

STATUS MANAGEMENT FOR PLANT ASSETS

FIELD OF INVENTION

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The invention relates to a system for asset management in a plant.

BACKGROUND OF THE INVENTION

10 ANSI/ISA-88 (S88) is a standard which is approved by the Instrumentation, Systems, and Automation Society (ISA), for batch control. According to S88, plant assets are organized as hierarchical structure of seven layers namely Plant, Site, Area, Process Cell, Unit, Equipment Module and Control Module as shown in Figure 1.

15 For example, a plant is a manufacturing facility having multiple sites and an area is a part of a site. A process cell can be a manufacturing line for a particular product or process; a unit is a machine used in the manufacturing line; an equipment module is a temperature controller for the machine and a control module is a valve for the temperature controller.

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As illustrated in Figure 2, a resource manager system manages the plant assets in three layers - a database layer 210, a logic layer 220 and a presentation layer 230. In the database layer 210, there is a database 212 having two types of information, static 214 and dynamic 216, for control modules 217.

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The static information 214 is stored in the database 212 during the registration of new control modules. Examples of static information for a control module include the location and inventory information.

30 The dynamic information of the field devices is stored in a Field Communication Server FCS 218. A data acquisition means 219 retrieves the dynamic information from the field devices for storing in the database 212. Examples of dynamic information include the process parameter, diagnosis result and status information.

The logic layer 220 has a status decision means 222. An example of the status decision means 222 is an alarm manager to determine an alarm status based on the dynamic information of the control modules. The status decision means 222 stores the determined alarm status as dynamic information in the database 212.

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In the presentation layer 230, a client 232 is a computer or program which displays the static and dynamic information on a Graphical User Interface GUI 234.

10 In a typical resource manager of the prior art, only the control module can be created as a device and the equipment modules as a folder for monitoring purposes on a GUI as illustrated in Figure 3. The control module can only be associated with the equipment module layer in the plant hierarchy. Only the devices can contain information. The other layers are folders and each folder cannot contain any information.

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Based on the above, the resource manager can only display the status of each device with colour according to the mechanism below:-

1. each device has its own information;
2. each device is displayed with a device area property such as colour; and
- 20 3. each device area property is rolled up to the top through the hierarchy.

When the resource manager determines the colour of a folder, the device status colours which belong to the devices in the folder are considered according to the predefined priority.

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In Figure 3, related Control Modules, DY-FF01 and DY-FF02, are in the folder EMODULE, which is for an equipment module of the control modules. The diagnostic results of the control modules are displayed on the right side panel and the statuses are represented by the colours Red and Green respectively in the device areas 301
30 302. Assuming that the priority is in the order of importance – Red, Grey and Green, the status colour of the folder EMODULE is RED. Accordingly, the status colour is rolled up to its parent hierarchy towards the top folder so that a user can identify the error without expanding all the folders. In a typical plant, a resource manager can have up to 1000 devices under 500 folders.

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When multiple control modules are linked to an equipment module, it is logical to manage the equipment module as a device. However, as discussed above, on a GUI, an equipment module is represented by a folder which cannot contain any information. Since the folder cannot contain any information, a predefined derivative
5 of the equipment module is not stored and cannot be displayed on the GUI.

A heat exchanger is an example of such an equipment module. A heat exchanger has many control modules such as sensors and actuators for monitoring and controlling purposes. The heat exchanger has its own information, which is a
10 predefined derivative or self-diagnosis of its sensors and actuators. There is a likely event that all of its sensors and actuators may be within the specifications, but the derivative or self-diagnosis shows that the heat exchanger is not working properly.

Since the folder for the heat exchanger cannot contain information, the predefined
15 derivative or self-diagnosis is not stored. The status of the heat exchanger is displayed as working within specifications. There is a need to provide a system and method to display the predefined derivative or self-diagnosis of the heat exchanger.

20 SUMMARY OF THE INVENTION

The invention is a system for monitoring an entity having a group of related devices, each device having its own information, and the entity having information which is a predefined derivative of the information of each device. The system has a virtual
25 device, device areas which represent the devices and the entity, and a device area property for each device area. The device area property of the entity is derived from the device area property of all the devices.

BRIEF DESCRIPTION OF THE DRAWINGS

30 Figure 1 illustrates a model of plant assets in a hierarchical structure according to S88.

Figure 2 illustrates a resource manager system in the prior art.

Figure 3 illustrates a Graphical User Interface in the prior art.

Figure 4 shows an image of visualized connection of the invention.

5 Figure 5 shows a Graphical User Interface display of the invention.

Figure 6 shows an embodiment of the method of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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According to an embodiment of the invention, Figure 4 illustrates an image of visualized connection of a system for monitoring an entity 401 comprising a group of related devices 402, 403. A virtual device 404 is created to contain the information of the entity. In an example of a plant, an entity is an Equipment Module and a device is a Control Module. Connection data of an entity 401 is stored in database 212 as static information 214.

15 Illustrated in Figure 5 is a Graphical User Interface (GUI) 500 of the system. On the GUI, for the entity, devices and virtual device, there are corresponding device areas 501, 502, 503, 504 having the respective device area properties 511, 512, 513 and 514. The device area property can be colour, pattern or icons. The device area property can be varied with the information. Taking as an example a case of a device area property which is colour, and the information is diagnostic, if the diagnostic information is "critical", the device area property is set to the colour RED. If the diagnostic information is "normal", the device area property is set to the colour GREEN.

