Design of a remote image monitoring system based on GPRS

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Abstract. This paper introduces a remote image monitor system based on the technology of ARM9 and GPRS wireless communication. presents the structure and work principles of the system, furthermore, it puts emphasis on the hardware processing circuits of image and the foundation of GPRS remote communication protocol.

Keywords: ARM, image monitoring, GPRS.

1. Introduction

With the continuous improvement of people's living standard, people pay more attention to their own personal safety and property security. Contemporary, The rapid development of the economy along with the city's population sharp increase , add a new problem to the city social order, To protect the security of personal property and avoid thieving incident happened, Every family must have its own security system. In their traditional family system anti-theft alarm, fire alarm, and gas leak alarm subsystems' function are single , false alarm rate is higher, it can only achieve local alarm, it naturally fails to achieve remote alarm in real time to reduce losses, but also record evidence of a crime for later inspection. To resolve these shortcomings and scarcity, and meet people's needs for intelligent home, therefore, Adopting image processing technology and GPRS wireless communication technology, the paper studys and designs remote image monitoring system based on ARM9 and GPRS[1].

2. the structure and work principles of the system

The system is mainly composed of alarm input, control unit, image processing, GPRS wireless communication and alarm output , and its working principle as shown in Figure 1. when the system works, the control unit detects the door magnetic sensor installed indoor, infrared, smoke, gas sensor circularly, once there is illegal personnel have intruded, gas leak or firing, etc. it will immediately send a warning signal to the CPU. The CPU will determine which and where the alarm is , and the scene immediately sends a sound and light alarm and takes emergency treatment, by controlling the camera to capture video images, Then the CPU carrys out image processing and sends data through the GPRS network to users in the form of SMS or MMS for attention. In addition, even if the host is away, he may master the situation at home through the GPRS network, and set defending or withdrawing mode to achieve remote monitoring function.
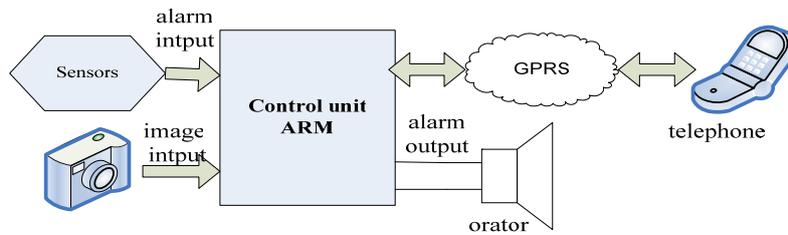

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Figure 1 work principles of the system

3. System hardware design

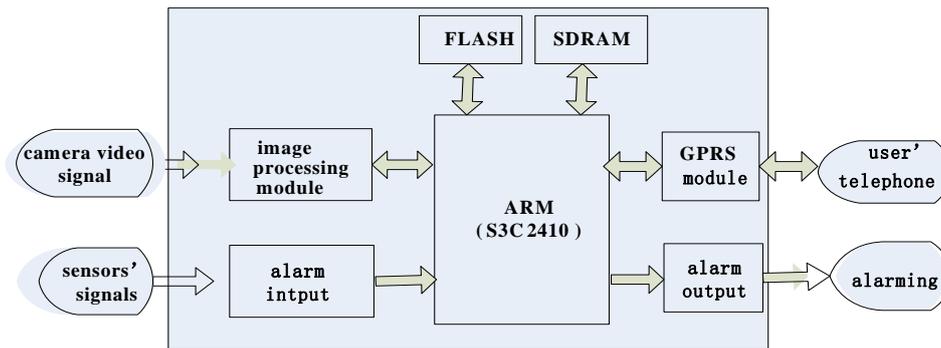System hardware structure as shown in Figure 2:

Figure 2 System hardware structure

3.1. ARM master module

The ARM main control module is composed of the ARM controller, FLASH, SDRAM and related peripheral circuits. The ARM controller mainly controlls alarm input and output I / O port and other parts , at the same time, accepts and transmits video data, and achieves GPRS network communication and other functions[2], Therefore, the system need to choose the chip with more general-purpose I / O port and rich external resources for building peripheral circuits easily. So, the system selects Samsung S3C2410 as its processor, AM29LV160DB and 28F128J3A as FLASH, which stores bootloader guide code and source code respectively. and two pieces of HY57V561620 as SDRAM for constituting the capacity of 64MB high-speed dynamic random access memory.

