Latest Operation and Engineering Functions of Small- and Medium-Scale Monitoring and Control System, "MICREX-VieW XX"

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ABSTRACT

The small- and medium-scale monitoring and control system "MICREX-VieW XX" is equipped with the latest functions as follows. The "XOS-3000" operator station achieves high operability with a multi-window platform MPF. The "XDS-3000" database station is capable of data analysis using relational database (RDB) and duplex configuration with no data missing. The "XES-3000" engineering station allows high-efficiency, high-quality engineering by the integrated TAG and variable database and simulation feature that eliminates the need for the actual equipment.

1. Introduction

The "MICREX-VieW XX (Double X)" small- and medium-scale monitoring and control system comes equipped with the highly-operable operator station "XOS-3000," the reliable and open database station "XDS-3000" and integrated engineering station "XES-3000." In this paper, we will describe the functions and features of these devices, and give information on control system security based on recent trends.

2. Operation Functions

2.1 High-operability via the multi-window of the operator station "XOS-3000"

To provide operators of the MICREX-VieW XX with user-friendliness and high operability, the multi-window platform "MPF" was developed. The MPF has many display functions such as a multi-window display for simultaneously showing individual monitoring windows and a multi-display that utilizes multiple display screens. Operators can easily arrange the screens to meet their purposes such as increasing the size of the screens they want to monitor the most and decreasing the size of screens that provide supplemental information (see Fig. 1). Furthermore, the screen window layout can be saved and restored.

The MICREX-VieW XX generally uses a 27-inch 1,920×1,080 resolution display. Operators want to enlarge or reduce the screen display freely depending on the distance from the screen and room lighting on to ensure that it is always "easy to see." This functionality is achieved in the MPF by utilizing vector format drawing based on windows presentation foundation (WPF) technology. The operator can freely zoom-in and zoom-out by using the "pan and zoom panel" (see Fig. 2) to adjust the screen arbitrarily so that it is easy to view.

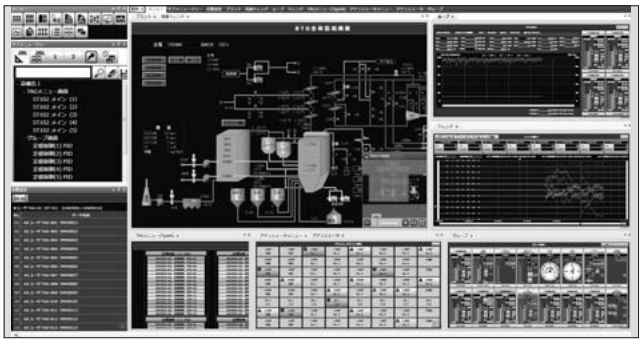

Fig.1 Example of multi-window display

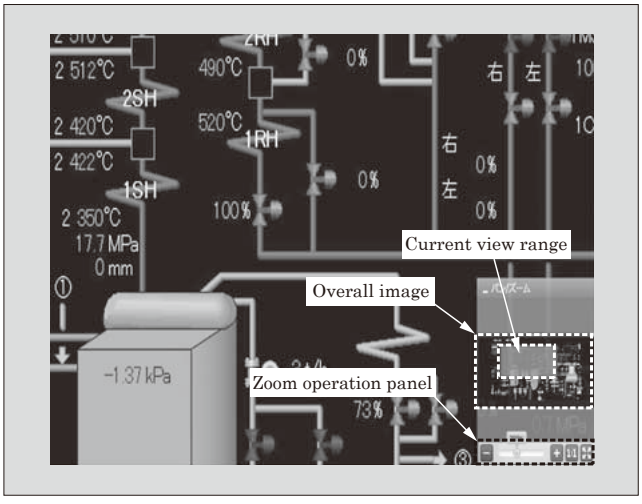

Fig.2 Pan and zoom panel

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Fig.3 Example of icon display

2.2 Visibility and operability of the "XOS-3000"

The operator station XOS-3000 carries out the design of the operation screen to ensure visibility and operability with consideration given to the arrangement of the graphics and window, as well as the operation and color scheme of the keyboard and mouse.

