

Remote Video Monitoring System Based On ARM and GPRS

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Abstract: This Paper, A wireless video monitoring system based on GPRS network and ARM9 is designed. The embedded chip and the Linux programming techniques are adopt. Central monitor which adopts S3C2416 chip as controller. USB camera video data are collected by the embedded Linux system, processed, compressed and transferred by the processing chip. The video data are sending to the monitor client by GRPS network. All implemented tests show the presented wireless video surveillance system is more suitable, reliable and stable. It provides real-time monitoring of a facility's environment, people, and assets. Video surveillance systems play an increasingly important role to maintain social security.

Keywords: USB Camera, ARM9 Chip S3C2416, Embedded Linux (V4L), GPRS Module.

I. INTRODUCTION

Recent years monitoring facilities are necessary and useful for our daily life to make we secure. From small firms to many large companies some kinds of video capturing systems have introduced to keep their security. In this paper video monitoring system is designed bases on real time operating system i.e. Embedded Linux. The video data collection and sharing are designed with ARM9 processor and Ethernet controller and GPRS network.

The video data collection is designed with the capability of both wired and wireless internet accesses. The new version of our monitoring system will be powerful and useful for several kinds of clients. So one can say this system is client security oriented system. In this paper it is introduced new surveillance system that captures video, shares through wired or wireless internet access using GPRS network.

Wireless monitor system was evolved from wired surveillance step by step. In the System, embedded technology, GPRS wireless transmission technology and MPEG-4 standard were adopted, after compressed and encoded the data which comes from the web camera, the data was sent to GPRS network by intelligent wireless communication, ultimately implemented point-to-point and point-to-multipoint transmission[1]. The test system is stable, reliable, clear performance on video; to meet the monitoring requirements under the difficult, complex environment the research provides a novel application scheme with the wide application prospect for the monitor of the remote environment[2].

II. SYSTEM ARCHTECHTURE OF VIDEO CAPTURING

The network video surveillance system mainly consists of video capture system based on friendly ARM9 board support package, Ethernet interfaces for wired and wireless internet accesses, display device cum touch panel and Global system for mobile communication module. This capturing and alerting system is a real time system based on Embedded Linux[3]. GPRS module is interfaced for alerting the controlling person from the client. Captured video is displayed both in the sharing network and on the display at the client.

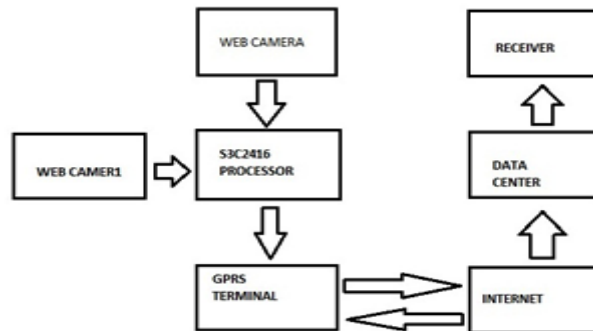


Fig. 2.1 Architecture of video capturing

A. Web Camera

Capturing the live video feed is the first step in video surveillance. We cannot process the video as it is. Video sequence is composed of series of video images. Images are pre-processed which contains features of containing geometry information of the target. Analyzing images, we can classify the target and extract relevant information to analyze the motion of targets. executes the alarm according to the user settings. Video encoder can improve the efficiency of compression algorithms and reduce the transmission rate. The video is compressed by H.264 coding by adjusting the QP value. The compressed video is sent to the mobile phone of the user. The mobile phone can decode them and play the surveillance video. The Video processing techniques that are used in the proposed system has been explained in the following sections.

