

STAFF SCHEDULING METHOD, DEVICE AND MONITORING SYSTEM IN EMERGENCY SCENE

TECHNICAL FIELD

5 **[0001]** This disclosure relates to a staff scheduling method, an electronic device, a computer-readable storage medium, a device and a monitoring system in an emergency scene.

BACKGROUND

10 **[0002]** A data center generally refers to key devices for centralized processing, storage, transmission, exchange, and management of information within one physical space and carriers required for the key devices to operate. The carriers include key physical infrastructure such as building facility,
15 environment, power supply system, refrigeration system, cabinet system, fire system, monitoring system, and the like.

[0003] In the case of an emergency scene such as a major accident or a dangerous situation in the data center, it is necessary to take emergency disposal measures in time to control
20 the deterioration of the situation and reduce destructiveness.

SUMMARY

[0004] The present disclosure provides a method and device for scheduling staff in an emergency scene.

25 According to some embodiments of the present disclosure,

there is provided a staff scheduling method in an emergency scene, applied to an industrial site that comprises a plurality of devices and data collectors for collecting data of the respective devices, the method comprising: receiving device
5 identification data and device attribute data from the data collectors, and recognizing the emergency scene based on the received data; and determining staff to be scheduled based on the recognized emergency scene, wherein the recognizing the emergency scene based on the received data comprises:
10 recognizing the emergency scene in accordance with a pre-established first undirected graph that comprises a plurality of first nodes, a plurality of second nodes, and a plurality of edges, wherein the first node represents a preset emergency scene, the second node represents the device identification data
15 and the device attribute data, and the edge connects the second node with an associated first node.

[0005] Other features and aspects of the present disclosure and their advantages will become apparent from the following detailed description of exemplary embodiments thereof, which
20 proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Preferred embodiments of the present disclosure will be described below with reference to the accompanying drawings. The
25 accompanying drawings described herein are used for providing a further understanding of this disclosure, and the drawings

together with the following specific description are included in the specification and form a part of the specification for explaining this disclosure. It should be understood that the drawings in the following description relate only to some
5 embodiments of the present disclosure, rather than constituting a limitation to the present disclosure. In the drawings:

[0007] Fig. 1 is a block diagram of an exemplary device (also referred to as an emergency disposal device) for scheduling staff in response to an emergency scene according to some
10 embodiments of the present disclosure.

[0008] Fig. 2 is a flowchart illustrating an exemplary method (also referred to as an emergency disposal method) for scheduling staff in response to an emergency scene according to some embodiments of the present disclosure.

15 **[0009]** Fig. 3 is a flowchart illustrating an exemplary process of recognizing an emergency scene based on device identification data and device attribute data according to some embodiments of the present disclosure.

[0010] Fig. 4 illustrates an exemplary first undirected graph
20 used in recognizing an emergency scene according to some embodiments of the present disclosure.

[0011] Fig. 5 is a flowchart illustrating an exemplary process of determining staff to be scheduled based on the recognized emergency scene according to some embodiments of the present
25 disclosure.

[0012] Fig. 6 illustrates an exemplary second undirected graph

used in determining staff to be scheduled according to some embodiments of the present disclosure.

[0013] Fig. 7 illustrates a general hardware environment in which the present disclosure can be applied according to some
5 embodiments of the present disclosure.

DETAILED DESCRIPTION

[0014] The technical solutions in the embodiments of the present disclosure will be clearly and completely described below with
10 reference to the drawings in the embodiments of the present disclosure, but it is obvious that the embodiments described are only some of the embodiments of the present disclosure, not all of the embodiments. The following description of the embodiments is merely illustrative in nature and is in no way intended to
15 limit this disclosure and its application or use. It should be understood that the present disclosure can be implemented in various forms and should not be construed as limited to the embodiments set forth herein.

[0015] It should be understood that various steps recited in
20 method embodiments of the present disclosure can be performed in different order, and/or performed in parallel. Furthermore, the method embodiments can include additional steps and/or omit performing the illustrated steps. The scope of the present disclosure is not limited in this respect. Unless otherwise
25 specified, the relative arrangement, numerical expressions, and numerical values of components and steps set forth in these

embodiments should be construed as merely exemplary and not limiting the scope of the present disclosure.

[0016] In the present disclosure, a data center comprises a plurality of devices and data collectors for collecting device
5 attribute data representing attributes of the respective devices. Device identification data and device attribute data are output from the data collectors. Here, the device identification data uniquely identifies the device, and the device attribute data includes electrical attribute data of the
10 device and/or Heating Ventilation Air Conditioning (HVAC) attribute data of the device. The data center can comprise, for example, a machine room, cabinets, etc., and more specifically, the data center can comprise a device such as "AC header cabinet", "high-voltage DC header cabinet", "miniature bus bar",
15 etc. The data collectors can collect the electrical attribute data of the device, such as master switch state data of the AC header cabinet, master switch state data of the high-voltage DC header cabinet, master switch state data of the miniature bus bar, and the like. For another example, the data center can
20 comprise a device such as air conditioner and a plurality of temperature and humidity sensors within a same module machine room. The data collectors can collect the HVAC attribute data of the device, such as supply air temperature of the air conditioner, temperature and humidity within the module machine
25 room, and the like. Also for example, the data center can comprise a device such as cooling water tanks. The data

collectors can collect the HVAC attribute data of the device, such as liquid level of the cooling water tank, and the like. By monitoring and analyzing the device attribute data of the plurality of devices in the data center, a possible emergency scene in the data center can be automatically recognized.

