DESCRIPTION

INFORMATION PROCESSING APPARATUS, SYSTEM CONSTRUCTION SUPPORT METHOD, AND SYSTEM CONSTRUCTION SUPPORT PROGRAM

Field

[0001] The present invention relates to an information processing apparatus, a system construction support method, and a system construction support program that support system construction of a control system.

Background

[0002] In the industrial field, a supervisory control system for performing supervisory control is constructed in some cases, the supervisory control system being also called supervisory control and data acquisition (SCADA). In order to construct the supervisory control system, a user needs to define a monitoring target and then implement various designs such as screen design and control design. Hereinafter, a term “overall design” will be used to refer to the overall design including the various designs for constructing the supervisory control system.

[0003] Patent Literature 1 discloses a system construction support tool that supports construction of a supervisory control system. The system construction support tool described in Patent Literature 1 automatically generates a control program for controlling equipment on the basis of an equipment list including attributes of equipment to be monitored and controlled.

Citation List

Patent Literature

[0004] Patent Literature 1: International Publication No.

Summary

Technical Problem

[0005] In recent years, cases are increasing in which the supervisory control system is constructed by adding a function as a supervisory system to an existing control system. In this case, although existing control design information in the existing control system can be used in the control design, a user needs to redefine the monitoring target and then implement the overall design, which requires man-hours for constructing the supervisory control system.

[0006] The present invention has been made in view of the above, and an object of the present invention is to provide an information processing apparatus that can reduce the number of man-hours for constructing a supervisory control system in a case where the supervisory control system is constructed by diverting existing control design information.

Solution to Problem

[0007] To solve the above problem and achieve an object, an information processing apparatus according to the present invention includes: an equipment list creation unit to create an equipment list that is information specifying equipment subject to supervisory control, on a basis of control information acquired from a control device included in an existing system, an equipment list display unit to display the equipment list and be able to accept an input designating equipment to be excluded from a monitoring target in the equipment list; and a data management unit to update the equipment list on a basis of the equipment to be

excluded. The equipment list includes information indicating an operating state of the control device, and

the data management unit updates the equipment list on a basis of the operating state of the control device after the equipment list is created.

Advantageous Effects of Invention

[0008] The present invention has an effect of being able to reduce the number of man-hours for constructing the supervisory control system in the case where the supervisory control system is constructed by diverting the existing control design information.

Brief Description of Drawings

[0009] FIG. 1 is a diagram illustrating an example of the configuration of a supervisory control system according to a first embodiment.

FIG. 2 is a block diagram illustrating an example of a hardware configuration of a system construction support apparatus in the first embodiment.

FIG. 3 is a diagram illustrating an example of a functional configuration of an input data generation module in the first embodiment.

FIG. 4 is a diagram illustrating an example of a configuration of management data managed by a data management unit in the first embodiment.

FIG. 5 is a table illustrating an example of a configuration of detailed equipment data in the first embodiment.

FIG. 6 is a table illustrating an example of a configuration of an equipment list in the first embodiment.

FIG. 7 is a flowchart illustrating an example of a processing procedure of the input data generation module in

the first embodiment.

FIG. 8 is a diagram illustrating an example of a display screen for accepting exclusion of equipment in the first embodiment.

FIG. 9 is a flowchart illustrating an example of a processing procedure of the PLC search in step S2 illustrated in FIG. 7.

FIG. 10 is a diagram illustrating an example of a configuration of PLC data in the first embodiment.

FIG. 11 is a flowchart illustrating an example of a processing procedure for the processing of creating the detailed equipment data in the first embodiment.

FIG. 12 is a flowchart illustrating an example of a processing procedure for the processing of creating the equipment list in the first embodiment.

FIG. 13 is a diagram illustrating an example of a configuration of an existing system and an example of the equipment list generated in the first embodiment.

FIG. 14 is a flowchart illustrating an example of a processing procedure including update of an operating state in an input data generation module in a second embodiment.

Description of Embodiments

[0010] An information processing apparatus, a system construction support method, and a system construction support program according to embodiments of the present invention will now be described in detail with reference to the drawings. Note that the present invention is not limited to the embodiments.

[0011] First Embodiment.

FIG. 1 is a diagram illustrating an example of a configuration of a supervisory control system according to a first embodiment of the present invention. As

illustrated in FIG. 1, the supervisory control system of the present embodiment includes a supervisory control apparatus 11, a system construction support apparatus 12, programmable logic controllers (PLCs) 13 and 17, and pieces of equipment 14. The supervisory control apparatus 11 and the PLC 13 are connected by a first network 15, and the system construction support apparatus 12 and the PLC 13 are connected by the first network 15. The PLC 17 and the pieces of equipment 14 are connected to the PLC 13 via a second network 16.

[0012] The PLCs 13 and 17 are examples of controllers that control the equipment 14. The equipment 14 is, for example, an inverter that drives a motor, an air conditioner, or a lighting device. The first network 15 is, for example, a network conforming to the Ethernet (registered trademark) standard. The first network is an Internet Protocol (IP) network, and an IP address is assigned to each device connected to the first network. In the first network, the IP address corresponding to a destination device is contained in communication data as information indicating the destination. One or more gateway devices (not illustrated) are connected to the first network, and each device connected to the first network can communicate with the outside via the corresponding gateway device. For each gateway device, a range corresponding to the gateway device is specified as an IP address range. The second network 16 is, for example, a network based on CC-Link IE (registered trademark). In the second network 16, a station number corresponding to a destination device is contained in communication data as information indicating the destination. Note that the methods of communication by the first network 15 and the second network 16 are not limited to the above examples.

