The AOS-3000 Advanced Operator Station for Multimedia

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1. Introduction

Automated and unmanned control of monitoring equipment have increasingly been adopted in many plants. However many inspection, operation and monitoring tasks are still performed manually.

Recent and remarkable developments in the infrastructure and technology for multimedia have made it possible to integrate multimedia data such as image, voice, and process data. In the future it will be important to realize visual operator interfaces that utilize the above technology, making it possible to detect abnormal conditions accurately and quickly.

To cope with the rapid progress of technology, Fuji Electric has made it possible to construct an operator workstation utilizing a workstation in an open system. An advanced human-computer interface (HCI) can be installed in the operator station to facilitate supervisory control through multimedia.

This paper outlines the function of the AOS-3000 advanced operator station and describes a multimedia human interface to realize visual monitoring and control.

2. Overview of the AOS-3000

2.1 Characteristics

(1) Open platform

The AOS-3000 has used UNIX workstations[*1] for a long time as a hardware platform that can utilize recent technical developments. This enables a system construction with up-to-date and open technology.

"S-family" workstations, installed with the latest version of UNIX are used. These workstations provide the necessary hardware and software for monitoring. Therefore, an enormous amount of distribution software as well as standard communication protocols such as Ethernet[*2] and FFDI (fiber distributed data interface) can be used. In addition to the S-family, operator stations can also be constructed from Fuji Electric's industrial-use DS/90 UNIX computer.

(2) Flexible system

It is necessary for the operator station to expand and change functions in response to changing plant conditions.

To accommodate this requirement, the operator station has a changeable software configuration and is installed with software suitable for load distribution. Figure 1 shows the software configuration.

(3) User-friendly human-computer interface

The AOS-3000 utilizes multi-window operation, enabling the monitoring and operation of two or more conventional operation panels at the same time.

The introduction of multimedia functions into the functions of the conventional operator station allows the AOS-3000 to accurately and quickly determine site conditions.

2.2 Functions

The operator station is composed of the following seven function blocks.

(1) Message communication function

This function allows the operator station to exchange messages through dataways with controllers and computers connected to those dataways.

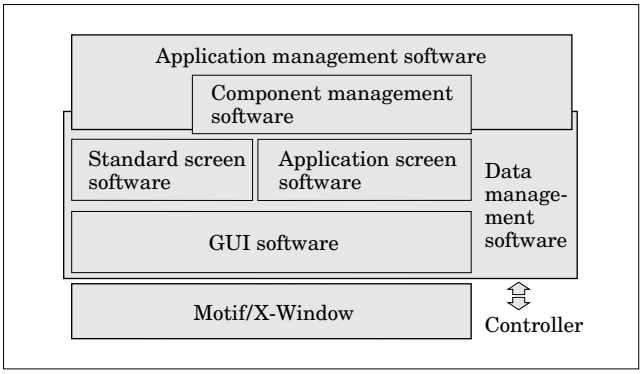
(2) Data management function

This function allows the operator station to use the message communication function to read and write

∗1 UNIX : A registered trademark of X/Open Company Ltd.

∗2 Ethernet: A trademark of Xerox Corp., USA

Fig.1 AOS-3000 software configuration



data from controllers and computers connected to the dataways. In addition, this function allows the operator station to collect and store time series data and document data as well as to receive, record and store events such as alarms generated by controllers.

(3) Document function

This function allows the operator station to print daily, monthly and annual reports based on the data collected by the data management function.

(4) Window operation function

This function allows the operator station to perform overall window management and various types of processing in addition to window display, such as alarm events.

(5) Standard screen function

This function allows the operator station to provide a standard monitoring operation screen. Since definition information is collected from the corresponding controller, monitoring screens can be displayed without much engineering effort.

(6) Supporting function for monitoring operation screen

This function supports the creation and display of monitoring operation screens such as a system screen created for each system. Various components for creating screens are provided to facilitate the design and creation of screens.

(7) Multimedia HCI function

This function allows the operator station to display an on-site image on the screen, and to monitor the on-site sound and process data in synchronization with that on-site image. This function is described below.