[0017] It should be understood that the emergency disposal method and device of the present disclosure are not limited to monitoring the data center, but can also be used for monitoring another industrial site having a plurality of devices and a plurality of data collectors, for example, a production workshop, etc.

[0018] Fig. 1 is a block diagram of an exemplary emergency disposal device 100 according to some embodiments of the present disclosure.

[0019] As shown in Fig. 1, the device 100 may comprise: a scene design section 110 configured to design an emergency scene; a scene recognition section 120 configured to recognize the emergency scene based on device identification data and device attribute data; a staff determination section 130 configured to determine staff to be scheduled based on the recognized emergency scene; and a notification and display section 140 configured to send a notification to the determined staff to be scheduled and display location movement of the determined staff to be scheduled.

[0020] Operations of the sections shown in Fig. 1 will be further described in detail below.

[0021] Fig. 2 is a flowchart illustrating an exemplary emergency disposal method 200 according to some embodiments of the present disclosure.

[0022] The method 200 starts from step S210, at which the scene design section 110 designs an emergency scene.

[0023] Specifically, the scene design section 110 defines a number and name for the emergency scene, defines a device, a device attribute, a corresponding threshold, and a corresponding weight, which are involved in this scene, and also defines a personal skill required for disposing the scene and a required proficiency level of staff with respect to the personal skill.

[0024] In some embodiments, the section 110 defines the emergency scene as follows:

Scene = {code (number), name (name), device_code (device identification), attribute_code (device attribute), upper (threshold), weight (weight), $C = [\{c_1, v_1\}, \{c_2, v_2\}, \{c_3, v_3\}, \dots]$ }.

[0025] Here, *Scene* denotes one exemplary scene defined. The scene has a number and name that uniquely identify the scene, device_code denotes device identification (i.e., device identification data), attribute_code denotes a device attribute, upper denotes a threshold corresponding to a device attribute of a device, weight denotes a weight corresponding to a device attribute of a device, C denotes a plurality of personal skills and proficiency levels of staff with respect to the personal

skills required for disposing the scene, $\{c_i, v_i\}$ denotes a required personal skill c_i and a required proficiency level v_i with respect to the personal skill c_i , where i is an integer greater than or equal to 1.

5 **[0026]** It should be understood that the section 110 can similarly define many scenes, such as hundreds or thousands of scenes.

10 **[0027]** It should be understood that one scene can be associated with one or more groups of device identifications, device attributes, thresholds, and weights. Table 1 below illustrates an example situation in which one scene is associated with multiple groups of device identifications, device attributes, thresholds, and weights.

TABLE 1

Number and name for scene	Device identification, device attribute, threshold, and weight	Location
0001 header-cabinet-level power supply interruption	1. device identification: AC header cabinet 2. device attribute: master switch state 3. threshold: open 4. weight: 3	301 module machine room header cabinet 3a4B
	1. device identification: high-voltage DC header cabinet 2. device attribute: master switch state 3. threshold: open 4. weight: 4	
	1. device identification: miniature bus bar 2. device attribute: master switch state 3. threshold: open 4. weight: 3	

[0028] As shown in Table 1, the emergency scene "header-cabinet-level power supply interruption" relates to, for example, three devices "AC header cabinet", "high-voltage DC header cabinet",
5 "miniature bus bar". More specifically, for each device, such as the "AC header cabinet", the device attribute involved is "master switch state", the threshold is "open", and the weight is 3. That is to say, when the master switch state of the AC header cabinet is open, this indicates that there is likely to
10 be the emergency scene of "header-cabinet-level power supply interruption". Furthermore, when the master switch states of both the AC and high-voltage DC header cabinets are open, this indicates that there is very likely to be the emergency scene of "header-cabinet-level power supply interruption".
15 Furthermore, when the master switch states of the AC header cabinet, the high-voltage DC header cabinet, and the miniature bus bar are all open, this indicates that there is extremely likely to be the emergency scene of "header-cabinet-level power supply interruption". The information in the column "location"
20 in Table 1 can be considered as a part of the device identification, which clearly indicates the locations of the listed devices: "301 module machine room" and header cabinet number "3a4B".

[0029] In the present disclosure, the device identification
25 data can include any data capable of uniquely identifying the device, such as the device number, device name, device location,

or the like. In the present disclosure, the device attribute refers to a parameter (or data identifying the parameter) of the device, such as supply air temperature of an air conditioner, while the device attribute data refers to the parameter of the device and a specific value of the parameter, such as the supply air temperature of the air conditioner — 25°C.

[0030] It should be appreciated that the association relation between the emergency scene and one or more involved groups of device identifications, device attributes, thresholds, and weights, and the association relation between the emergency scene and the personal skill and the proficiency level required for disposing the scene, can be determined according to expert experience. Alternatively, a portion of these association relations can be determined according to the expert experience, while the other portion thereof can be determined by using a machine learning technology. Still alternatively, these association relations can be determined by using the machine learning technology. Any known machine learning technology can be used, and the present disclosure is not limited thereto.

[0031] Next, the method 200 proceeds to step S220, at which the scene recognition section 120 receives the device identification data and the device attribute data from the data collectors and recognizes the emergency scene based on the received data. More specifically, the scene recognition section 120 recognizes the emergency scene using a pre-established first undirected graph

that comprises a plurality of first nodes and a plurality of second nodes and a plurality of edges, wherein the first node represents a preset emergency scene, the second node represents the device identification data and the device attribute data, and the edge connects the second node with an associated first node.