[0013] The supervisory control system includes one or more devices of a system. The system refers to an assembly of devices with a plant or factory as a unit.

[0014] Note that the configuration illustrated in FIG. 1 is an example, and the number of the PLCs connected to the system construction support apparatus 12 via the first network 15, the number of pieces of the equipment 14 connected to each PLC, and number of the PLCs connected to each PLC are not limited to the example illustrated in FIG. 1. Moreover, although FIG. 1 illustrates a state in which no equipment is connected to the PLC 17, the equipment 14 can also be connected to the PLC 17.

[0015] The PLCs 13 and 17 are PLCs described in Japanese Industrial Standards (JIS) B 3502:2011, and control the equipment 14 by operating in accordance with a control program described in a ladder language, for example. The control program is stored in a storage device (not illustrated) in each of the PLCs 13 and 17. The PLCs 13 and 17 each have a communication function. In the example of the configuration illustrated in FIG. 1, the PLC 13 has a function of performing communication via the first network 15 and a function of performing communication via the second network 16. Also, the PLC 17 has at least a function of performing communication via the second network 16. The PLC 17 may have a function of performing communication via the first network 15.

[0016] The supervisory control apparatus 11 and the system construction support apparatus 12 are each implemented by a computer such as a personal computer. The supervisory control apparatus 11 performs supervisory control that is also generally called SCADA. Specifically, the supervisory control apparatus 11 collects data for monitoring the equipment 14 via the PLCs 13 and 17, and

controls the equipment 14 via the PLCs 13 and 17. The supervisory control apparatus 11 can also display at least one of a screen for monitoring the equipment 14 and a screen for controlling the equipment 14.

[0017] The system construction support apparatus 12 is an information processing apparatus according to the present invention, and is an apparatus that supports the overall design of the supervisory control system. The overall design includes control design and screen design. The control design is the design related to the operations of the PLCs 13 and 17, and the screen design is the design related to the supervisory control apparatus 11. The control design includes creation of the control program that is executed by the PLCs 13 and 17 to monitor and control the equipment 14 via the PLCs 13 and 17. The screen design includes the design of a screen displayed on the supervisory control apparatus 11.

[0018] FIG. 2 is a block diagram illustrating an example of a hardware configuration of the system construction support apparatus 12. The system construction support apparatus 12 includes a display device 21, an input device 22, a central processor 23, a storage device 24, and a communication device 27. The storage device 24 includes a non-volatile storage 25 and a volatile storage 26. The non-volatile storage 25 stores a program and setting data for implementing functions as the system construction support apparatus of the present embodiment. The operation as the system construction support apparatus 12 of the present embodiment is implemented when the central processor 23 executes the program stored in the non-volatile storage 25. The volatile storage 26 is appropriately used as a work memory at the time of execution of the central processor 23.

[0019] The display device 21 is, for example, a monitor or a display, and the input device 22 is a keyboard, a mouse, or the like. The display device 21 for example performs screen display implemented by the function of the system construction support apparatus 12, the screen display including display of a screen indicating an equipment list described later. The input device 22 accepts an input of information from a user. The display device 21 and the input device 22 may be integrated and implemented by a touch panel or the like. The central processor 23 is a processor such as a central processing unit (CPU). The storage device 24 is a memory. The non-volatile storage 25 is a magnetic disk, a semiconductor memory, or the like. The volatile storage 26 is a dynamic random access memory (DRAM), a static random access memory (SRAM), or the like. The communication device 27 is a receiver and a transmitter. The communication device 27 carries out communication with the PLC 13. Each unit illustrated in FIG. 2 is hardware for implementing each functional unit of the system construction support apparatus 12 described later, and the correspondence between each unit illustrated in FIG. 2 and each functional unit of the system construction support apparatus 12 will be described later.

[0020] The hardware configuration of the supervisory control apparatus 11 is similar to the hardware configuration of the system construction support apparatus 12. The supervisory control apparatus 11 is implemented when the central processor 23 executes the program stored in the non-volatile storage 25 for implementing the function of the supervisory control apparatus 11.

[0021] Note that although FIG. 1 illustrates an example in which the supervisory control apparatus 11 and the

system construction support apparatus 12 are implemented by separate computers, the supervisory control apparatus 11 and the system construction support apparatus 12 may be mounted on one computer.

[0022] Next, the system construction support apparatus 12 will be described in detail. As illustrated in FIG. 1, the system construction support apparatus 12 includes an input data generation module 30 and a system construction support module 70. The input data generation module 30 is a functional component used when the supervisory control system is constructed by diverting an existing control system. As described later, the input data generation module 30 creates an equipment list using a control program of an existing control system, and outputs the equipment list to the system construction support module 70. As a result, a user does not need to set an equipment list in the system construction support module 70, and the number of man-hours for constructing the supervisory control system is reduced.

