

MOVING OBSTACLE DETECTION AND VIDEO MONITORING USING OPENCV AND ARM

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ABSTRACT

In this paper the Detection of Moving obstacle and remote video monitoring and extracting the key frames from the captured video based on high performance SAMSUNG S5PV210 CORTEX-A8 processor is build by expanding peripheral devices using embedded Linux as the operating system. Generally monitoring systems are either using webcam based or simple motion detection based. we have interfaced both webcam and PIR sensor to the embedded system so that the user can get a immediate alert message and can take necessary actions. monitoring system is based on the kernel of Cortex board with the GSM module being triggered by a Pyroelectric Infrared Sensor (PIR), which senses the changes in the external temperature, especially when an invader enters in to remote location it sends an SMS to the user.By using a smart device or a PC, the user can directy link to the video streaming server constructed on the embedded board using internet user can browse the webpage to monitor the surveillance area, here the UVC driver and V4L programming is used to interface USB camera to the board to capture video information and then board will do two works parllely first one is it transmits the processed captured video information using wireless network, which will be collected and monitored at client side using the wireless network connection through the wireless device, second one is it extracts the key frames from captured video using OpenCV and served on a server, the both provides an advantage to surveillance monitoring system.

Keywords - Samsung S5PV210 Cortex-A8, Video Capture, histogram difference,video streaming, server, Key Frame Extraction, OpenCV.

1. INTRODUCTION

The video data collection has been designed with the capability of wired and wireless internet access.The new version of monitoring system will be very useful and

powerful to different types of clients.Interfacing this applications with smart devices has become an advantage.A low end micro computer cannot handle the IP based survivallence monitoring system at low cost and high performance..Inorder to overcome the above mentioned disadvantages we use an embedded system which captures the video and transmits the data packets by compressing [1-6] to the sever by the use of “smart devices” the user can view the video through internet. A pyroelectric infrared sensor is used to sense variations in temperature. The sensed signal of the PIR is amplified by a high-gain amplifier and generates an interrupt signal to send SMS to the user. This design has high efficiency resource utilization [7-8].In view of existing designs and previous projects, we use an embedded board which provides video streaming server support and a webpage browsing function. And extracting the key Frames from captured video and serves it on server.

2. SYSTEM HARDWARE AND SOFTWARE DESIGN

2.1 Hardware Architecture

Fig.1 shows the Hardware Architecture of the monitoring survivallence system. Hardware system consists of processor, video-capturing device, and a router to receive video information through Wi-Fi. It consists of a SAMSUNG S5PV210 [9] Cortex-A8 processor is chosen to complete the core control, for video capturing Logitech CMOS camera is used and any smart device or phone or PC connected to the wireless Internet to receive video information to achieve realtime. Video monitoring.

