HIRFL PC-based distributed control system

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Abstract

A centralized control system in which a VAX/8350 computer was used ran before 1996. The rebuilt HIRFL control system is a distributed one based on the powerful PC, workstation and server. It consists of some independent subsystems: Ion source control station, SFC control station, SFC beam diagnosis station, SSC power control station, SSC beam diagnosis station, SSC vacuum control station and RF control station. A high-speed network, 100M, is used to communicate between control stations. The windows socket is used in network programming. The application programs that are used to control equipment are written in C or C++ . They are linked into a DDL(dynamic linking library) which is called by the standard window applications. The GUI is programmed in OOP programming language C++ or VB and run under Windows/95 Chinese version(next: Windows/ NT). The system was built in 1996 and completed in 1998.

1 INTRODUCTION

HIRFL control system before 1996 was a centralized control system. A VAX/8350 computer was used as a center control machine and only used to control SSC power supplies. The computer had some trouble in some years and its spare parts are very difficult to buy since VAX/8350 is old type. In order to insure the accelerator operating, we have decided to upgrade the control system.

A new HIRFL control system is rebuilt. It is based on a high grade PC workstation and server and a DCS control system. Fig.1 shows the control system network.

It is two level control architecture. The upper level consists of Central Manage Workstation, server (CMW), Local Control Workstations (LCW) and a high-speed network, 100M, is used to interconnect them. The Local Control Workstations (LCW) consist of ECR Ion Source Control Workstation (ECR-CW), SFC, injector, Control Workstations (SFC-CW), SFC Diagnosis Workstation (SFC-DW), Technical Control Workstation (TCW), Radio Frequency Control Workstations (RFCW), SSC Power Supply Control Workstations (SSC-PSCW), SSC Diagnosis Workstation (SSC-DW) and Vacuum Control Workstation (VCW). The lower level consists of CAMAC series loops which were used to control equipment, IPC and Field Bus.

2 SYSTEM UPGRADE

2.1 Hardware upgrade

The old computers, VAX/8350, IBM PC/XT, 286 and IBM PC/AT, are replaced into HP Pentium 586/200, petum2/300M workstations and servers because they are very difficult to run a high-speed network.

2.2 Computer Network

A Fast Ethernet is used in HIRFL control system. The Inter express 100M HUBs and Switch are used in the network. The 3COM's 3C905 100M PCI network adapter is used in each PC workstation and the AMP type 5 cable is used to interconnect between PC workstation and HUB. In order to insure the correct transport, the cable Max. distance is limited to 90M.

3 INTERFACE AND BUS

3.1 CAMAC

Some CAMAC series loops are still used in some control stations since there were many CAMAC crates and modules in HIRFL control system. The CAMAC power supply controllers which are developed by control group have been used to control over 200 magnet power supplies.

3.2 IPC

IPC (Industry PC) is used in Vacuum Control Workstation (VCW).