USB camera captured video data and images are collected by the embedded Linux system, processed, compressed and transferred by the processing chip. Then, video data are sent to the monitor client by GRPS network.^[3]

B. ARM Processor

In this project ARM9 is used because of The ARM926EJ-S processor is the entry point processor capable of supporting a full Operating System such as Linux, Windows CE, and Symbian. An ideal choice for many applications, the ARM926EJ-S processor is one of the most popular ARM processors. Some of the features offered by the ARM926EJ-S processor are:

- Java acceleration
- DSP extensions
- Optional floating point unit
- Flexible local memory system with cache and exceptional Tightly Coupled Memory (TCM) integration

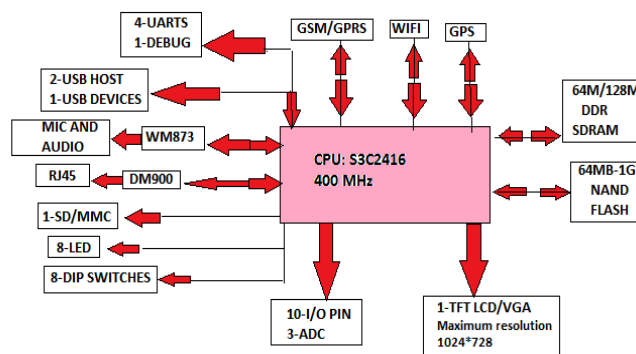


Fig. 2.2 Block Diagram of s3c2416 processor

The main processor uses the S3C2416. The S3C2416 offers outstanding features with its CPU core, a 16/32 bit ARM920T RISC processor designed by ARM, Ltd. The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16kB instruction and 16kB data caches, each with 8-word line length. It has 2-port USB Host and 1-port USB Device, support 64MB Flash and 64 MB SDRAM memory cell. GPRS module connected GPRS network through the RS232 expansion interface, the module with the address locator can also be extended, and system can take full advantage of the 3G network for data transmission. JTAG port is used for system debugging.

S3C2416 ARM9 is designed by Samsung in the second half of year 2008, which can take the place of S3C2440A perfectly. It is with main frequency of 400MHz, and it contains 2D graphics acceleration video card which supports common graphics acceleration function such as DirectDraw and GDI. The maximum resolution of the video card is up to 1024*1024 pixels. And S3C2416 ARM9 also has the following functions: supporting USB2.0 high-speed interface, SD/MMC2.0 protocol interface, high-speed SPI interface protocol (the maximum speed is 50Mbps), and so on. In addition, S3C2416 supports a variety of startup modes, such as SD card, USB, One NAND flash, NOR flash so it greatly accelerates the debugging and development of the upper applications and underlying drivers.

C. GPRS Module

The GPRS cellular modem offers standards-based quad-band GSM/GPRS Class 10 performance. This ready-to-deploy, standalone modem provides wireless data communication and integrates seamlessly with virtually any application. It is available with RS-232 and USB interfaces to address your application needs. GPRS cellular modem is based on industry-standard open interfaces and can be desktop or panel mounted [4].

The design of GPRS Communication Module In order to connect GPRS module with GPRS wireless communications network, the opened-GPRS-services external SIM card must be in use. SIM_VCC is the mains to which the G20 uses to provide power, SIM_Reset is used by G20 for the SIM card resetting control, SIM_Clock is provided to the SIM card for clock, SIM_DIO is for the data transmission connection between the G20 and the SIM card.

III. SYSTEM HARDWARE DESIGN

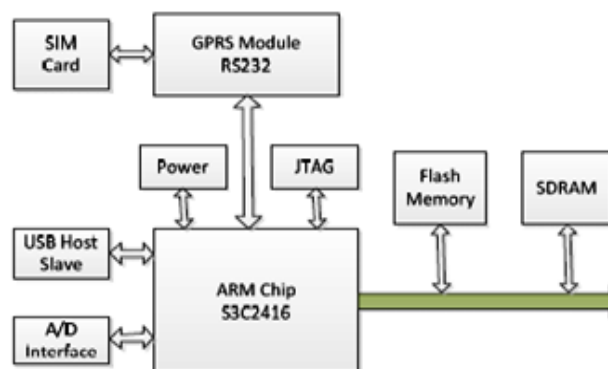


Fig. 3.1 System hardware structure

In this paper it is considered ARM9 processor module, which has on board peripherals. It is an SOC chip based on ARM9 with low power, high performance, very suitable for embedded product development. The application system hardware uses external peripherals GSM modem, RGB web camera, LCD cum Touch screen panel. And also standalone PCs for loading real time operating system, for loading applications and to see the captured video through wired or wireless internet access.

