to the Map by the View button. The zone has some states. The state of arming is marked the red color. The state of disarming, bypass is marked the color green, green flash respectively. The function of setting the perimeter of the map provides three states of arming successfully. It depends on the different parameter,and displays different perimeter. The perimeter can show or hide in the interface.

The specific security zone number can be hidden after pressing the display / hidden to avoid messy interface. The mother can log in the system in the gateway to check out her baby's case by her intelligent telephone connecting the WiFi. Some codes are as follows.

```
bool QFFmpeg::Init()
{
    //open the video stream
    int result=avformat_open_input(&pAVFormatContext,
url.toStdString().c_str(),NULL,NULL);
    if (result<0){
        qDebug()<<"fail to open the video stream";
        return false;
    }
    //get the information of the video stream
    result=avformat_find_stream_info(pAVFormatContext,NULL);
    if (result<0){
        qDebug()<<"fail to get the information of the video stream";
        return false;
    }
    //get the index of the video stream
    videoStreamIndex = -1;
    for (uint i = 0; i < pAVFormatContext->nb_streams; i++) {
        if (pAVFormatContext->streams[i]->codec->codec_type ==
AVMEDIA_TYPE_VIDEO) {
            videoStreamIndex = i;
            break;
        }
    }
    if (videoStreamIndex==-1){
        qDebug()<<"fail to get the index of the video stream";
        return false;
```

```
    }
    //get the resolution size of the video stream
    pAVCodecContext = pAVFormatContext->streams[videoStreamIndex]->codec;
    videoWidth=pAVCodecContext->width;
    videoHeight=pAVCodecContext->height;
    avpicture_alloc(&pAVPicture,PIX_FMT_RGB24,videoWidth,videoHeight);
    AVCodec *pAVCodec;
    //get the video stream decoder
    pAVCodec = avcodec_find_decoder(pAVCodecContext->codec_id);
    pSwsContext =
sws_getContext(videoWidth,videoHeight,PIX_FMT_YUV420P,videoWidth,videoHeight,
PIX_FMT_RGB24,SWS_BICUBIC,0,0,0);
    //open the corresponding decoder
    result=avcodec_open2(pAVCodecContext,pAVCodec,NULL);
    if (result<0){
        qDebug()<<"fail to open the decoder";
        return false;
    }
    qDebug()<<"successful initialization for the video stream";
    return true;
}
void QFFmpeg::Play()
{
    //read the video frame by frame
    int frameFinished=0;
    while (true){
        if (av_read_frame(pAVFormatContext, &pAVPacket) >= 0){
            if(pAVPacket.stream_index==videoStreamIndex){
                qDebug()<<"start to
decode"<<QDateTime::currentDateTime().toString("yyyy-MM-dd HH:mm:ss");
                avcodec_decode_video2(pAVCodecContext, pAVFrame,
&frameFinished, &pAVPacket);
                if (frameFinished){
                    mutex.lock();
                    sws_scale(pSwsContext,(const uint8_t* const
*)pAVFrame->data,pAVFrame->linesize,0,videoHeight,pAVPicture.data,pAVPicture.lin
esize);
                    //obtain or transmit an image signal
                    QImage
image(pAVPicture.data[0],videoWidth,videoHeight,QImage::Format_RGB888);
                    emit GetImage(image);
                    mutex.unlock();
                }
            }
        }
        av_free_packet(&pAVPacket);// free the resources
    }
}
```


4. The Result of the System

The system result is shown as the following figures. The gateway can display the temperatures and videos from the temperature sensors and the WIFI cameras through wireless multi-channel. Because the gateway embeds the 3G module as shown in the Figure 1, users can view the concerned videos by her intelligent telephone. In the Figure 5, the gateway show one temperature from the 433m wireless temperature sensor. In the Figure 6, users set the how many temperatures in one screen, the scale of the temperature, and so on. Figure 7, Figure 8 and Figure 9 display four temperatures, nine temperatures and sixteen temperatures respectively. Of course, the value of the temperature can be saved in the database. The operating for videos is the same. One of many pictures in a screen can be discharged in the form of full screen by mouse double click. The Figure 3 displays the screen of the video monitoring.