3.3 Fieldbus

A new Field bus control system (FCS) will be used in the ECR Ion Source Control Workstation (ECR-CW). There are some Fieldbuses to be selected, CAN, LONWorks, profibus, Wordfip and so on. CAN is the first choice for HIRFL control system. The Intelligent Equipment Controller (IEC) will be used in the front ends of FCS. (Fig.3)
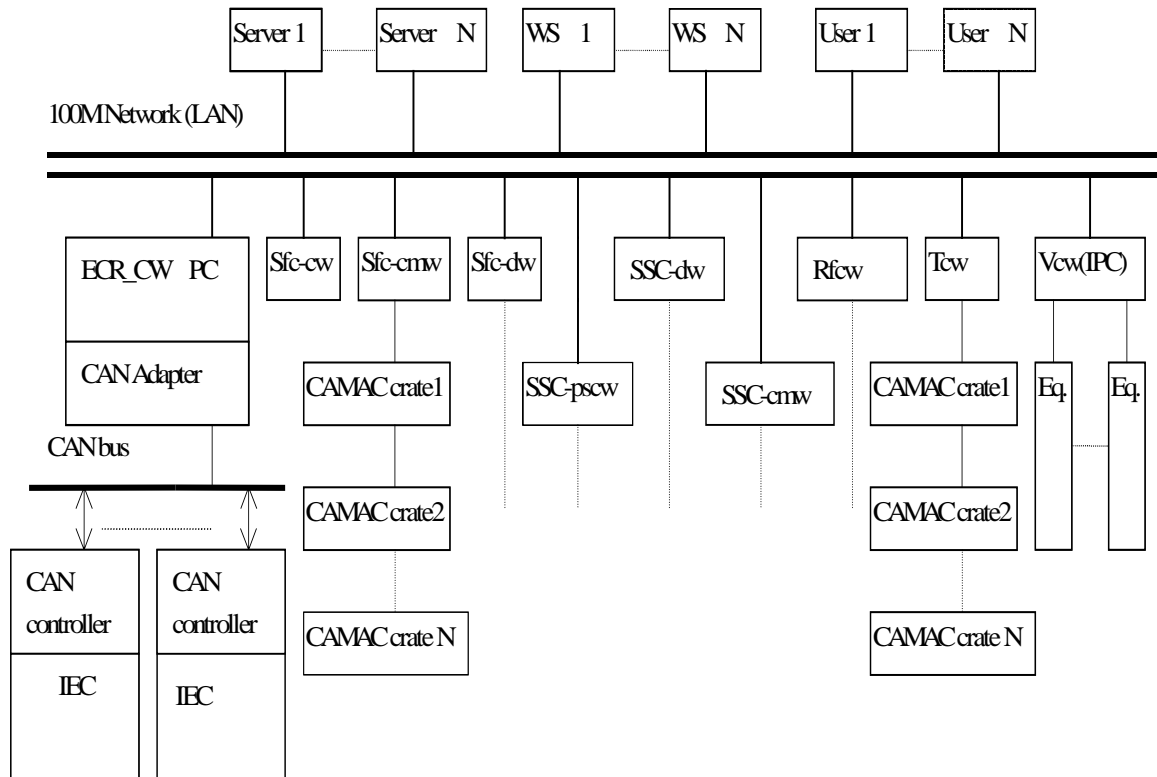
Fig.1 Control system network

4 SOFTWARE REBUILDING

4. 1 Application programs in LCW

Applications in LCW are written in C or C++. All subroutines have a uniform format, such as subroutine-name (input parameter 1, input parameter 2,output parameter 1,output parameter 2). All the subroutines are linked, in C++ V4.5 development kit, into a Dynamic Link Library, naming as ECR_CON.DLL for ECR control, SFC_CON.DLL for SFC control, SSC_CON.DLL for SSC power supply control, RF_CON.DLL for RF control, SFC_DIA.DLL for SFC Diagnosis, SSC_DIA.DLL for SSC Diagnosis and VAC.DLL for vacuum control and monitor. All DLLs are storied under the windows/system sub-directory and are called by The Man Machine Interface (MMI) in running time.

4.2 MMI software

The MMI for the control system is a standard Microsoft Windows interface, programming in visual basic V4.0 and visual C++. It runs under the Windows/95 Chinese version and is operated by a mouse. The multimedia technique is used in the control system to provide the on-line voice help and the equipment operating state information.

4.3 Communication software

The winsock is used to communicate between control stations.

4.4 Database

Some databases are suitable for Accelerator control system, such as Oracle, Sybase, DB2 and MS SQL server. The Microsoft SQL server is a good database, which is suitable for windows/95 and windows/NT. The HIRFLDB which is developed in MS SQL server is used in HIRFL control system.

5 CONTROL ROOM

There are two control rooms in HIRFL control system, SFC control room (injector control room) and SSC control room. The SFC control room can independently operate in order to extract Ion beam to experiment. There are 3-4 20-inch high-resolution color displays located on the SFC control desk and 6 20-inch high resolution color displays located on the SSC control desk. The LCD Projector, Panasonic PT-595E, with high luminance, high-density and high-quality pictures is used to monitor the Accelerator operating status and display the beam parameters. The 100 inches screen is very convenient for the operators.