The S3C2410 is a SOC chip based on ARM9T, low-power, high performance, which is very suitable for embedded product development. With LCD controller, 3-channel UART, 4-channel DMA, IIC and SPI bus interfaces, 117 Universal I / O ports, two USB host interfaces and a USB device interface and other resources, S3C2410 can meet the requirements of the whole system for the processor.

3.2. image processing module

Image processing module includes the image acquisition chip, image compression chip and related peripheral circuits[3].The system adopts dedicated image acquisition and compression chips forming hardware circuits to realize image processing functions, not software.For one thing, it can guarantee real-time of the security alarm system, and reduce the burden of the controller in order to facilitate GPRS telematic,for another, it can obtain better digital compression images. The system selects image acquisition chip of Techwell's TW9903. The TW9903 internal has a software control selector with the election of one in four signal inputs, and chooses different types of input methods by composite video sources and S-videosource composed, it can automatically identify the input analog signal format, and input 24 bit RGB of decoding output, 8bit or 16 bit YUV digital signal and VREF, HREF control signals and the PCLK clock signals directly to image compression chip. The system uses a 8 YUV 4:2:2 output format, collects analog image signal of the camera through the BNC, and makes S3C2410 control and initialize TW9903 through IIC bus.Anotrher,the system select image compression chip GO7007 of WIS Technologies Corporation. GO7007 using MPEG4 compression algorithm, supporting for CCIR-601, RGB Bayer and 8 bit CCIR-656 YUV 4:2:2 input format, can provide high-quality for narrow-band communication of 40 kb / s QCIF video

and 2 Mb/sMPEG4 video, as a while, with the Internet adjusting bit rate and frame rate dynamically using bandwidth , it is able to output high-quality Microsoft video formats. It contains video input interfaces, SDRAM interfaces, debug interfaces, and USB interfaces connected to controller HPI output interfaces ect.. The system uses 8bit YUV 4:2:2 input format and HPI output interface, using MT48LC2M32 the SDRAM as an external buffer, so that S3C2410 can pass initialized program and data to GO7007 through the HPI interface , and read compressed video data.
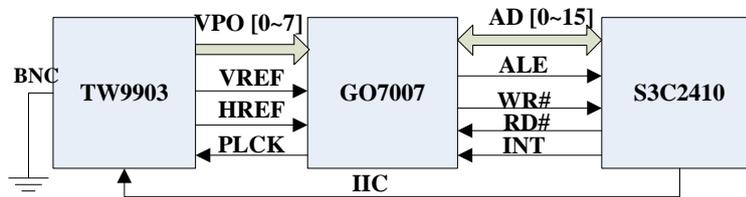
Image processing module wiring as shown in Figure 3:

Figure 3 Image processing module wiring

3.3. GPRS module

The system adopts GPRS module of Siemens MC35i GPRS MODEM[4]. The MC35i with a high performance-price ratio can speed up the exploiture and reduce cost. The MC35i integrates the complete RF circuit and GPRS baseband processor, and provides a complete GSM and GPRS wireless interface, It also supports EGSM900/GSM1800 dual-band, GRPS Class 8/Class B and GSM phase2 / 2 +, using TCP / IP network protocol to communicate, The MC35i connects with the controller through RS232 serial ports and is controlled by AT command. The S3C2410 controls MC35i by UART, which communicates with users to achieve alarm and remote monitoring. through the GPRS network by message or callings.

3.4. Alarm input and output circuits

All the detectors and alarm devices used in the system are connected to controller through the GPIO to complete alarm input and output functions. However, these input and output signals have a so strong current, that the system would be affected largely. so the system uses respectively photoelectric isolation chip TLP521 and relays for alarm input and output signals to minimize impact which external signals produces on the system.