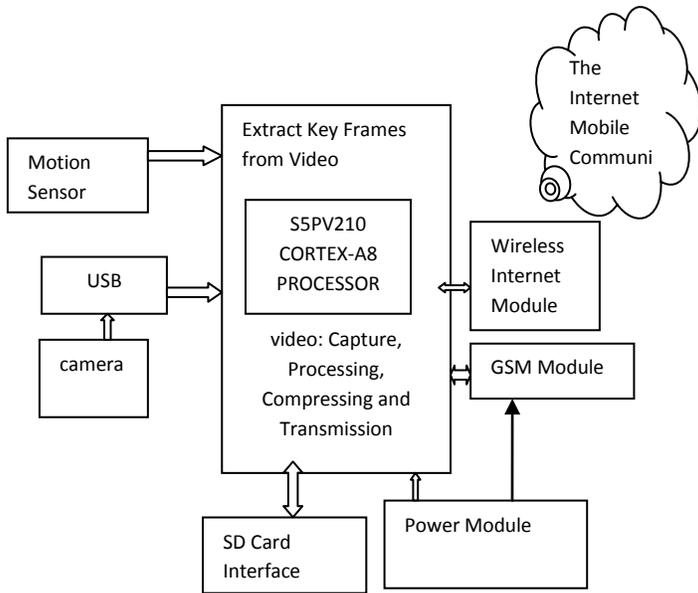


Figure 1: Hardware architecture

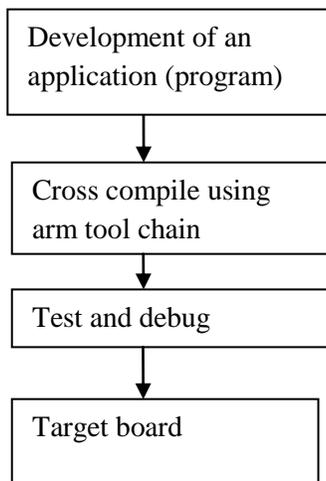


Figure 2: Development procedure

2.1.1 Samsung S5PV210 Processor

Mini210 development board is an efficient one to perform multimedia applications. It consists of S5pv210 processor speed is 1GHZ, it has 512MDDR2 memory, NAND flash of 1GB SLC, USB 2.0, wifi module built in, HDMI HD output, touch screen lcd, it has high performance graphic engine, long video 1080p can smoothly play back, it supports both linux and android through this feature it has many advantages android, tablets pc based applications are developed, a tf

card slot is reset through refreshing it various users can use the os. It can be operated in idle mode.

2.1.2 Web Camera

Logic tech camera with 1.3 million pixels is selected in the built system. In poor light, the speed of CMOS camera is slower, but its price very low, and CMOS has power consumption only when the circuit is connected, it is generally used low-end cameras, digital cameras and toys. There is a 20P plug with 2mm pitch in ARM used as extension to connect the camera. This continuously captures the video.

2.1.3 Pyroelectric Infrared (PIR) Sensor

PIR sensor is used to sense whether someone is passing through the surveillance area or not. If an intruder enters the surveillance area, the sensor is triggered and sends SMS to user using GSM. PIR sensor receives the variations of the temperature made by someone emitting infrared energy to the surroundings it produces the variations of electric charges by means of a Pyroelectric effect. Because the electric charges are very few and not easily sensed, we adopt the high impedance FET to pick up the signal. In this paper we are using DYPME003.

2.1.4 Global System for Mobile Communication (GSM)

The Fargo Maestro 100 /Fargo Maestro 20 are a ready-to use GSM modem for voice, data, fax and SMS services. It also supports GPRS Class 10 (Fargo Maestro 100), Class 2 (Fargo Maestro 20) for high speed data can be easily controlled by using AT command for all kinds of operations. With standard 9-pin RS232 port and telephone-like audio plug (via optional cable) the Maestro 100 /Fargo Maestro 20 can be set up with minimal effort. By using this GSM modem user will get the altering message.

2.1.5 Router

In this paper we use netgear router. Router is a networking device that forwards the data packets between computer network. It is connected to Corex-A8 board through Ethernet cable. Using Wi-Fi we can stream the video through laptops or mobiles the processed data is uploaded to the embedded server using TCP/IP protocol and at the client side the user can see the video and keyframes.

2.2 SOFTWARE DESIGN

We develop the application program and the debugging program at the PC host. By using a cross compiler we compile the embedded application and bundle them into the specific OS that is suitable for the hardware. Mainly in embedded linux software we have three components they are bootloader, kernel, root file system. The bootloader loads the low level hardware components. Fig. 3 shows the software architecture of video monitoring system in which we use the Embedded Linux as the system os. Embedded Linux is used for embedded boards which can be used in mobile devices, home appliances, embedded devices and single purpose systems. OS excels at network communication and also it to GPL and features of free software. The architecture of embedded Linux and Linux are very similar. Embedded Linux is a kernel specified on a specific platform and for specific sets of libraries and utilities. Embedded Linux is a combination of a kernel image and a root-file system image. It can also be built on different kinds of embedded platforms. Linux c language is used for programming. It includes a series of compiler tools and debugging tools (gdb, gcc) as well as a unction toolbox. It has the features of high-level language, as well as low-level language to easily control of the hardware. system for us. OpenCV libraries are used to extract the key frames from captured video. Our software program consists of 4 parts as shown in Fig. 3

- (a) Streaming program: Captures dynamic video
- (b) Key Frame Extraction program: captures dynamic images
- (c) Sensor scan: Scans trigger from GPIO
- (d) Web server: Builds a webpage on embedded system.

