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## Remote Video surveillance System Based on S3C2440 and GPRS

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**Abstract:** In this paper a wireless robust system for video monitoring is designed using ARM9 core and GPRS connectivity. Client server architecture is employed in which S3C2440, webcam and GPRS module is on server side and client side is the monitoring device. Programming is done using DOT NET coding. The image is captured using a webcam, compressed and transmitted to the monitor client both via MMS and email. The received image is decompressed using JPEG and viewed in real time. A novel system can be used as per the requirement. Most effective for applications where it is difficult for humans to reach.

**Keywords:** S3C2440, GPRS, Linux Fedora, JPEG, MMS.

### I. INTRODUCTION

With the advancements in the embedded system, networking and communications technology, the video monitoring systems are playing a major role in today's world, especially in the military, industrial and civilian security applications. Traditional video surveillance can generally achieve close distance monitoring, by using the PC as a monitoring unit connected to surveillance camera with coaxial cable. These video surveillance systems are broadly classified into analog and digital video surveillance systems. But today in this digital world, the video surveillance systems based on embedded technology are more advantageous compared to the traditional surveillance systems, as it provides high performance at low cost and good stability. Meanwhile, it possess some advantages, for example, enhanced design simplicity, compact construct, portable, low power consumption, long-distance transmission This paper puts forward a video surveillance system based on ARM9 architecture based S3C2440 controller which is an Friendly ARM platform.

Video data is captured using a USB web camera, compressed into JPEG format, transferred through the 3G network under the control of the ARM9 chip; then, the monitor client will receive the data frames which are later compressed to restructure, and recompose video images. To demonstrate mobility the server is placed on a robot model which will take a square path and capture an image.

The video capture is the core part of the system. The camera capture video images, this data is compressed, and transferred into a video stream format. GSM transceiver module is used for GPRS wireless network module [2] [3].

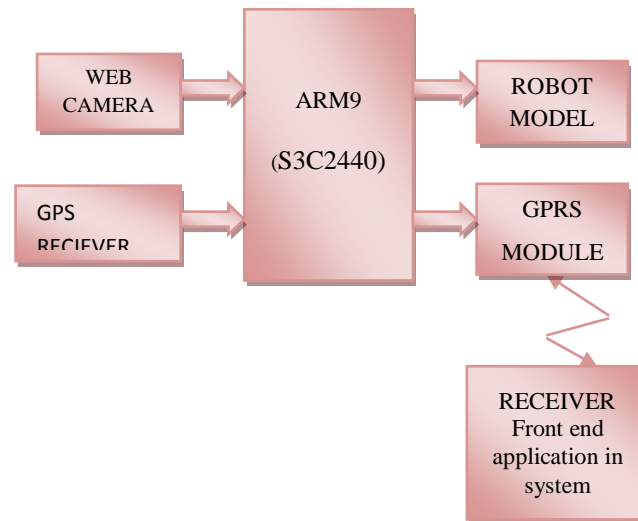


Fig. 1. Basic block diagram of proposed video surveillance system

Images are transmitted on MMS and email via GPRS network. The system can be applied in smart anti-theft, dynamic transportation, smart home for security, medical treatment, as well as in all kinds of video surveillance systems. The system structure is shown in Figure 1. Compared with video capture systems based on the digital signal processor (DSP), this system has the advantages of fewer and simplified modules, cost effective, enhanced intelligence, greater system stability and higher security.

## II. DESIGNING THE HARDWARE

Block Diagram of System hardware is shown in Figure 2. After comparison and research, the S3C2440 microprocessor is regarded as the main chip for video capture and processing. The S3C2440 offers outstanding features with its CPU core, 16/32 bit ARM920T RISC processor designed by Samsung, Ltd equipment as well as is cost-effective and requires less power. The chip implements MMU (memory management unit), AMBA (advanced microcontroller bus architecture), BUS, and Harvard cache architecture with separate 16kB instruction and 16Kb data caches, each with 8-word line length long. It has 1-port USB Device and 2 port USB Host, support 64MB Flash and 64 MB SDRAM memory cell.

