A RECIPE CONFIGURATION SYSTEM, A RECIPE CONFIGURATION METHOD AND COMPUTER PROGRAM

Field of invention

The disclosure of the invention relates to a recipe management system and method for use in an industrial plant, and a computer program.

Background

Recipe management provides functions to generate and edit master recipes. The functions categorize recipes into groups, generate, edit, save and load master recipes to process management. Process management provides functions to create control recipes based on specified master recipes.

A recipe prescribes the group of units, procedure, method to be used, and the parameter values to be set in order to produce a particular product. International Society of Automation (ISA) defines S88 to provide a consistent set of standards and terminology for batch control. S88.01 classifies recipe types into four hierarchical levels, for example, 1) general recipe, 2) site recipe, 3) master recipe and 4) control recipe which depends on the activities to be done at each time and the resources required. The disclosure perform the management of master recipes.

Recipe

Each master recipe 1 includes four parts described below and shown in Fig. 1:

(1) Header: Contains the basic information for recipe management, such as recipe name, comment, version and author;

(2) Procedure: Graphically defines the procedure to produce the product in the form of a sequential function chart (SFC);

(3) Formula: Parameter values such as control settings for producing the product; and

(4) Equipment Requirements: Defines the requirements of equipment for producing the product, such as a hardware component to be used.

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Procedure Types

Each procedure in a recipe is an ordered set of unit procedures, where each unit procedure is an ordered set of operations or steps.

(a) A recipe procedure defines an order of execution of unit procedures.

10 (b) A unit procedure defines a sequential procedure to be completed within a particular unit by specifying the order of execution of sequences called operations or steps in the form of the SFC. The particular unit is a hardware component such as a distillation column or reactor. The unit procedure has a set of functions to systematize process equipment modules and control modules for the particular unit.

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Common Block

A plurality of formulas or formula items is used to define a procedure and unit procedure. In an implementation to reuse the formulas for other operations, the formulas are stored as common block and common block items in a common block repository.

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A common block builder is an editor which is used to configure and edit the common blocks and common block items in the common block repository. The common blocks includes data extracted from multiple data sources or systems managing and controlling equipment units, or field devices related to the equipment units in an industrial plant.

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Fig. 2A is illustrative of an example of a common block builder 100. The common block builder 100 includes a detailed setting tab 110 to define properties as common block items 112 for each common block 114. A generic operations tab 120 is an editor to define common blocks 114 for generic operations 122. An operations tab 130 is another editor to define common blocks 114 for operations 132, such as field devices, referenced as Tag Name 134. A unit tab 140 is a still another editor to define the common blocks 114 for a unit 142 such as an equipment unit, referenced as Tag Name 144. A function block builder 150 is an editor to define generic operations 122 for each field device 142.

Fig. 2B is illustrative of an example of a formula editor 200 when common block and common block items from the common block repository are applied in a unit recipe 210. In the formula editor, propriety logic is applied to configure the unit recipe 210 using common block and common block items from the common block repository

In an existing recipe management system in Fig. 2B, a recipe procedure builder tool and a recipe builder tool are included to configure a procedure and a unit procedure.

A unit procedure is created in the recipe procedure builder tool, using the workflow illustrated in Fig. 3. First, in step S10, a user defines a new unit procedure by searching using a search key for a stencil suitable for the unit procedure operation. The suitable stencil is applied to a drawing canvas. The stencil is linked to a recipe database to retrieve a list of tag names for operations or steps. The tag names list is categorized according to source types, for example, generic or operation. In step S20, the user double-clicks the stencil to activate the category list in a dropdown format, selects a category and then the tag names are listed for the selected category source. In step S30, the user has to identify the correct source type of the desired tag name prior to selection.

In step S40, the user then uses a formula editor in the recipe builder tool to retrieve common blocks and common block items for the unit procedure operation based on the selected tag name. In step S50, in the formula editor, the user activates a function, for example a "Get Command Block Data" function, to retrieve common block items. The retrieved common block items are stored in a recipe database prior to being mapped to the unit procedure operation.

In step S60 the user switches back to the recipe procedure builder tool to create the next unit procedure operation when the function has been completed. This is inefficient for the user to switch between two tools, recipe builder and recipe procedure builder, to create each unit procedure. In step S505, the above-described series of process will continue to create the next unit procedure.