[0023] The system construction support module 70 is a functional component that supports the design for constructing the supervisory control system. The system construction support module 70 creates at least one of a program and data used in the supervisory control system in which equipment controlled by a PLC is subject to supervisory control. The system construction support module 70 uses the equipment list, which indicates the equipment to be monitored in the supervisory control system and the like, when starting the overall design for performing supervisory control on the system to be monitored. The operation and configuration of the system construction support module 70 are not restricted in particular, and thus the operation and configuration of a

typical system construction tool that generates the control program used to control equipment in the supervisory control system can be applied, the operation and configuration of the typical system construction tool being, for example, the operation and configuration of the system construction tool described in Patent Literature 1. The input data generation module 30 and the system construction support module 70 together can be considered as a design support module in a broad sense. That is, the input data generation module 30 may be mounted as a part of the system construction support module 70.

[0024] FIG. 3 is a diagram illustrating an example of a functional configuration of the input data generation module 30. As illustrated in FIG. 3, the input data generation module 30 includes an equipment list display unit 31, a setting information input unit 32, a transmission unit 33, a reception unit 34, a data management unit 35, a data analysis unit 36, an equipment list creation unit 37, and an equipment list output unit 38. The equipment list display unit 31 is implemented by the central processor 23, the display device 21, and the input device 22 illustrated in FIG. 2, and the setting information input unit 32 is implemented by the central processor 23 and the input device 22 illustrated in FIG. 2. The data management unit 35, the data analysis unit 36, the equipment list creation unit 37, and the equipment list output unit 38 are implemented by the central processor 23 and the storage device 24 illustrated in FIG. 2. The transmission unit 33 and the reception unit 34 are implemented by the central processor 23 and the communication device 27 illustrated in FIG. 2.

[0025] The program for implementing the input data generation module 30 and the program for implementing the

system construction support module 70 are both system construction support programs used to support system construction. The program for implementing the input data generation module 30 and the program for implementing the system construction support module 70 may be provided as one package or may be provided as individual packages.

[0026] The program for implementing the input data generation module 30 is the system construction support program that causes a computer to execute an equipment list creation step and an output step. In the equipment list creation step, the input data generation module 30 creates an equipment list as information specifying equipment subject to supervisory control, on the basis of PLC data acquired from a PLC included in an existing system. Details of the PLC data will be described later. In the output step, the input data generation module 30 outputs the equipment list to the system construction support module 70 that creates, on the basis of the equipment list, at least one of a program and data used in the supervisory control system in which equipment controlled by a control device is subject to supervisory control.

[0027] The setting information input unit 32 receives input of system information, which is information in the existing system, and gateway information from a user and passes the system information and gateway information received to the data management unit 35. The system information is information that identifies each system such as a system name of the existing system. The gateway information is information that defines a range to be searched in a PLC search described later, and is specifically information that identifies a gateway. The PLC search is performed for each gateway within the range of the gateway specified by the gateway information.

Details of the PLC search will be described later. The transmission unit 33 transmits request data for requesting a response to each PLC. The reception unit 34 receives response data transmitted from each PLC in response to the request data, and passes the response data to the data management unit 35. The data management unit 35 manages management data described later. Specifically, the data management unit 35 holds the management data and updates the management data on the basis of data received from each unit. The data management unit 35 also passes data received from each functional unit to another functional unit that uses the data.

[0028] The data analysis unit 36 extracts PLC information, which is control information used to create the equipment list, from the PLC data received from the data management unit 35, and passes the PLC information to the equipment list creation unit 37. The PLC information is information acquired from the PLC included in the existing system, and is information used to create the equipment list. The equipment list creation unit 37 creates the equipment list, which is the information specifying equipment subject to supervisory control, on the basis of the PLC information. The equipment list creation unit 37 passes the equipment list created to the data management unit 35. The equipment list output unit 38 is an output unit that receives the equipment list from the data management unit 35 and passes the equipment list to the system construction support module 70. The equipment list display unit 31 receives the equipment list from the data management unit 35, and displays a screen including the equipment list on the display device 21. The equipment list display unit 31 also accepts designation of equipment to be deleted from the equipment list displayed via the

input device 22, and notifies the data management unit 35 of the information accepted. That is, the equipment list display unit 31 can display the equipment list and accept the input designating equipment to be excluded from the monitoring target in the equipment list.

[0029] FIG. 4 is a diagram illustrating an example of a configuration of the management data managed by the data management unit 35. As illustrated in FIG. 4, management data 40 includes system information 41, gateway information 42, detailed equipment data 43, and an equipment list 44. The system information 41 and the gateway information 42 are input by a user as described above. The equipment list 44 is created by the equipment list creation unit 37 as described above.

[0030] The detailed equipment data 43 indicates details of each component in the supervisory control system of the present embodiment. The detailed equipment data 43 is created on the basis of the PLC information acquired from each PLC by the system construction support apparatus 12, as described later. FIG. 5 is a table illustrating an example of a configuration of the detailed equipment data 43. In the example illustrated in FIG. 5, the detailed equipment data 43 includes a PLC IP address 51, a PLC network connection mode 52, a station number (PLC station number) 53, an operating state (PLC operating state) 54, a plant 55, a cell 56, a unit 57, and an equipment 58.

[0031] The PLC network connection mode 52 includes information indicating to which network the PLC is connected. For example, the PLC 13 illustrated in FIG. 1 is connected to the first network and the second network, whereby the PLC network connection mode 52 corresponding to the PLC 13 includes information indicating that the PLC is connected to the first network and the second network.

