

PLANT MONITORING SERVER AND PLANT MONITORING METHOD

Background

The present invention relates to a plant monitoring
5 server and a plant monitoring method.

A large number of measuring apparatuses and control
apparatuses are installed in a plant. It is necessary to
inspect working conditions of those apparatuses regularly
or at a given point in time in order to promote operation
10 of a plant appropriately. It is important to know the
working conditions of a large number of apparatuses
accurately at the right timing in order to determine a
proper working condition, to decide an appropriate
repairing method if it is determined that an apparatus is
15 in trouble, to predict an appropriate lifetime, and to
decide when to replace components. In the past, some
systems, each of which assists a worker in charge of
monitoring to monitor apparatuses effectively and
accurately, have been developed.

20 Japanese Patent Application Laid-open No. 2000-
222027 discloses an information presentation method.
According to this method, in order to prevent an operator
from overlooking important information displayed on a
control terminal of a plant control system, the
25 operator's eye gaze is detected. If the operator does
not pay attention to the display apparatus, the control
terminal alerts the operator to the need for confirmation
of the very important information in speech (paragraphs
0005 to 0008).

30 Japanese Patent Application Laid-open No. 2003-
295975 discloses a fieldwork assist system. In the

fieldwork assist system, a handsfree computer
(hereinafter referred to as "wearable computer")
including a headset and a main computer is used. It is
possible to obtain various kinds of information on
5 apparatuses without using hands when a user checks the
apparatuses or keeps the apparatuses in good condition
(paragraphs 0004 to 0008). According to Japanese Patent
Application Laid-open No. 2003-295975, a worker wears a
wearable computer (Fig. 4). The worker selects an
10 operation from items on a menu in speech without using
hands. The computer recognizes the speech (Fig. 14,
paragraph 0094).

Japanese Patent Application Laid-open No. 2013-
101248 discloses a speech control method using an
15 augmented reality (AR) technology. There is disclosed a
speech control system configured to store position
information and tag information in relation in an AR
server, to receive position information on the current
position from a mobile terminal, and then to send
20 position information on the position near the mobile
terminal and tag information to a terminal apparatus
(paragraph 0019). According to Japanese Patent
Application Laid-open No. 2013-101248, a plurality of
pieces of tag information are output to the terminal
25 apparatus, and a plurality of pieces of desired tag
information can be provided to the user simultaneously.
This is based on the fact that a person is capable of
distinguishing a plurality of speeches (paragraphs 0027
to 0029).

Summary

However, when a plant is monitored and checked,

workers having different jobs or posts monitor a large number of apparatuses from many different viewpoints. It is rare that one uniformed monitoring procedure is established. In other words, it is necessary for workers, who are in charge of monitoring and checking a plant, to check items to be monitored from their own standpoints.

With regard to this point, according to the related art disclosed in Japanese Patent Application Laid-open No. 2000-222027, 2003-295975, or 2013-101248, the same speech information is provided irrespective of the job, the post, or interest of a user (worker). Because of this, not only information necessary for an individual user but also much unnecessary information is provided. As a result, a user may not obtain necessary information effectively. In addition, necessary information may be hidden by unnecessary information. As a result, a user may not carry out appropriate measures promptly. The larger the number of apparatuses to be monitored, the larger the adverse effect.

In view of the above-mentioned circumstances, it is desirable to provide a plant monitoring server and a plant monitoring method capable of providing appropriate information depending on users, and monitoring a plant effectively and reliably.

(1) According to a first embodiment of the present invention, there is provided a plant monitoring server capable of communicating with a mobile information terminal carried by a user, the plant monitoring server including: a user definition information database configured to store user definition information; an apparatus definition information database configured to

store identification information on an apparatus to be monitored; a monitor information database configured to store monitor information in association with the apparatus to be monitored; a user definition information obtaining unit configured to obtain user identification information from the mobile information terminal, to search the user definition information database, and to obtain user definition information in association with the user identification information; an apparatus determining unit configured to obtain position information from the mobile information terminal, to search the apparatus definition information database, and to determine the apparatus having a predetermined positional relation with the mobile information terminal; an information extracting unit configured to search the monitor information database, and to extract monitor information on the determined apparatus to be output based on the obtained user definition information; and a speech information generator configured to generate speech information based on the extracted monitor information, the speech information corresponding to speech to be output by the mobile information terminal.

According to the first embodiment of the present invention, there is further provided a plant monitoring method executed by a mobile information terminal carried by a user and by a plant monitoring server, the plant monitoring server including a user definition information database configured to store user definition information, an apparatus definition information database configured to store identification information on an apparatus to be monitored, and a monitor information database configured

to store monitor information in association with the apparatus to be monitored, the plant monitoring method including: obtaining user identification information from the mobile information terminal, searching the user definition information database, and obtaining user definition information in association with the user identification information; obtaining position information from the mobile information terminal, searching the apparatus definition information database, and determining the apparatus having a predetermined positional relation with the mobile information terminal; searching the monitor information database, and extracting monitor information on the determined apparatus to be output based on the obtained user definition information; and generating speech information based on the extracted monitor information, the speech information corresponding to speech to be output by the mobile information terminal.

According to the first embodiment of the present invention, the following configurations (2) to (4) may be provided.

(2) The plant monitoring server according to (1), in which the speech information generator includes a sentence template database configured to store a sentence template of speech to be provided to a user, and the speech information generator is configured to search the sentence template database, and to generate sentence information corresponding to the extracted monitor information.

(3) The plant monitoring server according to (1) or (2), further including: an importance decision unit

configured to decide importance of the sentence
information based on the user definition information and
the extracted monitor information, in which the speech
generated based on the speech information is to be output
5 in a mode corresponding to the decided importance.

(4) The plant monitoring server according to any
one of (1) to (3), further including: an information
analyzer configured to analyze speech information and/or
image information sent from the mobile information
10 terminal; and a monitor information updating unit
configured to update the monitor information database
based on monitor information corresponding to the
analyzed speech information and/or image information.

(5) According to a second embodiment of the present
15 invention, there is provided a plant monitoring server
capable of communicating with a mobile information
terminal carried by a user, the plant monitoring server
including: a user definition information database
configured to store user definition information, the
20 identification information including attribute
information on a user; an apparatus definition
information database configured to store identification
information on an apparatus to be monitored; a monitor
information database configured to store monitor
25 information in association with the apparatus to be
monitored; a user definition information obtaining unit
configured to obtain user identification information from
the mobile information terminal, to search the user
definition information database, and to obtain user
30 definition information in association with the user
identification information; an apparatus determining unit

configured to obtain position information from the mobile information terminal, to search the apparatus definition information database, and to determine an apparatus having a predetermined positional relation with the mobile information terminal; an information extracting unit configured to search the apparatus definition information database, and to extract identification information on the determined apparatus; and a sender configured to provide identification information on the apparatus and the user definition information to the mobile information terminal.

According to the second embodiment of the present invention, there is further provided a plant monitoring method executed by a mobile information terminal carried by a user and by a plant monitoring server, the plant monitoring server including a user definition information database configured to store user definition information, the identification information including attribute information on a user, an apparatus definition information database configured to store identification information on an apparatus to be monitored, and a monitor information database configured to store monitor information in association with the apparatus to be monitored, the plant monitoring method including:

obtaining user identification information from the mobile information terminal, searching the user definition information database, and obtaining user definition information in association with the user identification information; obtaining position information from the mobile information terminal, searching the apparatus definition information database, and determining an

apparatus having a predetermined positional relation with the mobile information terminal; searching the apparatus definition information database, and extracting identification information on the determined apparatus; sending part of the user definition information and identification information on the apparatus, and communicating with an apparatus in association with the identification information; and obtaining monitor information provided by the apparatus, and generating speech information, the speech information being used to output speech corresponding to the monitor information.