3. Multimedia Human-Computer Interface (HCI)

Fuji Electric has already realized the following functions in multimedia HCI.

(1) Window display of site image by the selection of camera icons on various monitoring screens

(2) Synchronized recording and playback of image, voice and process data before and after abnormalities.

Fuji Electric has recently developed a scene-based interface that utilizes site images, to performing remote monitoring as if on-site.

The scene-based interface is described below.

3.1 Functions

Figure 2 shows a schematic diagram of the scene-based interface.

When an image that includes the object to be monitored is displayed by camera operations such as panning, tilting and zooming, the scene-based interface determines what the object in the image is and automatically displays the image with information necessary for the operator. As a result, plant conditions can be easily monitored, as if the site were being surveyed.

Table 1 lists the scene-based interface functions and Figs. 3, 4 and 5 show examples of monitoring screens.

3.1.1 Multimedia display function

Figure 3 shows an example of a monitoring screen when a camera and a monitored image of an air-conditioned room have been selected. A control panel, meters and valves are displayed on the screen, and the site image is overlaid with their names and instanta-

Fig.2 Schematic diagram of scene-based interface

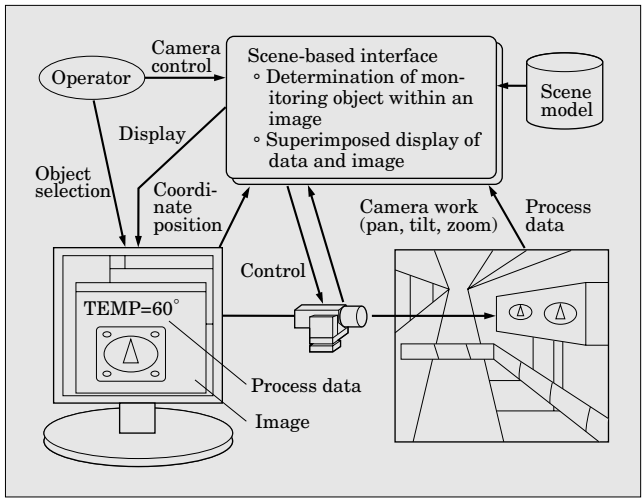


Table 1 Function of scene-based interface

Function name		Contents
Multimedia display	Video window display	The site image is displayed in a window on the screen of the operator workstation.
	Overlay display	Object name or process data are overlaid near the monitored object on the image.
	Monitoring window automatic display	The monitoring screen (trend graph, operation panel, guidance, etc.) for the monitored object in the image is automatically displayed in different windows.
	Site sound output	Sound from an on-site microphone in the image is output.
Operation as if on-site	Camera control through button	The camera is controlled from camera control buttons.
	Camera control by pointing to the image	The camera is controlled by pointing to the image and the pointed location in the image is displayed in the center of the video window.
	Camera control by pointing to the object	The monitoring object in the image is zoomed in when pointing to in image.
	Monitoring window display by pointing to the object	A detailed monitoring screen for the monitoring object is displayed in a different window by pointing to the object on the image.
Monitoring information input on image	Memo input	A memo (voice, text, etc.) is defined at the pointed position in the image. Memo mark is displayed on the target position in the image.
	Memo output	The memo is redisplayed by pointing to the memo mark.