[0032] The PLC operating state 54 is information indicating whether or not the PLC is in operation. The plant 55 is identification information of a system to which the PLC belongs. As described above, the system refers to a unit such as a plant or factory and, in the present embodiment, indicates a unit in the highest hierarchy when targets of supervisory control are classified. The cell 56 is identification information indicating an area within each system. One system includes one or more areas. The area is a unit in the second highest hierarchy when targets of supervisory control are classified in the present embodiment. The unit 57 is identification information of a PLC unit, specifically identification information of the PLC. One area includes one or more PLC units. The PLC unit is a unit in the third highest hierarchy when targets of supervisory control are classified in the present embodiment. The equipment 58 is identification information of equipment connected to the PLC. One or more pieces of equipment can be connected to each PLC. Note that the supervisory control system may include a PLC to which no equipment is connected. The equipment is a unit in the lowest hierarchy when targets of supervisory control are classified in the present embodiment.

[0033] Note that the equipment is the unit in the lowest hierarchy when targets of supervisory control are classified in the example described herein. However, it is possible to subdivide each equipment depending on the function of the equipment or the like, and define a unit in a layer lower than the layer of the equipment unit so that the unit is included in the detailed equipment data 43. For example, an attribute of the equipment may be included in the equipment list. Moreover, when one system is subject to supervisory control, the detailed equipment data

43 need not include the plant 55. Thus, the number of hierarchies in the detailed equipment data 43 need only be set in accordance with the configuration and preconditions of each system, and is not limited to the above example. Moreover, the items of information included in the detailed equipment data 43 need only be set in accordance with the configuration and preconditions of each system, and is not limited to the above example.

[0034] As described above, the plant 55, the cell 56, the unit 57, and the equipment 58 are the information having a hierarchical structure. In the following description, one row of the detailed equipment data 43 corresponds to one equipment, but one row of the detailed equipment data 43 may correspond to one PLC. In the case where one row of the detailed equipment data 43 corresponds to one PLC, and a plurality of pieces of equipment is connected to a PLC, the equipment 58 stores a plurality of pieces of identification information corresponding to the plurality of pieces of equipment.

[0035] FIG. 6 is a table illustrating an example of a configuration of the equipment list 44 in the present embodiment. The equipment list 44 is obtained by extracting information on predetermined items from the detailed equipment data 43, as described later. Specifically, as illustrated in FIG. 6, the equipment list 44 includes the plant 55, the cell 56, the unit 57, and the equipment 58. Note that the information items and the number of hierarchies included in the equipment list 44 are not limited to the example illustrated in FIG. 6, and items necessary as the equipment list for constructing the overall design of the supervisory control system, that is, the equipment list input to the system construction support module 70, need only be included.

[0036] The operation of the present embodiment will now be described. FIG. 7 is a flowchart illustrating an example of a processing procedure of the input data generation module 30 in the present embodiment. As illustrated in FIG. 7, the setting information input unit 32 of the input data generation module 30 of the present embodiment receives input of system information and network information (step S1). A user inputs system information of an existing system to be diverted and network information that is information indicating a PLC search range. Note that in the present embodiment, the PLC search range is specified with a gateway device as a unit. Accordingly, in the present embodiment, the network information is specifically a gateway address that is an IP address of the gateway device. The user inputs one or more gateway addresses corresponding to the PLC search range for the entire system or for a unit of area. When the gateway address is input for the unit of area, an equipment list related to the area is generated in the generation of an equipment list described later.

[0037] Upon receiving the input of the system information and the network information, the setting information input unit 32 passes the system information and gateway address received to the data management unit 35. The data management unit 35 stores the system information and gateway address received as the system information 41 and the gateway information 42 of the management data 40.

[0038] Next, the input data generation module 30 searches for a PLC in the system (step S2). Specifically, the data management unit 35 instructs the transmission unit 33 to search for a PLC. At this time, the data management unit 35 instructs the transmission unit 33 to use, as the PLC search range, the gateway address stored as the gateway

information 42. The transmission unit 33 searches for a PLC on the basis of the instruction. Details of the PLC search processing will be described later.

[0039] Next, the input data generation module 30 requests each PLC to transmit PLC data (step S3). The PLC data is data that can be acquired from the PLC and includes a control program held by each PLC. Details of the PLC data will be described later.

[0040] The input data generation module 30 extracts parameters from the PLC data that is received from the PLC (step S4). The parameters extracted are parameters necessary for creating the detailed equipment data 43 and are, for example, the information on the items illustrated in FIG. 5. The input data generation module 30 passes the parameters extracted from the PLC data to the data management unit 35, and the data management unit 35 stores the data received from the input data generation module 30 in the detailed equipment data 43.

[0041] Next, the input data generation module 30 creates an equipment list (step S5). Specifically, the equipment list creation unit 37 creates the equipment list according to an instruction from the data management unit 35. Details of the processing from step S3 to step S5 will be described later.

[0042] Next, the input data generation module 30 displays the equipment list 44 on a screen (step S6). Specifically, the data management unit 35 passes the equipment list 44 in the management data 40 to the equipment list display unit 31, and the equipment list display unit 31 causes the display device 21 to display a screen including the equipment list 44. The screen displayed in step S6 displays the equipment list 44 illustrated in FIG. 6, and also displays an input field for

accepting exclusion of each equipment in the equipment list 44. At this time, the screen may display the system information together with the equipment list 44. When equipment to be deleted, that is, equipment to be excluded from the monitoring target, is designated on the basis of a result input in the input field, equipment list display unit 31 notifies the data management unit 35 of information indicating the equipment designated, that is, information indicating the equipment to be deleted. The data management unit 35 deletes data of the corresponding equipment from the equipment list 44 on the basis of the information indicating the equipment to be deleted from the equipment list display unit 31.