According to the second embodiment of the present invention, the following configuration (6) may be provided.

(6) The plant monitoring server, further including: an information analyzer configured to analyze speech information and/or image information sent from the mobile information terminal; and a monitor information updating unit configured to update the monitor information database based on monitor information corresponding to the analyzed speech information and/or image information.

The mobile information terminal according to the first and second embodiments of the present invention may have the following configurations.

(7) A mobile information terminal capable of communicating with the plant monitoring server according to any one of (1) to (4), the mobile information terminal including: a speech synthesizer configured to generate speech information based on the sentence information, the speech information being used to output speech corresponding to the sentence information.

(8) A mobile information terminal capable of communicating with the plant monitoring server according to (5) or (6), the mobile information terminal including: an apparatus communication unit configured to send part
5 of the provided user definition information and the provided identification information on the apparatus, and to communicate with an apparatus in association with the identification information; and a speech synthesizer configured to obtain monitor information provided by the
10 apparatus, and to generate speech information, the speech information being used to output speech corresponding to the monitor information.

According to the present invention, monitor information on an apparatus to be monitored is extracted
15 based on user identification information, who operates a mobile information terminal. The monitor information is provided in speech. As a result, appropriate information is provided depending on the job or the post of a user without hindering the user's monitoring task. A plant
20 can be monitored effectively and reliably.

Brief Description of Drawings

Fig. 1 is a system diagram illustrating the outline of the plant monitoring system of Embodiment 1;

Fig. 2 is a block diagram showing the plant
25 monitoring server of Embodiment 1;

Fig. 3 is a block diagram showing the mobile information terminal of Embodiment 1;

Fig. 4 shows a structural example of the user definition information database of this embodiment;

30 Fig. 5 shows a structural example of the apparatus definition information database of this embodiment;

Fig. 6 is a structural example of the monitor information database of this embodiment;

Fig. 7 shows a structural example of the sentence template database of this embodiment;

5 Fig. 8 shows a structural example of the importance definition database of this embodiment;

Fig. 9 is a structural example of the speech mode definition information database of this embodiment;

10 Fig. 10 is a flowchart illustrating the behavior of Embodiment 1;

Fig. 11 is a system diagram illustrating the outline of the plant monitoring system of Embodiment 2;

Fig. 12 is a block diagram showing the plant monitoring server of Embodiment 2;

15 Fig. 13 is a block diagram showing the mobile information terminal of Embodiment 2; and

Fig. 14 is a flowchart illustrating the behavior of Embodiment 2.

Detailed Description of Embodiments

20 Hereinafter, embodiments of the present invention will be described in detail. Note that the following embodiments are merely examples to describe the present invention. The following embodiments may be variously modified within the gist of the present invention. For
25 example, in the following embodiments, an "xxx unit" or an "yyy apparatus" may be wholly realized by hardware, or may be wholly and functionally realized by a computer executing a predetermined software program.
Alternatively, part of an "xxx unit" or an "yyy
30 apparatus" may be realized by hardware, and the rest may be functionally realized by a computer executing a

predetermined software program. Moreover, division of a "database" is merely an example. Alternatively, databases, which are arranged differently from those of the embodiments, may be used. For example, one database
5 may include a plurality of databases. One database may be divided into a plurality of databases. The structure of records and fields in a database may be changed as necessary. Moreover, the positional relation (up, down, right, left, etc.) shown as necessary is based on the
10 drawings unless otherwise noted. Moreover, various dimensions and ratios are not limited to those shown in the drawings.

(0. Definition)

In this specification, terms are defined as follows.

15 To "monitor" means to know working conditions, to detect presence/absence of troubles, and to refer to measurement information.

"Monitor information" means, if an apparatus is a measuring apparatus, information on measured values
20 measured by the apparatus and its working condition.

"Monitor information" means, if an apparatus is a control apparatus, information on its working condition.

"Plant" means an indoor/outdoor space, in which apparatuses to be monitored are installed, such as a
25 factory.

(1. Embodiment 1)

According to Embodiment 1 of the present invention, a plant monitoring server side generates speech information, and a mobile information terminal side
30 provides speech based on the speech information.

(1-1. Plant monitoring system)

Fig. 1 is a system diagram illustrating the outline of the plant monitoring system of Embodiment 1. As shown in Fig. 1, the plant monitoring system 1000 of Embodiment 1 includes the plant monitoring server 100, the
5 apparatuses 200-1, 2, 3, ..., N to be variously monitored (hereinafter simply referred to as "apparatuses 200" if it is not necessary to distinguish each apparatus), the mobile information terminal 300, and the controller 500.

The field apparatus communication bus 401 connects
10 the apparatuses 200 and the controller 500. The field apparatus communication bus 401 is a communication bus capable of sending control signals to the apparatuses 200, and receiving detection signals from the apparatuses 200.

The field apparatus communication bus 401 meets Xbus
15 standard, for example.

The apparatuses 200 are field apparatuses installed in a plant. The apparatuses 200 roughly include measuring apparatuses and control apparatuses. A
20 "measuring apparatus" is a field apparatus configured to measure a predetermined physical quantity (flow rate, temperature, pressure, etc.) in the plant. Examples of such a "measuring apparatus" include a flow rate sensor, a temperature sensor, a pressure sensor, and the like. A
25 "control apparatus" is a field apparatus configured to control a predetermined physical quantity (flow rate control, temperature control, pressure control, revolution speed control, etc.) in the plant. Examples of such a "control apparatus" include valves, heaters, pumps, fans, and the like. Note that the "apparatuses"
30 are not limited to the above-mentioned measuring apparatuses and control apparatuses as long as they are

capable of outputting information that a user can use.

The apparatuses 200 are connected with the controller 500 via the field apparatus communication bus 401, and are capable of communicating with the controller 500 via the field apparatus communication bus 401. Each apparatus 200 is configured to send monitor information. The monitor information includes working conditions of the apparatus 200, presence/absence of troubles of the apparatus 200, and measurement information if the apparatus 200 is a measuring apparatus. Note that a serial interface circuit (not shown) connects the apparatus 200 with the field apparatus communication bus 401. A communication wire connects the apparatus 200 with serial interface circuit. The communication wire transmits analog signals or field apparatus communication signals of HART standard or the like.

The controller 500 is a controller unit configured to control the apparatuses 200 overall. The controller 500 is configured to obtain measurement information (flow rate, temperature, pressure, etc.), which is obtained from the apparatuses 200 (measuring apparatuses). The controller 500 is configured to send the obtained measurement information to the plant monitoring server 100. The controller 500 is further configured to send control information (flow rate, temperature, pressure, revolution speed, etc.) to the apparatuses 200 (control apparatuses), based on the measurement information. The controller 500 is further configured to send status information to the plant monitoring server 100. Some status information shows that a working condition of the apparatus 200 is out of the optimum range, which is

apparent from measurement information obtained from the apparatus 200 (measuring apparatus). Other status information shows that the apparatus 200 (control apparatus) sent a signal showing a trouble.

5 The upper layer network 400 connects the plant monitoring server 100, the mobile information terminal 300, and the controller 500. The upper layer network 400 is a computer network capable of performing wired and/or wireless communication. For example, the upper layer
10 network 400 is a LAN (Local Area Network) meeting Ethernet (registered trademark) standard, or a WAN (Wide Area Network) such as the Internet. Note that the communication protocol between the plant monitoring server 100 and the mobile information terminal 300 may be
15 an infrared near field communication standard such as IrDA (Infrared Data Association), a near field communication standard such as Bluetooth (registered trademark), a computer peripheral device connection standard such as HID (Human Interface Device Profile), a
20 wireless network standard between apparatuses such as PAN (Personal Area Network Profile), a headset (earphone microphone) connection standard such as HSP (Headset Profile), a mobile communication standard for mobile phones such as 3G communication standard (W-CDMA, etc.)
25 or Pre-4G/4G communication standard (LTE, etc.), or a communication standard for small mobile terminals such as PHS (Personal Handy-phone System).

