THAP021
cs.NI/0111008

THE CONTROL OF A BEAMLINE OVER INTRANET

X.J. Yu, Q. P. Wang, P. S. Xu
University of Science and Technology of China, Hefei, Anhui 230029, China,

Abstract

The machines and beamlines controlled by VME industrial networks are very popular in accelerator faculties. Recent new software technologies, among which are Internet/Intranet application, Java language, and distributed calculating environment, have changed the control manner rapidly. A program based on DCOM[1] is composed to control a variable angle spherical grating monochromator beamline at the National Synchrotron Radiation Laboratory (NSRL) in China. The control computer with a residential DCOM program is connected to Intranet by LAN, over which the user-end-operating program located in another computer sends driving beamline units' commands to the control computer. Also a coded-Java web page illustrates how to a use web browser to query the states of or to control the beamline units.

1 INTRODUCTION

The VME system, widely used in synchrotron radiation facilities [1,2], is very reliable, ease of integration and large commercial availability. Nevertheless its disadvantage is that the VME system executive unit is less powerful than the PC unit and usually not compatible with PC software. Many advantageous features based on Windows, for instance, ActiveX, DCOM, cannot be used in the VME system. Windows technology has advanced today the Windows operation system has reached a summit of stability and extendibility. It is no surprise when a W2K server runs a few months without breaking down. Moreover, a vast number of visual development tools, a giant reservoir of sample codes across Internet on the base of PC and Windows system, affords a great convenience in the development of beamline control software. A beamline control system comprised of PC units interconnected by Intranet is introduced to control a variable angle grating monochromator beamline that has been described elsewhere [3] in NSRL.

The control logic is made of two parts, one is an ActiveX server controlling the hardware, the other is the user operating interface which is distributed on Intranet/Internet, which can be a standalone program coded in C/C++ or WEB based page coded in JAVA.

[1]http://www.microsoft.com/TechNet/winnt/Winntas/technote/dcomtowp.asp

2 STANDALONE PROGRAM

This standalone program has been discussed in detail [4]. An ActiveX server running on a beamline control computer controls a set of hardware units of a beamline, including motor drivers, opto-decoders, amplifier, digital readers, detectors et al, Fig.1. Since the calculating logic of a variable angle grating monochromator is quite complicated, the time spent in determining the optics' positions for a single photon energy by the program on a VME system has been reported to be up to one third of a second [2]. This duration is not acceptable as it will add up to a large amount of time during a photon energy scan while stepping the monochromator resolution level. A cubic curve is adopted to fit the positions of mirror and grating against photon energy. The drawback is that it cannot change the monochromator parameters in real time. This is very important during the beamline commissioning phase. A fast PC computer needs only several milliseconds to do a real time calculation.

The server program loading steps are as following. At first, the client program calling the server interface loads the ActiveX server in which one public class initializes a public variable that represents an instance of one set of the beamline hardware units. Any function subsequently operating the hardware must be accessed from this instance variable. The subsequent call to the ActiveX does not re-initialize the variable again so that it keeps tracing the current states of the hardware units.

In the server program, every beamline unit is related to a form window, which is usually created invisibly, because when ActiveX runs in a remote computer no parameters need to be entered. Some Windows standard controls, such as serial port control, timer control, whose properties can be preset or changed by calling to interface functions supplied by the ActiveX server, can be placed. All modules must be designed to process every encountered event of the hardware units to prevent program crash on any critical error. In ActiveX server no message box can be brought up because no one can dismiss it at the remote computer.