[0032] Fig. 3 is a flowchart illustrating a specific procedure of the scene recognition process 300 at the step S220. Fig. 4 illustrates an exemplary first undirected graph.

[0033] As shown in Fig. 4, a black node corresponds to the first node, and a white node corresponds to the second node. The graph can be formed by the scene recognition section 120 based on the scene designed in the step S210. Specifically, each first node corresponds to one scene defined in the step S210, each second node corresponds to the device identification and device attribute defined in the step S210, and a plurality of edges connect the first node representing a scene and the second node representing the device and the device attribute involved in the scene.

[0034] In Fig. 4, the first nodes 410 and 411 represent two preset emergency scenes. The second nodes 420 to 425 represent six groups of device identification data and device attribute data. As shown in Fig. 4, the first node 410 is connected together with the five second nodes 420, 421, 423, 424, 425, which indicates that the data represented by these five second nodes are associated with the scene represented by this first

node. Moreover, the first node 411 is connected together with the three second nodes 421, 422, 425, which indicates that the data represented by these three second nodes are associated with the scene represented by this first node. It should be understood
5 that the number of the first nodes or the second nodes is not limited to the number shown in the figure. In practice, the number of the first nodes or the second nodes can be, for example, hundreds or thousands.

[0035] In Fig. 4, in the first undirected graph, each edge is
10 set with an associated threshold (HT in Fig. 4) and weight w . The threshold and weight here are the threshold and weight set in correspondence with the device identification and the device attribute with respect to the scene in the step S210.

[0036] In Fig. 4, a Hash table for associating device
15 identification data and the device attribute data from the data collectors with corresponding second nodes is also shown. The Hash table uses "device identification # device attribute" (DEV id # DEV attrib. in Fig. 4) as a key value, and maps the key value to the corresponding second node. It should be appreciated
20 that the manner of associating the data from the data collectors to the corresponding second nodes is not limited to the use of the Hash table, and that other known manners can be adopted for achieving this association.

[0037] Next, the scene recognition process 300 at the step S220
25 will be discussed with reference to Fig. 3. The scene recognition process 300 can be performed by the scene recognition section

120.

[0038] At step S2202, the section 120 recognizes, as a target edge, an edge among the plurality of edges of the first undirected graph, for which the device attribute data
5 represented by a corresponding second node and a corresponding threshold meet a preset condition.

[0039] Specifically, for each edge of the first undirected graph, it is judged in turn whether the device attribute data of the second node with which the edge is connected and the
10 threshold with which the edge is associated meet the preset condition, and the edge is recognized as the target edge under the condition that the preset condition is met.

[0040] The preset condition can be, for example, that the device attribute data of the second node with which the edge is
15 connected is greater than or equal to the threshold with which the edge is associated (for example, a supply air temperature of an air conditioner is greater than or equal to a preset temperature). Alternatively, the preset condition can be, for example, that the device attribute data of the second node with
20 which the edge is connected is less than or equal to the threshold with which the edge is associated (for example, a liquid level of a water tank is less than or equal to a preset value). Also alternatively, the preset condition can be that the device attribute data of the second node with which the edge is
25 connected is just the threshold (for example, a value of a master switch state of an AC header cabinet indicates "open"). It should

be understood that the preset condition can be set according to actual needs.

[0041] As shown in Fig. 4, taking the second node 425 as an example, it is assumed that the device attribute data represented by the second node 425 is greater than or equal to thresholds 1.3 and 0.8 of two edges with which it is connected, then both of the two edges with which the second node 425 is connected are the target edges. Conversely, it is assumed that the device attribute data represented by the second node 425 is less than the thresholds 1.3 and 0.8 of the two edges with which it is connected, then neither of the two edges with which the second node 425 is connected is the target edge. It should be understood that a single threshold is set for each edge in Fig. 4, however, two or more thresholds can be set for each edge as needed. By using the thresholds, device attribute data falling within a range defined by the thresholds can be recognized.

[0042] In step S2204, the section 120 determines a score of the first node based on a corresponding weight of the target edge connected with the first node.

[0043] In some embodiments, the section 120 determines a sum of corresponding weights of target edges connected with the first node as the score of the first node.

[0044] Still referring to the first undirected graph shown in Fig. 4, it is assumed that all the edges in Fig. 4 are target edges, then a sum of corresponding weights of target edges connected with the first node 410 is: $2+1+2+5+1=11$, and a sum

of corresponding weights of target edges connected with the first node 411 is: $2+1+3=6$. That is to say, a score for the first node 410 is 11, and a score for the first node 411 is 6. It should be understood that the manner of determining the score is not limited to calculating the sum of the weights, and the score of the first node can be determined in other manners based on the weights. It should be appreciated that the score of the first node can reflect a possibility that the emergency scene represented by the first node will occur.

10 **[0045]** In step S2206, the section 120 ranks the plurality of first nodes by the scores of the first nodes, and determines one or more possible emergency scenes as the recognized emergency scene based on a result of the ranking.

15 **[0046]** In the first undirected graph, assuming that there are M (M is an integer greater than or equal to 1) first nodes, the M first nodes are ranked by the scores of the first nodes, and scenes corresponding to first N (N is an integer greater than or equal to 1, $N \leq M$) nodes with the highest scores can be determined as emergency scenes that are likely to occur.

20 Incidentally, for a first node with a score of zero (i.e., without a target edge connected therewith), it may not be ranked.

[0047] It can be appreciated that one or more recognized emergency scenes output by the scene recognition section 120 can be output directly to the staff determination section 130.

