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Development of Web-Based Control and Monitoring System for Facility in Shipbuilding Yard

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Abstract: Generally, boiler and gas utility management is dependent on human. This facility has been installed over a wide area in the shipyard. The operators usually maintain and monitor the systems for their best conditions. It is also difficult to manage the installed facilities because of a long distance. The main problem is that maintenance costs and time have been increased. Therefore, we need to introduce a remote control and monitoring system which can manage facilities by the internet. But, most facilities have the analog controller due to install a long time ago. The controller's type is different. So, these systems can't be directly connected to the internet for remote control. In this study, we developed the interface algorithm and protocol for a local boiler and utility using industrial controller. The serial communication protocol between industrial controller and boiler was also developed for remote control. The interface algorithm based on PLC was able to access the internet with Ethernet module for the web based control. In addition, we developed the remote monitoring system with web cameras and servers using wavelet algorithm. In result, it was confirmed that web-based control system has been convenience, efficiency and reliable in operation. We checked the maintenance cost savings, too.

Keywords: Facility, Web-based control, PLC, Web-camera, Monitoring

1. INTRODUCTION

Lately, according to a generalization of internet based technology, we have good condition to be made home, plant and factory automation. It is also possible to control and manage of systems. All information of systems is used for database in network server. But there are many restriction to automation based on internet in heavy industrial field which coexists a large scale facility and offices together.

There are various facilities to support work in the industrial field. Especially, it is used to wide area in industrial divisions such as shipbuilding yard. Factories and offices in yard are also divided into several places. There are facilities like absorption chiller systems and boiler installed in each factory and office for work. Those facilities which are installed in each building in shipbuilding yard are needed of maintenance and management. Therefore, many operators are assigned to each place work to maintain facilities in the most shipbuilding factory. But there are some problems that it is simple and repetition work to operator, using to human cost and the inefficiency for work because operators move around extensively to maintain and control.

In this study, we developed web-based monitoring and control system by using internet based network infrastructure. The developed system can control utility and facilities which are spread out wide area like shipbuilding yard. But the installed facilities have the different type control devices and only included serial communication function to interface with other device. Therefore, we need additional local system which can control each facility and access to internet for data exchange. We developed the PLC (Programmable Logic Controller) control systems which have the function that is able to control at local facilities and connect to internet by UDP(User Datagram Protocol). In additional, in order to operate these facilities efficiently, we developed a web-based monitoring system by using web server and camera. These systems are able to observe or recode by image data about wide areas status in the real time.

Now, we are able to control different type facilities by using integrated web-based system in our shipbuilding yard. We also confirmed convenience, efficiency of operation, and reduced operator workload for maintenance due to web-based control and monitoring system.

2. FACILITIES OF SHIPBUILDING YARD

Every facility in our shipyard is distributed to 6Km × 2Km wide area like Fig.1.

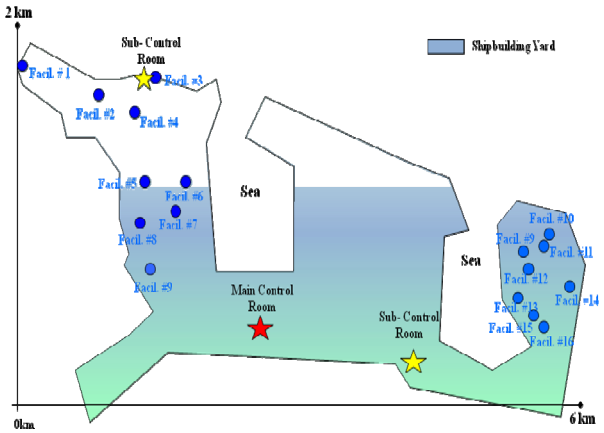

Fig. 1 Position of facilities in shipbuilding yard

In general, facilities are installed inside building or factory. These consist of absorption chiller to check temperature in office, boiler and natural gas control utility. These facilities, which are separated from No. 1 to No.16, were operated and controlled by two local parts. The operators directly managed by manual control. Especially, every facility here is installed with respectively different specification at initial design. Those systems have no function for interface with other controllers or some of them have limited serial communication method. Hence, in order to control web-based system, we need to develop different type control system for our facilities.

3. DESIGN OF WEB-BASED CONTROL AND MONITORING SYSTEM

3.1 Configuration of web-base control

The configuration of combined control system is designed below Fig. 2. The servers for facility control and monitoring are built in each sub-control room 1 and 2. The information of each server in sub-control rooms is sent to the main control room. All data are managed by the server in main control room. This server in the control room has not only total system control function but data saving, monitoring, recoding about the acquired data from facilities. Now, it is able to check facility working condition by creating report automatically every month.

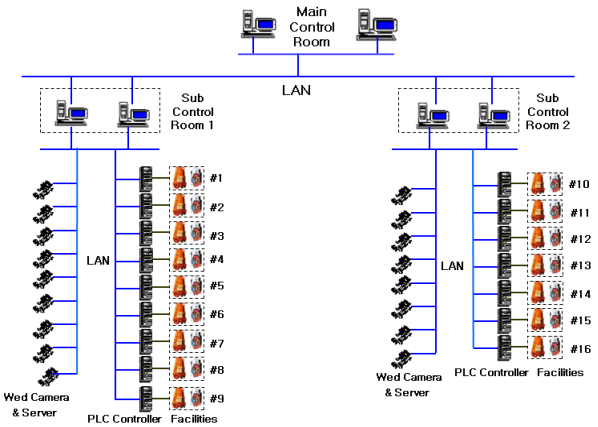

Fig. 2 Design of system

3.2 Design of local control system

Facilities installed in 16 places can be operated independently by manual operation. So, in this study, we used industrial PLC to make the combine control system about all facilities. Original systems are interfaced by PLC which has analog input & output unit, digital input & output unit and communication unit to control system.

