Design of the Intelligent Field Controller with Network

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Abstract. This paper proposes embedded networking industrial field controller design based on ARM9. The CPU is high-performance ARM9-based S3C2440 chip controller, and its acquisition board is enhanced high-speed single-chip controller for the RS422 bus to achieve a C/S structure. The software of master device is based on embedded Linux operating system platform, according to the system kernel needs to cut, drive transplant. The design of another feature is its powerful networking capabilities, you can remote access controllers via Ethernet, remote data display, on-line configuration and select data model according to your own remand.

Keywords: field controller, embedded system, Linux, network

1   Introduction

In today's industrial production process of parameter control and detection, the extensive use of various circuit control instrument as the main controller and the data acquisition device. Traditional analog separation device is adopted to form single loop controller and low control precision, high failure rate, adjustment difficulties, maintenance workload is big, and the function of a single, don't have the ability to connect with production control computer system, also do not have real time data processing functions, access ability is also limited. Today, with the development of computer technology, control technology and network technology, Modern industrialized mass production require to set up production equipment system that integrates the management with the control . To further improve the requirement of the industrial process controllers, an urgent need to improve the use of intelligent network and data information sharing capabilities.

2   Controller general structure design

Field controller use host controller as core. the scene of the physical signal is shifted through transmitter into industry standard voltage and current signal, the shifted signal enter into the host controller and the host display data in form of touch screen in a real-time numerical curve bar chart after processing transformation, Host controller embedded apache web server at the same time, and access to the Internet, users need not arrived on the scene can remotely access to visit a web server through

the network to realize web site data, the controller develop USB SD card interface in the same time , making it easy for users to copy the historical data used as the basis for later analysis. The controller structure is divided into three layers:the field signal processing layer, the host controller layer and the upper computer browser layer.Host controller of the overall structure is shown in figure 1.
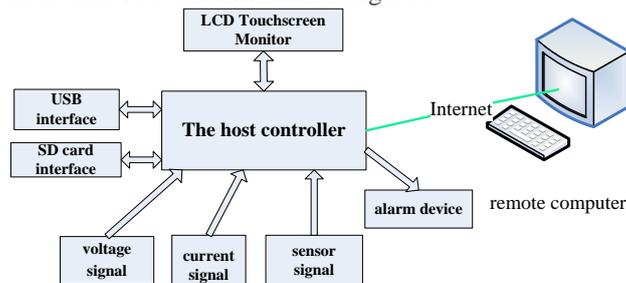

Fig. 1. The overall structure of the controller host

3   Host controller hardware circuit design

3.1   Hardware structure

The control hardware is divided into three parts: the main control board, the power board and the function module board. Figure 2 shows the logical relationship between the three parts. the three parts.

The mother-board connected with function modules board through RS422 bus, view main control board as the host as well function module board as slave, forming C/S structure, the power board provide the original power to main board and function module board, the effect of three parts express as follows:

1. Main control board:

   Main control board uses a high speed ARM chip as the core and embeds the Linux operating system, is mainly responsible for the scheduling of the whole system and the transformation of data, displays and receives the remote network computer access.

2. Function module board:

   Function module board is divided into four types board, including universal-analog-input board, current-input board, voltage-output board and relay-output board. The universal-analog-input board and the current-input board have the main function to collect signal at the scene and deal with the signal conversion as well as to reply of PC data query command, upload the data to the main control board. The main function of voltage-output board is to output the control results to drive the execution of the structure at the scene. The function of relay-

output board is to output results and control whether the relay is opened or closed, but what is most important is to control the alarm device.

3. Power board

Power board is the backup power for the whole system, its main function is to provide stable and initial 5v power supply to main control board and the function module board. Main control board and the function module board convert 5-v power supply to other voltage according to their own needs on the basis of this power supply.

3.2   Main control board design

The hardware structure of the main control board is shown in figure 3. Main control board used the S3C2440 chip from samsung based on arm9 kerne as core, it owns extension 64 MB FLASH storage system program and user data, and provide system operation space through expanding 64 MB of RAM. Main control board also contains network interface, USB and SD-card interface, serial interface and debugging interface, etc. In addition, the main control board adopted design ideas that separate the core board and the bottom board. The core board contains the running basic conditions of ARM9 master controller, draws a interface to bottom board, facilitates the maintenance and the upgrade of the system.
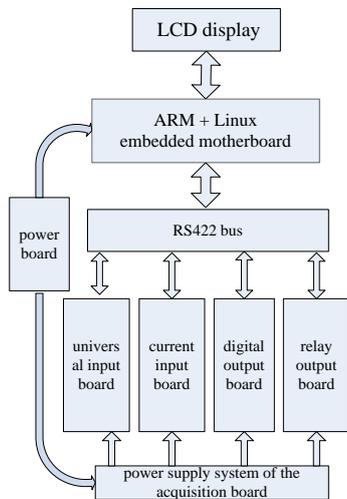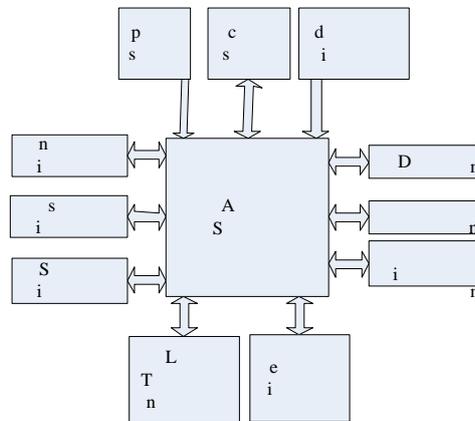
Fig. 2. The hardware structure   **Fig. 3.** The main control board hardware structure

4   The applications software design of host controller

4.1   build the target platform

1. Bootloader transplanting and burning

The position of Bootloader in the embedded system is similar to BIOS of the Windows platform, it not only can set up the software and hardware environment before the operating system start but also can be used to update the system kernel and file system.   Bootloader transplanting is a kind of related hardware transplantation according to the developer's platform. This system adopts the u-boot from the development board manufacturers, so it only needs to set the related parameters just according to their own need.

2. kernel transplantation and burning

Kernel transplantation is the most difficult part of embedded system development. As the large number of the source code and the complex data structure, So transplant from the bottom through a home-grown transplantation is difficult. Fortunately, many communities have launched the perfect drive of kernel for a particular platform, developers only need to drive out and transplant drive that related according to its system needs. Kernel burning is accomplished through the bootloader .Firstly bootloader transmit the kernel image from the host to RAM of the target computer through FTP service, then execute the burning command of the FLASH and curing to the FLASH.

3. the root file system building and burning

Root file system generally includes the configuration files that Linux kernel up and running and the system application program and user data. The type this system uses the cramfs. Cramfs file system is a read-only file system and very suitable for application in embedded system. The root file of this system is cramfs type, it should be packaged into a particular type through special packaging tools after constructing and transmit bootloarder to the target board through FTP service, using the burn written instructions of FLASH to burn the file system.

4.2 The application program of controller host design

The application program of controller host is based on embedded Linux operating system, using famous development tool called miniGUI from **Beijing Feynman Software Technology Co., Ltd** to design the application program.

5   Conclusion

The field controller system based on ARM9 embedded Linux operating system has the function of grid and C/S structure, the users can flexibly configure data processing module according to their needs, and then set the related parameters of the controller based on the actual engineering application through the software, completing the signal collection, display and remote access which are used in industrial field.The field controller designed in this paper has wide application prospect, can be applied to the conventional single loop control system and some other processing control of chemical, oil boiler and boiler.

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