[0043] FIG. 8 is a diagram illustrating an example of a display screen for accepting exclusion of equipment. A display screen 80 illustrated in FIG. 8 is an example of the screen displayed in step S6. The display screen 80 includes an area 81 in which the equipment list 44 is displayed, and an input area 82 for selecting equipment to be deleted. As illustrated in FIG. 8, check boxes are displayed in the input area 82 corresponding to the rows of the equipment list 44 displayed in the area 81. A user selects equipment to be deleted by checking the check box. Note that the display screen illustrated in FIG. 8 is an example, and the method of accepting the input designating equipment to be deleted is not limited to the example using the check box, but may be any method such as a method in which corresponding information is selected by double-clicking the information with a mouse. The equipment list display unit 31 may also be able to accept at least one of changing the order of items displayed as the equipment list and deleting the items.

[0044] Returning to the description of FIG. 7, next, the

input data generation module 30 exports the equipment list (step S7), and ends the processing. Specifically, the data management unit 35 passes the equipment list 44 to the equipment list output unit 38, and the equipment list output unit 38 passes the equipment list 44 to the system construction support module 70. At this time, when the format of input data of the system construction support module 70 is different from the format of the equipment list passed from the equipment list output unit 38, the data management unit 35 converts the equipment list 44 into a format that can be read by the system construction support module 70, and passes the data after conversion to the system construction support module 70.

[0045] Through the above processing, the equipment list input to the system construction support module 70 can be created using the control program that is created in the existing system. As a result, a user can define the monitoring target simply by selecting equipment to be deleted from the equipment list displayed, whereby the number of man-hours for the overall design of the supervisory control system diverting the existing system can be reduced. Note that the equipment list may be input to the system construction support module 70 without performing the processing of selecting equipment to be deleted from the equipment list.

[0046] Next, details of the PLC search processing will be described. FIG. 9 is a flowchart illustrating an example of a processing procedure of the PLC search in step S2 illustrated in FIG. 7. As illustrated in FIG. 9, the transmission unit 33 searches for a device connected to the first network within the gateway range corresponding to the gateway address instructed by the data management unit 35 (step S11). Specifically, for example, the transmission

unit 33 may search for a device connected to the first network by broadcasting data that requires a response within a subnet corresponding to the gateway address, and extracting an IP address included in a response received from each device. Alternatively, the transmission unit 33 may acquire an IP address of a device within a range managed by the corresponding gateway device from the gateway device.

[0047] Next, the transmission unit 33 determines whether or not one or more PLCs are included among the devices found in step S11, that is, whether or not a PLC has been found (step S12). In step S12, specifically, the transmission unit 33 transmits a PLC-specific command to the device found in step S11, and determines whether or not the device found in step S11 is a PLC on the basis of whether or not a response has been received.

[0048] If no PLC has been found (No in step S12), the transmission unit 33 ends the PLC search processing. If a PLC has been found (Yes in step S12), the transmission unit 33 adds information on the PLC found to a PLC list (step S13). The PLC list is information indicating the PLC found by the search, and in this case assumed to be information indicating the IP address or station number of the PLC found. Therefore, in step S13, the IP address of the PLC found is added to the PLC list.

[0049] The transmission unit 33 checks whether the PLC found is connected to the second network (step S14). Specifically, the transmission unit 33 requests the PLC to acquire information indicating a connection mode. The transmission unit 33 can know whether the PLC is connected to the second network by receiving the connection mode from the PLC. If the PLC found is not connected to the second network (No in step S15), the transmission unit 33 excludes

the PLC already found from the search target and re-executes the processing from step S11.

[0050] If the PLC found is connected to the second network (Yes in step S15), the transmission unit 33 searches for the PLC connected to the second network (step S16). In step S16, specifically, the transmission unit 33 transmits data requesting a response to the device connected to the second network, and acquires the station number used in the second network from each device. The transmission unit 33 transmits a PLC-specific command to the station number of the device found, and determines whether or not the device is the PLC on the basis of whether or not a response has been made. Specifically, for example, the transmission unit 33 transmits a communication start command based on a protocol conforming to PLCs toward the device, and determines whether or not it is the PLC on the basis of a result of a response to the command.

[0051] If no PLC has been found by the search in step S16 (No in step S17), the transmission unit 33 excludes the PLC already found in step S12 from the search target and re-executes the processing from step S11.

[0052] If the PLC has been found by the search in step S16 (Yes in step S17), the transmission unit 33 adds information on the PLC found to the PLC list (step S18). In step S18, for example, the station number used in the second network is added to the PLC list. After step S18, the transmission unit 33 excludes the PLC already found in step S17 from the search target, and re-executes the processing from step S16.

[0053] FIG. 10 is a diagram illustrating an example of a configuration of the PLC data. PLC data 60 includes information about a program acquired from a PLC and setting information of the PLC. In the example illustrated in FIG.