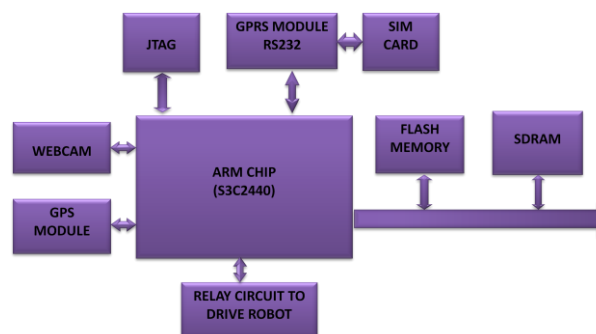


Fig. 2. Block Diagram of System hardware

### A. ARM920T processor

ARM920T processor is used in our model due to its advanced features described below. Samsung S3C2440 32-bit ARM processor is the contemporary general purpose microprocessor in the embedded market used in industrial level applications. ARM9 consists of a number of peripherals interfaced to it. We use LCD display, keypad matrix, UARTS, GPIO and I2C protocol. ARM9 processor is a link between GPS and GSM modules for communication. The description of ARM9 is discussed in further sections.

#### FEATURES:

- 32-bit ARM920T microcontroller 400MHz, max. 533Mhz

- 64MByte SDRAM, 32bit Bus, 100MHz Clock.
- 64MByte or 128MByte NAND Flash, 2MByte NOR Flash with Bios
- In-System Programming (ISP) and In-Application Programming via on-chip boot-loader software. Single sector or full chip erase takes 400ms.
- B Two 32-bit timers (with 4 capture and 4 compare channels), PWM timer (4 channel), Real Time Clock and Watchdog.
- Multiple serial interfaces including three UARTs (1 RS232), I2C 20C08 EEPROM (1024bytes) and two SPIs 60MHz maximum CPU clock available from programmable on-chip Phase-Locked Loop.
- On-chip system clock is of 12 MHz crystal.
- OS support: Linux2.6, Android, Windows CE 5and6.
- Two low power modes Power down and Idle.
- Processor wake-up from Power-down mode via external interrupt.

### **B. GPRS communication module**

General Packet Radio Services (GPRS) is a packet oriented mobile data service on 2G and 3G cellular communication system's global system for mobile communication (GSM). GSM is the most widely used mobile technology using a simple Subscriber Identity Module (SIM) it has taken the world of mobile communication to new heights. Even with the introduction of new technologies like CDMA, GSM has stood its strength due to its efficiency and simplicity.

A GSM modem is a wireless modem that works with a GSM wireless network. Computers use AT commands to control modems. Both dial-up modems and GSM modems support a common set of standard AT commands. So we can use a GSM modem just like a dial-up modem. The difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

The following AT commands are used:

Goal: Call a phone

Dial 123-456-7890 = ATD1234567890;\r

This command returns OK or ERROR. Returns NO CARRIER when phone hangs up

Goal: Send a text

AT+CMSF=1\r →Find message

Returns OK or ERROR

AT+CSCS="GSM"\r →Select TE Character Set

Returns OK or ERROR

AT+CSCA="+13123149810"\r →Service Center Address

Returns OK or ERROR. This number +13123149810 is the short message center for AT&T/Singular service. T-Mobile's is +12063130004

AT+CSMP=17, 167, 0,240\r →Set Text Mode Parameters

Returns OK or ERROR. These numbers refer to settings for text message sending.

AT+CMGS= '1234567890'\r →Send Message

Returns>, prompting what message to send. 1234567890 is the phone number the text will be sent to.

Hello this is a message<Ctrl+z>

Type any message, and then press <Ctrl+z>. Returns conformation message and Message ID number

Goal: Read a text

AT+CMGF=1\r →Preferred Message Format

Returns OK or ERROR

AT+CMGDA= "DEL ALL"

Delete all text

AT+CNMI=0, 0 →New Message Indication

Disable unsolicited error code

AT+CMGR=1 →Read Message

Read Message #1

AT+CMGL= "REC UNREAD" →List Message

Read all received unread messages

GSM is one of the most vital components in our set up since all the communication between the users and Centralized unit takes place through this modem. GSM communicates with ARM through I2C bus.