20 The information of the entity, such as self-diagnosis information, is a predefined derivative of the devices. The self-diagnostic information is contained in the virtual device. Depending on the predefined derivation, there may be a case where all the devices are normal but the self-diagnostic information of the entity is "critical". In such a case, device area property 511 of the entity 501 is set to the "critical" colour RED.

The device area property of the entity is set to correspond to the most critical status in the devices 502, 503, 504. For example, if any of the devices has a "critical" device area property, the device area property 511 of the entity 501 is set to "critical". By using a virtual device 504 to contain the information of the entity, the information of the entity 501 is taken into consideration for updating the device area property of the entity. Hence, the status of the entity is better represented than in the prior art.

On a GUI, the entity and its related devices can be represented in a hierarchy by folders on a GUI with a folder representing the entity and its related devices are associated with the folder. In the present invention, the information of the entity is stored in the virtual device and not the folder. This allows for ease of viewing and managing an entity and its related devices. Advantageously, a hierarchical representation enables the monitoring of multiple entities and their related devices. Further this system can be advantageously applied to any stage of a plant management model.

The virtual device can be another entity having information which will affect the status of the present entity. Hence, users have the ability and flexibility to create virtual devices optionally and associate them to an upper folder in a hierarchical representation. This allows users to manage and diagnose other entities, assets or field devices if required.

In an example, an entity is a heat exchanger. The heat exchanger has many sensors and actuators for its control purpose. The heat exchanger is an entity represented by a folder and the sensors and actuators are the devices associated with the folder. Applying the present invention, the heat exchanger is further represented as a virtual device associated with the folder.

According to another embodiment of the invention, illustrated in Figure 6, the invention is a method for monitoring an entity having a group of related devices, in which each device has its own information. The entity has information which is a predefined derivative of the information for all the related device.

The method includes a Step 601 of defining a virtual device to represent an entity having the group of related devices. Step 602 defines device areas where each

device area represents each device, the virtual device and the entity. Step 603 defines a device area property for all the related devices and the entity. Step 604 sets the device area property of each device based on the information, and Step 605 determines the device area property of the entity based on the device area property
5 of the devices.

As the information of each device is changed, the device area property is updated accordingly. The information in the virtual device is determined and its device area property is updated. Accordingly, the device area property of the entity is updated.

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It is to be understood that the foregoing description of several preferred embodiments is intended to be purely illustrative of the principles of the invention, rather than exhaustive thereof, and that changes and variations will be apparent to those skilled in the art, and that the present invention is not intended to be limited other than
15 expressly set forth in the following claims.

What is claimed is:

1. A system for monitoring an entity having a plurality of related devices, each device having its own information and the entity having information which is a predefined derivative of the information of each said device, comprising:

- a. a virtual device to represent said entity;
- b. device areas, each device area representing:
 - i. each said device;
 - ii. said virtual device;
 - iii. said entity; and
- c. a device area property for each device area,

wherein the device area property of said entity is derived from said device area property of all said devices.

2. A system for monitoring an equipment module having a plurality of related control modules, each control module having its own information, the equipment module having information which is a predefined derivative of the information of each said control module, comprising:

- a. a virtual device;
- b. device areas, each device area representing:
 - i. each said control module;
 - ii. said virtual device;
 - iii. said equipment module; and
- c. a device area property for each device area,

wherein the device area property of said equipment module is derived from said device area property of all said control modules and said virtual device.

3. A system as claimed in claim 1 or 2 wherein said device area property varies with said information.

4. A system as claimed in claim 1 wherein said virtual device represents said entity.

5. A system as claimed in claim 2 wherein said virtual device represents said equipment module.

6. A system as claimed in claim 1 wherein said virtual device represents any one of a device, an entity or a system.

7. A system as claimed in claim 2 wherein said virtual device represents any one of an equipment module, a control module or a system.

8. A system as claimed in claim 1 or 2 wherein said information is a diagnosis result.

9. A system as claimed in claim 1 or 2 wherein said information is status information.

10. A system as claimed in claim 1 or 2 wherein said information is inventory information.

11. A method for monitoring an entity having a plurality of related devices, each device having its own information, the entity having information which is a predefined derivative of the information of each said devices, including the steps of :

- a. defining a virtual device to represent said entity;
- b. defining device areas, each device area representing:
 - i. each said device;
 - ii. said virtual device;
 - iii. said entity;
- c. defining a device area property for all devices and said entity;
- d. setting the device area property of each device based on the information; and
- e. determining the device area property of said entity based on the predefined priority of the device area property of said devices.

12. A method for monitoring an equipment module having a plurality of related control modules, each control module having its own information, the equipment module having information which is a predefined derivative of the information of each said control module, including the steps of :

- a. defining a virtual device to represent said equipment module;
- b. defining device areas, each device area representing:
 - i. said control module;
 - ii. said virtual device;

- iii. said equipment module;
 - c. defining a device area property for each said control module, said virtual device and said equipment module;
 - d. setting the device area property of each control module based on the
5 information; and
 - e. determining the device area property of said equipment module based on the predefined priority of the device area property of said control modules and said virtual device.
- 10 13. A method as claimed in claim 11 or 12, further including the step of updating said device area property of said according to changes in said information.