

CONTROL DESK: A GENERIC CONTROL APPLICATION FOR THE SRS

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Abstract

The Synchrotron Radiation Source (SRS) is a 2GeV synchrotron light source with 15 beam-lines serving approximately 34 experimental stations. All parameters on the SRS Control System have a subset of common properties including operating status, analogue value and interlock status. This makes control of parameters possible from a single generic application that allows monitoring and control of these common properties. Control Desk is the primary means of providing operational control on the SRS and allows flexibility through both pre-defined pages of parameters and the ability to create pages dynamically. Control Desk was recently re-engineered following an object-oriented approach using ActiveX/COM components written in Visual C++ and Visual Basic. This paper describes the components of the application and the techniques used during development.

INTRODUCTION

The SRS control system is based upon a client/server architecture. The server side of the control system consists of a number of Front End Computers (FECs). These FECs include industrial PCs running the Linux operating system, and embedded VME computers running the OS-9 operating system. Many of the FECs are interfaced to the linac, booster synchrotron, storage ring and beam-lines over CAMAC serial highways. The CAMAC crates then interface to the equipment being controlled via the status system. Some of the FECs are also connected directly to hardware [1, 2].

The client machines are standard desktop PC's running various Microsoft operating systems, including Windows NT4 and Windows 2000. The clients PC's communicate with the FECs via Ethernet using the UDP/IP network protocol. There are approximately 3500 controllable parameters currently available on the control system. Each of these parameters has a subset of common properties, which allow control and monitoring of status, analogue and interlock values.

The primary method of operational control on the SRS is provided by the Control Desk application. Control Desk is a table based Microsoft Windows application that provides control of parameters via pre-defined and dynamically created pages. This application has recently been re-engineered to improve both performance and stability. Extensive use was made of ActiveX technology, with components written in Visual C++ and Visual Basic. This object-oriented approach was well suited to the SRS control system, as each parameter may be represented by a single instance of an ActiveX object.

CONTROL DESK

Control Desk consists of a number of distinct components. Many of these components are implemented as ActiveX controls, with the others being standard or modified Windows user interface components. The majority of these components are written in Visual Basic with a single performance critical one developed using Visual C++. The performance critical component is used to access parameters on the SRS control system, and makes use of a separate thread of execution to improve performance and to prevent blocking of the main user interface thread.

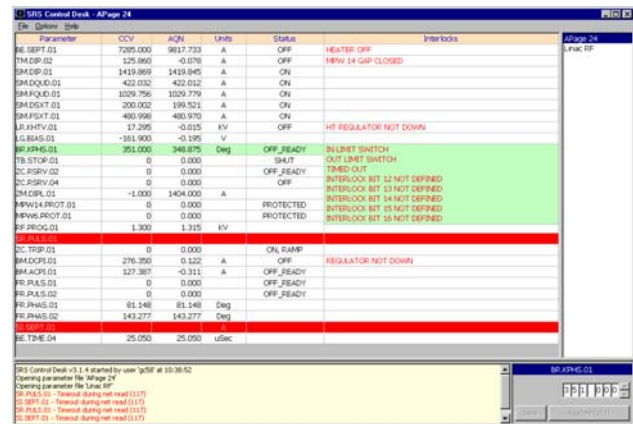


Figure 1: Control Desk main screen

The main screen of Control Desk (Figure 1) is made up of four distinct areas. The parameter panel, which is the table style area used to display all the parameters contained within a page, along with their properties. The page selection panel, which is used to manage multiple loaded parameter pages. Several pages can be loaded into memory, and selected for display using the page selection panel. The parameter control panel, which is used to control the analogue values for the parameters of the currently loaded page. Finally, the diagnostic and warning panel, which displays user information and error messages to the screen. Control Desk also has a parameter selection tool, which is used to update, and create new parameter pages. This selection tool is displayed in a separate dialog box when the user wishes to update, or to create a new parameter page.

