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Design of Wireless Monitor System Based On S3C2440 and GPRS

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ABSTRACT: This Paper introduces a new type Wireless Monitoring System, which applied in Industrial Field. In the Proposed system, the main hardware includes the S3C2440 Microcontroller based on ARM9 core, and the software adopts Embedded Linux which is an embedded operating system, is communicated by GPRS Wireless transmission service. The real-time video data through USB camera is captured. It is compressed and encoded with MPEG-4. The compressed data will be monitored through wireless transmitting system using Socket Communication Mechanism. The data can be transmitted at higher data rates. The Proposed design has a small size, portable. It is a low cost solution for the real-time monitors that are required in Industrial Field.

Keywords: S3C2440, GPRS, MPEG-4,USB CAMERA

I. INTRODUCTION TO WIRELESS MONITORING SYSTEMS:

Monitor systems have been widely applied in many fields, such as bus system, public security system, banking system, logistics system and power system, it plays an irreplaceable role. With the developing of science and technology, people take a higher request for the remote environment. Wireless monitor system was evolved from wired surveillance step by step.

1.1 Need for wireless monitoring System:

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 USB camera, the data was sent to GPRS network by intelligent wireless communication, ultimately implemented point-to-point and point-to-multipoint transmission. The system overcomes some shortcomings of traditional wired monitor system, such as short-distance transmission, poor image quality and so on. It is suitable for many occasions, and has universal significance and actual value in many domains.

There is a real on-going need for monitoring of various sensors like valve positions actuated or manual in the process line of industrial applications. Malfunctioning of a valve can result in danger to human health and safety, affect yields and generate environmental risks. In some industries, regulation requires constant recording of valve position. Currently, such monitoring is done through wired "switch boxes." Each such device requires data transmission and power cabling. Not only are these cables costly to manufacture and install, they are also one of the most frequent sources of failures in the process line, due to the fact that they are very often exposed to harsh environmental conditions. In fact, it is right here, at the field device level, where the majority of problems with wires really exist.

The various field buses that have been integrated into most applications over the past years ago have not really changed the situation. The Switch Boxes are still typically connected via wires, in a star topology, to bus concentrators.

Wireless monitoring of valves can revolutionize industrial processing and help industries meet the demands of increasing competitiveness. Intelligent wireless monitoring in industrial environments enables real-time data sharing throughout a facility and this, by definition, increases industrial safety, efficiency, and productivity. Wireless monitoring technology offers reliable, autonomous, and improved process control enhancing safety, and reducing costs.

2. Block Diagram of Proposed Design:

The video data provides information about open or closed states of the valve, and also measures the valve's angle position in degrees, at ±0.500 accuracy with 0.100 resolutions. It also provides its temperature, battery status and other house-keeping information. The video data has inputs to collect data from the field (analog and digital) and outputs to deliver commands to field devices (planned enhancement).

It collects the dynamics-of-state change of an actuated valve and transmits it as a data packet, thus providing preventive data on the health of the actuator/valve set.

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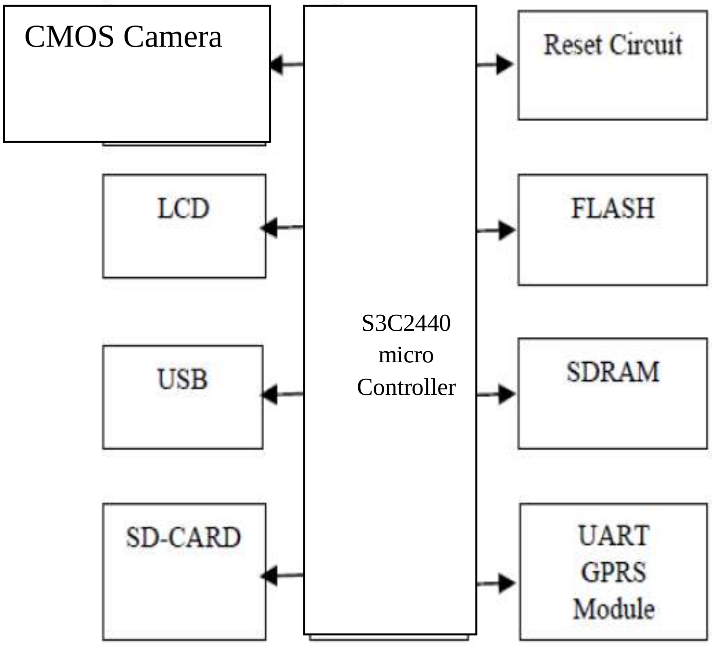

2.1 Block Diagram of Proposed Design

The operation of the VD can be commissioned and programmed from the system server as well as from a handheld operator device, which allows short-range, low frequency communication with the VD.The current product utilizes a Zigbee chip set from Ember. However, once the ISA100 standard is released and a stack is commercially available, the product will be upgraded to the new ISA-S100 standard. Eltav plans to carry both ZigBee and ISA100 based products.

