

NEW HUMAN INTERFACE STATION 'HIS' FOR CENTUM VP

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We have developed a new Human Interface Station (HIS) as Human Machine Interface (HMI) software for CENTUM VP, a New Integrated Production Control System. The HIS runs on Windows Vista, the latest operating system of Microsoft Corporation. The HIS offers a unified and intuitive operation environment to improve operation efficiency and maintain the improvement. This operation environment is designed to facilitate access to necessary information when the users need it, and also improve operability as the users operate. This paper outlines the concept and functions of the HIS.

INTRODUCTION

CENTUM VP is a next-generation Integrated Production Control System which provides solutions to improve operation efficiency (Operational Excellence) based on Yokogawa's VigilantPlant concept⁽¹⁾. In the development of Integrated Production Control Systems, we have expanded the functions of the Human Machine Interface (HMI) maintaining the main essence of CENTUM series, regardless of the changes of platforms. The newly developed Human Interface Station (HIS) offers a unified and intuitive operation environment to continually improve operation efficiency. This operation environment is designed to show data scattered throughout a plant in an intuitive manner to facilitate access to necessary information when users need it. It is also designed to minimize operation errors and losses by using the mental model of plant operators to offer intuitive Look & Feel operability, based on Human Factors Engineering. In addition, this operation environment aims to increase operability as users acquire experiences and accumulates operation histories over time.

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HARDWARE AND SOFTWARE OF CENTUM VP HIS

Hardware

The HIS hardware comes in three types: general-purpose PC, industrial PC (for the Japanese market only), and console (Figure 1).

- General-purpose PC: Desktop PC superior in cost performance
- Industrial PC: Desktop PC with reliability, availability, and serviceability (RAS) functions
- Console: Console with an operation keyboard (OPKB) having eight-loop keys



Figure 1 Example of Desktop PC Configuration

Software Architecture

The HIS is the first major distributed control system (DCS) which runs on Windows Vista, the latest operating system of Microsoft Corporation, as well as Windows XP and Server 2003. The HIS comes in an all-in-one configuration which incorporates in a single computer all functions required for operating and monitoring a plant. It features real-time capabilities for reliable updating of plant data as well as display function with quick response to operations. A further advantage of the all-in-one configuration is that multiple HIS units can be installed to easily achieve HMI redundancy. A maximum of four monitors can be connected to a single HIS, and the monitors can be placed either vertically or horizontally.

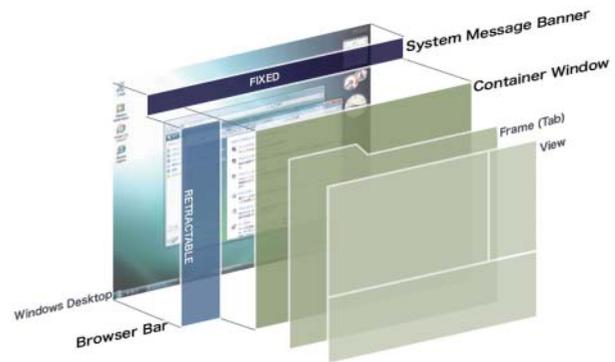


Figure 2 Configuration of HIS

GRAPHICAL USER INTERFACE (GUI) DESIGN

GUI Design Concept

In the development of the HIS, the GUI design concept was drawn up in collaboration with the Design Planning Center, which takes exclusive responsibility for the design of Yokogawa products. The keyword of the GUI design is “simple and intuitive”.

(1) Simple and intuitive

The essence of plant operations is to operate a plant, not to use a production control system successfully. Therefore, the GUI in the operation environment must be as simple and intuitive as possible. There are three main elements required to construct “simple and intuitive” GUI: “clearness in visual aids”, “clearness in understanding”, and “goodness”.