 The mobile information terminal 300 is a computer apparatus. A user, i.e., a worker, can carry the mobile
30 information terminal 300. The mobile information terminal 300 has at least a communication function, a

position-detecting function, and a speech-generating function (described later). In this embodiment, the mobile information terminal 300 is a wearable computer that the user wears. The mobile information terminal 300 is configured to send user identification information and position information to the plant monitoring server 100. The user identification information is input by a user and stored. The position information is detected by using the position-detecting function. The mobile information terminal 300 is further configured to optionally send speech information and/or image information to the plant monitoring server 100. The speech information is generated based on what a user speaks. The image information is generated based on an image-taking function. The mobile information terminal 300 will be described later in detail with reference to Fig. 3.

(1-2. Plant monitoring server 100)

The plant monitoring server 100 is configured to receive user identification information, position information, speech information and image information (selectively), and the like from the mobile information terminal 300 via the upper layer network 400. The plant monitoring server 100 is further configured to send information, which is extracted in a process (described later), to the mobile information terminal 300. Typically, one plant monitoring server 100 is installed in one plant. Alternatively, a plurality of computer apparatuses may execute distributed processing to thereby realize the mobile information terminal 300 in an integrated manner. Alternatively, cloud computing may

provide the plant monitoring server 100. The plant monitoring server 100 is further configured to receive monitor information via the controller 500. The monitor information includes working conditions of the apparatuses 200, presence/absence of troubles of the apparatuses 200, and measurement information if the apparatuses 200 are measuring apparatuses.

Fig. 2 is a block diagram showing the plant monitoring server 100 of Embodiment 1. The plant monitoring server 100 has a configuration of a general-purpose computer apparatus or a workstation. The plant monitoring server 100 includes, as hardware, a CPU (Central Processing Unit), a ROM (Read-only Memory), a RAM (Random Access Memory), an interface circuit, mass storage, a communication device, and the like (not shown).

For example, the mass storage stores a software program of the plant monitoring method of the present invention. When the plant monitoring method is executed, the RAM reads the software program and the CPU executes the program. As a result, the functional blocks of Fig. 2 are realized.

As shown in Fig. 2, the plant monitoring server 100 of Embodiment 1 includes, as databases, the user definition information database 101, the apparatus definition information database 102, the monitor information database 108, the sentence template database 107, and the importance definition database 112. Storage such as the RAM or the mass storage is virtually divided, whereby those databases are obtained. Information stored in the databases may be text data, which includes letters illustrated in the attached drawings. Alternatively,

information stored in the databases may include numerical values/symbols corresponding to the letters that the computer can recognize. The plant monitoring server 100 further includes the receiver 113 and the sender 114.

5 The plant monitoring server 100 further includes, as functional blocks, the user definition information obtaining unit 103, the apparatus determining unit 104, the information extracting unit 105, the speech information generator 106, the information analyzer 109,
10 the monitor information updating unit 110, and the importance decision unit 111. Hereinafter, those blocks will be described in detail.

(Receiver 113)

The receiver 113 is configured to receive at least
15 user identification information and position information from the mobile information terminal 300 via the upper layer network 400. The receiver 113 is further configured to as necessary receive speech information and/or image information from the mobile information
20 terminal 300. The receiver 113 is further configured to receive monitor information sent from the controller 500.

The monitor information includes measurement information or status information on the apparatuses 200.

(User definition information database 101)

25 The user definition information database 101 is a database configured to store user's identification information. Mainly the user definition information obtaining unit 103 refers to the user definition information database 101.

30 Fig. 4 shows a structural example of the user definition information database 101 of this embodiment.

As shown in Fig. 4, for example, the user definition information database 101 includes "user ID", "affiliation", "job", and "preference" fields. The "user ID" is user identification information, which is allocated to each user and identifies each user. For example, an alphabet, a number, or the like is recorded as a "user ID". In Fig. 4, the alphabets "A" to "F" are allocated to the user IDs, for example. The "affiliation" is information on a user's affiliation. For example, a group of an organization, a section/division name, or the like is allocated to the "affiliation". In Fig. 4, for example, "P group", "Q group", and "R group" are allocated to the affiliation. The "job" is information on a user's job. For example, a role in a monitoring task, a post in an organization, or the like is allocated to the "job". In Fig. 4, for example, "daily check", "monthly check", and "audit" are allocated to the job. A user sets up the "preference" field as necessary. A user's concern, i.e., an event to be monitored, about which the user worries in particular, is prerecorded in the "preference" field. In Fig. 4, for example, "sensor pressure" and "pump" is allocated to the preference.

(User definition information obtaining unit 103)

With reference to Fig. 2 again, the user definition information obtaining unit 103 is a functional block configured to obtain user identification information from the mobile information terminal 300, searches the above-mentioned user definition information database 101, and obtains user's identification information in association with the user identification information. For example,

if the mobile information terminal 300 sent the user identification information "C", the user definition information obtaining unit 103 searches the user definition information database 101 for a record whose "user ID" is "C" to thereby retrieve "P group" as the "affiliation", "audit" as the "job", and "sensor pressure" as the "preference". Further, for example, if the mobile information terminal 300 sent the user identification information "F", the user definition information obtaining unit 103 searches the user definition information database 101 for a record whose "user ID" is "F" to thereby retrieve "R group" as the "affiliation", "monthly check" as the "job", and "N/A" (not applicable) as the "preference".

(Apparatus definition information database 102)

The apparatus definition information database 102 is a database, which stores identification information on apparatuses to be monitored. The apparatus determining unit 104 and the information extracting unit 105 refer to the storage, i.e., the apparatus definition information database 102.

Fig. 5 shows a structural example of the apparatus definition information database 102 of this embodiment. As shown in Fig. 5, for example, the apparatus definition information database 102 includes "apparatus ID", "installation position", "type", "measurement control target", "optimum range", and "unit" fields. The "apparatus ID" is identification information allocated to each apparatus to identify each apparatus. For example, a number, an alphabet, or the like is recorded as the "apparatus ID". In Fig. 5, for example, numbers "1001"

to "1006" are allocated to the apparatus ID. The
"installation position" is information on the
installation position of each apparatus. If the mobile
information terminal 300 is configured to detect its
5 position by using a GPS (Global Positioning System), the
installation position is preferably information, which is
to be checked against an output of the GPS. For example,
information corresponding to latitude/longitude is
allocated to the "installation position". In Fig. 5, for
10 example, "N1, E1" (N: north latitude, E: east longitude)
to "N6, E6" are allocated to the installation position.
Note that if the mobile information terminal 300 detects
a position by using another means (for example, a barcode
or matrix code is read, or a position is input by a user),
15 information, which is to be compared with the means, is
stored. The "type" is information on the kind of an
apparatus. For example, the kind of a physical quantity
detected by a measuring apparatus (sensor), a control
means of a control apparatus, or the like is allocated.
20 In Fig. 5, for example, "flow rate sensor", "pressure
sensor", and "temperature sensor" are allocated to the
types of measuring apparatuses. "Flow rate control
valve", "pump", and "fan" are allocated to the types of
control apparatuses. The "measurement control target" is
25 information on a physical quantity of measure or control
of an apparatus. In Fig. 5, for example, "flow rate",
"pressure", and "temperature" are allocated to the
measurement control target of measuring apparatuses.
"Flow rate", "revolution speed", and "revolution speed"
30 are allocated to the measurement control target of
control apparatuses. The "optimum range" is information

on a range of a measured value to be detected by each apparatus or a driving quantity to be controlled by each apparatus. The "unit" is information specifying a unit of a numerical value of the above-mentioned "optimum range". In Fig. 5, for example, "m³/h" (flow rate), "Pa" (pressure), "°C" (temperature), and "rpm" (revolution speed) are allocated to the unit.