The system is designed to maximize the probability of message transfer from the Valve Device to the Management System. In preliminary pilot tests, a 100% data transfer has been demonstrated (460,000 messages with no losses and with less than 0.1% retries or rejoins). The measured average latency was less than 100 ms.

ZigBee is using Direct Sequence Spread Spectrum (DSSS). This technique increases the bandwidth of the transmitted signal. The wideband technique provides improved communication qualities but usually sacrifice spectrum utilization. DSSS can be modeled by applying a prearranged pseudo-random digital sequence to directly phase-modulate the already data modulated carrier, at a rate in excess of the data rate. The resulting DSSS signal occupies a much greater bandwidth, albeit with a lower spectral power density.

The signal is recovered by demodulating the received signal with a replica of the same modulating pseudo-random digital sequence.

The DSSS signal process spreads the original signal into a wider bandwidth for transmission over the channel, and then dispreads the signal at the receiver to recover the original signal and the information it contained.

3. S3C2440 Microcontroller: Samsung's S3C2440A 16/32-bit RISC microprocessor. Samsung's S3C2440A is designed to provide hand-held devices and general applications with low-power, and high-performance microcontroller solution in small die size. To reduce total system cost, the S3C2440A includes the following components as shown in below fig 2.1**.**

The S3C2440 is developed with ARM920T core, 0.13um CMOS standard cells and a memory compiler. Its low power, simple, elegant and fully static design is particularly suitable for cost- and power-sensitive applications. It adopts a new bus architecture known as Advanced Micro controller Bus Architecture (AMBA). The S3C2440 offers outstanding features with its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd.

The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length. By providing a complete set of common system peripherals, the S3C2440 minimizes overall system costs and eliminates the need to configure additional components.

The integrated on-chip functions included 1.28V,1.8V,5V,3.3V to external I/O microcontroller with 16KB I-Cache/16KB D Cache/MMU and has external memory controller (SDRAM Control and Chip Select logic).The LCD controller (up to 4K color STN and 256K color TFT) with LCD-dedicated DMA and 4-ch DMA controllers with external request pins,3-ch UARTs (IrDA1.0, 64-Byte Tx FIFO, and 64-Byte Rx FIFO),2-ch SPls , IIC bus interface (multi-master support),IIS Audio CODEC interface,AC'97 CODEC interface,SD Host interface version 1.0 & MMC Protocol, compatible,2-ch USB Host controller / 1-ch USB Device controller,4-ch PWM timers / 1-ch Internal timer / Watch Dog Timer,8-ch 10-bit ADC and Touch screen interface ,RTC with calendar function,

Camera interface (Max. 4096 x 4096 pixels input support. 2048 x 2048 pixel input support for scaling),130 General Purpose I/O ports / 24-ch external interrupt source, Power control modes are Normal, Slow, Idle and Sleep mode.