The Parameter Panel

The parameter panel (Figure 2) is the main component of Control Desk. It displays all the parameters contained within a page, along with their properties. It also allows control of parameters analogue values and their status values.

Parameter	CCV	AQN	Units	Status	Interlocks
BE_SEPT.01	7285.000	9817.733	A	OFF	HEATER OFF
TM.DSP.02	125.860	-0.039	A	OFF	MPW 14 GAP CLOSED
SM.DOP.01	1418.869	1419.845	A	ON	
SM.DQUD.01	422.032	422.012	A	OFF	
SM.FQUD.01	1029.756	1029.779	A	ON	
SM.DEXT.01	200.002	199.521	A	ON	RESET
SM.PST.01	480.998	480.980	A	ON	
LR.KHTV.01	17.295	-0.000	KV	OFF	HV REGULATOR NOT DOWN
LG.BAS.01	-151.900	21.636	V		
BR.KPH6.01	351.000	348.743	Deg	OFF_READY	TIMED OUT
TS.STOP.01	0	0.000		SHUT	LIMIT SWITCHES ...
ZC.RSRV.02	0	0.000		OFF_READY	INTERLOCK BIT 2 NOT DEFINED
ZC.RSRV.04	0	0.000		OFF	INTERLOCK BIT 4 NOT DEFINED

Figure 2: The parameter panel

The parameter panel is made up from five separate constituent controls. Each of these controls is an ActiveX control written in Visual Basic 6, with the exception of the data acquisition control, which is written in Visual C++ 6. There is one parent control, and four child controls, which are contained within the parent control.

The parent control, RPCStripContainer, is essentially just a container for the four child controls. Its also exposes methods for loading and unloading parameter pages, and manages control of analogue and status properties from external sources, for example, the parameter control panel mentioned later.

Each parameter is represented by an instance of the RPCStrip control. The RPCStrip control contains six fields, each representing a particular property of the parameter. The properties displayed by this control are parameter name, analogue value, analogue set-point, status value, and interlocks. The analogue set-point can be controlled via a text-box, and the status value via a pop-up menu. This pop-up menu contains all the available enumerated status values for the selected parameter. Failed interlocks may also be displayed by expanding the interlocks field with a mouse-click. Further failed interlocks are indicated by three dots following an interlock message in the interlock field (Figure 1).

The header control, RPCStripHeader, provides the headings for each field of the RPCStrip control and also manages the dynamic resizing of these fields. Its boundaries can be resized at run-time by hovering over and dragging them with the mouse.

Configuration information, such as interlock messages, is stored in a Microsoft Access database. The RPCDatabase control gives access to information from this database, without the need to formulate SQL statements for each request.

Acquisition of data from the SRS control system is handled by the multi-threaded FastRPC control. This control is written in Visual C++ to take advantage of multi-threading capabilities. Data requests are queued into the control and requested in a separate thread of execution. This thread then calls back the main thread via an ActiveX event, allowing further processing to continue in the main thread. Using this approach prevents the graphical user interface of the application becoming unresponsive during data acquisition.

The Page Selection Panel

The page selection panel (right side, Figure 1) is a standard Windows list-box control with extended functionality provided through a Visual Basic class file. The panel provides management of all loaded parameter pages, allowing the page currently displayed in the

parameter panel to be changed to any of the loaded parameter pages.

The page selection panel extends the standard list-box functionality using a Visual Basic class file. This class file allows the list-box to highlight each item as the mouse hovers over them. This is achieved using calls to the Windows API, and is done to give a clear indication which parameter page would be displayed in the parameter panel if the mouse button were clicked.

Management of loaded parameter pages is handled by another class file. This file uses Visual Basic collection objects to maintain a comma-separated list of parameters along with file locations. This allows parameter files to be dynamically loaded from memory, removing any unnecessary disk access when selecting a page for display from the page selection panel. The collection object of the class file holds changes to parameter pages in memory, until a request to save to disk is made by the user.