US Patents US7,369,913B2 and US6,834,370B1 do not disclose clearly how to configure formula data. In US Patents US5,499,188A and US7,065,714B1, recipe formulas are tightly coupled with products or operations, lacking in flexibility in configuration for plant factories.

There was a need for providing an improved system and method for configuring a unit procedure.

Summary

A recipe configuration system, configured to communicate with a common block database, includes but not limited to, a recipe procedure tool configured to display a plurality of operation stencils relevant to a level for selection, the level is a unit procedure. The recipe procedure tool displays multiple tags, receives an input to select one operation stencil and position the selected operation stencil to a drawing area, the

positioned operation stencil is a unit procedure operation. The recipe procedure tool receives an input to select and move one tag to the drawing area. A tag linking module is configured to communicate with the recipe procedure tool to determine if the selected tag is within a predefined area of the unit procedure operation, and assign at least one predefined property and a category of the selected tag when it is determined the selected tag is within the predefined area of the unit procedure operation. A common block linking module is configured to communicate with the recipe procedure tool to determine if the positioned operation stencil has a new or different tag, and assign a formula from the common block database to the positioned operation stencil when it is determined the positioned operation stencil has a new or different tag.

Brief Description of Drawings

Fig. 1 shows four parts of a recipe.

Fig. 2A shows common block application.

Fig. 2B shows a recipe management system in the related art.

Fig. 3 is a workflow in the related art.

Fig. 4 shows a recipe management system according to some embodiments of the invention.

Fig. 5 shows an example of a level window according to some embodiments of the invention.

Fig. 6 shows an example of a stencil window and a drawing area according to some embodiments of the invention.

Fig. 7 shows an example of a tag window and a drawing area according to some embodiments of the invention.

Fig. 8 shows an example display on a user interface according to some embodiments of the invention.

Fig. 9 is a workflow according to some embodiments of the invention.

Detailed Descriptions

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While some aspects of the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed descriptions of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one of ordinary skill of the art that the present invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and features have not been described in detail as not to unnecessarily obscure aspects of the present invention.

In some embodiments of the present invention illustrated in Fig. 4, a recipe configuration system 400, which can be implemented in a computer system, and can be configured to communicate with a repository 300. The repository 300 includes, but not limited to, a recipe database 310, a common block database 320 and a plant database 330. The recipe configuration system 400 includes, but not limited to, a recipe procedure tool 410.

There are different levels which can be configured and edited in the recipe procedure tool 410. In a preferred embodiment, the recipe procedure tool 410 includes a level selection option 420. Preferably, the level selection option 420 is provided in a level window 422 illustrated in Fig. 5. In the level window 422, available levels 424 such as recipe, procedure and unit procedure are listed in a hierarchical order or hierarchical tree format for ease of viewing and selection. Such a display is intuitive for even an inexperienced user to select the desired level for configuration. The embodiments of the present invention relates to configuring and editing the unit procedure level, which is the unit procedure for the procedure of the recipe, in particular, configuring and editing a unit procedure operation.

The recipe procedure tool 410 includes a stencil option 430 in a stencil window 432, illustrated in Fig. 6, which provides operation stencils 434 for configuring and editing a recipe procedure. In some embodiments, each operation stencil 434 has a property which defines the level(s) the stencil is relevant. The stencil option 430 is linked to the level selection option 420. In some embodiments, when a unit procedure level is selected, the recipe procedure tool 410 is configured to display operation stencils 434 relevant to the selected level. In another embodiment, all the operation stencils 434 are displayed, and only those which are relevant to the selected level are available for user selection. This minimizes an error of selecting of a wrong stencil for configuration.

Different stencils are used to represent different functionalities. Accordingly, the different stencils are configured to have different properties required to perform the functions. The selected operation stencil for a unit procedure operation has at least three properties: operation name, operation identifier and operation type.

The recipe procedure tool 410 provides a tag list 440 of tags 442. The tags 442 are field device identifiers and equipment identifiers for the available field devices and equipment installed in the industrial plant. The recipe procedure tool 410 identifies and retrieves from the plant database 330, the available field devices and equipment installed in the

industrial plant. In the plant database 330, each tag 442 has a hierarchy property 444(not shown) which defines the tag 442 in a hierarchy of the industrial plant. In a preferred embodiment, the recipe procedure tool 410 retrieves the hierarchy property 444 of the tags 442 to display the tags 442 in a hierarchical tree in the tag window 446.