25 Alternatively, one or more recognized emergency scenes output

by the scene recognition section 120 can also be output to an emergency disposal specialist for reference, and a recognized scene after confirmed by the emergency disposal specialist is output to the staff determination section 130.

5 **[0048]** Hereinafter, a specific example of the scene recognition process will be discussed. This example includes steps 1 to 4 as described below. The scene recognition process can be performed by the scene recognition section 120.

10 **[0049]** Step 1, initializing a scene memory structure, which is denoted as graph G_{scene} and Hash table $H_{condition}$. The step 1 can be subdivided into the following steps 1.0 to 1.3.

[0050] Step 1.0, initializing the graph G_{scene} and Hash table $H_{condition}$.

15 **[0051]** Step 1.1, according to the number and name for the emergency scene designed in the foregoing step S210, inserting the first node N_{root} into the graph G_{scene} , which is denoted as $N_{root}=\{\text{scene_code, scene_name, ...}\}$. Here, the number of the first nodes corresponds to the number of the emergency scenes designed in the foregoing step S210.

20 **[0052]** Step 1.2, according to the device identification and the device attribute involved in the emergency scene designed in the foregoing step S210, inserting the second node $N_{condition}$ into the graph G_{scene} , which is denoted as $N_{condition}=\{\text{device_code, attribute_code, ...}\}$. The involved device identification and device attribute are

spliced into a character string by using a character "#", and the character string is used as a key value of the Hash table $H_{condition}$, and the key value is mapped to a memory address of the second node $N_{condition}$ in the graph G_{scene} .

5 **[0053]** Step 1.3, according to the relation between the emergency scene and the involved device identification and device attribute designed in the foregoing step S210 and, inserting, in the graph G_{scene} , an undirected edge that connects the first node N_{root} and the second node $N_{condition}$. Moreover, each edge is set
10 with an associated threshold "upper" and weight w , which are the threshold and weight designed in the foregoing step S210.

[0054] Step 2, collecting device's attribute data, which is denoted as $R_{device}=[\{cc_1, vv_1\}, \{cc_2, vv_2\}, \{cc_3, vv_3\}, \dots]$. Here, cc_i denotes the device identification data, vv_i denotes the device attribute
15 data, and i is an integer greater than or equal to 1. It should be appreciated that in some embodiments one same device can have multiple pieces of attribute data, and in this case, these multiple pieces of attribute data can correspond to a plurality of second nodes $N_{condition}$.

20 **[0055]** Step 3, acquiring records in R_{device} in turn, and searching for, in the graph G_{scene} , the first node N_{root} , which is denoted as $R_{spare}=[\{N, W, D, A\}]$. Here, N denotes a scene represented by the first node N_{root} , W denotes a weight, D denotes the device identification data, and A denotes the device attribute data.

The step 3 can be subdivided into the following steps 3.0 to 3.3.

[0056] Step 3.0, acquiring one record in R_{device} , which is denoted as $\{cc_i, vv_i\}$.

5 **[0057]** Step 3.1, searching for a key value in the Hash table $H_{condition}$, according to "device identification # device attribute", so as to find a corresponding second node $N_{condition}$.

[0058] Step 3.2, comparing the threshold corresponding to the
10 edge of the found second node and vv_i , if the condition is met, finding, along a corresponding edge (namely a target edge), the first node N_{root} , which is denoted as N; and a weight W of the edge meeting the condition is denoted as W.

[0059] Step 3.3, putting $\{N, W, D, A\}$ into an array R_{spare} ; and
15 returning to perform the steps 3.0 to 3.2 until the data in R_{device} have all been processed.

[0060] It should be understood that when there are a plurality of target edges connected to a certain first node N_{root} , a weight W of the first node N_{root} is a value obtained by adding up
20 corresponding weights of the plurality of target edges.

[0061] Step 4, ranking R_{spare} by W and then outputting it. Alternatively, a predetermined number of R_{spare} ranked top can be output.

[0062] Next, the method 200 proceeds to step S230, at which the
25 staff determination section 130 determines the staff to be

scheduled based on the emergency scene recognized at the step S220. More specifically, the staff determination section 130 determines the staff to be scheduled using a pre-established second undirected graph that comprises a plurality of third
5 nodes, a plurality of fourth nodes, and a plurality of edges, wherein the third node represents staff available for the scheduling, the fourth node represents a personal skill, and the edge connects the fourth node with an associated third node, and wherein in the second undirected graph, each edge is set with
10 an associated weight, which represents a proficiency level of staff with whom the edge is connected with respect to a personal skill with which the edge is connected.

[0063] Fig. 5 is a flowchart illustrating a specific procedure of the staff determination process 500 at step S230. Fig. 6
15 illustrates an exemplary second undirected graph.

[0064] As shown in Fig. 6, a black node corresponds to the third node and a white node corresponds to the fourth node. Each third node may represent one staff available for the scheduling, such as an electrical engineer, an HVAC engineer, or the like. Each
20 fourth node may represent a personal skill of an associated staff. The personal skill of the staff may be, for example, a certificate held by the staff. The edge connecting the third and fourth nodes indicates that the staff represented by the connected third node has the personal skill represented by the
25 connected fourth node. As shown in Fig. 6, each edge is set with an associated weight w' , which represents a proficiency level

of the staff with whom this edge is connected with respect to the personal skill with which this edge is connected. The proficiency level here refers to a level as to experience of the staff handling works related to his personal skill (such as his
5 certificate).