(Apparatus determining unit 104)

With reference to Fig. 2 again, the apparatus determining unit 104 is a functional block configured to obtain position information from the mobile information terminal 300, to search the apparatus definition information database 102, and to determine an apparatus 200, which has a predetermined positional relation with the mobile information terminal 300. Specifically, if an apparatus 200, which is in a predetermined neighborhood area of the mobile information terminal 300, is detected, the apparatus determining unit 104 determines that the apparatus 200 is in the "neighborhood". For example, if a neighborhood area is within a judge distance Δd from the mobile information terminal 300 and if an apparatus 200 is within the judge distance Δd , the apparatus determining unit 104 determines that the apparatus 200 is in the "neighborhood". A "neighborhood area" may be set instead of a judge distance. The "neighborhood area" is an area surrounded by a plurality of coordinate points each having latitude and longitude, the center of the area being the mobile information terminal 300. Moreover, if the mobile information terminal 300 is in the "neighborhood" of the apparatus 200 and the mobile information terminal 300 faces the apparatus 200, the

apparatus determining unit 104 determines that the apparatus 200 is in "front". For example, if the mobile information terminal 300 sent position information (north latitude, east longitude, direction)=(N3', E3', D3) and the distance d between the position (N3, E3) and the position (N3', E3') is equal to or less than the judge distance Δd ($d \leq \Delta d$), the apparatus determining unit 104 determines that the apparatus 200 in the "neighborhood" is a temperature sensor having an apparatus ID "1003". Moreover, if a temperature sensor is in the direction D3 from the position (N3', E3') of the mobile information terminal 300, the apparatus determining unit 104 determines that the apparatus 200 in "front" is a temperature sensor having an apparatus ID "1003". Note that if the mobile information terminal 300 is configured to detect an elevation angle, position information may include an elevation angle in addition to direction. For example, a positive angle (upper elevation angle) or a negative angle (lower elevation angle), the horizontal direction being 0° , may be sent and received. The positive or negative angle may be used to identify an apparatus.

Note that in this embodiment, the apparatus determining unit 104 determines that the apparatus 200 to be monitored is in "front" if the apparatus 200 is in the "neighborhood" and the mobile information terminal 300 faces the apparatus 200. Alternatively, for example, the apparatus determining unit 104 may determine that the apparatus 200 to be monitored is in "front" only based on the direction that the mobile information terminal 300 faces irrespective of the distance between the apparatus

200 to be monitored and the mobile information terminal 300. This is because, if the mobile information terminal 300 (user) faces the front, he can recognize the apparatus 200 that he looks at even if the apparatus 200 is relatively far, because the user knows the apparatus 200 that he looks at. Moreover, the distance d_2 between the apparatus 200 and the mobile information terminal 300 may be different from the distance d . Based on the distance d_2 , it is determined that the apparatus 200 to be monitored is in "front". Based on the distance d , it is determined that the apparatus 200 to be monitored is in the "neighborhood". For example, it is appropriate that the distance d_2 is larger than the distance d . Based on the distance d_2 , it is determined that the apparatus 200 to be monitored is in "front". Based on the distance d , it is determined that the apparatus 200 to be monitored is in the "neighborhood". As described above, if the mobile information terminal 300 faces the front, a user can recognize that the apparatus 200 to be monitored is in "front" even if the apparatus 200 is relatively far. However, if the mobile information terminal 300 does not face the front, the user is not capable of recognizing an apparatus 200 to be monitored only if the apparatus 200 is relatively near.

(Monitor information database 108)

The monitor information database 108 is a database configured to store monitor information in association with each apparatus to be monitored. The information extracting unit 105 refers to the monitor information database 108 (storage). The monitor information updating unit 110 is capable of updating the monitor information

database 108 (storage).

Fig. 6 is a structural example of the monitor information database 108 of this embodiment. As shown in Fig. 6, for example, the monitor information database 108 includes "apparatus ID", "type", "measurement control target", "measured value", and "status" fields. Each of the "apparatus ID", "type", and "measurement control target" is information same as the field having the same name of the apparatus definition information database 102.

If an apparatus 200 is a measuring apparatus, the "measured value" is information on a value measured by the apparatus 200. If an apparatus 200 is a control apparatus, the "measured value" is information on a value controlled by the apparatus 200. The "status" is information on a status of the working condition of an apparatus, for example, normal or trouble. In Fig. 6, for example, one of "OK" (normal) or "NG" (trouble) is stored as a status. A working condition, which the controller 500 (see Fig. 1) obtains by communicating with each apparatus 200, is reflected in the "status" field. For example, the "status" is "OK" if the apparatus 200 returns a measured value within the "optimum range" of the apparatus definition information database 102. The "status" is "NG" if the apparatus 200 returns a measured value out of the "optimum range", or if the driving quantity of control is out of the "optimum range". Moreover, the "status" is "OK" if it is determined that the working condition of the apparatus 200 is normal. The "status" is "NG" if it is determined that the working condition of the apparatus 200 has a trouble. In Fig. 6, because the measured value of the temperature sensor

having the apparatus ID "1003" is within the "optimum range", its "status" is "OK". Because the measured value of the pressure sensor having the apparatus ID "1002" is out of the "optimum range", its "status" is "NG".

5 Because the measured value (driving quantity) of the fan having the apparatus ID "1006" is "out of the optimum range", its "status" is "NG". Moreover, even if the flow rate control valve of the apparatus ID "1004" is controlled within the "optimum range", if information on
10 a trouble is returned, its "status" is "NG".

(Information extracting unit 105)

With reference to Fig. 2 again, the information extracting unit 105 is a functional block configured to search the monitor information database 108, and to
15 extract monitor information on the determined apparatus 200 to be provided based on obtained user definition information. Specifically, the information extracting unit 105 searches the monitor information database 108 for an apparatus ID of an apparatus 200 as an index, the
20 apparatus determining unit 104 having judged that the apparatus 200 is in the "neighborhood" or in "front". The information extracting unit 105 extracts and outputs the "measured value" and "status" of the appropriate apparatus 200. For example, if it is judged that the
25 temperature sensor (apparatus 200) having the apparatus ID "1003" is in the "neighborhood", the information extracting unit 105 extracts a measured value "26" and a status "OK" from the monitor information database 108. If it is judged that the fan (apparatus 200) having the
30 apparatus ID "1006" is in "front", the information extracting unit 105 extracts a measured value (driving

quantity) "320" and a status "NG" from the monitor information database 108.

(Sentence template database 107)

The sentence template database 107 is storage
5 configured to store sentence templates of speech to be provided to a user. Mainly the speech information generator 106 refers to the sentence template database 107.