In addition to, the PLC has each static IP address. The protocol is used by UDP to access the internet for the construction of web control in the shipyard. Fig. 3 is diagram of the local system to connect with web-server.

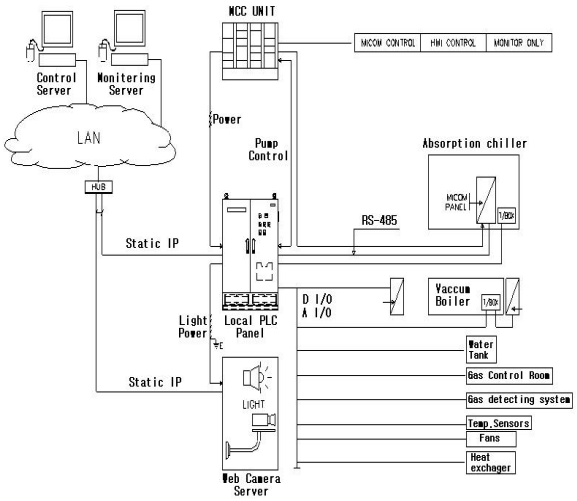

Fig. 3 Configuration of local control system

The absorption chiller is independently controlled by microprocessor with serial communication port. So, in order to interface between local PLC system and chiller, we need to develop serial communication protocol and modify control program in microprocessor.

The format of serial communication data to control absorption chiller is divided into two ways, sending from host(PLC) to microcontroller, sending from microprocessor to host(PLC). Due to using half-duplex communication method, when one-side transmits the data, the other side is only able to receive it at all times. This method is to avoid data loss and error. Transmission data protocol is like table 1 and 2.

Table 1. Data format from PLC to Micro Processor

Data	Rx/Tx	Micom No.	Command Code	Data Setting		Check Sum		End Code
				Low	High	Low	High	
Byte No.	1	1	1	1	1	1	1	1

Table 2. Data format from Micro Processor to PLC

Data	Rx/Tx	Micom No.	Mode	Status	Error	Data	Check Sum		End Code
							Low	High	
Byte No.	1	1	1	1	1	31	1	1	1

3.3 Monitoring system

We designed a monitoring system to help operator not to move but to check facilities in several place using web-camera. The operator is able to check a measurement value of instrument in 16 places through camera system. Hence, we can be compared actual data

with measurement data for the reliability. We also can prepare to emergency situations in direct. Especially, web-camera has pan, tilt and zoom in/out control function through web server. The target points can be accurately checked from a remote control room. The acquired video file can be stored by real time recording function in monitoring system server. It is specification about web-camera and server in the table 3 as below.

Table 3. The Specification of Web Camera and Server

	Web camera	Camera server
Spec.	- Moving angle Pan: 320°(Manual) 290°(Auto) Tilt : 20°(Up) 30°(Down) - Speed Pan: 6.2 deg/sec Tilt: 4.5 deg/sec - Control RS-232C/422/485 - Zoom: optic×23 - Pixel : 410,000	- 32Bit RISC Embedded linux Processor - Flash memory 8MB, Ram 16MB -Wavelet transfer

4. MAN MACHINE INTERFACE

We developed PLC system to control local boiler, absorption chiller and utility for gas in 16 positions. Remote control system is needed for the cost saving about manpower and management. Therefore, we also developed the MMI(man-machine interface) program. MMI program has the function which controls all facilities in the ship yard using combined screen of main control server. This program has on effect to save manpower and time for operation.

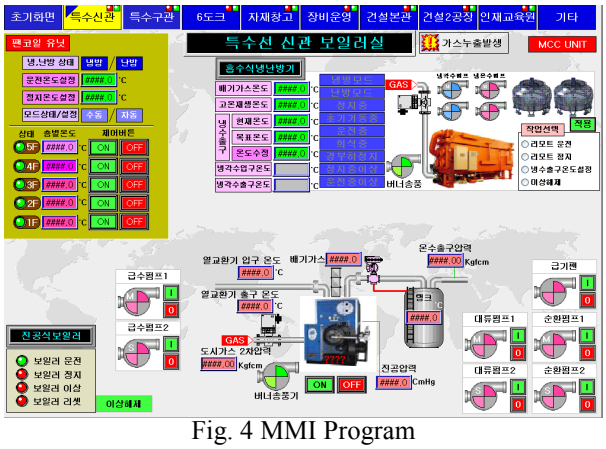

Fig. 4 MMI Program

The developed MMI is divided by the two parts, using control and monitoring about total areas. One of MMI is installed in the sub-control room #1 to control facility #1~#9, the other is installed in the sub-control room #2 to control facility #10~ #16. In the MMI for the control, there are boiler control screens for absorption chiller, pump and building temperature.

5. CONCLUSION

We developed PLC system to control utilities and facilities, such as boiler, absorption chiller system and gas control system in wide shipbuilding area. The PLC for web-based control has its static IP address to access network of shipbuilding yard. The MMI program is developed to control industrial facilities at long distance by internet. Also, web-based camera system is available to check and monitor the situation in several areas. Therefore, these kinds of systems are able to replace operators. We can reduce costs of human and repair. In result, it was confirmed that web-based control system has been convenience, efficiency and reliable in operation. Also, we made a basement for application of the other facilities. This study is an good example that is applied by IT(Information Technology) technique at heavy industrial part, such as shipbuilding yard.

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