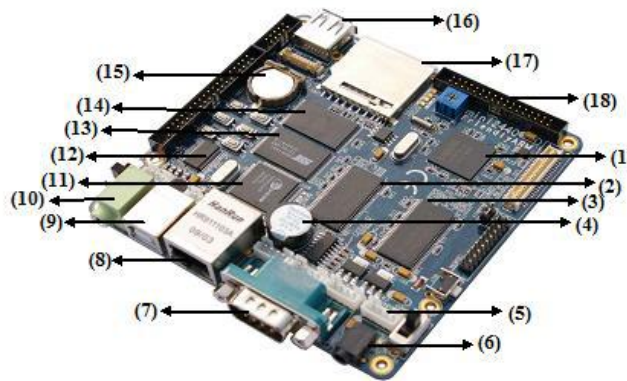


Fig. 3.2 Diagram of Friendly A RM9 Structure

IV.SYS TEM SOFTWARE DESIGN AND DEV ELOPMENT

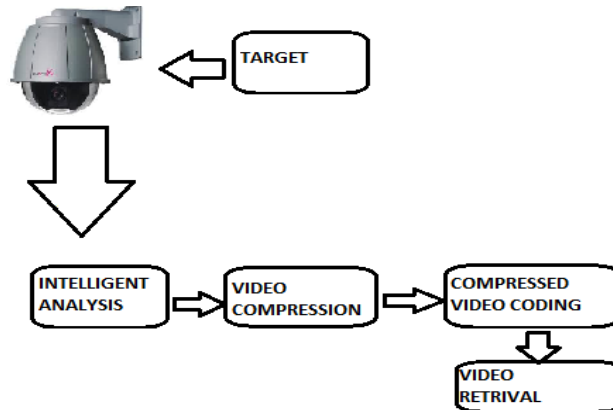


Fig. 4.1 System software design

A. Image capturing

The external device is managed by the device file in theLinux operating system. So, the operations of external devices are transformed into the operation of the device files. The main process is shown in Fig .After the above steps, the camera video data is acquainted into memory. First the video data of collection is compressed into JPEG. Then the data is packaged into the data packet transmission to the video application server for processing.

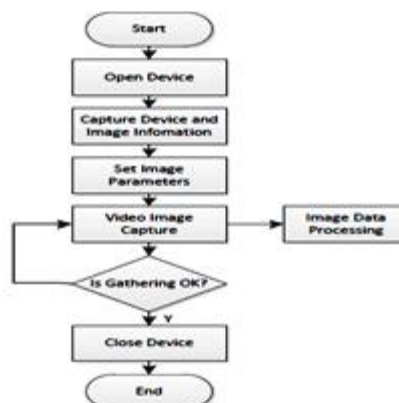


Fig. 4.2 Image processing

B. Video Compression

Compression is a reversible conversion (encoding) of data that contains fewer bits. This allows a more efficient storage and transmission of the data. The inverse process is called decompression (decoding). Software and hardware that can encode and decode are called decoders. Both combined form a codec and should not be confused with the terms data container or compression algorithms.

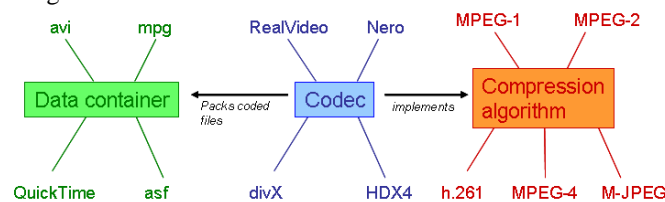


Fig. 4.3 Relation between codec, data containers and compression algorithms.