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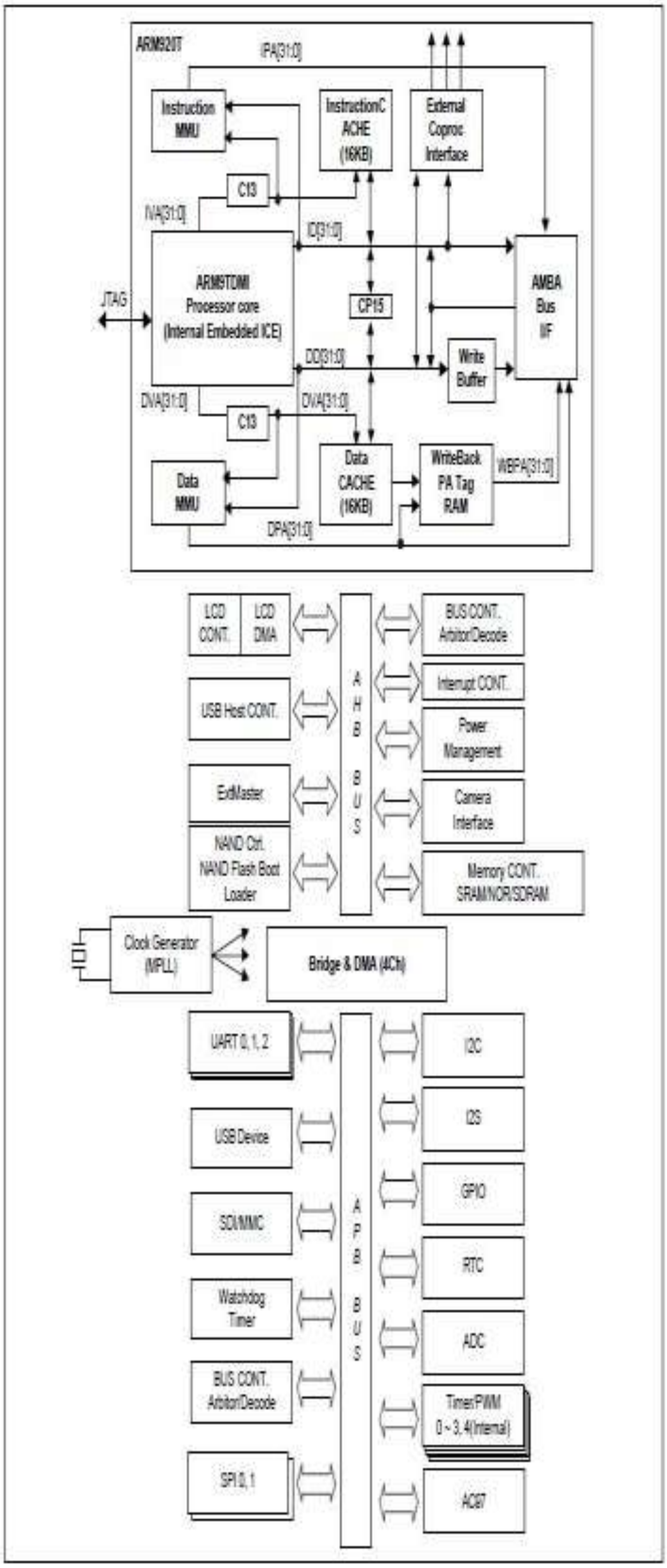
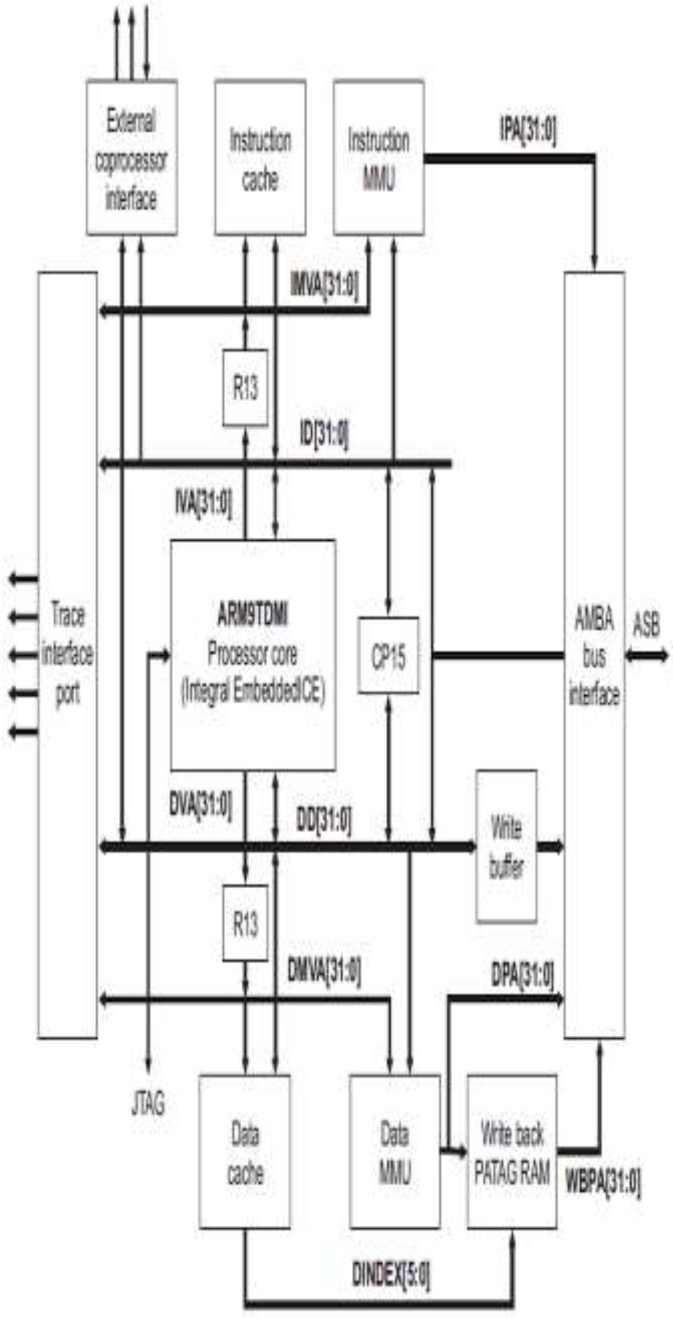


Figure2.2 S3C2440A Block Diagram

3.1ARM920T Block Diagram

The functional block diagram of ARM920T is shown in figure 2.3



3.2 ARM9 Development Board:

Mini2440 is a practical low-cost ARM9 development board, is currently the highest in a cost-effective learning board. It is for the Samsung S3C2440 processor and the use of professional power stable core. Cpu chip to chip and reset security permit system stability.

