VERSATILE DATA SERVER SOFTWARE

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Versatile Data Server Software (VDS) is a component of a Network-based Control System (NCS) and SCADA software of a client/server architecture offering a thin client solution by use of Web-based human-machine interfaces (HMIs). Using Graphic Designer, windows with various active graphical presentations can be created without programming. Installing OLE for Process Control (OPC) client in the data server of VDS allows access to every kind of controller that has OPC server functionality and achieves integration of data and operation. This paper outlines the functions and architecture of VDS.

INTRODUCTION

This paper introduces Versatile Data Server Software (VDS) developed as a core component of a network-based control system (NCS) architecture proposed by Yokogawa. VDS performs data acquisition and saving, operation, and monitoring in a STARDOM system (see Figure 1).

FEATURES

VDS has a client/server architecture and the following features.

Data Server Functionality

VDS’s data server can connect to virtually all kinds of controllers and I/O devices including FCN (field control node) and FCJ (field control junction) autonomous controllers and Yokogawa FA-M3 programmable controllers, and optimally acquire control data from them. The data acquired to the data server is accessible from the outside via “open” interfaces, such as OLE for Process Control (OPC), to allow access according to a unified procedure and handling in a generalized format.

Network Redundancy

For connections to FCN and FCJ autonomous controllers, a duplexed 100-Mbps Ethernet network can be used, raising the reliability of the network, which will be becoming increasingly important in the future.

Web-based HMI Functionality

The manufacturing industry, in which the phenomenon of manufacturing systems and business operation systems becoming borderless is prominent, calls for an HMI system that allows users to grasp the statuses of the manufacturing sites from anywhere, anytime. VDS answers this need by providing an operation and...
monitoring environment in which full-graphic pages can be presented in a Web browser of a thin client.

**SYSTEM CONFIGURATIONS**

Figure 2 shows a typical system configuration. VDS is installed in a generic personal computer, which then implements the data server and HMI functionality. An HMI client works as a thin client on a personal computer and hence VDS need not be installed, which thus means high maintainability. As the control LAN to which the data server and various controllers and I/O devices are connected, 100-Mbps Ethernet can be used. The control LAN can be made dual-redundant, in particular, for connections to FCN and FCJ controllers. Flowing on the information LAN are Hypertext Transfer Protocol-based (HTTP-based) data for HMIs and data exchanged between the data server and external applications.

**SOFTWARE CONFIGURATION AND FUNCTIONS**

**Data Server**

When building a manufacturing system with a variety of controllers and devices, the differences in the format of data and in the data access method between them have hindered system integration. VDS's data server cleared this hindrance by its capability of acquiring data in different formats residing inside controllers and devices and providing those data to the outside in generalized abstract formats.

In the data server, primitive data residing in diverse programmable controllers and control data residing in FCN and FCJ autonomous controllers, such as data of PID control logic, are encapsulated into objects and provided as software parts. VDS's data server acts as a container in which these software parts can work optimally. For efficient acquisition of control data residing in controllers and devices on the network, the part-time scanning and method of updating data in response to asynchronous events inside the data server are employed, resulting in a dramatic increase in data acquisition efficiency.

For enhancing connectivity to other vendors' programmable controllers and devices, various I/O drivers are installed (some are available as options) to enable flexible system configurations. Besides, Visual Basic for Application Edition (VBA) is enabled for primary processing of the acquired data to support a broad range of applications. External applications can access the data in the data server via its OPC interface according to a unified procedure and handle those data in a generalized format. Functions requisite for configuring a manufacturing system, such as message management, trend data acquisition, and report functions are provided and deliver in various forms the data acquired from controllers (see Figure 3).

**Control LAN**

As the LAN to connect FCN and FCJ autonomous controllers and various other controllers and I/O devices, 100-Mbps Ethernet, which at present is the most widely used LAN, is employed. The duplex configuration of the control LAN is implemented solely using a generic network application programming interface (API) without the use of special hardware; hence, it is independent of not merely hardware but also the platform including the operating system and is applicable in every aspect. This enables a system to be configured flexibly within a low budget.
HMI Subsystem

Our objective to embody an integrated HMI, as an NCS component, suitable for the broadband network era of the Internet led to the adoption of a thin client architecture in which graphics load to Web browsers. Graphics data in an HMI server and control data in a data server can be graphically presented simultaneously. Monitored data values are updated automatically in real time, and the graphics can be dynamically modified (color changes, blinking, etc.) in accordance with the changes in those values for intuitive operation and monitoring.

Architecture

The HMI subsystem software configuration is illustrated in Figure 4. The HMI clients and server implement the HTTP for inter-communication for durability under various networking environments. This results in an increased affinity with the existing network devices and equipment, such as firewalls, and hence a network-based operation system can be easily configured. Also employed was an asynchronous protocol that detects a change in data values inside the data server and sends only the data needed for the display of an HMI client when necessary. This minimizes the load on the network and makes the architecture resistant to sudden fluctuations in traffic.

Security

The user authentication system provided with this HMI architecture and VDS data server's security work together to ensure safety and integrity of operation and monitoring even when used in the Internet environment. Since well-proven Web server freeware is used for the HMI server, ever-progressing network and security technologies can be adopted with ease.

Display in HMI Client

Two types of pages can be displayed in an HMI client: graphic windows and object viewers. Their graphical presentations are the essence of Yokogawa's decades of expertise in providing sophisticated HMI functions for distributed control systems (DCSs). Creation of graphic windows need no programming and can be done by the user by assembling the provided basic shapes and the parts requisite for monitoring of a manufacturing system, such as alarm summary and trend graph displays, using Graphic Designer (see Figure 5). Object viewers are one kind of the graphic user interfaces corresponding to objects in the data server and they are automatically created based on the configurations of the respective objects. See Figure 6 for an example.

Application Development and Runtime Environments

Various application programs can be created, using the general-purpose programming language Microsoft Visual Basic (VB), depending on the type of the manufacturing system to which they are applied. The application interfaces provided by the data server include the industry-standard OPC interface and an interface easily accessible from VB. In addition, high-speed data access using an indexed sequential access method (ISAM) via an ActiveX data object (ADO) interface is also possible.
VB property links are a powerful device to facilitate application development. Using VB property links, the status of an object in the VDS data server can be simply linked to a property of a control of VB without programming, and a complicated procedure to access the OPC interface can be incorporated.

System Generation Tools

Various builder programs and a graphics creation tool, Graphic Builder, are prepared for the efficient configuration of VDS. Object Builder is used to configure the data server (see Figure 7). The user imports information of control logic for VDS into Object Builder, and necessary objects will be automatically created in the data server to enable acquisition of data corresponding to the specified control functions. At this time, VBA codes for primary data processing can be written and embedded into the data server.

Graphic Designer is used for creating graphics (see Figure 8). In Graphic Designer, previously created graphic components and frequently used symbols can be registered as parts for reuse. Moreover, using data binding which can switch over sets of variables in a graphics file, it is possible to create a graphic window and change only its data sources dynamically instead of creating multiple graphic windows having the same static image. All these features were devised for dramatic improvement of engineering efficiency. The user simply saves the created graphics files in the HMI server and there is no need for those files to reside in each HMI client, thus making graphics maintenance effortless.

CONCLUSION

We have developed an opportune data server and HMI software with an architecture that is adequately armed for the coming network. We are thankful for being given such an opportunity and are committed to further improvement to realize a better product.

REFERENCE


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