CONTROL SYSTEM BASED ON PCs FOR THE ISIR-FEL AT OSAKA UNIVERSITY

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Abstract

A control system composed only of personal computers (PCs) are being developed for the far-infrared free electron laser (FEL) at Institute of Scientific and Industrial Research (ISIR), Osaka University. The system is not only simple and flexible but also cost effective. All the control devices are connected directly to PCs using interface boards in them and the PCs are connected with Ethernet. The software for control consists of three layers; the user interface layer, the database layer and the device control layer. All data for control are transmitted through databases, which are shared by all the PCs using the LAN. Commercially available software is used for the databases and the file sharing, so that it is easy to make and maintain the control software.

1 INTRODUCTION

We have been developing a far-infrared free electron laser (FEL) using the L-band linac at the ISIR, Osaka University [1]. The linac and the FEL are operated with a manual control system consisting of helipots and meters. Since reproducibility of setting values for the accelerator components is crucial for operation of the FEL, we have started developing a computer control system for the FEL beam line. Figure 1 shows the linac and the FEL system schematically. The components to be controlled by the new system are two bending magnets and five quadrupole magnets in the FEL beam line and all steering magnets shown in Fig. 1. The basic guidelines for development of the new control system are as follows:

1. The control system should be simple and flexible.
2. Programming of control software should be easy.
3. Standard development tools for software should be used.
4. The control system should be easy expandable.

Based on these ideas, we are developing a control system composed of some personal computers (PCs) connected with a small scale local area network (LAN). In this paper, we will report of the control system and the present status of the development.

2 STRUCTURE OF THE SYSTEM

2.1 Hardware

The hardware structure of the control system is shown schematically in Figure 2, where QM denotes a quadrupole magnet, BM a bending magnet, and ST a steering magnet.

There are two kinds of PCs in this system; PCs with controlled devices and those without them, which are used for control and operator terminals. The controlled devices at present are power supplies for bending magnets, quadrupole magnets, and steering magnets in the FEL beam line as well as a vacuum gauge. They are directly connected to interface boards such as analog I/O boards, digital I/O boards, and GPIB boards, which are inserted into PCI or ISA buses. The power supplies have analog input and output terminals for setting and reading the output current and are controlled with analog I/O boards. The polarity of the steering magnets are changed using relay units connected to a digital I/O board. The analog output from the vacuum gauge is read using a digital multimeter connected with GPIB. All the PCs are connected with Ethernat (100Base-T).

2.2 software

The control software has the layered structure as shown in Figure 3. It is divided into three layers; the user interface layer, the database layer and the device control layer. The flow of data in the system is also shown in Figure 3. The databases have all the parameters of the controlled devices. Control panel programs in the user interface layer read the output current data from the databases, and write setting values in them. Device control programs in the device control layer check the databases, and change the output current of power supplies if the setting data in the databases are changed. This software structure has some advantages. First, the maintenance of programs becomes easy. Secondly, The system is flexible for expansion.