(2) “clearness in visual aids” involves the following perception elements:

- Amount of information (optimum density and grouping)
- Access performance (metaphor and affordance)
- Readability (proper sizes and pitches of characters)

(3) “clearness in understanding” involves the following cognitive elements:

- Mental model (a model which users expect about behaviors of GUI)
- Reassuring feedback (immediately reflecting the user’s intention)
- Navigability (“what you see is what you get” concept)
- Consistency (holding the same meanings throughout the system)

On the basis of these elements, designing interface with a simple layout and well-balanced color selection can lead to “goodness”.

GUI Design Policies

In designing the HIS’s GUI, design policies focus on three aspects: tools, arrangement, and transition:

- As for the tool aspect, for the HIS’s operating and monitoring windows, graphic and trend windows which are the center of operating and monitoring have been revised while other various operating and monitoring windows in the previous CENTUM series are inherited.
- As for the arrangement aspect, the layout of operation windows is the core concept in the HIS’s operation

environment. Information necessary for operating and monitoring is arranged in a well-balanced manner to achieve a design offering both good operability and visibility.

- As for the transition aspect, switching from one operating and monitoring window to another window inherits the concept of the previous CENTUM series. This allows the users of the previous CENTUM series to accept the new HIS operation environment without feeling any difference.

Screen Configuration

The HIS screen consists of the System Message Banner, the Browser Bar, and Container Windows (Figure 2). They are organized in terms of product characteristics, importance of information, and the laws of human behavior. The desktop has a clear, wide screen background with gradation to ensure a transparent and comfortable operation environment.

Container Window

Container Windows are the main area for displaying operating and monitoring windows as well as currently most important information. The HIS offers two types of window mode: full-screen mode in which a Container Window occupies the full screen, and window mode in which multiple Container Windows are arranged on Windows’ desktop (Figure 3).

The Container Window in full-screen mode can display multiple Views using Frames. These Frames help to collectively show information required for particular purposes, and provide Views of the HIS’s operating and monitoring functions such as graphic and trend windows.

In window mode, one Container Window contains one View and multiple Container Windows are displayed on the desktop. This is the same as conventional multi-window operation.

The Container Windows are based on View Collaboration⁽²⁾, the basic software architecture of CENTUM VP, and use .NET Framework 3.0, which is a Microsoft’s software component for building applications on Windows. In particular, the use of Windows Presentation Foundation (WPF), a user interface subsystem, gives the GUI a richer representation capability.

Color Scheme

The color scheme considers the roles of special colors having



Figure 3 Full-Screen Mode (Left) and Window Mode (Right)

specific meanings; 16 system colors have been defined based on Color Universal Design.

(1) Role of special colors having specific meaning

Individual colors have certain meanings according to the nature law or human wisdom. The HIS uses colors with consistent meaning: red means abnormality, yellow means caution, and green means safety/normal.

(2) Definition of 16 system colors

Color Universal Design is color management that lets more people recognize information at the same level.

In plant operations, information such as alarm status and trend pens can be conveyed by the difference in colors. The HIS has defined 16 system colors considering the following points to reduce differences in recognition of colors among individuals and thus ensure safer operations:

- 16 system colors are selected by simulating how people with color vision deficiency recognize differences in colors, so that more people can understand and share the same information.
- Pure white and pure black are respectively changed to gray-based colors, which enables stable color alternatives to be provided independent of the background color.
- Red, yellow, and green are respectively changed to neutral color containing the other colors to prevent problems in understanding information.

The HIS uses the 16 system colors as pen colors for trend lines.

OPERATING AND MONITORING FUNCTIONS

System Message Banner

The System Message Banner occupies the top area of the desktop and indicates the operation status of the plant. Frequently-used functions and important functions such as alarm information are arranged here. Just as an annunciator panel in an instrumentation room informs operators of the plant status, the System Message Banner clearly warns the user of alarms with blinking in the case of abnormalities. The symmetric design represents the reliability and value of the system.

Browser Bar

The basic concept of the Browser Bar is a “tool box” in which

familiar tools are stored in familiar locations. The “drawers” in the box are the starting point of plant operations and also accumulate users’ way of operations, such as customization of favorites or the screen display history. The customizable, flexible design allows cutting-edge technology to be optimized according to user requests and the rounded corners of the display frame give a sense of dynamism.