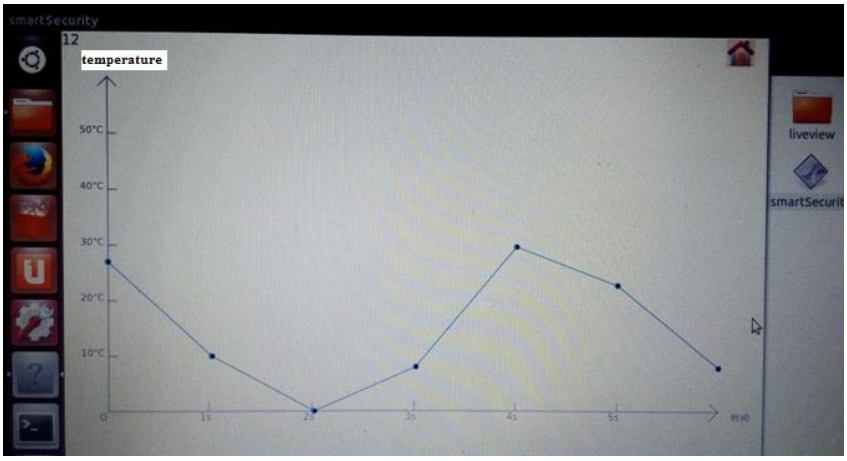

Figure 5. The Value of one Temperature Sensor

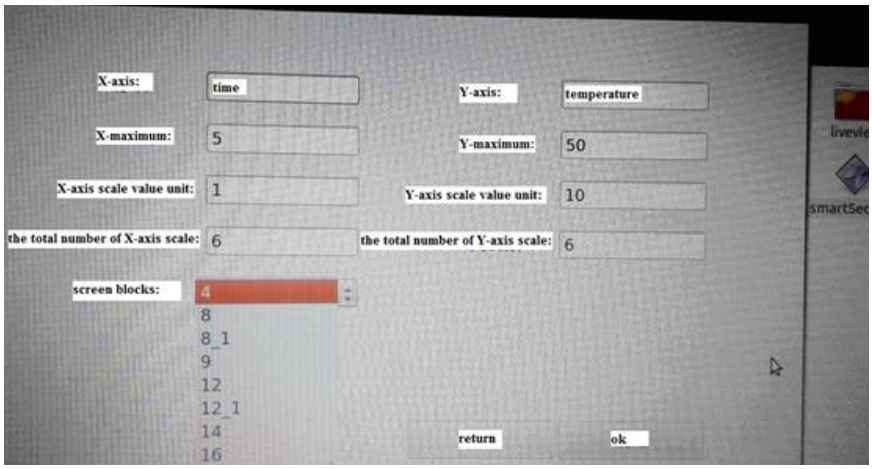

Figure 6. The Operating Dialog of Setting the Temperature Curve

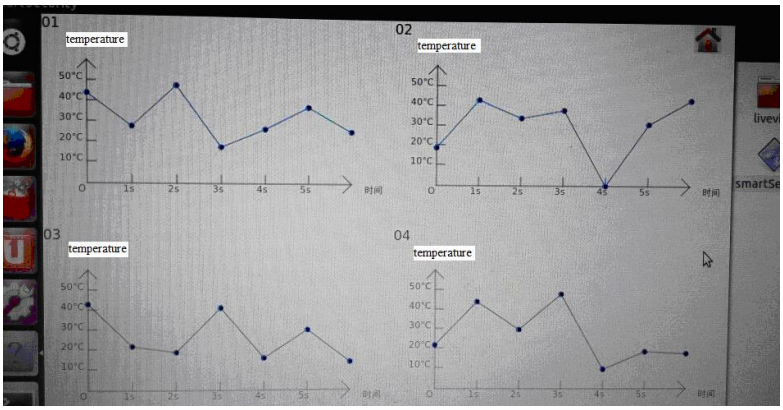

Figure 7. One Screen Simultaneous Displaying Four Temperatures

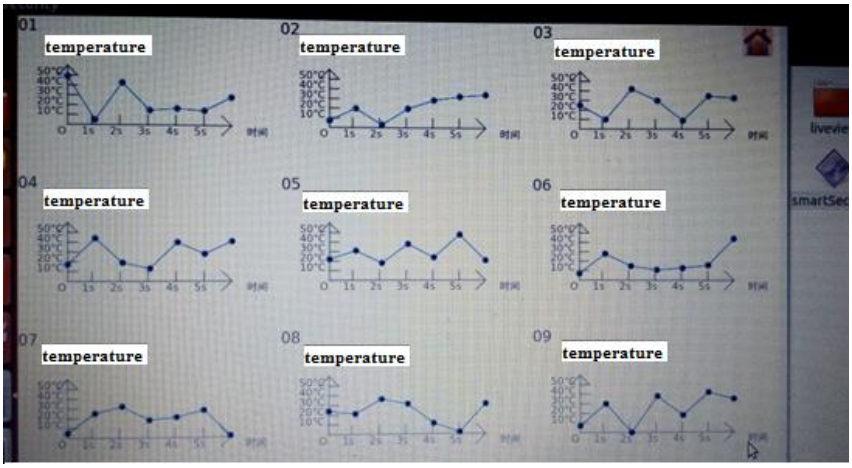

Figure 8. One Screen Simultaneous Displaying Nine Temperatures

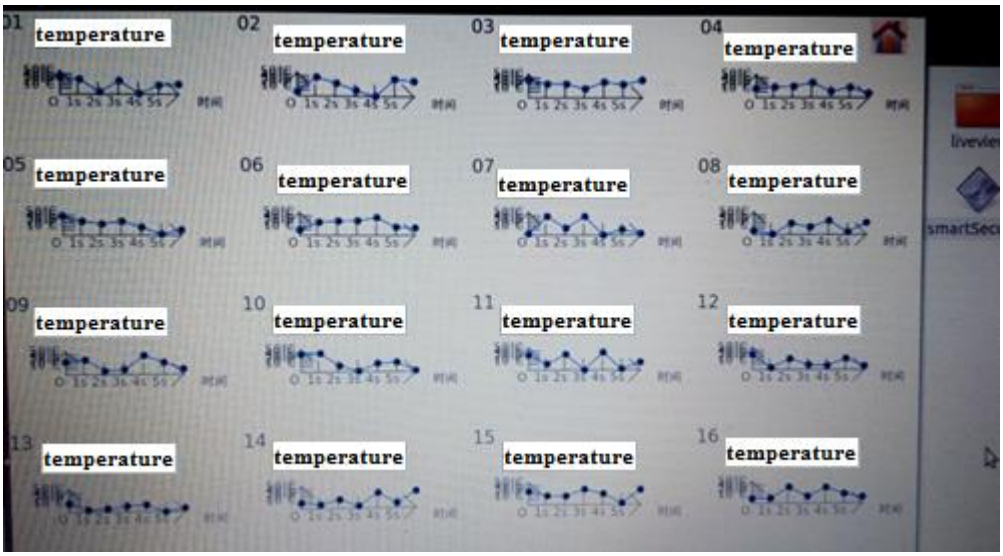

Figure 9. One Screen Simultaneous Displaying Sixteen Temperatures

5. Conclusion

This system uses the RTSP to transmit the multi-channel videos from different IP addresses to the gateway. It uses the H.264 to decode. It can also get the temperatures from different wireless temperature sensor in multi-channels. The system can monitor to view the real time video and the temperature. It can be widely applied in many respects.

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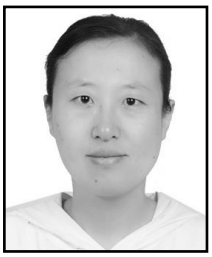

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