[0065] In the second undirected graph of Fig. 6, the third node 610 is connected with five fourth nodes 620, 621, 622, 623, 624, which indicates that staff represented by the third node 610 has five personal skills represented by the five fourth nodes.
10 Similarly, the third node 611 is connected with three fourth nodes 623, 625, 626, which indicates that staff represented by the third node 611 has three personal skills represented by the three fourth nodes. Moreover, taking an example of an edge connecting the third node 610 and the fourth node 620, the edge
15 has a weight of 2, which indicates that a proficiency level of the staff represented by the third node 610 with respect to the personal skill represented by the fourth node 620 is 2. In the exemplary graph of Fig. 6, a numerical value between 0 and 5 is used for representing a proficiency level of staff mastering a
20 personal skill. It should be understood that the number of the third or fourth nodes is not limited to the number shown in the figure. In practice, the number of the third or fourth nodes can be, for example, hundreds or thousands.

[0066] It should be appreciated that the second undirected graph
25 can be pre-established based on a staff information database. The staff information database can comprise: staff's

identification information (such as name and identification number, etc.), staff's personal skill information (such as which certificates are held), and proficiency level information on staff mastering a personal skill (for example, a numerical value of 0 represents no experience and a numerical value of 5 represents very rich experience). The second undirected graph can be pre-established by the staff determination section 130 based on the staff information database.

[0067] Next, the staff determination process 500 at the step S230 will be discussed with reference to Fig. 5. The staff determination process 500 can include the following steps S2302 to S2308. In the case where a plurality of emergency scenes are recognized at the step S220, the following steps S2302 to S2308 can be performed for each of the plurality of emergency scenes. Further, a predetermined number of staff to be scheduled can be determined for each emergency scene in turn. The staff determination process 500 can be performed by the staff determination section 130.

[0068] In the step S2302, the section 130 determines a personal skill and a proficiency level required for disposing the emergency scene according to the recognized emergency scene.

[0069] Specifically, the section 130 can determine the personal skill and the proficiency level required for disposing a certain emergency scene according to the emergency scene designed at the step S210 (see the definition of the emergency scene *Scene* by the section 110). More specifically, for a certain specific

emergency scene, a required personal skill and a required proficiency level $C=[\{c_1, v_1\}, \{c_2, v_2\}, \{c_3, v_3\}, \dots]$ associated therewith can be determined. Here, c_i represents a required personal skill, v_i represents a required proficiency level, and i is an integer greater than or equal to 1.

[0070] In step S2304, the section 130 determines, for a target fourth node representing each required personal skill, a difference between a proficiency level represented by a corresponding weight and the required proficiency level and an absolute value of the difference.

[0071] Referring to the second undirected graph shown in Fig. 6, it is assumed that the fourth nodes 622, 623, 624 represent required personal skills c_1 , c_2 and c_3 , respectively, then these three fourth nodes are target fourth nodes. For each of the target fourth nodes 622, 623, 624, a difference between the proficiency level possessed by the staff and the required proficiency level and an absolute value of the difference are determined. It is assumed that required proficiency level v_1 , v_2 and v_3 are all 2, then for the target fourth nodes 622, 623, 624, the following four differences are determined: $1.6-2=-0.4$; $4.5-2=2.5$; $3.5-2=1.5$; $1.8-2=-0.2$. Accordingly, absolute values of these four differences can be determined.

[0072] In step S2306, the section 130 determines, for a third node connected with one or more target fourth nodes, a sum of differences corresponding to the connected target fourth nodes

and a sum of absolute values of the differences.

[0073] Still referring to the second undirected graph shown in Fig. 6, for the third node 610 connected with three target fourth nodes, it can be determined that a sum of the differences
5 corresponding to the connected three target fourth nodes is: $-0.4+2.5+1.5=3.6$ and a sum of absolute values of the differences is: $0.4+2.5+1.5=4.4$. Furthermore, for the third node 611 connected with one target fourth node, a sum of the differences corresponding to the connected target fourth nodes can be
10 determined as: -0.2 and a sum of absolute values of the differences is: 0.2 .

[0074] In step S2308, the section 130 ranks the plurality of third nodes based on the sum of the differences and the sum of the absolute values of the differences, and determines the staff
15 to be scheduled based on a result of the ranking.

[0075] Still referring to the second undirected graph shown in Fig. 6, considering the foregoing sum of the differences of the third node 610 and the foregoing sum of the absolute values of the differences, i.e. 3.6 and 4.4 , and considering the foregoing
20 sum of the differences of the third node 611 and the foregoing sum of the absolute values of the differences, i.e. -0.2 and 0.2 , the third nodes can be ranked.

[0076] In some embodiments, firstly, the third nodes are ranked in a descending order of the foregoing sum of the differences,
25 and secondly, in the case where the foregoing sum of the differences is equal, the smaller the foregoing sum of the

absolute values of the differences, the more top level the ranking. Based on this ranking criterion, it can be determined that the ranking of the third nodes 610 and 611 is that 610 is ranked before 611. It can be appreciated that by using this
5 ranking criterion, staff whose personal skill and proficiency level are closer to the required personal skill and proficiency level can be selected. It should be understood that this ranking criterion is merely exemplary, and the present disclosure is not limited thereto. Other possible ranking criterions can be
10 employed.

[0077] Based on the ranking result, the section 130 can select a predetermined number of staff ranked top as the staff to be scheduled. Incidentally, for a third node with which no target fourth node is connected, it may not be ranked.

15 **[0078]** In some embodiments, in determining the staff to be scheduled, personal skills of the one or more determined persons to be scheduled can be made to cover all of the required personal skills, or as many required personal skills as possible.

