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Design and Development of ARM9 Based Embedded Web Server

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ABSTRACT
This paper describes the design of embedded web server based on ARM9 processor and Linux platform. It analyses hardware configuration and software implementation for monitoring and controlling systems or devices. User can monitor and control temperature and smoke information. It consists of application program written in 'C' for accessing data through the serial port and updating the web page, porting of Linux 2.6.3x Kernel with application program on ARM9 board and booting it from the RAM.
Keywords **–** Embedded Web Server, Linux Operating System, ARM9

I. INTRODUCTION

The embedded system is greatly improved in reliability, stability and safety in comparison with PC etc. The embedded system transplanted web server can be called embedded web server. The concept of web server gives us the flexibility of monitoring and controlling the electronic devices from every nook and corner of the world. This can be used as security system and has wide range of applications [2].

Through web page released by embedded web server, users can obtain the real-time status information and control remote equipments without time and space restriction. In this paper embedded systems and Internet technology both are combined to form a new technology-the Embedded Internet Technology, which is developed with the popularization of computer network technology in recent years. This technology could function in the hardware and software as long as they are connected. Only by using web browser through the Ethernet and TCP/IP protocol users can get access information of remote devices.

The main advantages of using embedded Web server system mainly include: (1) The client can be freely set and the browser can be used directly without installing additional client software; (2) The operating system Linux, which can be reduced and transplanted, provides a convenient, fast and simple method for embedded systems and Internet access. (3) Small size, low power consumption, low cost and flexible designed. [10]

II. EMBEDDED WEB SERVER

The system contains inbuilt data acquisition control system with online interaction. It makes the system more reliable and avoids more complication. The ARM board acts as data acquisition, monitoring, control unit and embedded web server. The embedded web server is the combination of embedded device and Internet technology, which provides a flexible remote device monitoring and management function based on Internet browser and it has become an advance development trend of embedded technology.

Embedded Web server is currently the main application equipment management and enterprise application network expansion. Embedded Web server as a background process in embedded equipment operation directly; the user through the network to the equipment configuration, control, monitor, to ensure that equipment is effective and efficient operation. Web interface allows the user can be in any one have Internet access ability of the Web browser with the device access to the embedded equipment. Embedded Web server is very good provides Internet network connection, the application and the Web interface combined, is application network good solutions.

III. SYSTEM ARCHITECTURE

The hardware part of this system consists of ARM9 development board and electronic devices which have to control.

Hardware of an embedded system has the following characteristics:
1) Small size and fine electromagnetic compatibility performance. An embedded system is a minimum system without a lot of components needless for target functions.
2) Low power consumption and high integration. It is capable of working in bad environments and supporting quick restart when the system is dead.
The software of embedded systems has the following characteristics:
1) The development of embedded software is closely relative to the hardware. The embedded software is implemented on certain hardware platform, dealing with some parts of hardware-software co-design on device drivers.

2) Codes with both high efficiency and high reliability. Due to the limited and precious memory space for program running in the embedded system, it is necessary to take the code efficiency into account during programming. For a real-time operating system, the processor should rigidly deal with all kinds of tasks produced asynchronously. Besides, an embedded software system is supposed to have some capabilities such as exception handling and quick reset, etc.

3) The software should been solidified into FLASH or ROM. Generally, to improve both executing speed and system reliability, and as well, to reduce system-reset time, the embedded software will be downloaded and solidified into FLASH or ROM of the target device. [8]

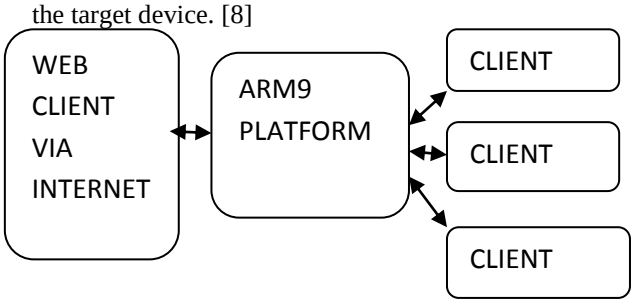

Fig. 1 System Architecture

3.1 HARDWARE DESIGN

The fig. 2 shows hardware architecture of Samsung S3C2440A processor. Samsung Mini2440 is a practical low-cost ARM9 development board, is currently the highest in a cost-effective learning board. On the main controller, Embedded Linux and Embedded web server runs to manage various types of devices or external peripherals. Working voltage of Samsung S3C2440A processor is 3.3V. The mini2440 Immersion Gold PCB using the 4-layer board design process, professional, such as long-wiring to ensure that the key signal lines of signal integrity, the production of SMT machine, mass production; the factory have been a strict quality control, with very detailed in this manual can help you quickly master the development of Embedded Linux and WinCE process, as long as there is C language. [6]

By using DNW tool we can load Root file system, Linux kernel, Boot loader and all other board related software and drivers will load in to NOR flash. The application program will load in to NAND flash by using RS-232. [4]

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.

Features:

1. CPU Processor: Samsung S3C2440A, frequency 400 MHz, the highest 533 MHz
2. SDRAM Memory: On-board 64MB SDRAM 32-bit data bus SDRAM clock frequency up to 100 MHz
3. FLASH Memory: On-board 64 MB NAND flash, Power-down non-volatile. On-board 2 MB NOR flash, Power-down non-volatile, BIOS has been installed.
4. LCD Display: On-board integrated 4-wire resistive touch screen interface, you can directly connect 4-wire resistive touch screen. Support for black and white, 4 gray-scale, 16 gray-scale, 256-color, 4096-color STN LCD screen size from 3.5; to 12.1; 1024x768 pixels screen resolution can be achieved. Standard configuration for the NEC 256K-color 240x320/3.5; TFT True Color LCD Screen with touch screen leads to a 12 V power supply on-board interface, for the large-size TFT LCD 12 V CCFL backlight module (inverting) power supply.

