

APPLICATIONS OF INTERNET AND INTRANET TECHNOLOGIES FOR DISTRIBUTED CONTROL

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Abstract

Possible applications of Internet and Intranet technologies for accelerator control are discussed. These technologies include VRML, Java, JavaScript, HTML and CGI. Using WWW for accelerator control provides new possibilities for the design and deployment of control applications. Since there are many WWW authoring and programming tools now available, software development can be done in a short time. The use of Java in combination with CGI offers unique possibilities for developing distributed applications. VRML and other Internet virtual-reality standards make it possible to easily create and manipulate 3D data and to provide user interactivity. Problems and possible solutions of Java, VRML and other WWW applications for accelerator control are also mentioned.

Introduction

The KEK e+/e- Linac is a 2.5 GeV injector for the Photon Factory and TRISTAN AR. It will be upgraded into 8GeV electron and 3.5 GeV positron Linac for the KEKB project in 1998. During the last 2 years a feasibility study of the application of Internet and Intranet technology for control and data analysis was performed. We estimated possible areas of applications of Internet virtual (VRML) [1], Java and other distributed technologies for control tasks. The existing local network in Linac can be used for creating a distributed multimedia environment where users can perform various control and data-analysis tasks using Web browsers available for many platforms, such as Windows, UNIX or Macintosh. By using this approach we can reduce the development cost compared with that of commercial control software packages.

Java and CGI

Java is used as a main development language for implementing the environment described above. It is a multiplatform language supported by almost all WWW browsers currently available. Automatic garbage collecting and support for threads make this language a reasonable selection for developing a wide range of applications from data analysis to resource servers. Multithreading also improves the interactive performance of graphical applications for the user. Our experience shows that if the JIT

compiler is used Java performance lies in the middle of the spectrum compared with other programming languages. A high level of portability makes it possible to share and reuse code written for different operating systems. In Java, programs are compiled to an architecture neutral bytecode format that allows a Java application or applet to run on any system, as long as that system implements the Java virtual machine. Since Java language is dynamic we can dynamically link classes into a running system. Classes are loaded as needed, even from across a network. Dynamic language can adapt to an evolving environment, the kind of environment that accelerator control systems usually are. To speed up the development of applications, Java was designed to be simple so that programmers experienced in C or C++ can learn to use it quickly. Since Java is an object-oriented language, a programmer can focus on the data in an application and methods that manipulate that data, rather than thinking strictly in terms of procedures. Using Java, developers can use the power of the OOP paradigm.

Although security is also an important issue, applets security restrictions can be redundant inside a closed network used for control. We bypass this restriction, if necessary, by using CGI scripts, which provide applets with access to files and other resources. For developing CGI scripts we use Perl language, since it is highly portable

and faster than most scripting languages. We have also found it convenient to use Perl for device parameters' tables handling, because it is a convenient language for file and text processing. The restriction that allows an applet to open socket connections only to hosts from which it was loaded is bypassed, if necessary, by using of an intermediate Java application running on a Web server and redirecting requests from applets to other computers in a local network. An example of an application for a klystron aging data analysis is given in Figure 1.

Internet Virtual Reality

Recently, the number of applications of Internet virtual reality has been rapidly growing, and many WWW browsers can now display interactive 3D worlds using VRML 2.0 or other data formats. There are also applications or VRML for scientific-data visualization. Beginning with version 2.0, VRML became interactive, so that user actions can trigger events. New object types can be defined so that the development of a complex model is simplified. In VRML 2.0 it is possible to define Java or JavaScript programs as a node, which can receive or send events to other nodes in a virtual world. VRML is also a distributed language, so that a world can be composed from objects which are loaded from across a network. It provides further possibilities for the integration of heterogeneous applications in a control network environment. Download time of a virtual world from a remote host can now be significantly reduced, since some browsers (Netscape) support compressed VR data files.

In our control system we created a model of Linac building in VRML format, which contains devices with links to corresponding control programs. Links are implemented using a remote application loader which downloads an application using an http connection and executes it on a local OS (see Figure 2). JavaScript controls can also be used to manipulate a virtual world on the Netscape browser by using Netscape LiveConnect.

3D interactive worlds have an obvious advantage if they compared with 2D control programs, since a 3D representation is easily understandable by users with any level of skills in computing.

Conclusions

The examples given in this paper prove that the current state of Internet and Intranet technologies

makes in possible to use them for various tasks in accelerator control. Virtual reality or other types of hypertext representation can also be applied for the integration of previously developed applications to give users new opportunities in implementing their tasks. The development of new applications is simplified, since many problems which arise in distributed control-application development already have their solutions in Internet/Intranet world.

Reference

- [1] The Use Of Virtual Reality For A Multimedia Informational System Development; Igor Mejuev and Isamu Abe; International Workshop on Controls for Small- and Medium-Scale Accelerators, KEK, Tsukuba, Japan, Nov. 11-15, 1996.

Figures

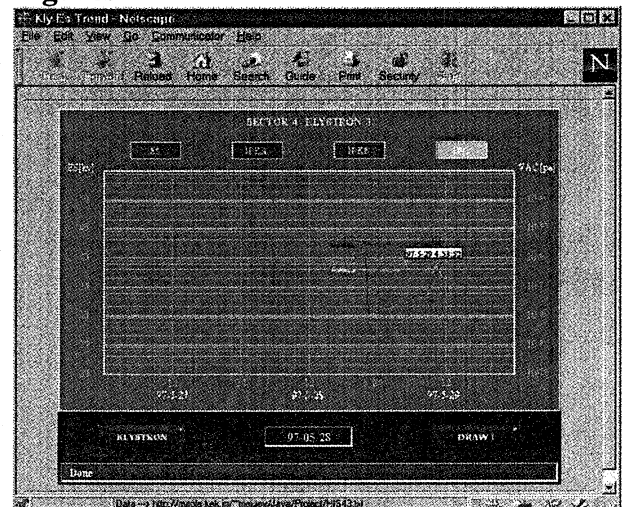


Figure 1

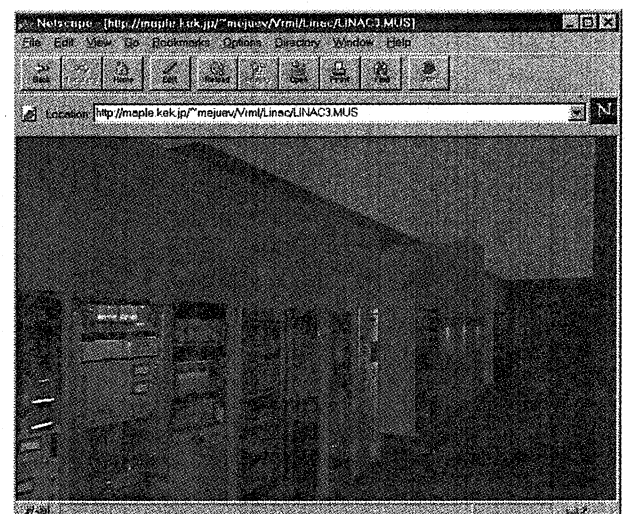


Figure 2