10, the PLC data 60 includes a program block 61 that is the information about a program, and an IP address 65, a connection mode 66, and a station number 67 that are the setting information of the PLC. The program block 61 is configuration data of the program and includes a local label 62, a program body 63, and a function block 64. When a control program describing the overall operation of the PLC includes a combination of multiple programs, the program block 61 corresponds each of the programs that constitutes the program for the overall operation. The local label 62 is label information used in the program block 61 and is identification information associated with the program. The program body 63 is each control program itself held in the PLC. The function block 64 is a component of the program in the PLC and includes a function block corresponding to each equipment controlled by the PLC. The connection mode 66 is information indicating which of the first network and the second network the PLC is connected to. The IP address 65, the connection mode 66, and the station number 67 may be acquired in step S2 illustrated in FIG. 7 or may be acquired in step S3 illustrated in FIG. 7. When the IP address 65, the connection mode 66, and the station number 67 are acquired in step S2 illustrated in FIG. 7, the transmission unit 33 acquires these pieces of information by the processing of steps S12 and S14 illustrated in FIG. 9 and notifies the data management unit 35 of these pieces of information.

[0054] FIG. 11 is a flowchart illustrating an example of a processing procedure for the processing of creating the detailed equipment data. The processing of creating the detailed equipment data corresponds to the processing of steps S3 and S4 illustrated in FIG. 7. The data analysis unit 36 acquires system information from the data

management unit 35 (step S21). At this time, the data analysis unit 36 also acquires "N_i" and "N_j" from the data management unit 35. The character "N_i" denotes the number of gateway addresses input in step S1, and the character "N_j" denotes the number of PLCs found for each gateway device. The data analysis unit 36 sets an initial value of a counter "i" indicating a gateway address number to 1, and starts a loop that increments the counter by one up to $i=N_i$. This loop is called a loop of "i". In the loop of "i", steps S22 to S27 are executed in each loop.

[0055] In the loop of "i", first, the data analysis unit 36 acquires an i-th gateway address from the data management unit 35 (step S22), and the data analysis unit 36 sets an initial value of a counter "j" indicating a PLC number to 1, thereby starting a loop that increments the counter by one up to $j=N_j$. This loop is called a loop of "j". In the loop of "j", steps S23 to S27 are executed in each loop.

[0056] In the loop of "j", the data analysis unit 36 acquires the IP address, the connection mode, the station number, and the operating state of a j-th PLC (step S23). Note that the data analysis unit 36 need not acquire the operating state in the present embodiment. The data analysis unit 36 acquires the IP address, the connection mode, the station number, and the operating state acquired in step S23 as described above from the data management unit 35, for example.

[0057] Next, the data analysis unit 36 acquires a PLC program from the data management unit 35 (step S24). The PLC program is a control program implemented in a PLC and includes the program block 61, the local label 62, and the program body 63 described above. Specifically, in step S24, according to an instruction from the data management unit

35, the transmission unit 33 acquires the PLC program from each PLC stored in the PLC list and passes the PLC program to the data management unit 35. The data analysis unit 36 acquires the PLC program for the j-th PLC from the data management unit 35.

[0058] Next, the data analysis unit 36 obtains the number of pieces of equipment "N_k" connected to the j-th PLC by analyzing the PLC program, sets an initial value of a counter "k" indicating an equipment number to 1, and starts a loop that increments the counter by one up to $k=N_k$. This loop is called a loop of "k". In the loop of "k", the processings of steps S25 to S27 are executed in each loop.

[0059] The data analysis unit 36 acquires a function block of k-th equipment (step S25). Specifically, in step S25, according to an instruction from the data management unit 35, the transmission unit 33 acquires the function block from each PLC stored in the PLC list and passes the function block to the data management unit 35. At this time, the transmission unit 33 may acquire the function blocks of all equipment controlled by the PLC at once, or may acquire the function block for each equipment. The data analysis unit 36 acquires the function block of the k-th equipment from the function blocks of all the equipment controlled by the PLC that are stored in each PLC. The function block is a component of the program in the PLC, and the component corresponds to each equipment. A function block name included in the function block corresponding to each equipment corresponds to identification information that identifies the equipment. Therefore, the data analysis unit 36 can know the equipment controlled by the PLC by referring to the function block name included in the function block acquired from each PLC. The data analysis unit 36 can thus generate the detailed

equipment data as described later on the basis of the function block.

[0060] The data analysis unit 36 sets, as the detailed equipment data of the k-th equipment, the system information to the plant, the gateway address to the cell, the PLC program name to the unit, and the function block name to the equipment (step S26). Note that the PLC program name is stored in, for example, the program body of the PLC program described above. Also, the function block name is stored in the function block corresponding to each equipment. Steps S26 and S27 correspond to the extraction of parameters from the PLC data in step S4 of FIG. 7.

[0061] The data analysis unit 36 sets, as the detailed equipment data of the k-th equipment, the IP address, the connection mode, the station number, and the operating state acquired in step S23 (step S27). The data analysis unit 36 ends the processing when the loops of “i”, “j”, and “k” end. The data analysis unit 36 notifies the data management unit 35 of the detailed equipment data set in steps S26 and S27 upon setting each piece of data. Alternatively, the data analysis unit 36 may hold the detailed equipment data of each equipment until all the loops end, and then notify the data management unit 35 of the data collectively. The data management unit 35 updates the detailed equipment data 43 in the management data 40 on the basis of the detailed equipment data notified.