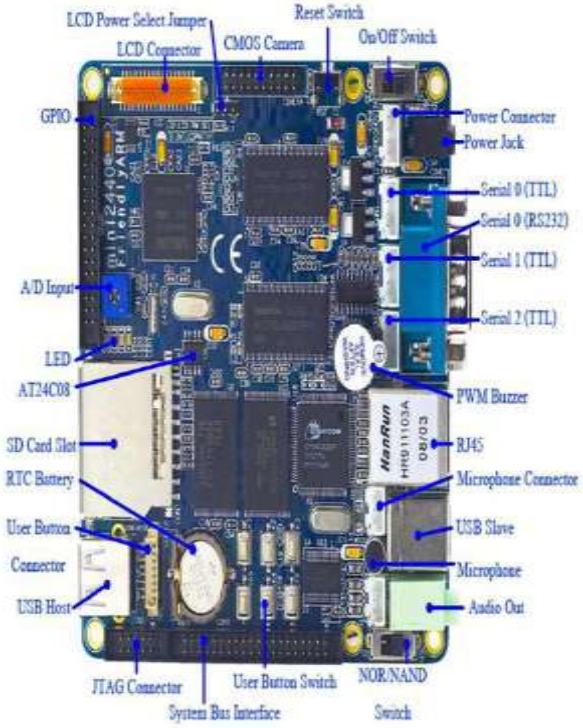

Fig. 2 Hardware Mini2440

3.2 SOFTWARE DESIGN

Software development process based on OS includes: the establishment of cross-compiler, the creation of root file system, the transplant of boot loader, the porting of Embedded Linux, and the development of embedded web server.

1. Linux:

Software development process based on embedded OS includes: Establishment of cross compiler, the Transplantation of Boot loader, transplantation of embedded Linux and root file system as shown in fig. 3 . Later the embedded application is ported onto the system. To begin with, system cross compiler environment using arm-Linux-

gcc-4.3.3 is established. Supervivi Boot loader is used as Boot loader.

For compiling the kernel on the ARM9 board cross compiler tools are used to generate executables for embedded system.

2. Porting Linux to ARM9Board:

To configure the kernel 2.6.3x according to requirement and its compilation to obtain the required zImage.

1. Cross-build environment:

The arm-Linux-gcc cross compiler is employed to generate the executables for the Master system.
The following steps are done to install it.

The arm-linux-gcc-4.3.2.tgz tar file is copied into a directory.
tar xvzf arm-linux-gcc-4.3.2.tgz -C
The installed compiler path is added to the system environment variable: PATH.
It is done by editing the .bashrc file as follows.
vim / root /.bashrc
At the end of the file the following line is added
export PATH = $ PATH: / usr/local/arm/4.3.2/bin

2.The Transplantation of Linux Kernel:
cd /opt/Friendly ARM/mini2440
#cd /Linux-2.6.32.2
cp config_mini2440_n45 .Config
make menuconfig
make zImage

3.Downloading kernel image to Mini2440:
#ftp 192.168.1.200
Name: *prn*
Password: *prn*
ftp<put server.c
#minicom

3. Implementation of Web server:

Initialization of the web server such as creating an environment variable, binding a port, listening a port entering the loop and waiting for connection request from a client. When there is a connection request from a client, web server is responsible for receiving request and saving related information. After receiving the request, Boa analyzes the request and it processes it accordingly.

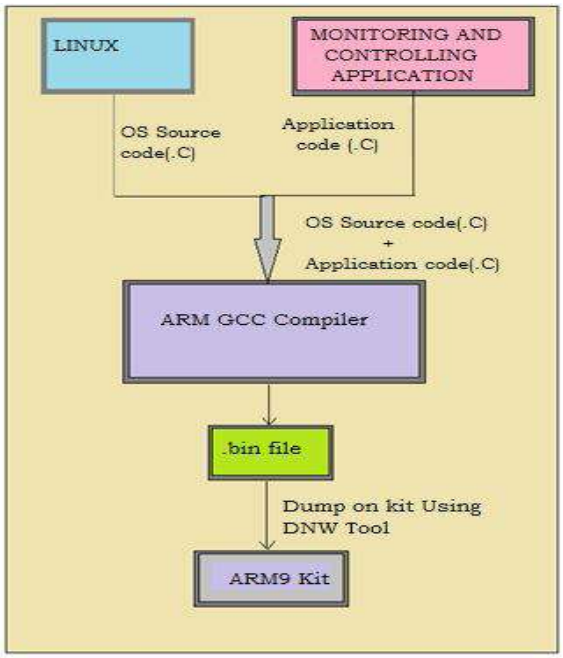

Fig.3 Software Design

IV. RESULTS

As mentioned earlier the application of embedded web server for monitoring and controlling of devices through internet has to be developed on Samsung S3C2440A board. The proposed approach tests the operation successfully and produces the required result. The data from devices which we have to control is stored in the data base of web server through TCP/IP protocols can be retrieve through the web browser by using internet facility.

V. CONCLUSION

In this paper we are connecting temperature sensor and gas sensor to control board. By using control board hardware as well as cost is increased. By connecting the sensors directly to ARM9 board we can reduce the hardware components as well as cost.

This embedded ARM system can adapt to the strict requirements of data acquisition and control system such as reliability, cost, power consumption and size. Embedded web server mode is used to share the data with clients in online. The modes of server are efficiently carried out by multi-tasking operating system.

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