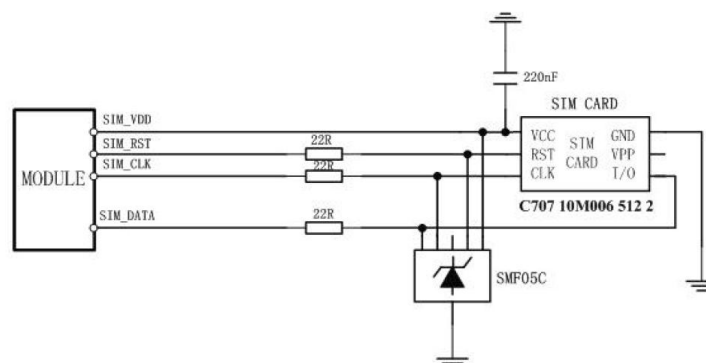


Fig. 3. Interfacing circuit with 6-pin SIM card.

The single supply voltage range is 3.4V-4.5V. Its current consumption is as low as 1.5mA in SLEEP mode. Normal operating temperature range is -30°C to +80°C which are best suited for this application which will be used in places where human reach is difficult.

GSM module SIMCOM SIM900A is used. SIM900A is a quad-band GSM/GPRS engine which works on frequencies GSM 850MHz; EGSM 900MHz and PCS 1900MHz. SIM900 features GPRS multi-slot class 10/ class 8 and supports the GPSR coding Schemes CS-1, CS-2, CS-3 and CS-4. This GSM module is interfaced with a 6pin SIM card. AT commands are used to get information in SIM card.

### C. Global Positioning System (GPS)

GPS is wireless communication module. This design adapts the current leading GPS technology and the integrated positioning chip Cirotech 600L. Specifically Designed for OEM Applications, it is a GPS receiver module with high sensitivity, low power consumption, and 51 channels. Compared with other independent GPS solutions GPS600L is able to

help users gain and continuously track GPS signals at a very low signal intensity, which means GPS600L can be used in the environment where it has never been thought to be accessible, such as buildings of the city, dense forest, garage, and many indoor environment, with a position accuracy of less than 10 meters. With only an addition of relevant circuit at the periphery, longitude, latitude, positioning information including time, rate, moving direction, etc., can be output through the serial.

The GPS module can receive data when connected to ARM9 development-board through RS232port. When the ARM9 chip sends the instruction AT to GPS module, the GPS module starts receiving the data and saves it into memory. This instruction sends the region information to the support-server center through GSM net. Because the system is based on GPS data which is sent through GPRS net, it must be initiated at first.

The GPS is initialized as:

```
private void textBox3_TextChanged(object sender, EventArgs e)
```

```
{
    buffer = textBox3.Text;
    try
    {
        gps = buffer.Substring(0, 200);
        buffer = "";
        if (gps.Length >= 200)
        {
            for (i = 0; i < 200; i++)
            {
                Thread.Sleep(100);
                if (gps.Substring(i, 6) == "$GPRMC")
                {
                    textBox4.Text = gps.Substring(i + 20, 9);
                    textBox2.Text = gps.Substring(i + 32, 10);
                    textBox3.Text = "";
                    gps = "";
                    timer2.Enabled = false;
                    still();
                    upload();
                    send();
                    timer1.Enabled = true;
                }
            }
        }
    }
}
```

}

}

#### D. JTAG circuit

IEEE 1149.1 commonly known as JTAG (Joint Test Action Group) is an international standard test protocol. It is mainly used for chip internal test, system simulation and debugging [4][5]. JTAG technology is an embedded debugging technique. Inside the chip it packages a special test circuit TAP (Test Access Port). It uses the dedicated JTAG test tools to test the internal nodes [6][7].