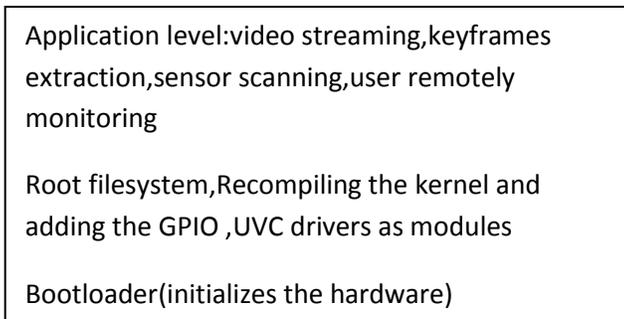


Figure 3: Software Architecture

Fig. 3 shows the kernel modules which includes a GPIO scan driver and camera module driver. When we recompile the Linux kernel, we have to combine them as a module dynamically. The camera module can be used on an Embedded Linux OS. In Linux platform the

drivers are the subsets in the kernel module, and they are compiled with the kernel by the gcc compiler, but the drivers cannot be combined with the kernel as an image file. when we launch the camera the drivers be downloaded (insmod) to the kernel. This method reduces the memory consumption and prevents the OS from not being able to be booted normally when the drivers fail.

2.2.1. Key Frame Extraction

The key Frame extraction [10] algorithm is implemented on the embedded device using Cortex-A8 board using OpenCV tools to extract the frames. Here the captured video will be processed and from it the key frames are extracted based on the histogram difference algorithm using function from opencv. Many algorithms using Matlab are efficient but are slow in computing. As we are developing here using board in order to run along the speed of the board it is better to use opencv based histogram difference method. Algorithm is developed for board purpose for extracting key frames and finally the receiver is connecting to the server end observes those extracted key frames and perform necessary actions. Flow chart of keyframe extraction is shown in fig 5. **Steps:**

- I). color histogram is a representation of the distribution of colors in the image. II). Representing the histogram by taking BIN value.
- III). The values stored in each bin is the number of pixels in the image that shows the range.
- IV). Different levels of intensities are present in this ranges of each RGB components.
- V.) RGB to HSV conversion is done.
- VI). Starting with the first frame to image distance between the current and the next frame $D(H_t, H_{t+1}) = \sqrt{\sum_{k=1}^n (H_{tk} - H_{t+1k})^2}$ Where H_t Denotes image histogram for the t th frame H_{tk} denotes the values on the k th colour H_t .
- VII). Then find the histogram difference between H and SS of two successive frames.
- VIII) sum to list difference for H and S is found.
- IX). The calculated sum is compared with empirically found threshold value.
- X). If the sum greater than the threshold then we obtain the key frames and then served on web server.