The Parameter Control Panel

The parameter control panel (Figure 3) is used for control of the analogue set point for parameters on the SRS control system. Values can be controlled either by the use of up-down buttons, or by manual text entry. Values can also be controlled via the knob control described later.



Figure 3: The parameter control panel

The parameter control panel is made up from a number of constituent controls. Text-boxes are used for the display and editing of each digit of the analogue set-point value, with up-down buttons provided to increment/decrement the digit. The active digit that is currently under control is highlighted in a light green colour. The analogue set point can be reset to a saved value using the restore button, with the save button being used to update this saved value.

Control of analogue set-point values can also be achieved using the optional knob control. The knob control is a rotary incremental encoder interfaced to a Hytec 5380 PCI up/down counter [3]. A Visual C++ ActiveX control contained within the parameter control panel is used to monitor movement of the knob control via a Windows device driver. This movement is then used to increment/decrement the analogue set point in the same way as the up-down buttons.

The Diagnostic and Warning Panel

The diagnostic and warning panel (Figure 4) is used for the display of information and error messages. The panel maintains a history of 100 entries, which can be viewed using the scrollbar on the right-hand side of the panel.

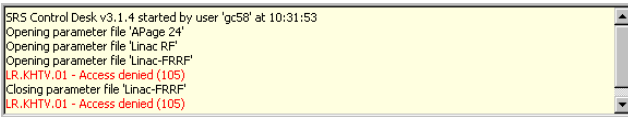


Figure 4: The diagnostic and warning panel

The panel is a standard Windows rich text-box, with added functionality to remove items over 100 entries old. Information and diagnostic messages are displayed in black text, with error messages being displayed in red text accompanied by a beep.

The Parameter Selector Tool

The parameter selector tool (Figure 5) is displayed within a pop-up dialog box when the user wishes to update, or to create a new parameter page.

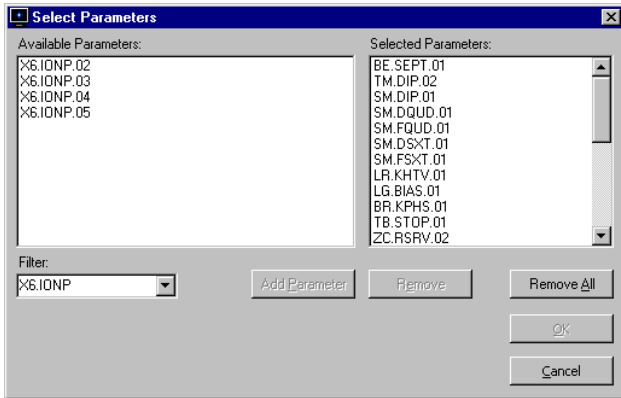


Figure 5: The parameter selector tool

All parameters available on the SRS control system are enumerated and displayed in a list-box to allow the user to select the required parameters. To allow easier and faster selection, the tool provides parameter filtering. Users may select from a number of pre-defined filter masks, or input a custom mask, as required. This tool is implemented as an ActiveX control and is used in other

client applications on the SRS control system to provide a standard method for parameter selection.

COMMISSIONING

Commissioning and testing of the application had to be completed without any interruption to the routine operation of the SRS. Initially, a single control console in the main control room (MCR) of the SRS was upgraded to the new version of the application. The new version was used for routine operation of the SRS for a period of approximately 3 months. During this period any reported bugs were ironed out, and a number of requested new features added. The new version of Control Desk has since been released to all users and is now running on all MCR control consoles.

CONCLUSIONS

The re-engineering of Control Desk has seen significant improvements in both reliability and stability, and also in the performance of the application. The new version of Control Desk has resolved known bugs and also introduced useful new functionality into the application. Some of the ActiveX objects developed for the project, notably the multi-threaded data acquisition control, have wider use in the SRS control system and have proven useful in other projects.

REFERENCES

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- [3] <http://www.hytec-electronics.co.uk/>