6 CONCLUSION

The hardware upgrading in HIRFL has been finished. Application programs in LCW have been completed and have been used to control equipment. The MMI software has finished and runs under Windows/95.

Many new programming techniques, such as OOP, OLE, DDE, DLL, COM, DCOM and so on, have been used and a very friendly user interface, GUI, has been supplied (Fig.2). The computer network is running very well. The severs are going to put into use and the three layers sever/client construction will be realized. Multimedia technique has being improved the control system. The CAMAC will be replaced step by step. The DCS will be substituted for a new Fieldbus Control System (FCS).
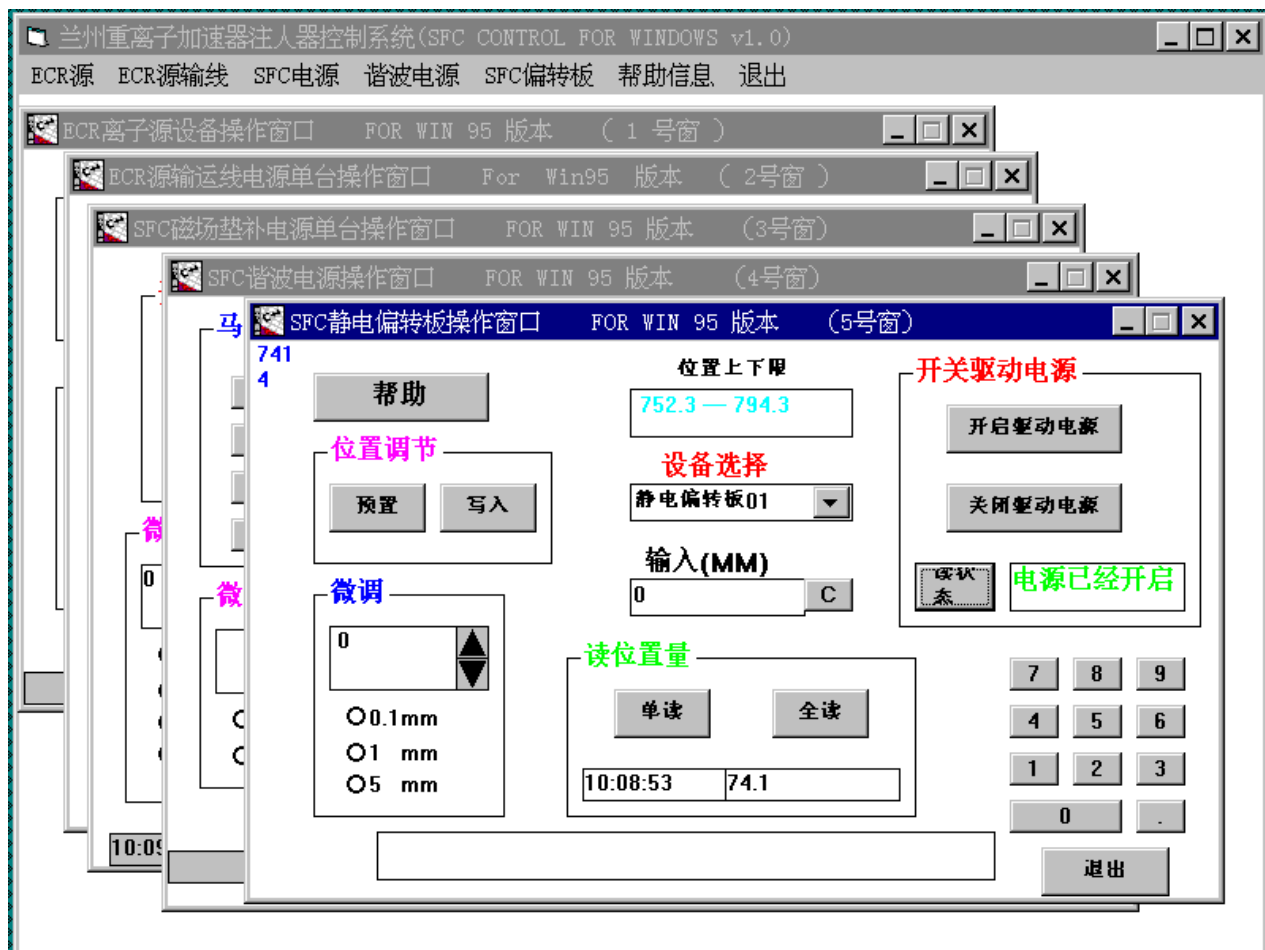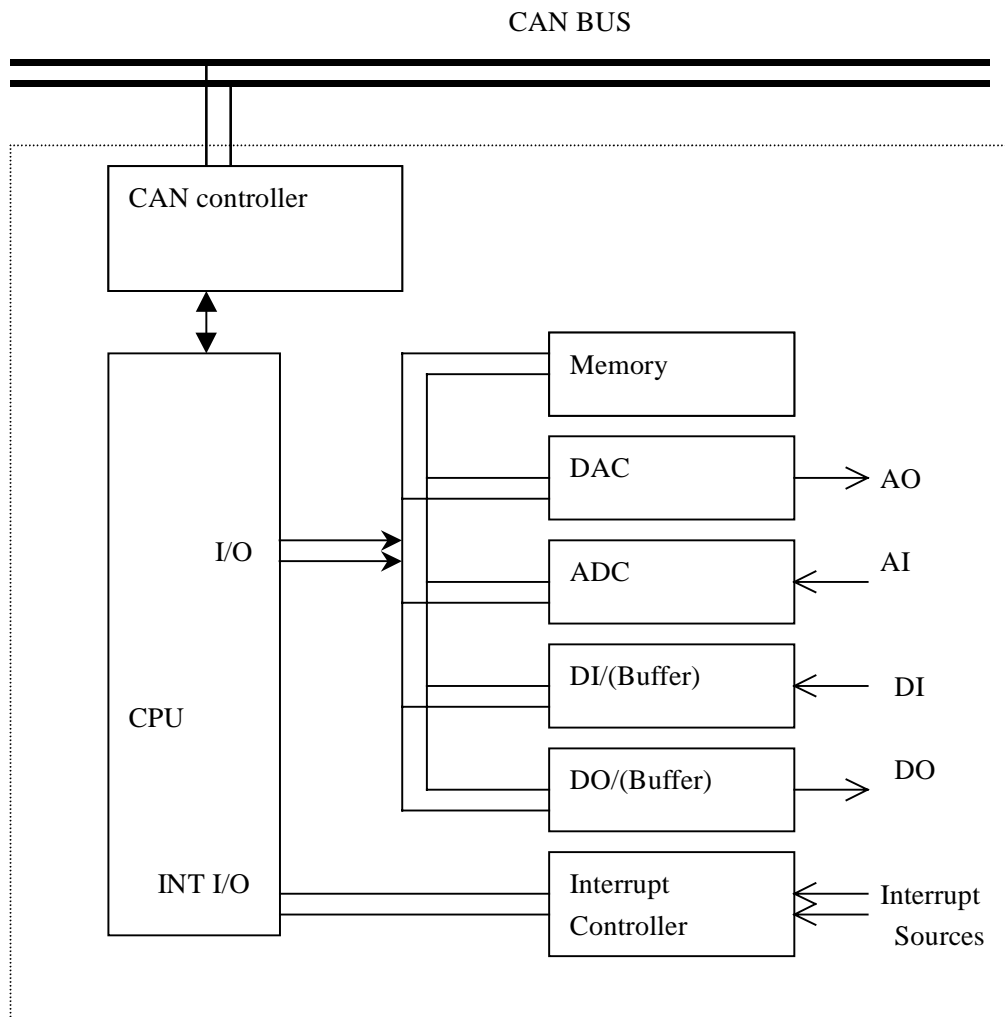

Fig.2 The User Interface on SFC-CW

CAN BUS

CAN controller

CPU

I/O

INT I/O

Memory

DAC → AO

ADC ← AI

DI/(Buffer) ← DI

DO/(Buffer) → DO

Interrupt
Controller ← Interrupt
Sources

Fig.3   IEC   Structure