In some embodiments, hierarchy properties 444 of some tags 442 are stored in a recipe database 330, for example at procedure or recipe level. In these embodiments, the recipe procedure tool 410 retrieves the hierarchy property 444 of the tags 442 from both the recipe database 310 and plant database 330 to display the tags 442 in a hierarchical tree in the tag window 446.

Advantageously, since all the tags are displayed in a tag window 446, available for selection, the user navigates the tag window 446 to locate a desired tag, the user does not have to know the source type , generic or operation, of the tag 442. Regardless of user's knowledge on the hierarchical order of the desired tag, the user can navigate the tag window 446 to locate the desired tag.

Preferably, the recipe procedure tool 410 displays properties of a selected tag 442 in a tag property area 448. The tag property area 448 is located in a separate window from the tag list 440 for clarity. The user can review the properties in the tag property area 448 to determine if the selected tag 442 is the desired tag. This improves the ease of identifying the desired tag.

The recipe configuration system 400 is configured to communicate with input devices to receive a user input. Examples of input devices include a mouse, keyboard or touchpad. Based on the user input, the recipe procedure tool 410 configures or edits a recipe on a drawing area 450 such as a drawing canvas.

The inputs received by the recipe procedure tool 410 include selecting a level 424 in the level selection option 420; selecting an operation stencil 434 in the stencil option 430 and dragging the selected operation stencil 434 to position on a desired location in the

drawing area 450; selecting a desired tag 442 in the tag list 440 and dragging the selected tag 442 to the desired stencil on the drawing area 450.

When the selected operation stencil 434 is positioned in the drawing area 450, it is a unit procedure operation 436. The recipe procedure tool 410 assigns a predefined property to the unit procedure operation 436. The predefined property is an identifier, such as an operation identifier.

A tag linking module 460 is provided in the recipe configuration system. In the preferred embodiment, the tag linking module 460 is configured to detect that a desired tag 442 in the tag list 440 is selected. When the input causes the selected tag 442 to move the drawing area 450, the tag linking module 460 is configured to detect a unit procedure operation 436 located in the drawing area 450. In some embodiments, the tag linking module 460 determines if the selected tag 442 is within a predefined area of the unit procedure operation 436. The predefined area of the unit procedure operation 426 can be configured as the size of a representation of the unit procedure operation 426 on the drawing area. The selected tag 442 is assigned to the detected unit procedure operation 436 located in the drawing area 450. Preferably, at least one predefined property of the selected tag 442 which are assigned to the unit procedure operation 436 is operation name; a category assigned from the selected tag 442 to the unit procedure operation 436 is operation type. These are some example of properties required to establish a formula for the unit procedure operation 436.

In some preferred embodiments, the tag linking module 460 includes a distance property to define the minimum or maximum distance for detecting the unit procedure operation 436 located in the drawing area 450. Preferably, the tag is linking module 460 detects that the selected tag 442 is on top of the unit procedure operation 436. The tag linking module 460 includes a verification function 462 (not shown) to determine if the unit procedure operation 436 located in the drawing area 450 is configured to register a tag 442.

Optionally, the tag linking module 460 provides an assignment option 464(not shown). The assignment option 464 allows the user to choose whether to assign the tag 442 to the unit procedure operation 436. In an embodiment when there is more than one unit procedure operation 436 in the drawing area 450, this option improves the ease of assignment by allowing the user to determine whether to assign the tag 442 to a first detected unit procedure operation 436.

A common block linking module 470 is provided in the recipe configuration system. In the preferred embodiment, the common block linking module 470 is configured to detect that a unit procedure operation 436, located in the drawing area 450, which is configured to register a desired tag 442. The common block linking module 470 determines if the unit procedure operation 436 has an undefined property, for example a new or different tag 442 assigned from the operation name or category properties of the unit procedure operation 436. The common block linking module 470 identifies common blocks and common block items from the recipe database, and assigns the identified common blocks and common block items from a common block database to the unit procedure operation 436 when a new or different tag 442 is detected to have been assigned.

In some embodiments, the recipe procedure tool 410 includes other recipe related editors, such as recipe header editor, equipment requirement editor and unit recipe attributes editor. This enables the user to further automate recipe configuration for other levels.

In an example implementation, the recipe procedure tool 410 includes an equipment requirement editor 480 to update, by configuration and editing, equipment and field devices installed in the industrial plant. In this embodiment, the updated equipment and field devices are stored in the recipe database 310.