[0079] In other embodiments, in determining the staff to be
20 scheduled, the staff to be scheduled can be determined based on a distance from the staff to a site of the emergency scene. For example, the ranking determined in the foregoing step S2308 can be modified based on the distance from the staff to the emergency scene site, so that the staff who are closer to the emergency
25 scene site are ranked at a more top level.

[0080] In other embodiments, in determining the staff to be

scheduled, the staff to be scheduled can also be determined based on a tool preparation situation of the staff. For example, the ranking determined in the foregoing step S2308 can be modified based on the tool preparation situation of the staff, so that staff who have prepared a tool are ranked at a more top level. Here, the tool refers to a tool required for disposing the recognized emergency scene.

[0081] It can be appreciated that the one or more determined persons output by the staff determination section 130 can be output directly to the notification and display section 140. Alternatively, the one or more determined persons output by the staff determination section 130 can also be output to the emergency disposal specialist for reference, and the determined staff confirmed by the emergency disposal specialist are output to the notification and display section 140.

[0082] Hereinafter, a specific example of the staff determination process will be discussed. This example comprises steps 1 to 3 described below. The staff determination process can be performed by the staff determination section 120.

[0083] Step 1, initializing a memory structure of staff and skills.

[0084] Further, the step 1 can be subdivided into the following steps 1.0 to 1.3.

[0085] Step 1.0, initialize a graph G_{staff} .

[0086] Step 1.1, according to the staff identification information in the staff information database, inserting a third

node N_{staff} into the graph G_{staff} , which is denoted as $S_{staff}=\{staff_code, staff_name, ...\}$.

[0087] Step 1.2, according to the personal skill information of the staff in the staff information database, inserting a fourth
5 node $N_{certificate}$ into G_{staff} , which is denoted as $C_{certificate}=\{certificate_code, ...\}$.

[0088] Step 1.3, according to the relation between the staff identification information and the personal skill information in the staff information database, inserting, in G_{staff} , an
10 undirected edge that connects N_{staff} and $N_{certificate}$, and setting a weight of the edge as a personal skill proficiency level, which is denoted as w' .

[0089] Step 2, according to R_{spare} as described above, finding appropriate staff and putting them in an array, which is denoted
15 as $R_{spare_staff}=[\{\{N, W, D, A\}, staff_code, \{d1, d2\}, ...\},.....]$. Here, $d1$ denotes the sum of the differences as described above, and $d2$ denotes the sum of the absolute values of the differences as described above.

[0090] Further, the step 2 can be subdivided into the following
20 steps 2.0 to 2.3.

[0091] Step 2.0, acquiring one record in R_{spare} as described above, which is denoted as $\{N, W, D, A\}$.

[0092] Step 2.1, according to a scene N , acquiring a skill list

required for disposing the scene, which is denoted as $C=[\{c_1,v_1\},\{c_2,v_2\},\{c_3,v_3\}, \dots]$.

[0093] Step 2.2, acquiring data in C in turn, which is denoted as $\{c_i, v_i\}$; finding an edge from c_i (corresponding to the target fourth node) to N_{staff} , and calculating a difference between w' and v_i in the path, which is denoted as $d1$, wherein an absolute value of the difference is denoted as $d2$; inserting $\{N,W,D,A\}$, $staff_code$, $\{d1, d2\}$ into the array R_{spare_staff} .

[0094] Step 2.3, jumping to the step 2.0, and repeatedly performing the steps 2.0 to 2.2 until all the records in R_{spare} have been processed.

[0095] It should be understood that, when a plurality of target fourth nodes $N_{certificate}$ are connected to a certain third node N_{staff} , a sum of differences corresponding to the connected plurality of target fourth nodes is calculated and taken as $d1$, and a sum of absolute values of the differences is calculated and taken as $d2$.

[0096] Step 3.0, ranking R_{spare_staf} according to the scene N and then ranking R_{spare_staff} according to $d1$ and $d2$. At this time, R_{spare_staff} is an output result of the staff determination process. Alternatively, a predetermined number of R_{spare_staff} ranked top of each scene N can be output.

[0097] Next, the method 200 proceeds to step S240, at which the

notification and display section 140 sends a notification to the determined staff to be scheduled and displays location movement of the staff to be scheduled.

[0098] Specifically, the notification and display section 140
5 can notify the determined staff to be scheduled of arrival at the emergency scene site, and can notify the determined staff to be scheduled of an operation guide to dispose the emergency scene. Such a notification can be a telephone notification, an email notification, a short-message notification, and the like.
10 The operation guide to dispose the emergency scene can be, for example, an electronic document such as a WORD document, a PDF document, a TXT document, which gives operation steps of emergency disposal. Moreover, the section 140 can also notify the emergency disposal specialist of an alert message.
15 Furthermore, the notification and display section 140 can highlight a location of the emergency scene site and location(s) of the determined staff to be scheduled on a map, and also highlight location movement of the determined staff to be scheduled on the map. For example, it may cause the map to be
20 displayed on a terminal device of the emergency disposal specialist and/or on terminal devices of the scheduled staff, it may cause the location of the emergency scene site and the location(s) of the scheduled staff to be displayed on the map, for example, in a colored manner, in a blinking manner, and the
25 like, and it may cause the location movement of the scheduled staff to be displayed on the map, for example, in a colored

manner, in a blinking manner, and the like. Such display can be accomplished by known location tracking technology, and the present disclosure is not limited thereto.