[0062] FIG. 12 is a flowchart illustrating an example of a processing procedure for the processing of creating the equipment list. The processing illustrated in FIG. 12 corresponds to step S5 in FIG. 7. The equipment list creation unit 37 first creates a blank equipment list (step S31). Next, the equipment list creation unit 37 acquires the detailed equipment data 43 from the data management

unit 35 (step S32). The equipment list creation unit 37 obtains the number of pieces of equipment N_m stored in the detailed equipment data 43 on the basis of the detailed equipment data 43, sets an initial value of a counter "m" indicating an equipment number to 1, and starts a loop that increments the counter by one up to $m=N_m$. In each loop of the loop of "m", steps S33 and S34 are performed.

[0063] The equipment list creation unit 37 extracts the plant, the cell, the unit, and the equipment for m-th equipment from the elements of the detailed equipment data 43 (step S33). The equipment list creation unit 37 adds the element including the plant, the cell, the unit, and the equipment as an equipment list to the equipment list (step S34). When the loop of "m" ends, the equipment list creation unit 37 passes the equipment list created to the data management unit 35.

[0064] FIG. 13 is a diagram illustrating an example of a configuration of an existing system and an example of the equipment list generated. In the example illustrated in FIG. 13, the existing system includes PLCs 1, 1-1, 2, 3, 3-1, and 3-2. The left diagram of FIG. 13 represents an example of a system configuration of the existing system, and the right diagram of FIG. 13 illustrates an example of the equipment list created from the example of the system configuration illustrated in the left diagram of FIG. 13. In FIG. 13, pieces of equipment controlled by the PLCs 1-1, 2, 3-1, and 3-2 are denoted as "Equip 1-1", "Equip 2-1", "Equip 3-1", and "Equip 3-2", respectively. In the right diagram of FIG. 13, the plant, the cell, the unit, and the equipment are represented in a list format as the equipment list. A first row in the right diagram of FIG. 13 indicates that the identification information of the system is "System 1", the PLC 1 is connected in an area with the

gateway address of “10.**.**.**”, and equipment to be controlled is not connected to the PLC 1. A second row in the right diagram of FIG. 13 indicates that the identification information of the system is “System 1”, the PLC 1-1 is connected in an area with the gateway address of “10.**.**.**”, and “Equip 1-1” as equipment to be controlled is connected to the PLC 1-1. In the example illustrated in FIG. 13, the number of pieces of equipment to be controlled by each PLC is none or one, but when one PLC controls a plurality of pieces of equipment, a row is generated in the equipment list for each equipment. For example, when three pieces of equipment being “Equip 3-2”, “Equip 3-3”, and “Equip 3-4” are connected to the PLC 3-2, two rows are added to the example illustrated in FIG. 13, the two rows including the same information as that in the last row of FIG. 13 regarding the plant, the cell, and the unit and each including corresponding one of “Equip 3-3” and “Equip 3-4” as the equipment.

[0065] As described above, in the present embodiment, the input data generation module 30 searches for the PLC, acquires information about the PLC from the PLC found, and generates the equipment list. The equipment list can be used as definition information of a monitoring target in the processing for system construction in the system construction support module 70. A user can define the monitoring target simply by selecting equipment to be deleted from the equipment list displayed, whereby the number of man-hours for the overall design of the supervisory control system diverting the existing system can be reduced. Moreover, the input data generation module 30 is configured such that the user can select the equipment to be deleted, thereby being able to adapt to a case where the equipment list generated from the PLC data

is not used as it is, and some pieces of equipment are not included in the monitoring target. Note that in the present embodiment, the system construction support module 70 and the input data generation module 30 are implemented by one apparatus, but the system construction support apparatus in which the system construction support module 70 is mounted and the information processing apparatus in which the input data generation module 30 is mounted may be separate apparatuses.

[0066] Second Embodiment.

Next, the input data generation module 30 according to an embodiment of the present invention will be described. The configuration of each apparatus of the present embodiment is similar to that of the first embodiment. Differences from the first embodiment will mainly be described below.

[0067] FIG. 14 is a flowchart illustrating an example of a processing procedure including update of an operating state in the input data generation module 30 according to the present embodiment. In the present embodiment, the processing illustrated in FIG. 14 is executed once an equipment list has been generated. As illustrated in FIG. 14, the data management unit 35 of the input data generation module 30 acquires the detailed equipment data 43 as in the first embodiment (step S41). The data management unit 35 obtains the number of pieces of equipment N_m stored in the detailed equipment data 43 on the basis of the detailed equipment data 43, sets the initial value of the counter "m" indicating the equipment number to 1, and starts a loop that increments the counter by one up to $m=N_m$. In each loop of the loop of "m", the processings of steps S42 to S44 are performed.

[0068] The data management unit 35 requests the PLC

corresponding to the m-th equipment to transmit the PLC data via the transmission unit 33 (step S42). If no response has been made from the PLC (No in step S43), the operating state of the PLC in the detailed equipment data corresponding to the m-th equipment is set to an inactive state (step S44). If a response has been made from the PLC (Yes in step S43), "m" is updated without executing step S44, and the processing returns to step S42.

[0069] Once the loop of "m" ends, the equipment list creation unit 37 creates an equipment list as in the first embodiment on the basis of the detailed equipment data 43 (step S45). Note that in the present embodiment, the equipment list also includes information indicating the operating state of the PLC. The equipment list creation unit 37 passes the equipment list created to the data management unit 35, and the data management unit 35 instructs the equipment list display unit 31 to display the equipment list. The equipment list display unit 31 displays a screen including the equipment list as in the first embodiment (step S46). At this time, as in the first embodiment, an input field for accepting designation of equipment to be excluded is also displayed on the screen.