In another example implementation, the recipe procedure tool 410 includes a formula editor 490 to update formulas in recipes. The formula editor is used for configuring and

editing, common block and common block items from the common block database to a formula. In this embodiment, the formula is stored in the recipe database 310.

Another embodiment of the invention is a workflow for recipe configuration illustrated in Fig. 8. The workflow 500 is performed in a recipe configuration system 400 described above.

In an optional step S501, the recipe procedure tool 410 receives an input from an input device to select a level 424 from the level selection option 420. The recipe procedure tool 410 displays operation stencils 434 relevant to the selected level 434 in a stencil window 432.

In step S502, an input is received from the input device to select an operation stencil 434 and move the selected operation stencil 434 to position on a desired location in the drawing area 450 as shown in Fig. 6A. In the present invention, the operation stencil 434 is for a unit procedure operation. The unit procedure operation 436 located in the drawing area 450 is assigned at least properties: operation name, operation identifier and operation type. Optionally, other properties are included to enable other functions, such as formula assignment automation.

When the selected operation stencil 434 is positioned in the drawing area 450, it is a unit procedure operation 436. The recipe procedure tool 410 assigns a predefined property to the unit procedure operation 436. The predefined property is an identifier, such as an operation identifier.

In step S503, an input is received from the input device to select a tag 442 from the tag list 440. In some embodiments, the properties of the selected tag 442 are displayed in a tag property area 448 for a use to review and determine if the selected tag 442 is a desired tag. A further input is received to move the selected tag 442 to the drawing area 450.

A tag linking module 460 is configured to detect for a unit procedure operation 436 on the drawing area 450. The tag linking module 460 assigns properties of the selected tag 442 to the detected unit procedure operation 436 when the detected unit procedure operation 436 is within a predefined distance from the tag linking module 460. In some embodiments when there are multiple unit procedure operations 436 on the drawing area 450, a query window is shown for the user to determine whether to assign the selected tag 442 to the detected unit procedure operation 436.

In step S504, a common block linking module 470 detects for each unit procedure operation 436 positioned on the drawing area 450 if a new or different tag 442 has been assigned to the unit procedure operation 436 from the assigned properties of the unit procedure operation 436. The common block linking module 470 identifies common blocks and common block items from the recipe database for the unit procedure operation 436, and assigns the identified common blocks and common block items from a common block database to the unit procedure operation 436 when a new or different tag 442 is detected to have been assigned. In step S505, the above-described series of process will continue to create the next unit procedure.

In an alternative embodiment, the common block linking module 470 identifies a formula from the recipe database based on the properties of the operation stencil: operation name, operation identifier and operation type. The common block linking module 470 uses the identified formula to retrieve common blocks and common block items from the common block database 320 and assign to the unit procedure operation 436 on the drawing area 450. If the unit procedure operation 436 has a formula, the common blocks and common block items are assigned to the unit procedure operation 436.

We claim :

1. A recipe configuration system configured to communicate with a recipe database and a plant database, the recipe configuration system comprising

a recipe procedure tool configured to:

display a plurality of operation stencils relevant to a level for selection, wherein the level is a unit procedure,

identify, from the recipe database and the plant database, a hierarchical property for a plurality of tags;

retrieve, from the recipe database and the plant database, the identified hierarchical property for the plurality of tags; and

display the plurality of tags in a hierarchical order based on the retrieved hierarchical property;

upon receipt of an input, select one of the plurality of operation stencils and position the selected one of the plurality of operation stencils to a drawing area, wherein the positioned operation stencil is a unit procedure operation,

assign a predefined property to the unit procedure operation, and

upon receipt of an input, select one of the plurality of tags from a tag list and move the tag as selected to the drawing area;

a tag linking module configured to communicate with the recipe procedure tool, and to:

detect the tag selected from the tag list;

detect the unit procedure operation located in the drawing area;

determine if the selected tag is within a predefined area of the unit procedure operation, and

assign at least one predefined property and a category of the selected tag to predefined properties of the unit procedure operation when it is determined the selected tag is within the predefined area of the unit procedure operation; and

a common block linking module configured to communicate with the recipe procedure tool to:

determine if the unit procedure operation has a undefined property, and

assign a formula from a recipe database to the unit procedure operation when it is determined that the unit procedure operation has a undefined property.

2. The recipe configuration system in claim 1, wherein the predefined properties of the unit procedure operation assigned from the selected tag comprises operation name and operation type.