The Figure 2.4 shows mini2440 immersion PCB using 4- layer board design process, development of µCOS and WinCE process as long as there is C language.

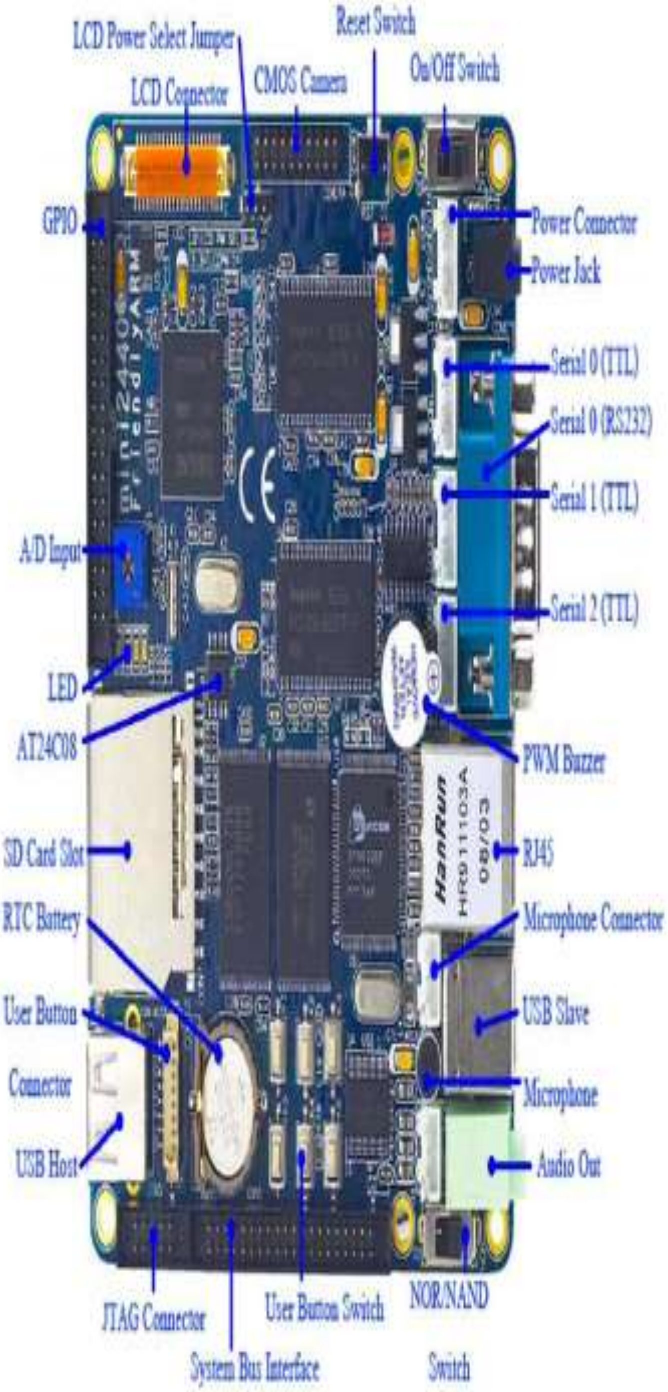


Figure 2.4 ARM9 Development Appearance Board

4. GPRS: With the rapid development of information technology, computers make intelligence melt into many devices. Furthermore, communication technology and network promote local devices networking. Although wire communication network is reliable and rapid, it has some unendurable disadvantages such as high cost, inconvenient wiring, easily destroyed by violence and so on. At present, many enterprises have workstations distributing in the place where the environment is very bad, which makes no supervision and long-distance control become absolutely necessary.

Obviously, using wire as the communication medium is improper both in technology and in cost, which rapidly promotes the application and the development of wireless communication technology in the field of industrial control. GPRS (general packet radio service) (2.5G) is a kind of wireless packet switching technology based on GSM. It provides end-to-end wireless IP (Internet Protocol) connection for a wide area and has the features of speediness, "always connected", etc.

GPRS is an intermediate between GSM and 3G (the third generation) mobile communication. Since GPRS allows information to be sent and received across a mobile telephone network, the supervision area will be wider and the cost will be lower if we establish a long-distance supervision system with GPRS technology. This paper has discussed how to extend the area of supervision to mobile networks and Internet with the help of GPRS and TCP/IP.

GPRS is an ‘always on’ service and therefore saves time connecting and dialing into an ISP. However, it does not constantly transfer data and for this reason many mobile service providers choose to charge on a pay per megabyte basis.