Lossless compression allows a 100% recovery of the original data. It is usually used for text or executable files, where a loss of information is a major damage. These compression algorithms often use statistical information to reduce redundancies. Huffman-Coding and Run Length Encoding are two popular examples allowing high compression ratios depending on the data.

Using lossy compression does not allow an exact recovery of the original data. Nevertheless it can be used for data, which is not very sensitive to losses and which contains a lot of redundancies, such as images, video or sound. Lossy compression allows higher compression ratios than lossless compression.

The JPEG compression encoding scheme is used in the system based on the DCT (Discrete Cosine Transform) sequence. The original image is divided into 8×8 small video image after DCT transform. The low frequency components are concentrated in the upper left corner, and high-frequency components are in the lower right corner (DCT transform is actually a low-pass filter of the spatial domain) [5].

The coding process is used. The system uses Huffman variable length coding to encode the Quantized DCT coefficients, so that the entropy is minimum. The JPEG encoding under Linux can use the library Libjpeg, that is used under Linux standard library, and its function is the picture in accordance with a certain percentage of compressed into JPEG format pictures or JPEG format to decompress. Many software operating on JPEG are based on this library.

- Huffman coding and Huffman tree
- Huffman tree generated from the exact frequencies of the text "this is an example of a Huffman tree". The frequencies and codes of each character are below. Encoding the sentence with this code requires 135 bits, as opposed to 288 bits if 36 characters of 8 bits were used. (This assumes that the code tree structure is known to the decoder and thus does not need to be counted as part of the transmitted information.)
- Reducing strings over arbitrary alphabet S_o to strings over a fixed alphabet S_c to standardize machine operations ($|S_c| < |S_o|$). Binary representation of both operands and operators in machine instructions in computers.
- It must be possible to uniquely decode a code-string (string over S_c) to a source-string (string over S_o). Not all code-strings need to correspond to a source-string.
- Both the coding and decoding should be efficient
- Huffman Coding Algorithm: 1) Take the two least probable symbols in the alphabet (longest code words, equal length, differing in last digit)
2) Combine these two symbols into a single symbol, and repeat.
- Image Compression: 2-stage Coding technique
A linear predictor such as DPCM, or some linear predicting function \rightarrow Decorrelate the raw image data
A standard coding technique, such as Huffman coding, arithmetic coding, Lossless JPEG:
 - - version 1: DPCM with arithmetic coding
 - - version 2: DPCM with Huffman coding

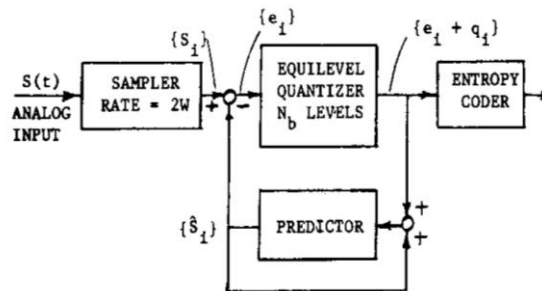


Fig. 4.3 DPCM Differential Pulse Code Modulation

- Huffman Coding Algorithm for Image Compression:
 - Step 1. Build a Huffman tree by sorting the histogram and successively combine the two bins of the lowest value until only one bin remains.
 - Step 2. Encode the Huffman tree and save the Huffman tree with the coded value.
 - Step 3. Encode the residual image.

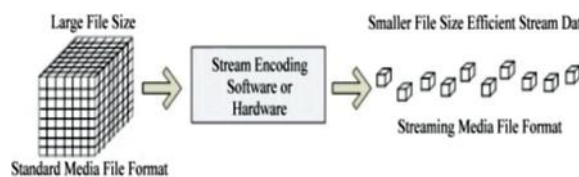


Fig.4.3 Streaming media codec process

C. The system designing

System programming is divided into client and server programming. The client program realizes the data collection and sending and server program completes the data reception and decoding, display. The socket programming is used. The socket is the interface of the same host between the application layer and transport layer. TCP or UDP may be used to provide concurrent services for more than one application process while communicating between application layer and transport layer [6]. In order to distinguish between different application processes and connections, many computer operating systems provide for the application by TCP / IP protocol.

