A PLATFORM CONTROL SYSTEM FOR 320 KV HV PLATFORM

W. Zhang, K.W.Gu, J.Y.Li, X.J.Liu
IMP, LAN Zhou 730000, P.R. China

Abstract

This article describes the platform control system applied to the Chinese Academy of 320KV HV platform for highly charged ions. This system is composed of the hardware and the software. The hardware is composed of the network controller based on ATmega128 core chip. Our control group has designed the network controller for controlling the different types of equipment on the platform. The control system achieves the reliability, stability control of the different types of equipment on the HV platform, and control of the network, improve operational efficiency. The software uses NI Corporation's LABVIEW to program user interface. We have established for the application modules of the network controller in the LABVIEW and realized the optimization of the network controller to configure and use. The platform control system has run three years in the 320KV HV platform.

INTRODUCTION

The 320KV HV platform for highly charged ions is based on the demand for physical experimental study. Currently, it is only able to provide 320 kV and a variety of highly charged ions in the international electrostatic acceleration device. The platform combines ions with atomic, molecular, biological molecules and clusters, ions with the surface of the solid and micro-nano tube research needs. The platform is equipped with five experimental terminals, greatly enhancing the ability of the comprehensive study of the interaction of the low-energy highly charged ions with matter [1]. In order to meet the platform device control convenient, fast, stable, reliable requirements, we have the original control system has been transformed.

SYSTEM INTRODUCTION

The device of the platform is on the 320kV of high voltage and control personnel is on the grand, so the equipment on the platform to be able to carry out normal control is necessary to have ground isolation measures. We use wireless communication to resolve this problem between the grand and the high voltage terminal. This method avoids the electrical connection between the grand and the high voltage terminal, thereby avoiding damage to the grand apparatus ignition due to the high voltage terminal. The control equipment is connected to the ground of the high voltage terminal, such that they are on the same electrical potential and avoiding the damage of the control apparatus of the high voltage terminal. A connection diagram of the control system showed in Figure 1. At the grand terminal, the client's browser established a wireless network connection with the front-end server on high voltage platform through the network build by the switch and the wireless router. The front-end server built up a network of high voltage terminal through another switch placed on the high voltage platform. The network controller is connected into the network system through the switch. Part of the network controller control the power supply, another is connected PCLD-885 relay card to control the motors, valves and Faraday cage. This article describes the hardware and software, and gives a summary of its application in the scene.

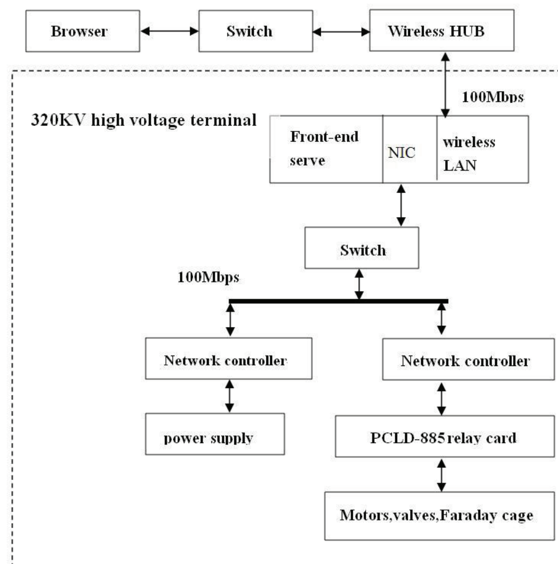

Figure 1: Connection diagram of the control system.

HARDWARE

There are four types of hardware for the control system. The specific contents are as follows:

The Network Controller

The control system uses the network controller designed by our control group and based on the ATmega128 core chip. ATmega128 is a high - performance, low - power AVR ® 8 -bit microprocessor, advanced RISC architecture, with 128K bytes of system programmable Flash, JTAG port programming mode .Its hardware circuit block diagram is shown in Figure 2. The communication between the network controller and the upper control software via the network port Signal through the network chip RTL8019S is converted to the ATmega128 can identify the signals, and then processed. The 8-channel analog input signal is converted into a digital signal through the analog to digital converter AD974 produced by AD Company, and then enter ATmega128 for processing. In order to extend the functionality of the controller, we adopt a CPLD chip EPM7160S achieve the ATmega128 output extensions. At

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the same time, we can achieve the flexibility of output hardware programming CPLD through the JTAG port [2]. According to the characteristics of the on-site power supply, we achieve a 12-way switch output, read the amount of 4-way state. The 8 analog output digital signals converted by AD5362 analog signal output, and provided to the power given reference voltage. The reference voltage range of -10V --- +10 V or 0-10V optional. The program in ATmega128 can be changed by the JTAG port.