Fig.3 Example of monitoring screen 1

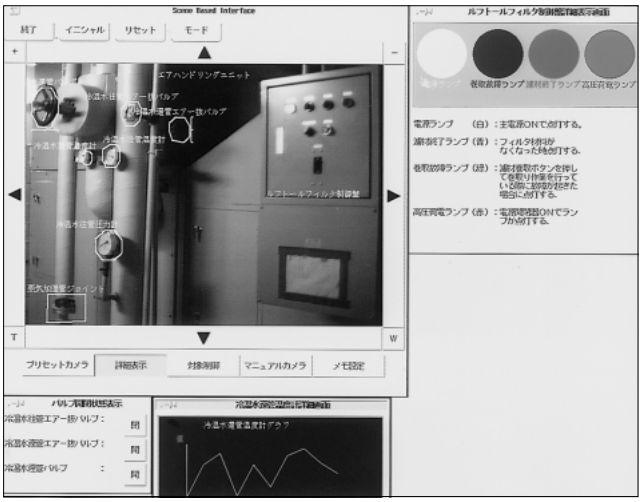


Fig.4 Example of monitoring screen 2

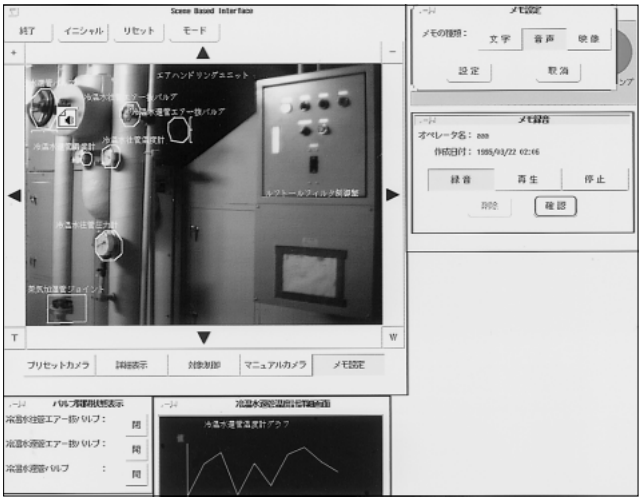
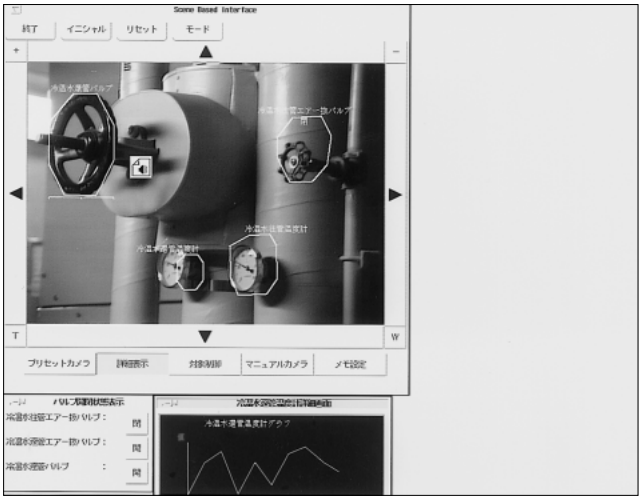


Fig.5 Example of monitoring screen 3



neous values of the related process data. A description of the control panel within the image is automatically displayed on the upper right window of the screen. A trend graph and a valve operation panel are automatically displayed in the bottom window of the screen. In addition, if a microphone is in the image, a microphone mark is displayed at the position of the microphone to indicate the position at which audio data is collected. The collected audio data is automatically output.

Figure 5 shows a zoom-up of the monitoring screen in Fig. 4. Because the control panel has disappeared from Fig. 4, the corresponding window in the upper right hand corner of the screen is not displayed. Information superimposed on the image is redisplayed at the corresponding object position.

Thus, the monitoring screen is automatically updated by operating a camera to display the monitoring object. Plant conditions can be easily monitored using multimedia image, audio and process data.

3.1.2 Virtual on-site operating function

Guidance information about meter indicators, which cannot be displayed simultaneously on the monitoring screen in Fig. 3, can be displayed in other windows by pointing to the meter image.

A camera can be controlled to face any desired direction either by pointing to a monitoring object or by pointing to any of the ▲ buttons located to the right, left, above and below of the image.

3.1.3 Setting function for image monitoring information

Figure 4 shows a monitoring screen in which a voice memo is input by pointing to the upper left valve position in the image and a memo mark is displayed next to the valve.

The memo mark can be set by pointing to the concerned position.

By selecting the record button in the window displayed at the upper right of the screen in Fig. 4, a voice memo can be input. Later, the input memo can be output by selecting the memo mark on the screen.