The basic colors used on the monitoring operation screen have been decided based on the Color Universal Design. Colors used on the screen are classified by accent colors and base colors, adopting a standard color pattern with consideration given so that no false recognition arises due to differences in each color perception. In addition, the screen uses only black, white, and the other basic six colors, and by maintaining a sufficient contrast between the characters on the screen and background colors, the display is easy to view and helps to ease the fatigue that comes with long-time use.

In order to make the screen easy to identify, high visibility icons are used, by avoiding indication only by characters or colors to express their meaning (see Fig. 3).

2.3 High-maintainability of the "XOS-3000"

The MICREX-VieW XX combines the functionality that customers need so that they can create a system for their purposes. This is done through highly independent operation whereby application software is treated as "add-ins" in the MPF. (see Fig. 4)

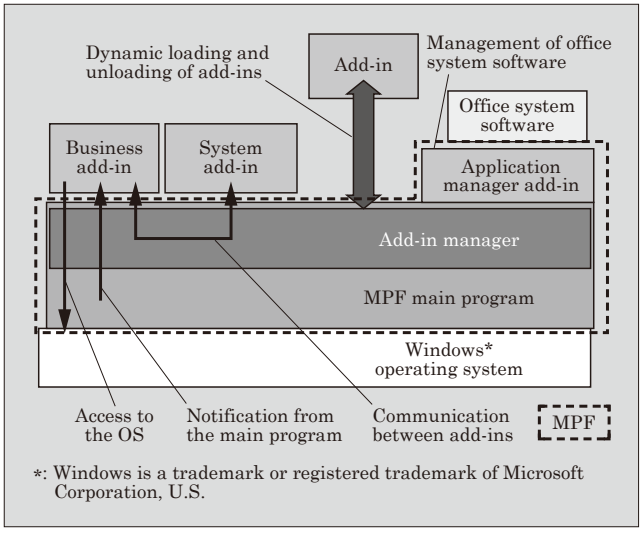

Fig.4 "MPF" structure

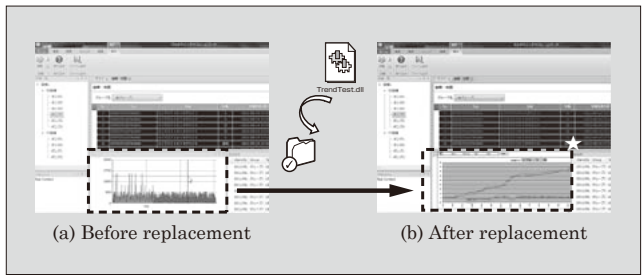

Fig.5 Online update of add-ins

Furthermore, when maintenance is required such as when adding display functions or performing updates, these actions should be done while minimizing the effects on plants that operate 24-hours a day. The MPF allows operators to install, update and remove add-ins while the system is running (see Fig. 5).

2.4 Highly reliable "XDS-3000" database station

Each of the stations that constitute the MICREX-VieW XX differs from common client-server configuration as an information system. Each is independent of the others and provides a robust way to acquire plant information through communication with the controller.

Among these components is the XDS-3000 database station that collects series (historical) data such as plant trend data, report data and at times of alarm, thus carrying out unitary management and making the station essential for performing analysis. Historical data is any important record information that arises while the plant is operating, for which defects must not occur as a result of accidents that may happen to the system.

The XDS-3000 forms a duplex system with two stations, one running and another as a standby. This ensures continuous operation based on a security and high reliability.

The historical data collected by the station on the operation side of the XDS-3000 is stored in a relational database (RDB), and equalization is continuously implemented through RDB mirroring to the standby station. Therefore, if the station in standby is shut down temporarily, the historical data during the shutdown will be automatically equalized with the standby station after it restarts, ensuring that defects in the historical data do not occur.