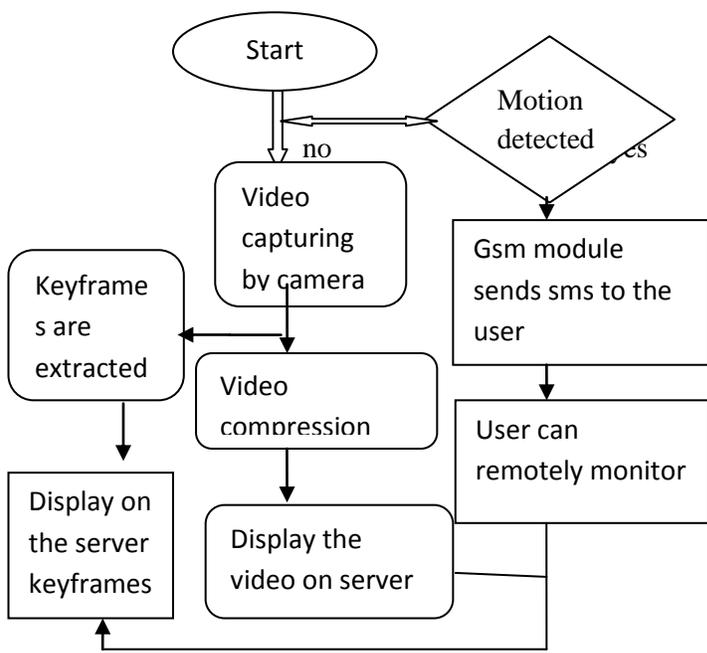


Figure 4: Flow chart of monitoring system

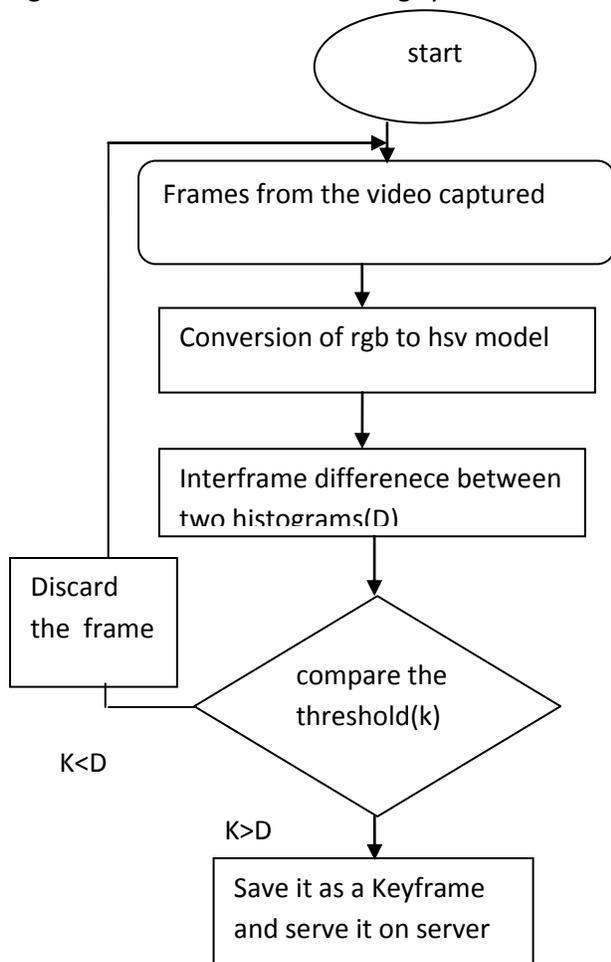


Figure 5: KeyFrame extraction

2.2.2. Building and Cross Compiling of Opencv tool
OpenCV [11] is a collection of software algorithms put together in a library that are used by industry and academics for computer vision applications and research. Using this libraries we can design the applications. To build OpenCV we need to install some libraries, Using below command we can install those libraries `sudo apt-get install libjpeg-dev libjasper-dev libtiff4-dev libpng12-dev libpango1.0-dev libcairo2-dev libgdk-pixbuf2.0-dev libgtk2.0-dev cmake cmake-gui`.

After installing this libraries Download OpenCV source and configure the OPENCV using below commands:`cmake-gui make make install`. Cross Compile OpenCV and its libraries to run on the board.

OpenCV cross compiling steps:

- Set the compiler tool chain.
- Build v4l-utils
- Configure OpenCV
- Build and install OpenCV

3. FLOWCHART

Step 1: If a person passes near to the PIR sensor it is triggered and sends an alert message to user. After seeing that message the user can link to the video streaming server 1 or server 2 constructed on the embedded board via the internet and browse the webpage to monitor the surveillance area.

Step 2: The camera continuously monitor the room and captured the video, the captured video is compressed using MPEG-2 compression technique and display in the server. Compression of video must be done, because some mobile devices allow only restricted amount of packet size between the server and device.

Step 3: From the captured video the key frames are extracted and compressed using JPEG which is done by using OpenCV and served on server.

4. EXPERIMENTAL RESULT

Logitech camera captures the video and it allows the user to monitor by synchronous video streaming. We implemented the software modules in the Linux C language for the video display and for the triggered signal while sensing the temperature. We also build the streaming server and a Web server on the embedded board in order to allow the user to browse the surveillance system. In the streaming server some Linux web streaming packages to be installed and configured on board, this implements the embedded server using TCP/IP protocol and is streamed at the client side using

HTTP protocol. Here the Mplayer embeds an encoder called mencoder and it will transform the different media specification to the standard format for video streaming (ex. transforming MPEG 2 to avi). We turn on the browser and then input the IP address on the embedded board. We link to the embedded video streaming server and build the operation interface by using a streaming server. Fig 6 shows the implementation of displaying the real time video streaming on the web server. Figure 7: shows that output of the PIR sensor and sending SMS to the user using GSM modem. Here the PIR sensor is used to sense whether someone is passing through the surveillance area or not. If an intruder enters the surveillance area, the sensor is triggered and sends SMS to user using GSM commands.