GPRS is a WWAN (Wireless Wide Area Network) which provides an IP based packet switching service over the GSM (Global System for Mobile communications) mobile phone circuit switched network, allowing for multiple users to share radio resources simultaneously.

The underlying architecture of the GSM network is a circuit switched service which requires a dedicated path to be setup before communication can commence. The best analogy of a circuit switched network is the PSTN (Public Switched Telephone Network), which requires a set of switches to physically connect two telephones.

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5. USB Camera:

Fig 2.5 : USB Camera

Hardware Methods to connect USB Camera:

1) Insert USB Camera Module into the USB host interface of the Mini4410.
2) Click "Friendlyarm-> usb camera" to open the tools.
3) Then you can click the "snap" to capture the camera.

The real time video data through USB camera is captured, then compressed and encoded with MPEG-4. The Compressed data will be Monitored through wireless transmitting system using socket communication mechanism. The data can be transmitted at higher data rates.

6. Software flow chart:

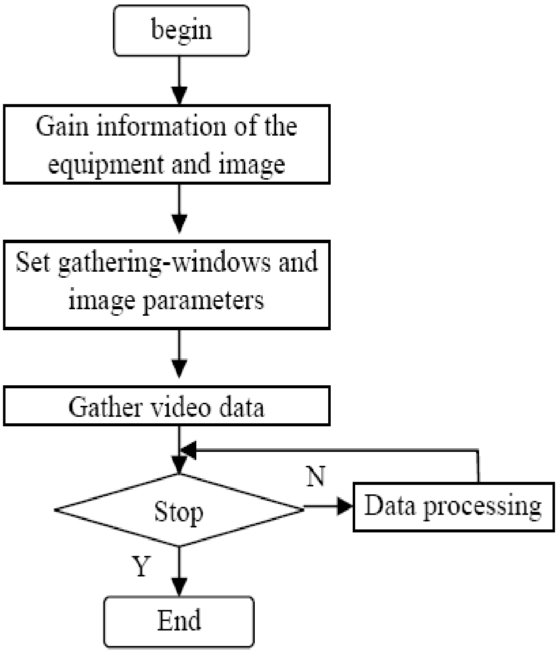

Fig 2.6: Flow Chart for video Capturing

An operating system (OS) is software, consisting of programs and data that runs on computers and manages the computer hardware and provides common services for efficient execution of various software's. For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between application programs and the computer hardware, although the application code is usually executed directly by the hardware, but will frequently call the OS or be interrupted by it. Operating systems are found on almost any device that contains a computer from cellular phones and video game consoles to super computers and web servers

6.1 kernel:

The kernel is a program that constitutes the central core of a computer operating system. It has complete control over everything that occurs in the system.
A kernel can be contrasted with a shell (such as *bash*, *csh* or *ksh* in Unix-like operating systems), which is the outermost part of an operating system and a program that interacts with user commands. The kernel itself does not interact directly with the user, but rather interacts with the shell and other programs as well as with the hardware devices on the system, including the processor (also called the central processing unit or CPU), memory and disk drives.

The kernel is the first part of the operating system to load into memory during booting (i.e., system startup), and it remains there for the entire duration of the computer session because its services are required continuously. Thus it is important for it to be as small as possible while still providing all the essential services needed by the other parts of the operating system and by the various application programs.

Because of its critical nature, the kernel code is usually loaded into a protected area of memory, which prevents it from being overwritten by other, less frequently used parts of the operating system or by application programs. The kernel performs its tasks, such as executing processes and handling interrupts, in kernel space, whereas everything a user normally does, such as writing text in a text editor or running programs in a GUI (graphical user interface), is done in user space. This separation is made in order to prevent user data and kernel data from interfering with each other and thereby diminishing performance or causing the system to become unstable (and possibly crashing).

When a computer crashes, it actually means the kernel has crashed. If only a single program has crashed but the rest of the system remains in operation, then the kernel itself has not crashed. A crash is the situation in which a program, either a user application or a part of the operating system, stops performing its expected functions and responding to other parts of the system.

The program might appear to the user to freeze. If such program is a critical to the operation of the kernel, the entire computer could stall or shut down.

The kernel provides basic services for all other parts of the operating system, typically including memory management, process management, file management and I/O (input/output) management (i.e., accessing the peripheral devices). These services are requested by other parts of the operating system or by application programs through a specified set of program interfaces referred to as system calls.

