The Application of Embedded System based on ColdFire in BEPC-II

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Abstract

The embedded system based on Coldfire and uClinux/uCOS-II will be used in more and more control system. This article introduce the architecture of this embedded system and its application in BEPC-II.

Keywords: BEPC-II, Embedded System, ColdFire, TCPIP, uCOS-II, uClinux

Due to the demand of higher and higher performance of the control module, more and more embedded systems have been used in the control systems. The system module we designed using uClinux/uCOS-II (software) and ColdFire 32-bit CPU (hardware) has superior performance, and can be used in the newest control systems as the central modules.

Background

Motorola’s M68K series micro-controllers have good fame in the area of industrial controlling. ColdFire series micro-controllers are the natural continuity of M68K series. They are also RISC (Reduced Instruction Set Computer) micro-controllers and have similar structures and instruction systems with traditional M68K series. What makes ColdFire different are the more advanced manufacturing techniques and more modules suit for application in industrial controlling. Using ColdFire series micro-controllers as the central processor is really a good choice for high-performance control systems.

Embedded system software normally runs on an embedded microprocessor like ColdFire.

For the hardware composition of the data acquisition module based on ColdFire micro-controller, please refer to Fig 1. The system includes:

- Motorola ColdFire 5307 32-bit micro-controller, with 45MHz exterior Bus frequency and 90MHz interior Bus frequency; can reach 75MIPS.
- 16Mbytes 32-bit SDRAM, composed of two 8Mbytes16-bit SDRAM, running on the 45MHz exterior frequency of ColdFire 5307.
- 2Mbytes16-bit Flash ROM, can be inline updated.
- 10Mbps Ethernet Interface, using RTL8019AS of the RealTek as the network interface chip. Connect to the Ethernet with 10Mbps (10BaseT).
- VME Bus Interface. Using Virtex-E100 of Xilinx to achieve part of the VME Bus Interface function. Can be used to get data from other devices connected to the VME Bus.
- UART Interface. The terminal interface to display debugging information.
- Debug Interface. Used to debugging ColdFire. Standard 26 pin BDM interface.

Software description

On this hardware platform runs the uClinux. The core edition is 2.0.1. The software mainly deals with the data read from the VME Bus, and then upload the data into the network storage devices via Ethernet interface. The data is then ready to be analyzed by other tools. The software also checks and calibrates the front-end detectors when the system power-on.
Subnet controller module

The subnet controller module, which makes a node on the network, has been developed in our lab. The module has another name of lean server. The hardware cost of the lean server is less than 10 dollars. The 8 bits MCU 68HC908GP32 has 32K Flash and 512 bytes RAM.

The 13 pins within the total of 31 I/O pins are used to interface the Ethernet controller RTL8019. The left 18 I/O pins has a RS-232 port and some A/D channels, which are good enough to control a little device such as a pump, a vacuum valve and so on. The TC/PIP stack has been developed, which has the code size around 7K bytes. (Fig. 4 shows the module and its size is as small as half floppy.)

Application

The module has been already used in the DAQ system for the saner of large containers and an image system.

In BEPC-II, the module would be useful in some sub system control systems such as power supply, vacuum system or beam monitor systems.

For Beijing Electron Spectrum, the modules could hopefully to replace some parts of the VME based DAQ systems, at least it would be useful in slow control.

The module will be used in the alpha and beta ray detector for the environment monitor.

Future Improvement

Further improvement will be the upgrade of the Ethernet interface from 10Mbps to 100Mbps, and the usage of higher-speed ColdFire5407 (pin compatible with ColdFire5307) to replace ColdFire5307. The higher operating speed and the better performance are expected.

And a PCMCIA based wireless LAN card(802.11b based) will added for wireless control.
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