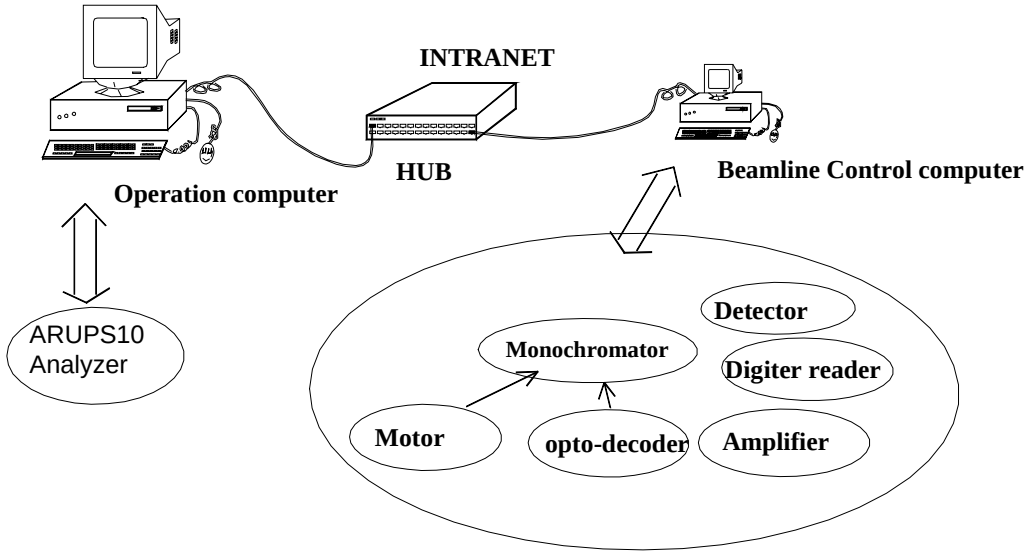

Figure 1: The distributed control logic of a beamline at NSRL

A client on an operation computer establishes a communication with the ActiveX server in the beamline computer by way of a HUB, so that it is very convenient to place the client computer anywhere. One can built the client by using Borland C++ builder or other visual programming tools. There are two types of connection between the client and the server, dynamic and static. DCOM is usually a dynamic one. When using dynamic connection, a DCOM component is created directly by the CoCreateInstanceEx function whose ComputerName parameter is set to the remoter beamline computer name. The DCOM component acts as an agent to pass hardware calls to the remote interface and we can regardless of what happens in the intermediate process. The dynamic connection between the client and the DCOM server does degrade the whole performance of the client software. Another solution that is using static connection can improve the performance dramatically. The ActiveX executable file must be copied and registered in the client computer. Then we can import it to the client program to create a package component. A reference instance is obtained by pulling it to a designing frame window, and several files wrapping all interface functions of the ActiveX server are automatically created. The RemoteMachineName property is also set to the remote computer name. The files created are then compiled and linked with the other client modules to form a static connection with the client executable program which is faster and more stable than the dynamic connection client.

3 JAVA PROGRAMMING

The above client program is standalone, the other way of control is not a client program but a web page residing in a web server which is written in Java. Java language is very common in platform-independent web design. If we write beamline control software in Java, then we can control and access the actions of all units of a beamline regardless where we are. To access the beamline hardware from a WEB page, an IIS Internet information server must be set up. Next, a component that enables DCOM being accessed across http protocol must be installed, which makes it possible to call the DCOM interface from a web page. Finally a Java wrapping interface which calls the ActiveX server discussed above with some graphically input panels and buttons is developed and then deployed in the IIS server.

4 SUMMARY

We have realized a control software built on base of Intranet and made up of PC computers. The challenges encountered in design the features of ActiveX server and many key problems have been overcome. The beamline control over Internet WEB page is a representation of the trend of thin client computer. Also the activities of the beamline are easily inspected by people in the world.

REFERENCES

[1] J. Krempasky, et al., “A system for controlling the variable angle spherical grating monochromators at Elettra”, SPIE, 3150 (1997) 76-85

[2] David E. Eisert, et al., “Computer control of the SRC high-resolution beamline”, Rev. Sci. Instrum. 66(2) (1995) 1671-1673

[3] X.J. Yu et al., “Optimization of a variable angle spherical grating monochromator”, Nucl. Inst. And Meth. A 467-8 (2001), 597-600

[4] X.J. Yu et al., “Computer control of surface physics beamline at NSRL”, Nuclear Techniques (in Chinese), 24 (2001), 534-539