7. FUNCTIONAL TESTING:

7.1. Start Up Window

To seek effect in the test we ought to make the connection between client and server. Then it shows the stated, observe the BIOS options generated by the friendly ARM 24440 board. By choosing any one option from the given, we can perform the BIOS operations. For Installing/ accessing Linux system we follow the following steps

1. The installation of boot loader
2. The installation of kernel
3. The installation of root file system

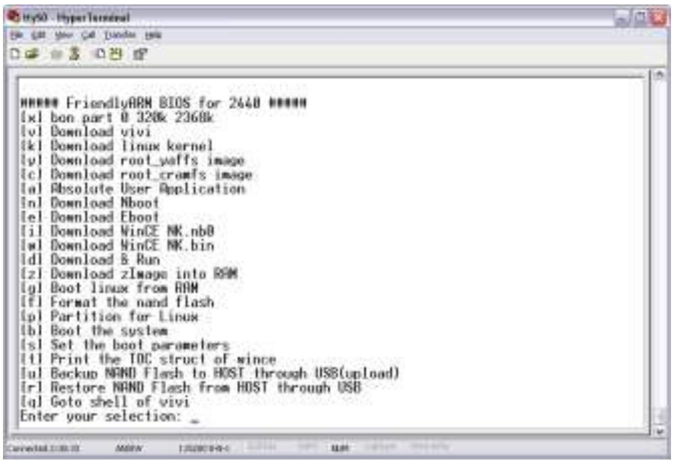

Figure 7:1 Start Up Window

7.2 Step 1: Install Boot loader:

Open the DNW procedures, connected to USB cable, if the title bar shows DNW [USB:OK], note USB connection, then in accordance with its menu to select the function [V] to start is as shown in, it will loads the Boot loader.

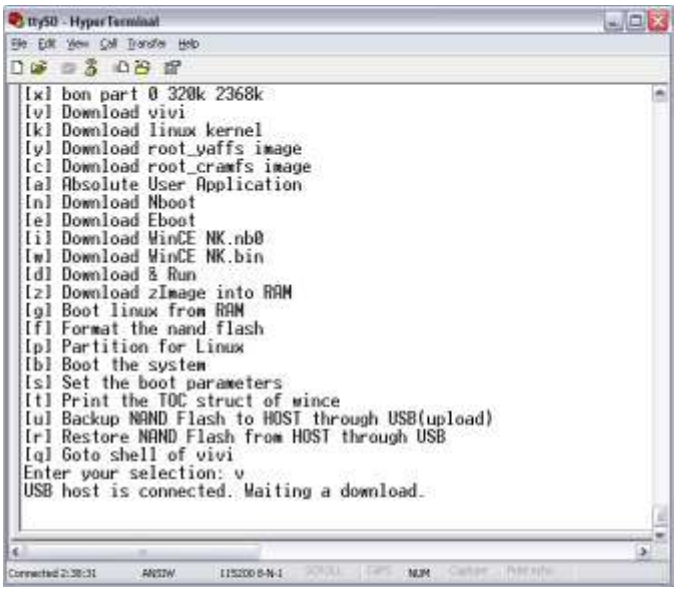

Figure 7.2 Boot loader Window

Open the DNW procedures window then follow the below steps for “install boot loader”, Click "USB Port > Transmit/Restore" option, and select Open File supervivi (the file is located in CD-ROM images/Linux/directory) is shown, then it will start the download process

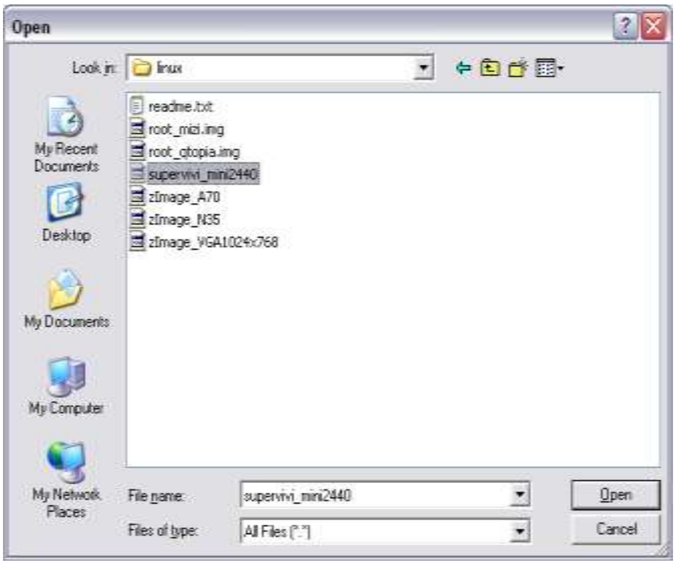

Figure 7.3 Selection of Boot loader

Download, BIOS will automatically NAND flash programmer to the district Supervivi, and return to the main menu.

7.3 Step 2: Install Linux Kernel

In the BIOS main menu, select the feature number [k], start the download linux kernel zImage is as shown and then it is ready to load the kernel in to the memory.