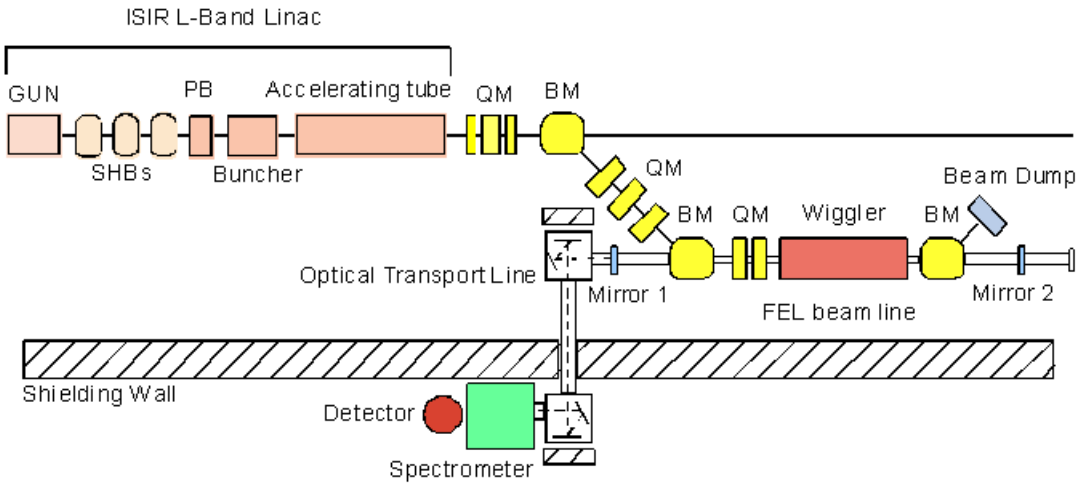

Figure 1. Layout of linac and FEL

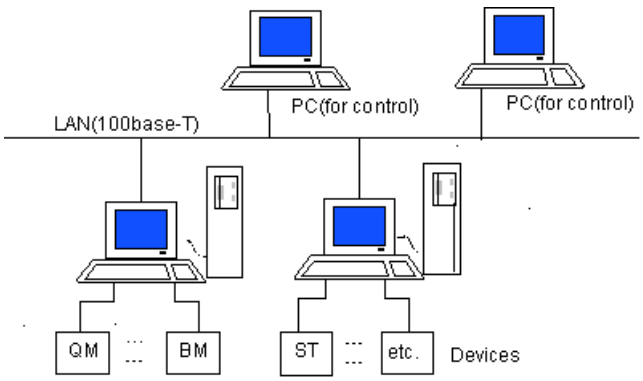

Figure 2. Schematic drawing of hardware

The Microsoft file sharing service is used for sharing database files. Since the databases are shared among programs, communication between them is easily made by writing a few words in a user interface program as '\\machine\folder\file'. Furthermore we can control devices under the other computers in the network using a Web browser [2]. Microsoft Visual Basic is used for development of these programs, so that we can easily make control panel programs on Windows and also can use device drivers for the interface boards provided by vendors.

Figure 3 shows control panels for the FEL. The layout of FEL beam line is shown on the main window. A device is controlled from a corresponding dialog, which can be opened by clicking an open button on the main window.