By making use of the features of an RDB, the XDS-3000 is able to provide users with search and display functionalities in their desired conditions. The RDB can be accessed by Structured Query Language (SQL), providing the operator with the ability to analyze with various database keys such as the time of the data, plant facilities, and information sources. In addition, the XDS-3000 can promote the effective use of data by users in the safety-ensured environment described in Chapter 4.

3. Engineering Functions

3.1 "XES-3000" integrated engineering station

The XES-3000 integrated engineering station is a unit to optimally engineer the MICREX-VieW XX for the plant. As is mentioned in Section 3.2, this station provides an integrated engineering environment that combines various tools focusing on the integrated TAG database.

3.2 Vertical and horizontal integrated engineering

(1) Integrated database

TAGs*1 and variables of XOS-3000, which is the human communication interface (HCI), and the controller "XCS-3000" in the engineering of this system are integrated by the database in the system without any overlapping definitions for each application software project. Even the TAGs and variables that span vertically (between the HCI and controller) and horizontally (between each station of the controller), access can be made anywhere inside the system via the integrated database. Doing this sets the system free from the transmission processing between each station of the controller and from the shared operation of the HCI and controller, which has been traditionally a troublesome task. This type of easy, highly efficient and high-quality engineering contributes to reduction in man-hours.

(2) Integrated cross-referencing

The system is also integrated entirely with respect to cross-referencing. Quick implementation can be made across the HCI and controller of follow-up studies when an abnormality arises during testing or operation, as well as of studies on the range of influence that requires confirmation when adding, modifying or deleting TAGs or variables (see Fig. 6).

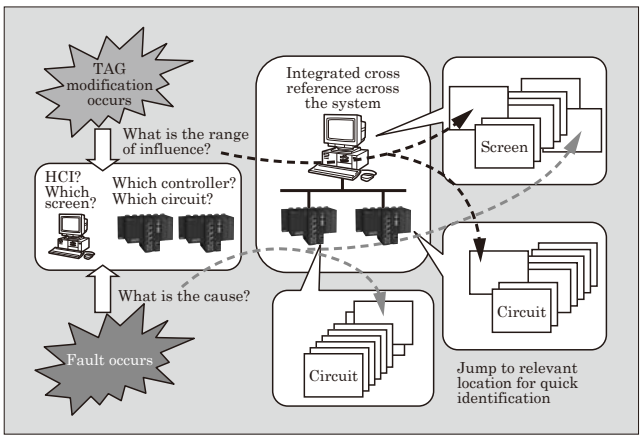

Fig.6 Integrated cross reference

*1: TAG is a unique symbol defined for controlling measurement objects.

3.3 Automatic generation of control software through the specification description

The engineering tool "HEART" is able to automatically generate control software from software function specifications created in general-purpose office automation (OA) software such as Excel*2 or Visio*3. Engineering support is available for all stages of development from determination of specification, design, testing, local adjustments, through maintenance. The tool has the following features:

(1) Specification editing

Since editing can be done in the user's familiar OA software, the tool has the advantage of reducing the burden on users during implementation, as well as making it easy to use in the engineering of customers.

Instrumentation flow, interlock block diagram (IBD), sequential function chart (SFC), time charts, etc. have all been provided as ways of describing the control function specifications, allowing the user to create the specifications using expressions that suit the desired form of control. With regards to drawings, in addition to Excel and Visio's excellent editing functions, HEART also comes with its own set of unique editing functions such as drag and drop from a group of function symbols prepared by HEART, as well as a clickable toolbar. Therefore, users can edit more easily and efficiently than creating the specifications in Excel or Visio alone. Furthermore, when there are places for which the control content is difficult to understand, HEART provides the ability to insert bubble comments and images, making it possible to have the same descriptions that as the information that is normally used in creating the specifications. In addition, it also takes advantage of the merits of general-purpose software and allows users to confirm the specifications created in Excel or Visio by e-mail, thus helping customers reduce the number of meetings that they need to have.