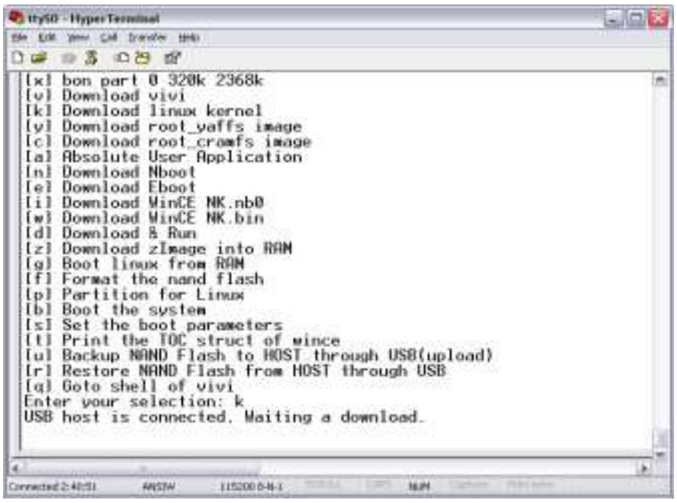

Figure 7.4 Kernel Installation Window

Click "USB Port-> Transmit" option, and select file to open the corresponding kernel z Image shown in (the document on CD-ROM images/linux/directory) to start the download.

Core files Description:
zImage_n35 - apply to NEC3.5-inch LCD
zImage_a70 - really applies to 7-inch color screen with a resolution of 800x480
zImage_VGA1024x768 - module for VGA output, a resolution of 1024x768
Reality may not be identical with this, please check the images /linux/directory readme.txt
Document describes about this.

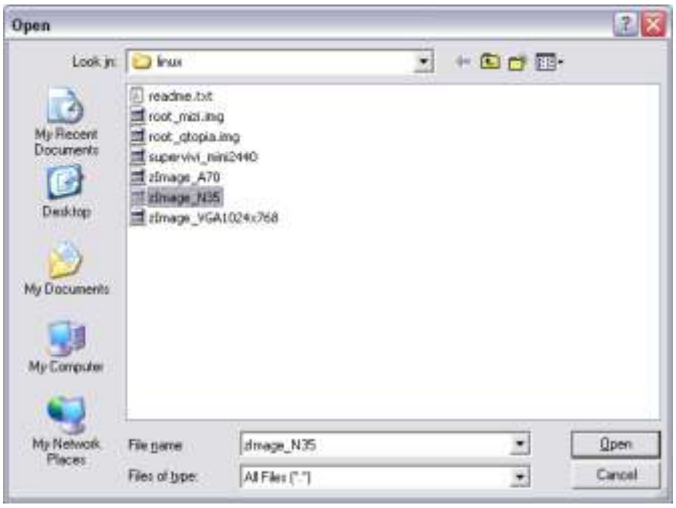

Figure 7.5 Kernel Selection Window

Download, BIOS kernel programmer will automatically partition the NAND flash and return to the main menu.

7.6 Step 3: Install Root File System

In the BIOS main menu, select the feature number [y], to start the download yaffsroot file system shown , after this transmit the image file.

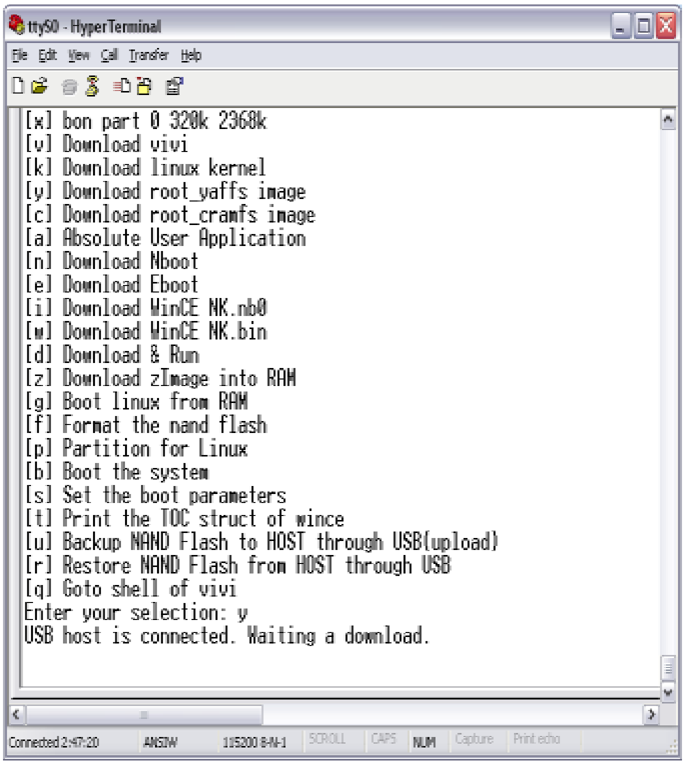

Figure 7.6 Root File System Window

Click "USB Port-> Transmit / Restore" option, and select to open the appropriate file system image file root_qtopia.img is shown in (the file is located in CD-ROM images / linux directory) to start the download

7.7. Root file system image file Description

Root_qtopia.img - The default file system image installation file, it will also support USB mouse and touch screen, and automatic identification VGA output and NFS module start root_mizi.img - Mizi image files provided by the company containing Chinese handwriting recognition, browser and so on.