[0070] The equipment list display unit 31 determines whether or not a user has excluded an element from the list, that is, whether or not equipment to be deleted from the equipment list has been designated (step S47), and if the user has excluded an element from the list (Yes in step S47), the equipment list display unit 31 instructs the data management unit 35 about the equipment to be excluded as list exclusion information. The data management unit 35 regenerates an equipment list on the basis of the instruction, that is, on the basis of the list exclusion information of the element (step S48). In other words, the

data management unit 35 updates the equipment list on the basis of the operating state of the PLC after the equipment list is created. As with the first embodiment, the equipment list output unit 38 outputs the equipment list to the system construction support module 70 (step S49), and the processing is ended. If "No" in step S47, step S49 is executed without executing step S48.

[0071] When a change is made in the system such as when the PLC enters an inactive state after the equipment list is created, the operation of the present embodiment enables a user to specify whether or not to exclude the PLC in the inactive state from the equipment list. Moreover, when the equipment list is displayed, the equipment corresponding to the PLC in the inactive state may be highlighted or the like so that the PLC in the inactive state is easily identified by the user.

[0072] As described above, in the present embodiment, the equipment list includes the operating state of the PLC. As a result, the effect similar to that of the first embodiment can be obtained, and when a PLC enters an inactive state due to a change in the system configuration or the like after the equipment list is created, a user can select whether or not to exclude corresponding equipment from the equipment list.

[0073] The configuration illustrated in the above embodiment merely illustrates an example of the content of the present invention, and can thus be combined with another known technique or partially omitted and/or modified without departing from the scope of the present invention.

Reference Signs List

[0074] 11 supervisory control apparatus; 12 system

construction support apparatus; 13, 17 PLC; 14 equipment; 15 first network; 16 second network; 21 display device; 22 input device; 23 central processor; 24 storage device; 25 non-volatile storage; 26 volatile storage; 27 communication device; 30 input data generation module; 31 equipment list display unit; 32 setting information input unit; 33 transmission unit; 34 reception unit; 35 data management unit; 36 data analysis unit; 37 equipment list creation unit; 38 equipment list output unit; 70 system construction support module.

CLAIMS

1. An information processing apparatus comprising:

an equipment list creation unit to create an equipment list that is information specifying equipment subject to supervisory control, on a basis of control information acquired from a control device included in an existing system,

an equipment list display unit to display the equipment list and be able to accept an input designating equipment to be excluded from a monitoring target in the equipment list; and

a data management unit to update the equipment list on a basis of the equipment to be excluded, wherein

the equipment list includes information indicating an operating state of the control device, and

the data management unit updates the equipment list on a basis of the operating state of the control device after the equipment list is created.

2. An information processing apparatus comprising:

an equipment list creation unit to create an equipment list that is information specifying equipment subject to supervisory control, on a basis of control information acquired from a control device included in an existing system, wherein

the control information includes a function block corresponding to each equipment, the function block storing a function block name corresponding to the equipment, and

the equipment list creation unit extracts the function block name from the control information, and sets the function block name extracted as identification information of the equipment in the equipment list.

3. The information processing apparatus according to claim 2, further comprising:

an equipment list display unit to display the equipment list and be able to accept an input designating equipment to be excluded from a monitoring target in the equipment list; and

a data management unit to update the equipment list on a basis of the equipment to be excluded.

4. The information processing apparatus according to claim 3, wherein the equipment list display unit is also able to accept at least one of a change in the order of an item displayed as the equipment list, and deletion of the item.

5. The information processing apparatus according to claim 3 or 4, wherein

the equipment list includes information indicating an operating state of the control device, and

the data management unit updates the equipment list on a basis of the operating state of the control device after the equipment list is created.

6. The information processing apparatus according to claim 1 or 5, wherein the equipment list display unit highlights, in the equipment list, an area corresponding to the control device for which the information indicating the operating state indicates an inactive state.

7. The information processing apparatus according to any one of claims 1 to 6, further comprising:

an output unit to output the equipment list to a system construction support module that creates, on a basis

of the equipment list, at least one of a program and data used in a supervisory control system in which equipment controlled by the control device is subject to supervisory control.

8. The information processing apparatus according to any one of claims 1 to 7, wherein

the control device is a programmable logic controller, and

the control information includes at least a part of a control program stored in the programmable logic controller.

9. A system construction support method, by an information processing apparatus, comprising:

an equipment list creation step of creating an equipment list that is information specifying equipment subject to supervisory control, on a basis of control information acquired from a control device included in an existing system, wherein

the control information includes a function block corresponding to each equipment, the function block storing a function block name corresponding to the equipment, and

in the equipment list creation step, the function block name is extracted from the control information, and the function block name extracted is set as identification information of the equipment in the equipment list.

10. A system construction support program that causes a computer to execute:

an equipment list creation step of creating an equipment list that is information specifying equipment subject to supervisory control, on a basis of control information acquired from a control device included in an

existing system, wherein

the control information includes a function block corresponding to each equipment, the function block storing a function block name corresponding to the equipment, and

in the equipment list creation step, the function block name is extracted from the control information, and the function block name extracted is set as identification information of the equipment in the equipment list.