Fig. 7 shows a structural example of the sentence
10 template database 107. As shown in Fig. 7, for example, the sentence template database 107 includes "sentence #", "item 1", "item 2", "text 1", "item 3", "text 2", "item 4", "item 5", "item 6", and "text 3" fields. The "sentence #" is a unique number identifying the kind of a
15 sentence. In Fig. 7, for example, the sentence "1" is a text for a measuring apparatus, and the sentence "2" is a text for a control apparatus. Each "item" field is information on a field of the monitor information database 108 to be referred to. In Fig. 7, with regard
20 to the sentence "1", the "item 1" shows that the "type" field of the monitor information database 108 is to be referred to, the "item 2" shows that the "apparatus ID" field is to be referred to, the "item 3" shows that the "measurement control target" field is to be referred to,
25 the "item 4" shows that the "measured value" is to be referred to, the "item 5" shows that the "unit" is to be referred to, and the "item 6" shows that the "status" is to be referred to. Moreover, the "item 1", "item 2", and "item 6" of the sentence "2" are the same as those of the
30 sentence "1". However, the "item 3" to "item 5" of the sentence "2" are blank. Each "text" field shows a

genitive, termination, or verb conjugation of a sentence with each "item". In Fig. 7, With regard to the sentence "1", the "text 1" shows a genitive "'s", the "text 2" shows a verb "is", and the "text 3" shows a termination". Moreover, the "text 1" and "text 3" of the sentence "2" is the same as those of the sentence "1". However, the "text 2" of the sentence "2" is "status is".

(Speech information generator 106)

With reference to Fig. 2 again, the speech information generator 106 is a functional block configured to generate speech information based on extracted monitor information. The speech information corresponds to speech that the mobile information terminal 300 outputs. Specifically, with regard to the apparatus 200 (apparatus determining unit 104 judged that it is in the "neighborhood" or in "front"), the speech information generator 106 generates sentence information in accordance with a sentence template stored in the sentence template database 107 based on information ("measured value" and "status") extracted from the monitor information database 108 by the information extracting unit 105, and based on information ("apparatus ID", "type", "measurement control target", and "unit") retrieved from the apparatus definition information database 102. A template (sentence template) whose sentence # is "1" is selected if the apparatus 200 to be monitored is a measuring apparatus. A template (sentence template) whose sentence # is "2" is selected if the apparatus 200 to be monitored is a control apparatus. For example, if it is judged that an apparatus 200 is in the "neighborhood" or in "front" and the apparatus 200 is

a temperature sensor having the apparatus ID "1003", the speech information generator 106 refers to the sentence # "1", which is the sentence template of a measuring apparatus, in the sentence template database 107. The
5 speech information generator 106 inserts the type "temperature sensor" having the apparatus ID "1003" in the "item 1", the apparatus ID "1003" in the "item 2", the measurement control target "temperature" in the "item 3", the measured value "26" in the "item 4", the unit
10 "°C" in the "item 5", and the status "OK" in the "item 6". As a result, the speech information generator 106 generates a text sequence of sentence information "Temperature sensor 1003's temperature is 26°C OK.". Moreover, if it is judged that an apparatus 200 is in the
15 "neighborhood" or in "front" and the apparatus 200 is a fan having the apparatus ID "1006", the speech information generator 106 refers to the sentence # "2", which is the sentence template of a control apparatus, in the sentence template database 107. The speech
20 information generator 106 inserts the type "fan" having the apparatus ID "1006" in the "item 1", the apparatus ID "1006" in the "item 2", and the status "NG" in the "item 6". As a result, the speech information generator 106 generates sentence information to reproduce a text
25 sequence "Fan 1006's status is NG.". The sentence information may include any data as long as speech is synthesized based on the data and the above-mentioned text sequence is thus reproduced. For example, the sentence information may include ASCII data or data
30 converted into encoded linguistic expressions of a text-to-speech system.

(Importance definition database 112)

The importance definition database 112 is a database, which defines importance of sentence information depending on user definition information and monitor information. Mainly the importance decision unit 111 refers to the importance definition database 112, i.e., storage.

Fig. 8 shows a structural example of the importance definition database 112. As shown in Fig. 8, the importance definition database 112 includes "setting #", "affiliation", "job", "status", "position relation", "preference", and "importance" fields, for example. The "setting #" is a unique number identifying importance setting. Each of the "affiliation", "job", and "preference" is information same as the field having the same name of the user definition information database 101.

Note that "any" means that this field may define anything. "N/A" means that setting of this field is ignored. The "status" is information same as the field having the same name of the monitor information database 108. The "position relation" is information corresponding to information judged by the apparatus determining unit 104 (described later). In Fig. 8, "neighborhood" or "front" is stored in each "position relation" field. The "importance" is information on importance set corresponding to each combination of the above-mentioned fields and is represented by a numerical value. In Fig. 8, "3", "2", or "1" is set for "importance". In this embodiment, the larger the importance, the larger the numerical value.

For example, in Fig. 8, the importance setting # "1"

means that if the "status" of an apparatus in the "neighborhood" is "NG", speech information on importance "2" is to be output irrespective of a user's "affiliation" and "job" and "preference". This is to alert a user, who is monitoring the plant, that he is in the neighborhood of an apparatus 200, whose trouble in working condition is detected. The importance setting # "2" means that if the "status" of an apparatus in "front" is "NG", speech information on importance "3" is to be output irrespective of a user's "affiliation", "job", and "preference". This is to alert a user, who is monitoring the plant, that the apparatus 200 in front of the user has a trouble in its working condition. The importance setting # "3" means that if the apparatus 200 in the "neighborhood" is a "fan" and if the status is "OK", speech information on importance "1" is to be output to a user whose "job" is "audit" irrespective of "affiliation". The importance setting # "4" means that if the apparatus 200 in "front" is a "sensor" and the status is "OK", speech information on importance "2" is to be output to a user whose "job" is "audit" irrespective of "affiliation". This is to inform a user, who is in charge of audit, that the working condition of the apparatus 200 in the neighborhood or in front is normal just for reference. Meanwhile, the importance setting # "12" means that if an apparatus to be monitored is set for "preference", speech information on importance "2" is to be output even if the status of the apparatus 200 in "front" is "OK" irrespective of "affiliation" and "job". This is to alert a user that he is in front of the specified apparatus 200, whose "preference" is specified with high

importance, because if "preference" is set, then it means that the user is interested in it.

(Importance decision unit 111)

5 With reference to Fig. 2 again, the importance decision unit 111 is a functional block configured to decide importance of sentence information generated by the speech information generator 106 based on user definition information extracted by the user definition information obtaining unit 103 and based on monitor
10 information extracted by the information extracting unit 105. Specifically, the importance decision unit 111 searches the importance definition database 112 for a record ("setting #") corresponding to the combination of: user definition information ("affiliation", "job",
15 "preference") of a user, who uses the mobile information terminal 300; extracted monitor information ("status"); and selectively position information ("positional relation" of "neighborhood" or "front") of the apparatus 200 to be monitored. Moreover, the importance decision
20 unit 111 retrieves "importance" of this record. For example, if a user, who uses the mobile information terminal 300, has a user ID "A" (see Fig. 4) and is in front of the apparatus 200 having the apparatus ID "1001" (see Fig. 6), the importance decision unit 111 extracts
25 the setting # "7" from the importance definition database (see Fig. 8), and outputs importance "1". Moreover, if a user, who uses the mobile information terminal 300, has a user ID "B" (see Fig. 4) and passes by the apparatus 200 having the apparatus ID "1002" (see Fig. 6), the
30 importance decision unit 111 extracts the setting # "1" from the importance definition database (see Fig. 8), and

outputs importance "2". Moreover, if a user, who uses the mobile information terminal 300, has a user ID "C" (see Fig. 4) and is in front of the apparatus 200 having the apparatus ID "1003" (see Fig. 6), the importance decision unit 111 extracts the setting # "12" from the importance definition database (see Fig. 8), and outputs importance "2" because "preference" is set.

(Information analyzer 109)

The information analyzer 109 is a functional block configured to analyze speech information and/or image information sent from the mobile information terminal 300, and to extract monitor information to be registered in the monitor information database 108. The information analyzer 109 is an optional functional block selectively provided. Specifically, the information analyzer 109 recognizes sent speech information by using a known technology, converts the recognized speech information into letter information or numerical value information, and extracts information on a measured value or a status to be stored in the monitor information database 108. Moreover, the information analyzer 109 recognizes sent image information by using a known technology, converts the recognized image information into letter information or numerical value information, and extracts information on a measured value or a status to be stored in the monitor information database 108.