[0099] The emergency disposal method 200 of the present disclosure has been discussed above with reference to Figs. 2 to 6. It should be understood that the steps S210 and S240 shown in Fig. 2 are not necessary. For example, the scene recognition process and the staff determination process as described above can be performed using a set of emergency scenes that are designed in advance, without performing the design step as shown in the step S210. For another example, the notification and display step as shown in the step S240 can be performed by a device other than the emergency disposal device 100.

[00100] In some embodiments, the present disclosure further provides a monitoring system for an industrial site, the monitoring system comprising an electronic device that comprises a memory and a processor coupled to the memory, the memory having stored therein instructions which, when executed by the processor, cause the electronic device to perform the emergency disposal method of the present disclosure. For example, the emergency disposal method of the present disclosure can be performed by one or more electronic devices (such as computers) in a monitoring system at an industrial site.

[00101] By using the emergency disposal method and device of the present disclosure, automatic monitoring for a computing center can be realized, an emergency scene likely to occur can be timely

and accurately found, and staff who should be scheduled can be timely and accurately determined. It makes sense to find an emergency scene as early as possible and to arrange the staff to dispose the emergency scene as early as possible, which makes it possible to dispose the emergency scene efficiently. In addition, the emergency scene is recognized and the staff are determined by using an algorithm, which can assist managerial staff to make an accurate decision and avoid the managerial staff from making a wrong judgment and decision due to insufficient experience or poor consideration or the like.

[00102] Hardware implementation

[00103] Fig. 7 illustrates a general hardware environment 700 in which the present disclosure can be applied according to an exemplary embodiment of the present disclosure.

[00104] Referring to Fig. 7, a computing device 700 as an example of a hardware device applicable to aspects of the present disclosure will be described now. The computing device 700 can be any machine configured to perform processing and/or computing, and can be, but is not limited to, a workstation, a server, a desktop computer, a laptop computer, a tablet computer, a personal digital assistant, a smart phone, a portable camera, or any combination thereof. The device 100 described above can be implemented in whole or at least in part by the computing device 700 or a similar device or system.

[00105] The computing device 700 can comprise an element capable

of being connected or communicating with a bus 702 via one or more interfaces. For example, the computing device 700 can comprise a bus 702, one or more processors 704, one or more input devices 706, and one or more output devices 708. The one
5 or more processors 704 can be any type of processor and can include, but are not limited to, one or more general-purpose processors and/or one or more special-purpose processors (such as special-purpose processing chips). The input device 706 can be any type of device capable of inputting information to the
10 computing device and can include, but is not limited to, a mouse, a keyboard, a touch screen, a microphone, and/or a remote control. The output device 708 can be any type of device capable of presenting information and can include, but is not limited to, a display, a speaker, a video/audio output terminal, and/or
15 a printer. The computing device 700 can also comprise or be connected with a non-transitory storage device 710, wherein the non-transitory storage device 710 can be any storage device that is non-transitory and can implement a data storage library, and can include, but is not limited to, a disk drive, an optical
20 storage device, a solid-state storage device, a floppy disk, a flexible disk, a hard disk, a magnetic tape, or any other magnetic medium, compact disk, or any other optical medium, ROM (read-only memory), RAM (random access memory), cache memory, and/or any other memory chip or cartridge, and/or any other
25 medium from which a computer can read data, instructions, and/or code. The non-transitory storage device 710 can be detachable

from the interface. The non-transitory storage device 710 can have data/instructions/code for implementing the methods and steps described above. The computing device 700 can also comprise a communication device 712. The communication device
5 712 can be any type of device or system capable of communicating with an external device and/or with a network and can include, but is not limited to, a modem, a network card, an infrared communication device, a wireless communication device, and/or a chipset such as a Bluetooth™ device, an 802.11 device, a WiFi
10 device, a WiMax device, a cellular communication facility, or the like.

[00106] The bus 702 can include, but is not limited to, an industry standard architecture (ISA) bus, a micro channel architecture (MCA) bus, an enhanced ISA (EISA) bus, a Video
15 Electronics Standards Association (VESA) local bus, and a peripheral section interconnect (PCI) bus.

[00107] The computing device 700 can also comprise a working memory 714, wherein the working memory 714 can be any type of working memory that can store instructions and/or data useful
20 to the operation of the processor 704 and can include, but is not limited to, a random access memory and/or read-only memory device.

[00108] Software elements can reside in the working memory 714, including, but not limited to, an operating system 716, one or
25 more applications 718, drivers, and/or other data and code. Instructions for performing the methods and steps described

above can be included in the one or more applications 718, and the sections of the device 100 described above can be implemented by the processor 704 reading and executing the instructions of the one or more application programs 718. More specifically, the scene design section 110 can be implemented, for example, by the processor 704 in executing the application 718 having instructions to perform the step S210. The scene recognition section 120 can be implemented, for example, by the processor 704 in executing the application 718 having instructions to perform the step S220 (or the steps S2202, S2204, and S2206). The staff determination section 130 can be implemented, for example, by the processor 704 in executing the application 718 having instructions to perform the step S230 (or the steps S2302, S2304, S2306 and S2308). The notification and display section 140 can be implemented, for example, by the processor 704 in executing the application 718 having instructions to perform the step S240. Executable code or source code for the instructions of the software elements can be stored in a non-transitory computer-readable storage medium (such as the above storage device(s) 710), and can be read into the working memory 714 in the case of possible compilation and/or installation. The executable code or source code for the instructions of the software elements can also be downloaded from a remote location.