Graphic Function

The graphic function displays process data or graphics that the user has defined. In the development of the graphic function⁽²⁾, a common graphic system with flexibility and superior extendibility has been created, and HIS-specific functions are added on top of it. Thus this common graphic system can be used in various functions which will be developed for CENTUM VP series. In addition, the graphic function offers complete compatibility with CENTUM CS 3000 HIS, so CENTUM CS 3000 can be upgraded to CENTUM VP without changing the graphic screens.

Trend Function

The trend function chronologically displays acquired plant data (Figure 4).

In the trend function, the target time of certain data can quickly be reached, related data can be grouped together for comparison, and the trend of data can easily be understood. This function uses the color schemes based on Color Universal Design for the trend display area or display pens, and the settings can easily be changed.

By dragging and dropping data from the browser bar to the trend window, the pen assignment can be modified. Also, data acquired at different intervals can be displayed together on the same screen. Displaying multiple index lines indicating specific times enables the trend of data to be easily grasped.

Custom Faceplate Function

The HIS offers faceplates (instrument faceplates), a standard feature of the system, as a tag operating and monitoring screen of a controller. Customers may need to customize the faceplate display or make other data displayed in addition to the displayed

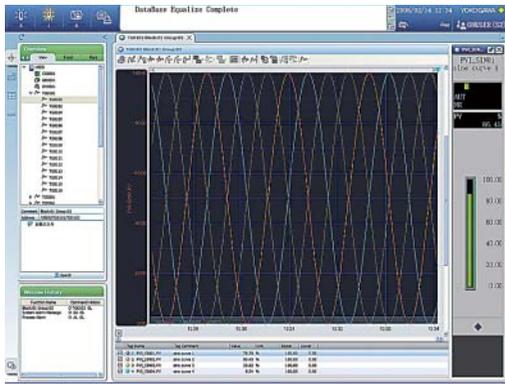


Figure 4 Trend Function

tag data: the custom faceplate function enables a faceplate of a specific tag or specific instrument type to be created. Definition of custom faceplates during the engineering phase enables customized faceplates to be recalled during operations.

Alarm & Event Function

The Consolidated Alarm Management Software for HIS (CAMS for HIS), which is available as an option in the CENTUM CS 3000 R3 HIS, now comes as standard. The CAMS for HIS is compliant with EEMUA No. 191, the guideline for alarm management, and offers integrated control of various alarms and events.

The CAMS for HIS collects alarms and events in real time and it informs the user of these information by adding monitoring objectives, time permitted to take action, identifiers such as alarm importance used to accept or reject the alarm, the cause of an alarm, and response guidance. The users can use the filter or sort function of the CAMS for HIS based on these pieces of information to receive only the information they require at the optimum timing from among a wide variety of alarms and events occurring in a plant. Consequently, safer and more efficient plant operations can be accomplished.

INHERITANCE OF CENTUM CS 3000 R3 HIS

Various operating and monitoring functions of the CENTUM CS 3000 R3 HIS can all be used on the CENTUM VP HIS's Container Windows. The Container Windows inherit the high

reliability based on a wealth of knowledge accumulated over many years such as the overview function in which alarm information is hierarchically managed. This enables existing customers of the CENTUM CS 3000 R3 to migrate to the CENTUM VP smoothly.

CONCLUSION

The HIS continually improves operation efficiency by offering a unified and intuitive operation environment. It facilitates access to necessary information when the users need, and improves operability as the users operate. The HIS has developed Container Windows which are the foundation to achieve this operation efficiency.

For the HIS development, a development office was set up in Singapore where a great deal of information on cutting-edge technology can be collected, so that we can adopt the latest technology.

The operating and monitoring function will continue to evolve, and the HIS will develop into HMI software for the operating and monitoring function of CENTUM VP. ◆

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