3. The recipe configuration system in claim 1, wherein the common block linking module is further configured to determine, at a predetermined interval, if the unit procedure operation has a undefined property.

4. The recipe configuration system in claim 1, wherein the recipe configuration system is further configured to communicate with a common block database, the common block database stores common blocks and common block items for configuring the formula, the common block linking module is further configured to:

identify, from the common block database, at least one common block or common block items for the formula based on the predefined properties of the unit procedure operation,

retrieve, from the common block database, the identified at least common block or common block items, and

assign the retrieved at least one common block or common block items of the formula to the unit procedure operation.

5. The recipe configuration system in claim 1 wherein the recipe procedure tool further comprises an equipment editor configured to:

update equipment and field devices; and

store the updated equipment and field devices to the recipe database.

6. A recipe configuration method, performed in a recipe configuration system configured to communicate with a recipe database and a plant database, the recipe configuration method comprising:

displaying a plurality of operation stencils relevant to a level for selection, wherein the level is a unit procedure; identify, from the recipe database and the plant database, a hierarchical property for a plurality of tags;

retrieve, from the recipe database and the plant database, the identified hierarchical property for the plurality of tags; and

display the plurality of tags in a hierarchical order based on the retrieved hierarchical property;

upon receipt of an input, selecting one of the plurality of operation stencils and position the selected one of the plurality of operation stencils to a drawing area, the positioned operation stencil is a unit procedure operation;

assigning a predefined property to the unit procedure operation;

upon receipt of an input, selecting one of the plurality of tags from a tag list and move the tag as selected to the drawing area;

detect the tag selected from the tag list;

detect the unit procedure operation located in the drawing area;

determining if the selected tag is within a predefined area of the unit procedure operation;

assigning at least one predefined property and a category of the selected tag to predefined properties of the unit procedure operation when it is determined the selected tag is within the predefined area of the unit procedure operation;

determining if the unit procedure operation has a undefined property; and

assigning a formula from the recipe database to the positioned operation stencil when it is determined the unit procedure operation has a undefined property.

7. The recipe configuration method in claim 6, wherein the predefined properties of the unit procedure operation assigned from the selected tag comprises operation name and operation type.

8. The recipe configuration method in claim 6, wherein the recipe configuration system is further configured to communicate with a common block database, the common block database stores common blocks and common block items for configuring the formula, the recipe configuration method further comprises:

identifying at least one common block or common block items for the formula based on the predefined properties of the unit procedure operation,

retrieving the identified at least one common block or common block items from the common block database, and

assigning the retrieved at least one common block or common block items of the formula to the unit procedure operation.

9. The recipe configuration method in claim 8, further including storing the retrieved plurality of predefined common block and common block data in the recipe database.

10. A non-transitory computer readable medium that stores a computer program to be executed by a recipe configuration system configured to communicate with a recipe database and a plant database to perform a recipe configuration method, the recipe configuration system comprising a recipe procedure tool, the recipe configuration method comprising:

displaying a plurality of operation stencils relevant to a level for selection, wherein the level is a unit procedure;

identify, from the recipe database and the plant database, a hierarchical property for a plurality of tags;

retrieve, from the recipe database and the plant database, the identified hierarchical property for the plurality of tags; and

display the plurality of tags in a hierarchical order based on the retrieved hierarchical property;

upon receipt of an input, selecting one of the plurality of operation stencils and position the selected one of the plurality of operation stencils to a drawing area, the positioned operation stencil is a unit procedure operation;

assigning a predefined property to the unit procedure operation;

upon receipt of an input, selecting one of the plurality of tags from a tag list and move the tag as selected to the drawing area;

detect the tag selected from the tag list;

detect the unit procedure operation located in the drawing area;

determining if the selected tag is within a predefined area of the unit procedure operation;

assigning at least one predefined property and a category of the selected tag to the unit procedure operation when it is determined that the selected tag is within the predefined area of the unit procedure operation; and

determining if the unit procedure operation has a undefined property;

assigning a formula from the recipe database to the positioned operation stencil when it is determined the unit procedure operation has a undefined property.

11. The recipe configuration method in claim 6, wherein the recipe configuration system is further configured to communicate with a common block database, the common block database stores common blocks and common block items for configuring the formula, the recipe configuration method further comprises:

identifying at least one common block or common block items for the formula based on the predefined properties of the tag,

retrieving the identified at least one common block or common block items from the common block database, and

assigning the retrieved at least one common block or common block items of the formula to the positioned operation stencil.