(Monitor information updating unit 110)

The monitor information updating unit 110 is a functional block configured to refer to monitor information extracted by the information analyzer 109 or monitor information provided by each apparatus 200 via

the apparatus network, and to update or add monitor information stored in the monitor information database 108. The monitor information updating unit 110 is an optional functional block selectively employed.

5 Specifically, if the information analyzer 109 extracts information on a measured value or a status, the monitor information updating unit 110 updates the monitor information database 108 based on the information. For example, if a measured value or a status is extracted,
10 the monitor information updating unit 110 overwrites and saves a measured value or a status in the record of the corresponding apparatus ID of the apparatus 200, which is recognized as an apparatus in the "neighborhood" or in "front" at this time.

15 Moreover, the monitor information updating unit 110 receives monitor information including measurement information or status information on each apparatus 200 from the controller 500, and then updates the monitor information database 108 based on the information. For
20 example, if the monitor information updating unit 110 receives measurement information and status information, the monitor information updating unit 110 searches the monitor information database 108 for identification information on the apparatus 200 associated with the
25 information, and stores the measurement information and the status information in the "measured value" and "status" fields of a record of the corresponding apparatus ID of the apparatus 200.

(Sender 114)

30 The sender 114 is configured to send sentence information generated by the speech information generator

106 and importance information decided by the importance
decision unit 111 to the mobile information terminal 300
via the upper layer network 400. The sender 114 may be
further configured to send image information to the
5 mobile information terminal 300 as necessary (not shown).

(1-3. Mobile information terminal 300)

The mobile information terminal 300 of Embodiment 1
is configured to communicate with the above-mentioned
plant monitoring server 100, and to provide, based on
10 sentence information and importance information sent from
the plant monitoring server 100, speech corresponding to
the sentence information in a mode corresponding to the
specified importance. The mobile information terminal
300 is a mobile computer apparatus at least having a
15 communication function, a position-detecting function,
and a speech-generating function. In Embodiment 1, the
mobile information terminal 300 is a wearable computer
like a wristwatch or glasses. Note that the mobile
information terminal 300 may be other hardware such as an
20 HMD (Head Mount Display), a smartphone, a notebook or
laptop personal computer, a mobile phone, a PDA (Personal
Digital Assistant), or the like.

Fig. 3 is a block diagram showing the mobile
information terminal 300 of Embodiment 1. As shown in
25 Fig. 3, the mobile information terminal 300 has a
configuration of a wearable computer. The mobile
information terminal 300 includes the receiver 301, the
sender 302, and the memory 310. The mobile information
terminal 300 further includes, as functional blocks, the
30 speech synthesizer 303, the image generator 305, the
speech obtaining unit 306, the image obtaining unit 307,

the position information obtaining unit 308, and the operation information obtaining unit 309. The mobile information terminal 300 further includes, as databases, the sound source database 304a and the speech mode definition information database 304b.

The headset 320 is detachably connected to the mobile information terminal 300. The headset 320 includes the speaker 321, the display 322, and the microphone 323.

Note that the mobile information terminal 300 includes, as hardware, all the configuration of a general-purpose personal computer. For example, the mobile information terminal 300 includes a CPU (Central Processing Unit), a RAM (Random Access Memory), a ROM (Read-only Memory), an interface circuit, and the like (not shown). For example, part of the storage area of the ROM is allocated to the sound source database 304a and the speech mode definition information database 304b.

Part of the storage area of the RAM is allocated to the memory 310. A software program is stored in the ROM or transferred to the RAM. The CPU executes the software program. As a result, the above-mentioned functional blocks are realized functionally.

(Receiver 301)

The receiver 301 is configured to at least receive sentence information and importance information from the plant monitoring server 100 via the upper layer network 400. Moreover, the receiver 301 selectively receives image information from the plant monitoring server 100.

(Sound source database 304a)

The sound source database 304a is a speech library,

which stores waveform data for reproducing speech corresponding to each text in sentence information. The speech synthesizer 303 is capable of referring to the sound source database 304a. The sound source database 304a stores, as sound source data, waveform data for reproducing speech corresponding to various speech synthesis methods. For example, if the concatenative synthesis method is used as a speech synthesis method, the sound source database 304a stores waveform data on each text for reproducing speech of a person. If the formant synthesis method is used, the sound source database 304a stores waveform data of artificial speech adjusted effectively. Specifically, the sound source database 304a stores a plurality of pieces of waveform data having different modes on one text. For example, the sound source database 304a stores waveform data corresponding to a male voice and waveform data corresponding to a female voice for one text.

(Speech mode definition information database 304b)

The speech mode definition information database 304b is a correspondence table data, which defines a speech mode allocated to importance information sent from the plant monitoring server 100.

Fig. 9 is a structural example of the speech mode definition information database 304b of this embodiment. As shown in Fig. 9, "tone", "number of times", and "volume" are defined corresponding to the importance "1" to "3" used in this embodiment. The "tone" defines the characteristics of synthesized speech, for example, a male voice or a female voice. The "number of times" defines the number of times of repeat of speech of a text

sequence corresponding to provided sentence information. The "volume" defines the volume of speech. In Fig. 9, if the importance is "1", a text sequence is output, where the tone is "male", the number of times of repetition is only "1", and the volume is "low". The importance "1" corresponds to the "status" "OK" of the apparatus 200, which means no problem. Even if a user fails to hear the text sequence by any chance, it has no influence. So the text sequence is output once in an even tone and with a low volume, which leads to no problem. Moreover, if the importance is "2", a text sequence is output, where the tone is "male", the number of times of repetition is "2", and the volume is "middle". The importance "2" is set if the user's "job" is "audit", or if a user of a "group", which has a great responsibility in confirming a "measured value" or a "status", monitors an apparatus. So it is appropriate to output a text sequence with a middle volume for a plurality of times. As a result, a user may not fail to hear the text sequence. Meanwhile, if the importance is "3", a text sequence is output, where the tone is "female", reproduction is "repeated", and the volume is "high". The importance "3" means that the "status" of the apparatus 200 is "NG" and that some kind of measure is needed. So it is necessary to repeatedly output a text sequence with a high female tone, which is easily heard even if an ambient noise level is high, and with a high volume. As a result, a user may not fail to hear the text sequence, and the mobile information terminal 300 is capable of alerting a trouble to a user.

(Speech synthesizer 303)

With reference to Fig. 3 again, the speech synthesizer 303 is a functional block configured to generate, based on sentence information provided by the plant monitoring server 100, speech information, which is used to output speech corresponding to the sentence information. Specifically, the speech synthesizer 303 refers to data of sentence information in order, and refers to waveform data stored in the sound source database 304a in the order of reference. At this time, the speech synthesizer 303 refers to the speech mode definition information database 304b where importance information provided by the plant monitoring server 100 is an index. The speech synthesizer 303 thus obtains a speech mode specified by the importance information. Moreover, the speech synthesizer 303 retrieves waveform data of a tone corresponding to importance specified by the importance information from the sound source database 304a. The speech synthesizer 303 synthesizes speech, and generates speech information. Based on the speech information, speech is to be output with a volume corresponding to importance for the number of times corresponding to importance. The speaker 321 of the headset 320 outputs speech corresponding to the speech information to a user who wears the headset 320.