Figure 7.8 Root File System Selection Window

As shown in fig download process, download completed, BIOS will automatically NAND flash programmer to partition the kernel, and Return to the main menu window.

This process will take approximately 2-3 minutes, the greater the downloaded files download and programmer time will be longer.

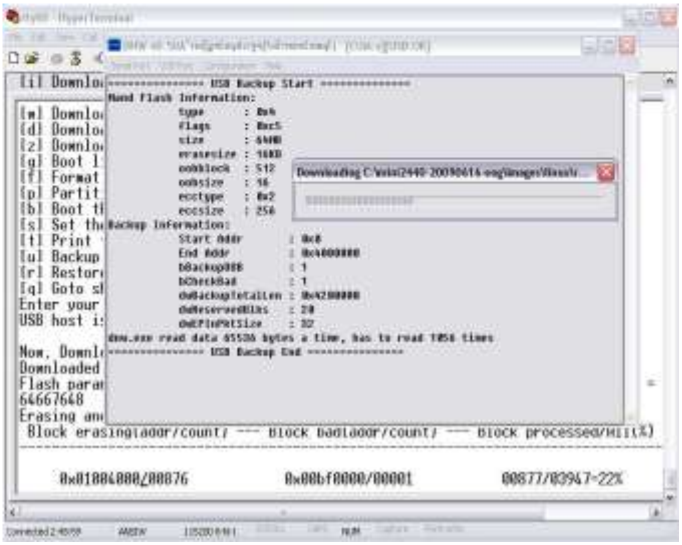

Figure 7.9 Installation Process Window

Download is complete, please unplug the USB cable, if we do not get down, there may be reset or restart the system when lead to our computer crashes.

In the BIOS main menu, select the feature [b], the system will be activated. If our development board to start-up mode is set to start NAND flash, the system will automatically restart after power. Finally once restart the board after the above all steps.

8. RESULTS:

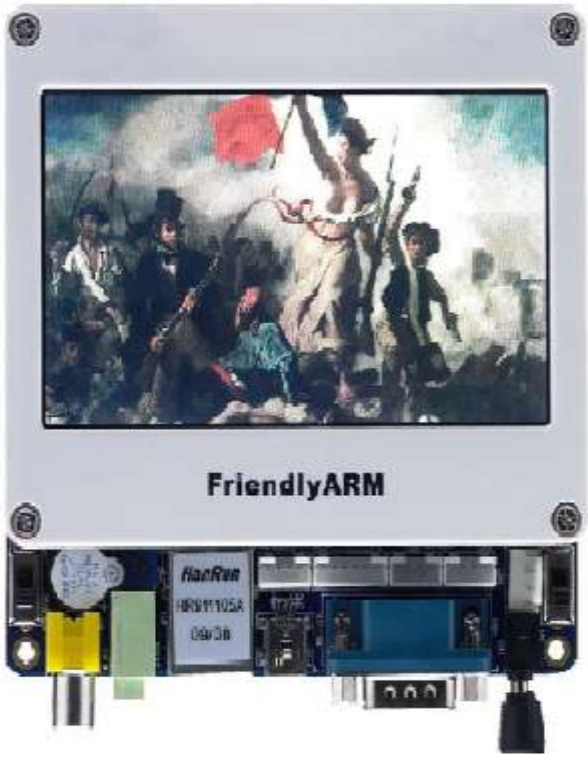

Fig 8.1 Output Window

After transmitting the real-time video data through CMOS camera, compress and encode it with MPEF-4 technology, ultimately complete the wireless remote monitor system with PPP and PMP.

9. Future Scope:

The future scope of my paper is the research by combining embedded Linux technology by using GPRS network. Proposes a wireless remote video monitor system based on GPRS. Analysis the overall design of the wireless remote image monitor system, and according to the characteristics of system choose embedded Linux operating system SAMSUNG S3C2440 controller as the hardware and software developing platform. Developed a prototype machine of the system successfully. The results show that the prototype machine can transmit the static image of the spot to monitor server through GPRS, and realize the function of wireless remote monitor. By using only one power supply section, the transmission of video image can be transmitted and it is encoded and compressed it with MPEG-4 technology, ultimately transmitted PPP or PMP.

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