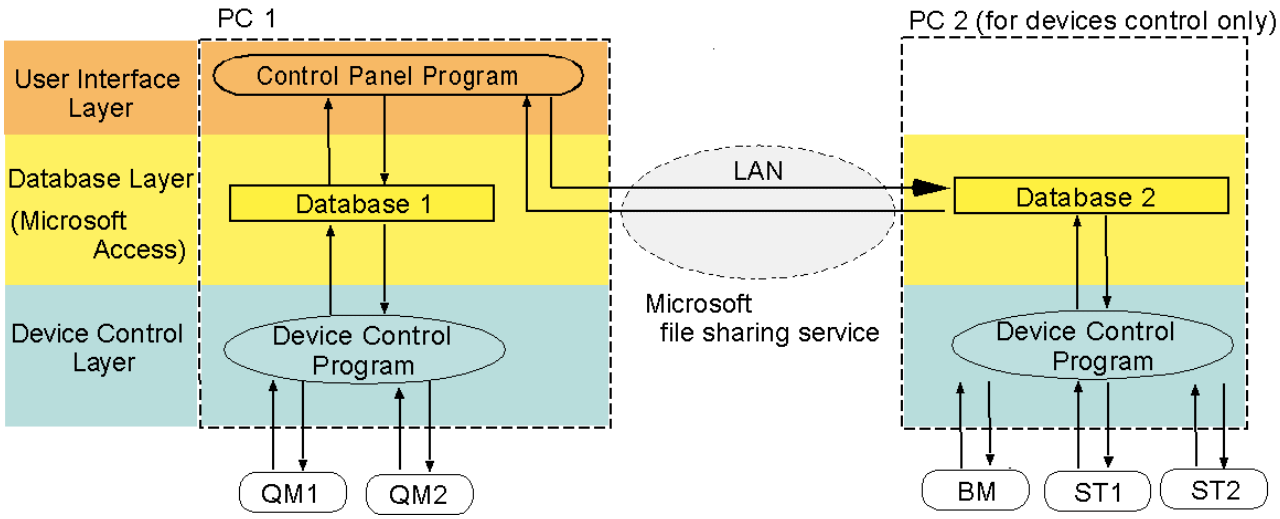

Figure 3. Schematic diagram of data flow

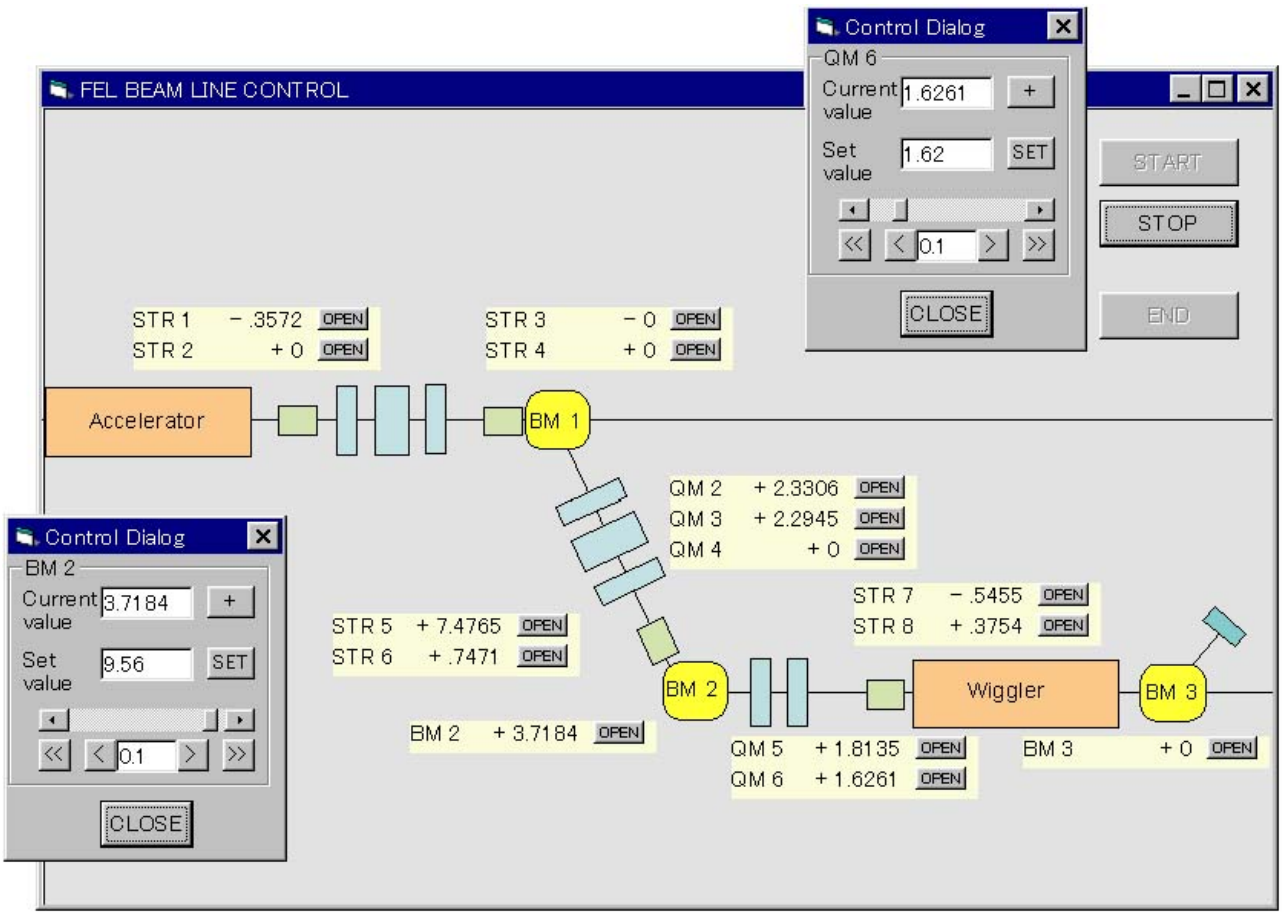

Figure 4. Control panels for FEL line

3 THE PRESENT STATUS AND FUTURE PLANS

The user interface programs and the device control programs have been accomplished. The new control system with one PC was used for FEL experiments successfully. However, some problems are found:

1. The access speed to the databases from the user interface programs is slower than expected.
2. The output currents shown on the control panels fluctuate.

We plan to improve the control software as follows:

1. The programs will be debugged during FEL experiments.
2. The software will be improved by operating the FEL system during experiments.
3. The beam profile monitors in the FEL line will be incorporated in the control system.
4. The database will be expanded for logging data

REFERENCES

[1] R. Kato, S. Okuda, Y. Nakajima, G. Kondo, Y. Iwase, H. Kobayashi, S. Suemine, G. Isoyama, “Oscillation at wavelengths from 21 to 126 μm on the ISIR FEL at Osaka University, “Nucl. Instr. And Meth. A407 (1998) 157-160.

[2] R. Kato, T. Igo and G Isoyama, “Control panel made on Web browser by using ActiveX Data Objects”, ibid.