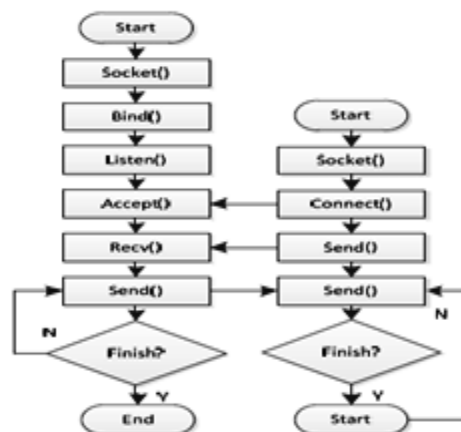


Fig. 4.4 The TCP/IP process between C/S

D. Video processing technique

- Target Detection: Analysis of Motion detection is an important step. In this step, we have to extract the foreground object from the background. Then classify the object whether it is human or non-human. Once the object classification is done, object tracking is next step. The tracking is done based on region and contours. There are three conventional approaches to moving object detection: temporal differencing, optical flow and background estimation methods. Background subtraction is a popular method for human detection in static background. Temporal differencing method is very adaptive to dynamic environments. Optical flow can be used to detect independently moving targets.
- Pre-Processing: First, the videos are separated as frames and pre-processing method is used for color conversion to subtract foreground objects from the background. Pre-processing is mainly used to enhance the contrast of the image, removal of noise and isolating objects of interest in the image.
- Video compression: The video is compressed by H.264 coding. The quantization parameter value and extent of data loss are associated with the picture quality. Less important information can be lost compression of in the surveillance video background. The area containing the moving object is the important information, so lossless compression or appropriate lossy compression is used.

Video retrieval: In the video analysis, the systems first segments video objects (VO) from surveillance videos, and the fundamental semantic information is then extracted and indexed into the database. Content-based retrieval capability is included in the system in order to recover the interesting video shots for obtaining information about the cause of the alarm. The proposed system automatically recovers the sequence in which abnormal activity is found. This sequence is characterized by a key frame, represented by the image that shows the maximum movement around the object. In most cases, the key frame is sufficient to recover the sequence. If it is not sufficient the whole video shot can be retrieved and visualized.

D. Image and Video Compression Standards

The following compression standards are the most known nowadays. Each of them is suited for specific applications. Top entry is the lowest and last row is the most recent standard. The MPEG standards are the most widely used ones, which will be explained in more details in the following sections.

Standard	Application	Bit Rate
JPEG	Still image compression	Variable
H.261	Video conferencing over ISDN	P x 64 kb/s
MPEG-1	Video on digital storage media (CD-ROM)	1.5Mb/s
MPEG-2	Digital Television	2-20 Mb/s
H.263	Video telephony over PSTN	33.6-7 kb/s
MPEG-4	Object-based coding, synthetic content, interactivity	Variable
JPEG-2000	Improved still image compression	Variable
H.264/ MPEG-4 AVC	Improved video compression	10's to 100's kb/s

V. CONCLUSION

The remote video monitoring system is designed based on ARM9 embedded processor and embedded Linux in the paper. The system adopts the higher standard treatment of JPEG compression. The test system is stable, reliable, clearer performance on video; to meet the monitoring requirements under the difficult, complex environment the research provides a novel application scheme with the wide application prospect for the monitor of the remote environment.

ACKNOWLEDGMENT

The goal of this paper is to design “Remote video monitoring based on ARM and GPRS”. The function has been realized successfully. I want to give my whole sincere to my supervisor and grateful appreciation to Prof.Mrs. S.G. Joshi as my supervisor of dissertation work; she tried her best to help me. Without her help and guidance I cannot bring the theories into practice. On the other hand, I want to thank all my family members and friends for their always support and spiritual motivation.

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BIOGRAPHY

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