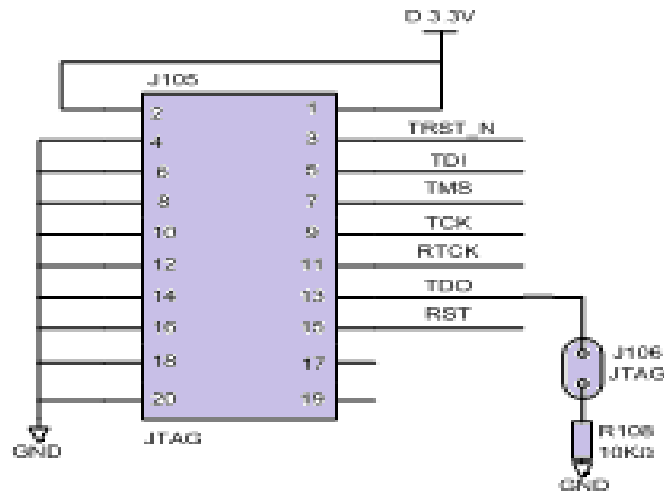


Fig. 4. The JTAG interface circuit

The most complex devices present till now such as FPGA, ARM, and DSP etc support JTAG protocol. The standard JTAG interface is 4-wire: TMS, TCK, TDI, and TDO [10]. They are test mode select, test clock, test data input and test data output [8]. JTAG is a simple and efficient means of developing and debugging embedded systems as all the internal parts can be accessed through JTAG interface. At present there are two standards to connect the JTAG interface: 14 pin connector and 20 pin connector. This design uses a 20-pin JTAG interface. The system's JTAG interface circuit is shown in Fig 4.

### III. SOFTWARE DESIGN

#### A. The image capturing process

The core of the entire video capture module is video capture. First the camera is initialized using the following:

```
private void cmdConnect_Click(object sender, EventArgs e)
{
    cam_.setMediaType(resolutionCombo.SelectedIndex);

    if (!cam_.init())
    {
        MessageBox.Show("Cannot Init camera");
    }
}
```

The video capture is finished once the robot model completes a square path. The OV511 chip with built-in drive is used in the system [1]. Driver loading process is as follows: making menuconfig in the kernel directory, and then selecting the Video

for Linux USB support directory, and support for USB and USB camera the OV511 support, finally save and exit. The program can be loaded successfully and the system starts with the new kernel after running the OV511. O.

The system functions are as follows:

```
DirectShowNETCF.Camera.Camera cam_ = null;

private void capTypeCombo_SelectedIndexChanged(object sender, EventArgs e)
{
    cam_.CapType = (DirectShowNETCF.Camera.CaptureType)capTypeCombo.SelectedIndex;
}
```

The external device is managed by the device file in the Linux operating system. So, the operations of external devices are transformed into the operation of the device files. The main process is shown in Figure 5.

After the above steps, the camera video data is acquired 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.

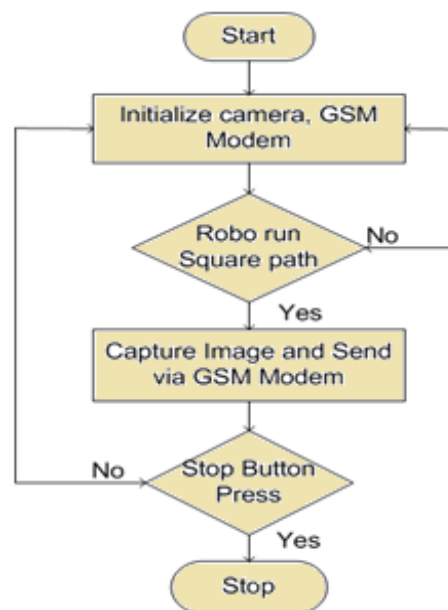


Fig. 5. The image capturing process

### B. Video 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  $8 \times 8$  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).