Once the above setting is made, the memo mark will be displayed at the position of the monitoring object even when a camera is controlled. For example, the voice memo set on the monitoring screen of Fig. 4 is still displayed next to the valve even when the screen switches to that of Fig. 5.

3.2 Method

3.2.1 Processing method

To realize the above functions, the on-site scene structure should be modeled in an operator workstation and the monitoring screen corresponding to each monitoring object should be saved.

When an operator selects a monitoring image, it is assumed that the operator's intent is reflected in the camera parameters (pan, tilt, zoom).

The monitoring object displayed in an image is determined from the scene model on-site and the camera parameters. Figure 6 shows the processing flow diagram of the scene-based interface.

3.2.2 Scene model

Cameras are usually installed in a fixed location such that an operator can only see the scene projected

Fig.6 Flow diagram

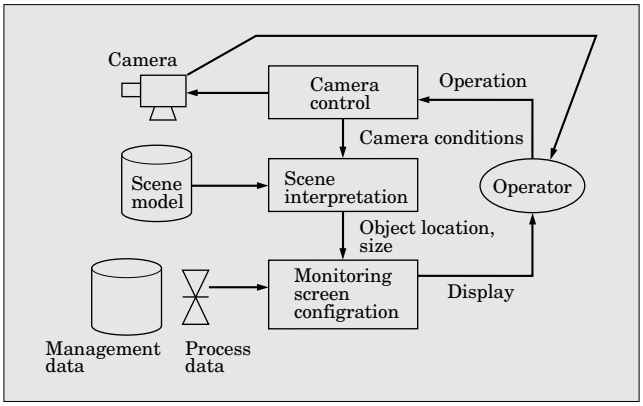
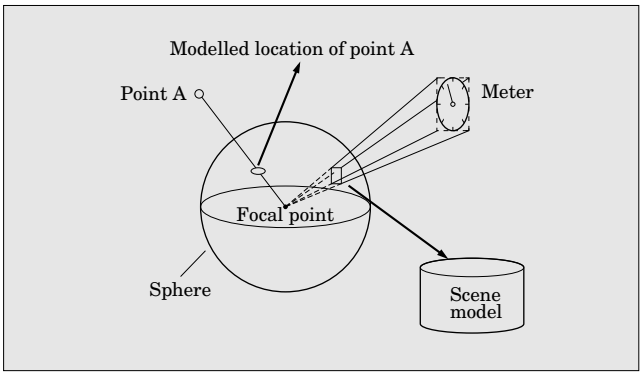


Fig.7 Scene model



on the image plane. Therefore the distance to the object is not necessary for modeling the site scene. As shown in Fig. 7, the structure of the site scene in which a camera is installed is obtained as a spherical projection, with the focal point of the camera at its center. From this, the external form of the projected monitoring object is modeled. As a result, the complete surroundings of the camera can be modeled, and the position and size of the monitoring object can be estimated by determining camera parameters. Once the positions of the object and memo mark are defined using the scene model, the scene-based interface can be realized with various camera parameters.

3.3 Features

(1) In the past, images and distributed control system process data were monitored on separate screens. Now they are correlated and displayed on the same screen. This facilitates the control and operation of monitoring while confirming on-site conditions.

(2) Operation items and their related information are displayed together with images, thereby reducing the work load for operators.

(3) A spherical model is utilized for the scene model. This facilitates the definition of a scene model that realizes a scene-based interface from camera parameters. The system configuration is also simplified.

4. Conclusion

In this paper, advanced operator stations have been introduced, focusing on a scene-based interface, a scene-determining-type, multimedia human-computer interface.

Advanced operator stations are playing an increasingly important role in monitoring control systems as the only point of contact between a plant and operators. Multimedia HCIs are also playing an important role, and it is expected that they will be widely used not only in more intelligent ITVs, but also as a new interface in remote monitoring control.

Fuji Electric will continue to improve applications and related functions so that operator stations will be widely used.