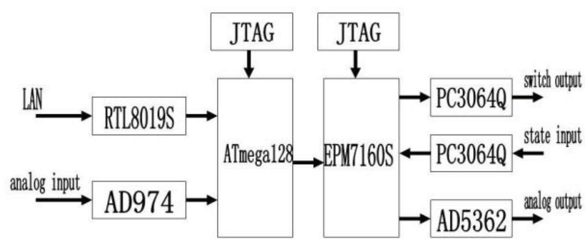

Figure 2: Hardware circuit block diagram.

Network Access

At the grand terminal, we have adopted a H3C S5100 switches and wireless HUB composition network. At 320KV high voltage terminal, we use an industrial computer (front-end server), a PCI wireless card, a PCI conventional network card and a H3C S5100 switches to form a network. In order to distinguish the two different networks, we arranged their network addresses in different segments in the front-end server. The grand address is 192.168.1.X segment. The high voltage address is 192.168.2.X segment. So it is easy to set up and identify.

Control of the Power Supply

In the platform, there are 6 power supplies need to control. A network controller has 4-way control output port, so it can control 4 power supplies. In order to ensure that problems can be resolved in a timely manner, we used a network controller to control two power supplies, which can significantly reduce troubleshooting time. There are 4 types of connection between the network controller and power supply the analog output, analog input, switch output and state input. The analog output provides the input reference (-10V --- +10 V or 0-10V voltages) to the power supply; the analog input reads output signal (-10V --- +10 V or 0-10V voltages) provided by the power supply; the switch output is the operation on the power supply with ON, OFF and reset. The signal is negative, pulse width of 0.5 seconds, amplitude of 5V; the status input reads status signal of the power supply. The signal type is level signal, active HIGH.

Motor, Control Valve and Faraday Cage

The control of Motors, valves and Faraday cage on the platform is achieved by controlling its pass or off. The device work when power turn on, and it stop when power turn off. Since the motor has a direction, so that it has three control amounts. The valve and the Faraday cage have only power-on and power-off the two quantities. Based on this, we use the three network controllers to achieve the control with four motors, a Faraday cage and two valves. The network controller can only output 5V pulse or level signal. Motors, valves and Faraday cup provides 220V AC input, so we purchased Advantech PCLD-885 power relay output card. It has 16 SPST relay channels, and has a maximum rated contact with power (250VAC @ 5A or 30VDC @ 5A). Through 20 - pin flat cable connector or 50 feet Opto-22 interface, PCLD-885 can be connected to the digital output port of the PC-LabCard to direct drive. In the control system, the network controller control PCLD-885 relay channel through 20 - pin flat cable and achieve control of motors, valves and Faraday cage.

SOFTWARE DESIGN

The control system software is divided into two parts. The first part is embedded program in the network controller; another part is the server procedures in the upper interface.

Embedded Program

For ATmega128 chip and on-site real-time requirements, we use the embedded NUT / OS operating system, the network controller program written in structured programming mode. We completed the implementation of the network, ADC, DAC, DI, DO. Each power supply requires 1 channel DAC Road, ADC, 3 - way switch (on the power, turn off the power, reset) and road status read volume. Therefore we have used all functions in the program. Motors, valves and Faraday cup only need the output switch. In order to simplify procedures, we only implement the switch output function. The same time, we set all digital interfaces for DO way through the FPGA program changes; so that we can best meet the requirements of the digital output. The software function shown in Figure 3.

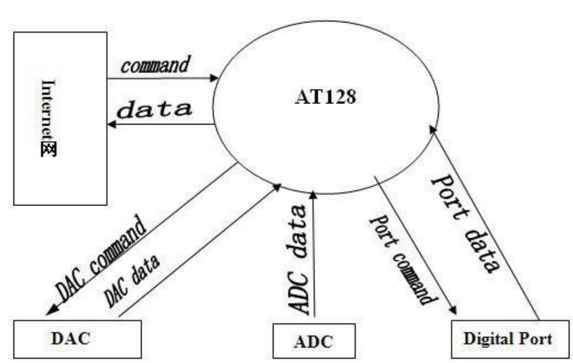

Figure 3: Software function shown.

Interface Program

The control interface program is written by the LABVIEW of NI Company's Virtual instrument platform. We write control command system and the upper layer protocol packets for the network controller in the LABVIEW [3]. In order to facilitate operation and monitoring, we optimize and control interface layout. The control interface is shown in Figure 4. The entire interface is divided into four functional areas. A first functional area is power function located in the left side of the control interface. It mainly completes the control of the power supply on the high voltage platform. The second functional area is motor function located in the upper right corner of the control interface. The third functional area is valve and Faraday cage function located in the bottom right of the control interface. The fourth functional area is the control signal display and auxiliary functions located in the bottom.

Figure 4: The control interface.

SUMMARY

The control system has been applied to the actual operation in October 2009 and achieved a low failure rate, high stability requirements. The control system has been stable operation of the three-and-a-half years, and ensures the normal conduct of the experiment.

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