Furthermore, the software provides a wealth of evolving functionality including segmentation of control functions created by users and speeding up utility functions that can be used when inputting variable information during editing. These functions provide traditional property input methods as well as other methods such as cross references and drag and drop from a variable list.

(2) Monitoring functions

After downloading the control software created in HEART to the controller, monitoring of the execution state of the controller (on and off state of bits and analog values) can be done according to the created control function specifications. Furthermore, values can be

*2: Excel is a trademark or registered trademark of Microsoft Corporation.

*3: Visio is a trademark or registered trademark of Microsoft Corporation.

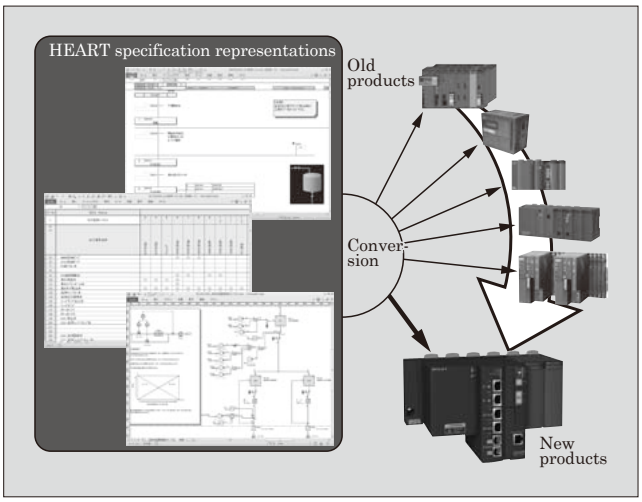

Fig.7 Engineering inheritance via "HEART"

written for the controller memory, which is effective in studying abnormalities during debugging and operation.

When using HEART, modifications and changes during testing and on-site adjustment are carried out on the specifications themselves. Therefore, specification follow-up to match up with the software modifications and changes is no longer necessary, and this eliminates mismatch between the specifications and the software due to follow-up description mistakes.

(3) Inheritance of engineering

The control function specifications created in HEART can be converted to the control software of various controllers. It supports various existing controllers such as the "ACS-2000," "ACS-250," "MICREX-SX," "MICREX-Jupiter" and "MICREX-NX."

In addition to supporting the MICREX-VieW XX controller XCS-3000, it also inherits high efficiency and high quality engineering. HEART can also be effectively utilized when migrating from previous products (see Fig. 7).

3.4 Simulation functions

The MICREX-VieW XX comes equipped with the "VieW System Simulator" (see Fig. 8). Even if the user has not prepared actual equipment such as a controller and I/O module, operation verification of the monitoring control system can be carried out easily through the use of a PC alone, thus allowing users to perform operation verification for the user-created program as well as coordinate operations between the controller and the monitoring and operations of the XOS-3000. In addition, since there will be frequent downloads to the controller while modifying the program during the initial stages of design, the use of a simulator allows users to shorten transfer time and also efficiently carry out operation verification. Table 1 shows the operation environment of the simulator.

(1) Modeling of multiple controller configurations

The simulator can be operated while simultaneously modeling configurations of multiple controllers connected by a control LAN. Modeling is also carried out for the data memory of the control LAN that connects multiple controllers and communicates plant data with the XOS-3000. This simulator alone can carry out operation verification of monitoring operation screens that target multiple controllers as well as data linkage between the controllers. It is possible to implement simulation for up to 8 controllers at once on a single PC.