An Experimental Set Up For Web Camera At first the parameters related to the video sequences are considered as listed in Table 1 then based on that for an amount of time interval the obtained the key frames from above mentioned steps are noted based on the appropriate threshold as listed in Table 2. Here the key frames are changing according to the threshold value, the higher the threshold the lesser the key frames are extracted and lower the threshold higher the key frames so based on application we can make a relevant threshold so that we can save the transmission bandwidth accordingly. Key frame Results the figure 8 represents the key frames which are extracted from live video using CORTEX-A8 board and served on the web server and Figure 9 shows the final output key frames.

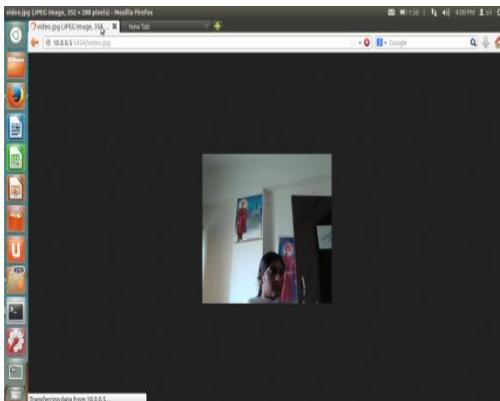


Figure 6 video streaming outputs on the server

```
> Sensed motion
Message sent successfully
sensed motion .... sending sms...
AT S7=45 S0=0 L1 V1 X4 &c1 E1 Q0
AT S7=45 S0=0 L1 V1 X4 &c1 E1 Q0
OK
AT
AT
OK
at+cmgf=1
at+cmgf=1
OK
OK
AT
AT
OK
AT
OK
at+cmgs="+919246566373"
```

Figure7: Gsm output



Figure 8: key frames obtained

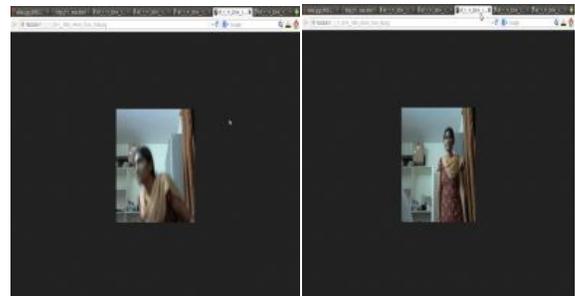


Figure 9: keyframes output on the server

TABLE 1: Experimental setup

SNO	PARAMETEER	SPECIFICATION
1	Video length(assumption)	60
2	Frame rate	25fps
3	resolution	352*288=101376
4	No of frames	25*60=1500
5	Bit rate compressed	60*512kbps=30.7mbps

TABLE 2: Result analysis

S.no	Threshold (K)	Keyframes	Detected Key Frames	Transistion Bandwidth (Mbps)
1	1	10	18	9.2
2	5	10	14	7.1
3	10	10	9	4.6

Coference on Mechatronic and Embedded Systems and Applications, Aug. 2006, pp. 1-4.

[6]http://www.friendlyarm.net/products/mini_210

[7]<http://opencv.org/>

5. CONCLUSION

In this paper we have designed and implemented the moving obstacle detection and remote video monitoring system using min210 board. We have combined PIR sensor to sense the temperature changes in the surveillance area if any changes sensor triggers and the gsm module sends SMS to the user,Logic tech CMOS Camera module to capture the video and video streaming server on the embeddedboard for surveillance to view the captured video and also we have implemented the extraction of the key frame from the captured video on the Cortex-A8 board using this we can save the transmission bandwidth and memory. We have adopted Embedded Linux as the operating system on the embedded board because it supports well on the network and many free.

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