The high spatial frequency for the human eye is far from low-frequency sensitive, so the treatment of visual loss is very small. The video image is clear and true by the method. The data is quantified after DCT. The quantization is a value divided by the quantization table corresponding value. Due to the smaller value of the upper-left corner of the quantization table, the value of the upper right corner on the upper left corner of the low frequency components can be maintained, high-frequency component can be fully inhibited. After Quantified at high spatial frequencies a large numbers of consecutive zero will appear. 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. Much software operating on JPEG are based on this library.

### C. Program design- Communication module

The client and server programming are the two parts of system programming. This system adopts a very simple approach of client and server program. The server program realizes the data collection, encoding and sending while the client program completes the data reception, decoding and display. At the client side Linux Fedora 50 operating system is used on which internet is accessed on QT creator based on QT platform. For communication between client and GPRS networking is used. In order to distinguish between different application processes and connections, many computer operating systems provide for the application by TCP / IP protocol. This interact is called the socket. Its main parameters are three: the destination IP address, transport layer protocol and port number. These three parameters can be distinguished from a different application process or a network connection communication, concurrent services of data transmission. The system uses the stream socket design whose communication process is shown in Figure 6.

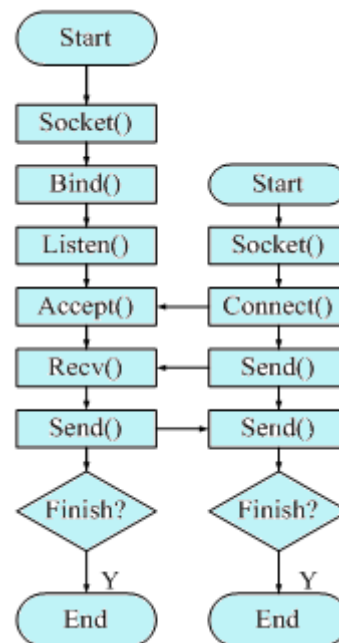


Fig. 6. The TCP communication process between C/S

### D. Program design- Server side

The server program realizes the data collection, encoding and sending while the client program completes the data reception, decoding and display. Coding at the server side is done in CSharp using Windows Embedded compact OS, commonly known as WinCE.

### E. Program design- Client side

First its IP address is obtained by the domain name server, and then a socket is created. The data is received from the server after connection is successful by connect function; finally the socket is closed after the communication is finished.

## IV. EXPERIMENTAL RESULTS AND ANALYSIS

The system is stable. Size is adjusted after compression; and frame rate can be improved.

The result is obtained from the experimental data.

1. The transmission rate is varied; with the changes of the network.
2. The image is smooth due to USB driver. The performance can be raised by improving the USB.
3. Stability of the system is achieved.



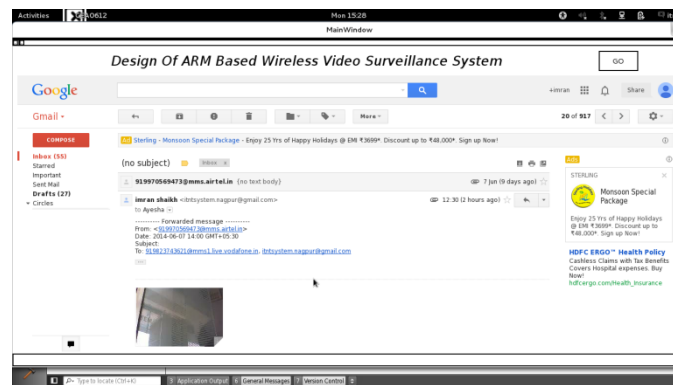


Fig. 7. Image received wirelessly on email.

## V. CONCLUSION

Now-a-days video monitoring is not only used for security purpose but also can be used in many other applications such as, searching lost ones from mountain ranges, in coal mines, or for making wildlife documentaries. The future scope of this project is with different advancements according to the requirement. The proposed system is based on ARM9 with GPRS and GPS connectivity which allows real time data transfer. Also the problem of range for data transfer is overcome by using internet connectivity through GPRS. Thus the system is reliable, stable and can be used in most critical conditions.

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