4. system software design

The system software mainly includes bootloader, operating system, file system and user applications. The bootloader using VIVI, is mainly used to initialize the processor and hardware equipment, download system image and initialize the operating system, then be ready to implement. The operating system uses a Linux2.4 core with powerful network and excellent transplant It has a powerful process, interrupt, memory, and equipment management, supports a variety of file system, a complete set of TCP / IP protocols and many necessary devices drivers embedded in the system, are used to manage a wide range of applications software to achieve systems' real-time and multi-task. The file system uses EXT3 file system, makes all the files and directories in the system form overall directory hierarchy by tree structure, in order to facilitate system management of documents and equipments. The user applications are made up of a series of functions which complete the corresponding functions, including alarm monitoring procedures, image acquisition compression procedures, GPRS communication procedures, etc. So the paper need to compile all driver procedures of devices in the system and the corresponding user applications in order to achieve the required functions of the system.
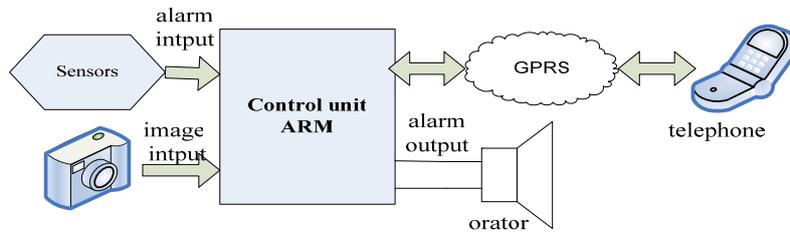
The main program of system flow shown in Figure 4:

Figure 4 the system main program flow chart

4.1.   Image acquisition compression procedure

The image acquisition compressed procedures is mainly designed to complete image processing and output in the center of the image acquisition chip and image compression chip. The mage acquisition part includes initialization procedures of the image acquisition chip, control procedures of register, and parameters control procedures, it achieves post-acquisition digital image input to image compression chip by controlling the output of the inage brightness, saturation and contrast . The image compression section includes GO7007 drivers and applications. The GO7007 drivers mainly complete initialization, turn off, checking the data and parameter control function for the chip. The GO7007 applications gain different data streams by controlling the parameters after acquiring compressed data.

4.2.   GPRS Communication Program

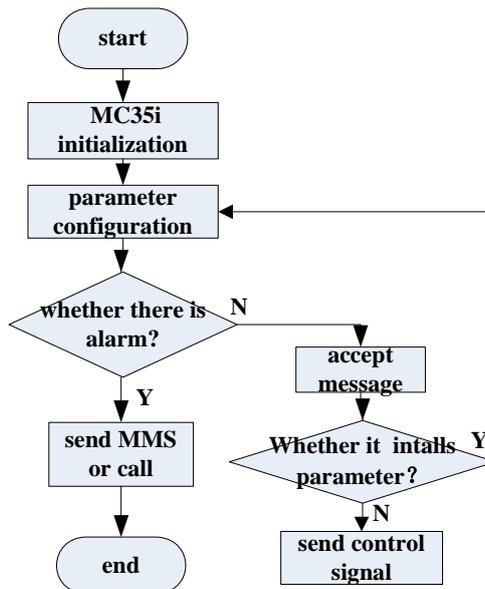GPRS communication flow subroutine in Figure 5 below:

Figure 5 GPRS communication program flow

The GPRS communication program is edited by AT commands, including GPRS module initialization, GPRS network parameter configuration, message alarm to send, message receive and calling, ect. It complete data's wireless transceiver base on TCP / IP protocol . when the GPRS module is initialized with + + +, ATV0, ATH and ATE0V0Q0 commands, ect. the MC35i executes instructions, data, hangs up and returns the results in the form of data. The GPRS network parameter configuration uses AT + CGDCONT = 1, "IP", "CMNET" commands, sets up GPRS network PDP mobile scene's identifier IP, APN access point is CMNET (China Mobile Net) respectively. It uses ATDT ***********# : to complete dial-up settings. Short message and telephone parts use AT +? =? and other commands to achieve the corresponding functions.

5. Concluding remarks

The wireless image monitoring system based on ARM embedded, image processing technology and GPRS technology, makes full use of the advantages embeding in the image processing, network communication and the existing GPRS network resources, It not only achieves a rapid security alarm, record evidence and remote monitoring, but also owns the advantage of high reliability, low False Alarm, cost-effective and less loss. At present, the system can be upgraded by hardware and software and integrated new functional modules to meet the intelligent home security development needs in the future. It is tested shows that the system works stably and achieves the design requirement. The system also can be used in the place requiring security and remote monitoring ,such as banks, libraries，museums and so on .

6. References

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