(Image generator 305)

The image generator 305 is configured to generate image data if the plant monitoring server 100 provides sentence information. The image generator 305 is further configured to display an image of a text sequence corresponding to the sentence information on the display 322 based on the image data. Not only speech but also an

image of a text sequence corresponding to sentence information is output. Because of this, even if a user fails to hear speech by any chance, he can look at and recognize the text sequence. The image generator 305 is further configured, if the plant monitoring server 100 provides other image information, to generate image data, which is used to display an image corresponding to the image information, and to provide the generated image data to the display 322.

(Speech obtaining unit 306)

The speech obtaining unit 306 is a functional block configured, if the microphone 323 of the headset 320 inputs a user's voice, to convert speech information corresponding to the user's voice into a digital signal, and to transfer the digital signal to the plant monitoring server 100. The information analyzer 109 of the plant monitoring server 100 is configured to analyze the speech information. As described above, if the speech information contains information on a measured value or a status of the apparatus 200, the monitor information on the apparatus 200 is to be stored in the monitor information database 108.

(Image obtaining unit 307)

The image obtaining unit 307 is a functional block configured to transfer image information corresponding to a predetermined image, which is output from a camera 331, to the plant monitoring server 100. The information analyzer 109 of the plant monitoring server 100 analyzes the image information. As described above, if the image information contains information on a measured value or a status of the apparatus 200, the monitor information on

the apparatus 200 is to be stored in the monitor information database 108.

(Position information obtaining unit 308)

The position information obtaining unit 308 is a functional block configured to obtain the current position of the mobile information terminal 300 based on a GPS satellite signal received by a GPS antenna 332. Moreover, the position information obtaining unit 308 refers to a GPS satellite signal and information output from a built-in direction detecting device (electronic compass, direction detecting gyro, or the like), and detects the direction in which the mobile information terminal 300 faces. Moreover, the position information obtaining unit 308 provides the current position to the plant monitoring server 100 in a form (for example, combination of latitude, longitude, and direction, etc.) based on an agreement with the plant monitoring server 100. Note that the position information obtaining unit 308 may not obtain the current position by using a GPS satellite signal. Alternatively, a technology of an indoor position information specifying system, for example, a position specifying system using a wireless LAN, a position specifying system configured to read a QR (Quick Response) code, a position specifying system using a ultrasonic wave (including infrared), or the like may be used. If a position is specified by using a wireless LAN, for example, the position information obtaining unit 308 determines a router, which establishes communication, to thereby specify a position. If a position is specified by using a QR code (registered trademark), for example, a unique QR code is attached to the apparatus

200, the camera 331 reads the QR code, and the position information obtaining unit 308 thus specifies a particular apparatus 200 in the neighborhood of the mobile information terminal 300. If a position is specified by using an ultrasonic wave, both the mobile information terminal 300 and the apparatuses 200 have ultrasonic wave communication functions, and the mobile information terminal 300 communicates with an apparatus 200 by using ultrasonic waves. As a result, the position information obtaining unit 308 specifies the apparatus 200, which communicates with the mobile information terminal 300.

(Operation information obtaining unit 309)

A user operates an operation portion 333 to thereby input letter information. The operation information obtaining unit 309 is a functional block configured to store the letter information in the memory 310. The letter information stored in the memory 310 includes user identification information. The user identification information is to be sent to the plant monitoring server 100 at the right time after communication between the mobile information terminal 300 and the plant monitoring server 100 is established.

(Sender 302)

The sender 302 is configured to send user identification information obtained by the operation information obtaining unit 309, position information obtained by the position information obtaining unit 308, and selectively speech information obtained by the speech obtaining unit 306 or image information obtained by the image obtaining unit 307 to the plant monitoring server

100 via the upper layer network 400.

(1-4. Behavior)

Fig. 10 is a flowchart illustrating the behavior of Embodiment 1. In Fig. 10, the plant monitoring server
5 100 executes Steps S101 to S111, and the mobile information terminal 300 executes Steps S301 to S306. The series of processes of the flowchart are executed again and again regularly or whenever a user chooses. Note that the process of each of the following steps is
10 merely an example. The order of the steps may be changed.

A plurality of steps may be processed as one step. One step may be divided into a plurality of steps and processed.

Firstly, a user, who is an operator of the mobile
15 information terminal 300, powers on or resets the terminal. Then he inputs his user identification information by using the operation portion 333. The memory 310 stores the user identification information. The mobile information terminal 300 sends the user
20 identification information to the plant monitoring server 100 at a given point in time prior to the monitoring task.

In Step S101, the plant monitoring server 100 judges if the plant monitoring server 100 has obtained user identification information. If the plant monitoring
25 server 100 has obtained user identification information (Step S101: YES), in Step S102, the user definition information obtaining unit 103 refers to the user definition information database 101 to thereby obtain user definition information.

30 Note that a user, who wears a mobile information terminal 300, walks about a plant. When the user walks

about the plant, the mobile information terminal 300 obtains a new current position. In other words, in Step S301, the mobile information terminal 300 judges if the position information obtaining unit 308 has obtained new position information or not. If the position information obtaining unit 308 has obtained new position information (Step S301: YES), in Step S302, the mobile information terminal 300 sends the obtained new position information (latitude N, longitude E, and direction D) to the plant monitoring server 100.

In Step S103, the plant monitoring server 100 judges if the plant monitoring server 100 has obtained new position information from the mobile information terminal 300 or not. If the plant monitoring server 100 has obtained new position information (Step S103: YES), the plant monitoring server 100 starts Step S104. In Step S104, the apparatus determining unit 104 searches the apparatus definition information database 102 for an apparatus 200, which has a predetermined positional relation with the current position of the mobile information terminal 300 identified by the obtained position information (latitude N, longitude E, and direction D). In this embodiment, an apparatus 200, which is in the "neighborhood" or in "front" of the current position, is searched for.

Then, in Step S105, the plant monitoring server 100 judges if there exists an apparatus 200, which has a predetermined positional relation with the current position of the mobile information terminal 300, or not. If there exists an apparatus 200, which has a predetermined positional relation, (Step S105: YES), the

plant monitoring server 100 starts Step S106. In Step S106, the information extracting unit 105 searches the monitor information database 108, and extracts monitor information on the identified apparatus 200 to be
5 provided based on user definition information. In other words, the information extracting unit 105 extracts and outputs the "measured value" and the "status" of the corresponding apparatus 200.

Next, in Step S107, the speech information generator
10 106 generates speech information corresponding to speech, which the mobile information terminal 300 outputs, based on the extracted monitor information. In other words, the speech information generator 106 generates sentence information in accordance with a sentence template stored
15 in the sentence template database 107 based on the monitor information extracted in Step S106 and based on the apparatus definition information retrieved from the apparatus definition information database 102.

Next, in Step S108, the importance decision unit 111
20 decides importance of sentence information generated by the speech information generator 106 based on the user definition information obtained in Step S102 and based on the monitor information extracted in Step S106.

Then, in Step S109, the sender 114 sends the
25 sentence information generated in Step S107 and the importance information decided in Step S108 to the mobile information terminal 300.

Note that if the plant monitoring server 100 obtains no new position information in Step S103 (Step S103: NO),
30 the plant monitoring server 100 finishes the process routine. Moreover, if there exists no apparatus 200

having a predetermined positional relation in Step S105 (Step S105: NO), the plant monitoring server 100 finishes the process routine. Note that if the plant monitoring server 100 obtains no new position information in Step S103 (Step S103: NO) or if there exists no apparatus 200 having a predetermined positional relation in Step S105 (Step S105: NO), the sender 114 may send sentence information again and again until a user gives a stop instruction purposefully (Step S109). In addition, when the mobile information terminal 300 receives the sentence information again and again, the mobile information terminal 300 may output speech again and again (Steps S303-306). Moreover, the mobile information terminal 300 may output previous speech again and again until the mobile information terminal 300 obtains next sentence information from the plant monitoring server 100 in Step S109 (Step S303-306).