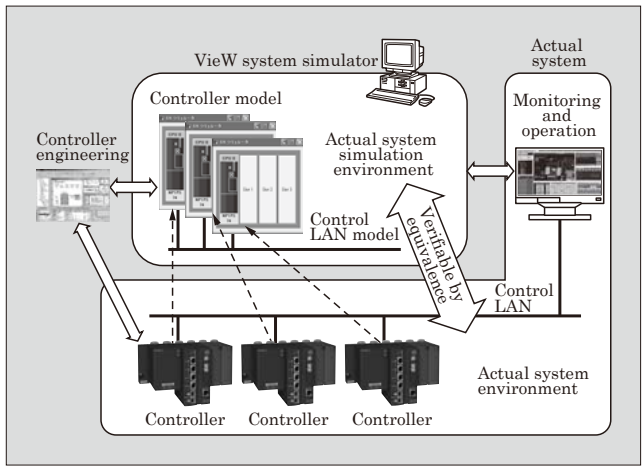

Fig.8 Simulation functions

Table 1 Simulation operation environment

Functions	Specifications
Compatible products	SPH300 Series, SPH2000 Series, SPH3000 Series, XCS-3000
CPU	8 per configuration
P/PE	8 per configuration
Control LAN	FL-net, SX-Net
I/O	Supports I/O expansion, compatible with E-SX bus I/O
System memory support	Free-running counter, cause of failure bit, application abnormality detection
Connection HCI	XOS-3000, POD

(2) Ease of switching between the simulator and actual equipment

By simply changing the XOS-3000 connection from the simulator control LAN to the actual control LAN, it is possible to switch from the PC simulation to the actual equipment. This has the merit of improving the development efficiency of customer systems.

When carrying out display and controller engineering for the MICREX-VieW XX in separate locations both domestically and abroad or even when sharing the tasks within an organization, it is possible to carry out operation verification of the system by using the actual equipment and simulator separately as needed. If the system is small-scale, it is possible to perform all system simulations using a single PC.

(3) Modeling of large-scale systems

When performing modeling of large-scale systems, loads are distributed by connecting multiple PCs to

Ethernet*4, using the data memory sharing functions in the control LAN model and carrying out data linkage. For example, in the case of HCI, it is easy to implement simulation of the controller on a separate PC. This makes it possible to carry out highly reproducible simulations, including responses, even in large-scale systems.

4. Control System Security

4.1 Trends in Japan and abroad

Starting with the Stuxnet attack virus, which targeted Iranian nuclear facilities in 2010, cyber attacks of control systems have been on the rise, and this has created a sense of urgency regarding security measures for control systems. Under these circumstances, third-party certification of security based on the IEC 62443 international standards has begun overseas, and there are now cases starting to appear where certification is becoming a procurement requirement in plants.

Even in Japan, the Control System Security Center (CSSC) was established in April 2012 under the guidance of the Ministry of Economy, Trade and Industry as an institution for evaluating and certifying control system security based on the IEC 62443 international standards in order to ensure the security of critical infrastructure and improve international competitiveness.

4.2 Security evaluation and certification

The preparation of international standards has been making progress to meet control system security requirements, and an environment is being developed that can apply evaluation and certification of security as a common standard. Fuji Electric participates in the IEC/TC65/WG10, which is a domestic council of IEC 62443, as well as participates as a joint enterprise cooperative in CSSC in order to support the creation of a security evaluation and certification scheme for control systems, and to improve Japan's international competitiveness in the control system market.

In light of these circumstances, we have created the MICREX-VieW XX as a system that ensures security by developing it with an eye toward the importance of security from the design stages in order to provide users with a safe and secure system to achieve stable plant operations.

In the future, we plan to obtain certification as soon as the international standard based security certification system commences operations to provide users of the MICREX-VieW XX with a system that ensures safety.

5. Postscript

In this paper, we provided an overview of the latest operation functions and engineering functions of the "MICREX-VieW XX" small- and mediun- scale monitoring and control system, as well as described some of its operation and security features.

As a manufacturer, it has been our duty to continuously pursue improvements in operability and engineering efficiency. We are committed to continue providing our customers with high-quality systems that accurately meet their needs and ensure their satisfaction.

*4: Ethernet is a trademark or registered trademark of Fuji Xerox Co., Ltd.