[00109] From the above embodiments, those skilled in the art can clearly understand that the present disclosure can be implemented by software and necessary hardware, or can be

implemented by hardware, firmware, and the like. Based on this understanding, the embodiments of the present disclosure can be implemented partially in the form of software. The computer software can be stored in the computer's readable storage medium, such as a floppy disk, hard disk, optical disk, or flash memory. The computer software comprises a series of instructions that cause a computer (e.g., a personal computer, a service station, or a network terminal) to perform the method or a portion thereof according to various embodiments of the present disclosure.

[00110] The present disclosure has already been described in this way, but it is apparent that the present disclosure can be varied in many ways. These variations are not regarded as departure from the spirit and scope of the present disclosure, and all such modifications that would be obvious to those skilled in the art are intended to be included within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A staff scheduling method in an emergency scene, applied to an industrial site that comprises a plurality of devices and data collectors for collecting data of the respective devices, the method comprising:

receiving device identification data and device attribute data from the data collectors, and recognizing the emergency scene based on the received data; and

determining staff to be scheduled based on the recognized emergency scene,

wherein the recognizing the emergency scene based on the received data comprises: recognizing the emergency scene in accordance with a pre-established first undirected graph that comprises a plurality of first nodes, a plurality of second nodes, and a plurality of edges, wherein the first node represents a preset emergency scene, the second node represents the device identification data and the device attribute data, and the edge connects the second node with an associated first node.

2. The method according to claim 1, wherein in the first undirected graph, each edge is set with an associated threshold and weight, and wherein the recognizing the emergency scene based on the received data further comprises:

recognizing, as a target edge, an edge among the plurality

of edges, for which the device attribute data represented by a corresponding second node and a corresponding threshold meet a preset condition;

determining a score of the first node based on a corresponding weight of the target edge connected with the first node; and

ranking the plurality of first nodes by the scores of the first nodes, and determining one or more possible emergency scenes as the recognized emergency scene based on a result of the ranking.

3. The method according to claim 2, wherein the recognizing the emergency scene based on the received data further comprises: associating, by a Hash table, the device identification data and the device attribute data from the data collectors with the second node.

4. The method according to claim 1, wherein the device identification data uniquely identifies the device, and the device attribute data includes electrical attribute data of the device and/or Heating Ventilation Air Conditioning (HVAC) attribute data of the device.

5. The method according to claim 1, wherein the determining staff to be scheduled based on the recognized emergency scene comprises:

determining the staff to be scheduled according to a pre-established second undirected graph that comprises a plurality of third nodes, a plurality of fourth nodes, and a plurality of edges, wherein the third node represents the staff available for the scheduling, the fourth node represents a personal skill, and the edge connects the fourth node with an associated third node, and wherein in the second undirected graph, each edge is set with an associated weight, which represents a proficiency level of the staff with whom the edge is connected with respect to the personal skill with which the edge is connected.

6. The method according to claim 5, wherein the determining staff to be scheduled based on the recognized emergency scene further comprises:

determining, in accordance with the recognized emergency scene, the personal skill and the proficiency level required for disposing the emergency scene;

determining, for a target fourth node representing each required personal skill, a difference between the proficiency level represented by a corresponding weight and the required proficiency level and an absolute value of the difference;

determining, for a third node connected with one or more target fourth nodes, a sum of the differences corresponding to the connected target fourth nodes and a sum of the absolute values of the differences; and

ranking the plurality of third nodes based on the sum of the

differences and the sum of the absolute values of the differences, and determining the staff to be scheduled based on a result of the ranking.

7. The method according to claim 6, wherein the ranking the plurality of third nodes further comprises: ranking the plurality of third nodes in a descending order of the sum of the differences, and in the case where the sum of the differences is equal, the smaller the sum of the absolute values of the differences, the more top level the ranking.

8. The method according to claim 5, wherein the determining staff to be scheduled based on the recognized emergency scene further comprises: determining the staff to be scheduled based on a distance from the staff to a site of the emergency scene.

9. The method according to claim 5, wherein the determining staff to be scheduled based on the recognized emergency scene further comprises: determining the staff to be scheduled based on a tool preparation situation of the staff.

10. The method according to claim 1, further comprising: notifying the determined staff to be scheduled of arrival at a site of the emergency scene, and notifying the determined staff to be scheduled of an operation guide for disposing the emergency scene.

11. The method according to claim 1, further comprising:
highlighting a location of an site of the emergency scene and
location(s) of the determined staff to be scheduled on a map,
and highlighting location movement of the determined staff to
be scheduled on the map.

12. The method according to claim 1, wherein the industrial
site comprises a data center.

13. The method according to claim 6, further comprising:
pre-establishing the first undirected graph;
pre-establishing the second undirected graph; and
pre-establishing an association relation between the
emergency scene and the personal skill and the proficiency level
required for disposing the emergency scene.

14. The method according to claim 13, further comprising:
wherein the first undirected graph and the association
relation between the emergency scene and the personal skill and
the proficiency level required for disposing the emergency scene
are pre-established according to expert experience and/or by
using a machine learning technology, and the second undirected
graph is pre-established based on a staff information database.

15. An electronic device, comprising:

a memory; and

a processor coupled to the memory, wherein the memory has stored therein instructions which, when executed by the processor, cause the electronic device to perform the method according to any of claims 1 to 14.

16. A non-transitory computer-readable storage medium, having stored thereon a computer program which, when executed by a processor, implements the method according to any of claims 1 to 14.

17. A staff scheduling device in an emergency scene, comprising: sections for performing the method according to any of claims 1 to 14.

18. A monitoring system for an industrial site, comprising: the electronic device according to claim 15.