In Step S303, the mobile information terminal 300 judges if the plant monitoring server 100 has sent sentence information or not. If the mobile information terminal 300 judges if the plant monitoring server 100 has sent sentence information (Step S303: YES), in Step S304, the speech synthesizer 303 refers to the sound source database 304a. At the same time, the speech synthesizer 303 synthesizes and generates speech information, which is used to output speech corresponding to sentence information, based on the sentence information.

Next, in Step S305, the speech synthesizer 303 refers to the speech mode definition information database 304b, where importance information, which is sent

together with the sentence information, is an index. The speech synthesizer 303 obtains a speech mode specified by importance information.

Then, in Step S306, the speech synthesizer 303 synthesizes speech information, whose tone, number of times of repetition, and volume correspond to the importance, based on the obtained speech mode. The speech synthesizer 303 outputs the synthesized speech information, and thus provides the speech to a user.

Note that the plant monitoring server 100 may send image information, which is the same as the monitor information provided as the speech information, to the mobile information terminal 300. The image generator 305 of the mobile information terminal 300 may output the image information to the display 322 of the headset 320, and the display 322 may display the image information. The mobile information terminal 300 provides an image of monitor information, which is the same as speech information, to a user. As a result, even if the user by any chance fails to hear speech, which informs him of monitor information, because of a noise around him, the mobile information terminal 300 is capable of informing the user of monitor information by means of an image and reliably notifying him of monitor information for sure.

In Step S110, the plant monitoring server 100 judges if there exists another apparatus 200, which has a predetermined positional relation with the current position of the mobile information terminal 300, or not. If there exists such an apparatus 200 (Step S110: YES), the plant monitoring server 100 executes the process of Steps S106 to S110 again.

Every time the mobile information terminal 300 receives sentence information and importance information (Step S303: YES), the mobile information terminal 300 executes the process of Steps S304 to S306 again and again. The mobile information terminal 300 provides speech about the other apparatus 200, which has a predetermined positional relation with the current position of the mobile information terminal 300.

(1-5. Effects)

Embodiment 1 provides the following advantages.

(1) According to Embodiment 1, monitor information on the apparatus 200 is extracted based on user definition information. So unnecessary monitor information is excluded, and monitor information necessary for a user is provided. As a result, the user can obtain necessary and sufficient monitor information effectively, and can carry out appropriate measures promptly.

(2) According to Embodiment 1, necessary and sufficient monitor information is provided to a user in speech. Because of this, the user can understand the necessary and sufficient monitor information while observation or confirmation with his hand and foot during a monitoring task is not disturbed.

(3) According to Embodiment 1, monitor information is extracted depending on a user's "affiliation". Because of this, if monitoring tasks are different depending on affiliation, appropriate monitor information can be provided depending on affiliation.

(4) According to Embodiment 1, monitor information is extracted depending on a user's "job". Because of

this, if monitoring tasks are different depending on jobs, appropriate monitor information can be provided depending on jobs.

(5) According to Embodiment 1, monitor information is extracted depending on a user's "preference". Because of this, if a user has registered a special concern about a monitoring task, it is possible to provide appropriate monitor information corresponding to a user's concern.

(6) According to Embodiment 1, if the positional relation between the mobile information terminal 300 and the apparatus 200 is "neighborhood", monitor information can be extracted. As a result, even if a user does not face the apparatus 200, it is possible to provide monitor information and to alert a trouble to the user.

(7) According to Embodiment 1, if the positional relation between the mobile information terminal 300 and the apparatus 200 is "front", monitor information can be extracted. Because of this, when a user faces the apparatus 200 and is paying attention to the apparatus 200 to be monitored, it is possible to provide appropriate monitor information.

(8) According to Embodiment 1, importance can be changed and set depending on a user's "affiliation" and "job" and depending on the "positional relation" between the mobile information terminal 300 and the apparatus 200.

In addition, speech mode provided to a user can be changed depending on the "positional relation" between the mobile information terminal 300 and the apparatus 200.

Because of this, when a user faces the apparatus 200, it is possible to provide monitor information on the apparatus 200 in an appropriate speech mode depending on

"affiliation", a "job", and a "positional relation".

(9) According to Embodiment 1, high importance is set if the "status" of the apparatus 200 is "NG".

Provided speech has a speech mode corresponding to the high importance. Because of this, if the apparatus 200 is in trouble, it is possible to alert a trouble to the user without delay.

(10) According to Embodiment 1, high importance is set if a user has registered "preference". Provided speech has a speech mode corresponding to the high importance. Because of this, if a user has a concern about something, it is possible to appropriately provide monitor information corresponding to the user's concern.

(2. Embodiment 2)

According to Embodiment 2 of the present invention, a plant monitoring server side provides identification information on an apparatus. A mobile information terminal side directly obtains monitor information on an apparatus based on the identification information on the apparatus. The mobile information terminal side provides speech based on the obtained monitor information.

(2-1. Plant monitoring system)

Fig. 11 is a system diagram illustrating the outline of the plant monitoring system of Embodiment 2. As shown in Fig. 11, the plant monitoring system 1000b of this embodiment includes the plant monitoring server 100b, the apparatuses 200b-1, 2, 3, ..., N to be variously monitored (hereinafter simply referred to as "apparatuses 200b" if it is not necessary to distinguish each apparatus), the mobile information terminal 300b, the controller 500, the field apparatus communication bus 401, and the upper

layer network 400. The controller 500, the field apparatus communication bus 401, and the upper layer network 400 are the same as those of the above-mentioned Embodiment 1. So description thereof will be omitted.

5 In the plant monitoring system 1000b of Embodiment 2, the plant monitoring server 100b is connected to the mobile information terminal 300b via the upper layer network 400. The plant monitoring server 100b is capable of communicating with the mobile information terminal
10 300b via the upper layer network 400. Each apparatus 200b provides monitor information to the plant monitoring server 100b via the controller 500. This is similar to the plant monitoring system 1000 of the above-mentioned Embodiment 1.

15 Note that in the plant monitoring system 1000b of Embodiment, the apparatus 200b and the mobile information terminal 300b are capable of communicating with each other directly. This is different from the above-mentioned Embodiment 1. Specifically, in Embodiment 2,
20 the apparatus 200b and the mobile information terminal 300b are capable of communicating with each other wirelessly. The mobile information terminal 300b is capable of directly obtaining monitor information from the apparatus 200b via no plant monitoring server 100b.
25 The communication protocol of this wireless communication is not limited. Any near field communication system may be adopted. A wireless LAN, an infrared near field communication standard, a near field communication standard, or the like may be adopted.

30 (2-2. Plant monitoring server 100b)

 Fig. 12 is a block diagram showing the plant

monitoring server of Embodiment 2. As shown in Fig. 12, the plant monitoring server 100b receives user identification information, position information, selectively speech information and image information, and the like from the mobile information terminal 300. This is the same as the above-mentioned Embodiment 1. However, the plant monitoring server 100b provides apparatus identification information and user definition information to the mobile information terminal 300b instead of speech information and importance information. This is different from the above-mentioned Embodiment 1.

As shown in Fig. 12, the plant monitoring server 100b of Embodiment 2 includes, as databases, the user definition information database 101, the apparatus definition information database 102, and the monitor information database 108 similar to those of the above-mentioned Embodiment 1. However, the plant monitoring server 100b of Embodiment 2 does not include the sentence template database 107 and the importance definition database 112 of the above-mentioned Embodiment 1. This is because in Embodiment 2, the mobile information terminal 300b side generates speech information. Note that in Embodiment 2, the mobile information terminal 300 is capable of directly obtaining monitor information from the apparatus 200. Because of this, if it is not necessary to store monitor information on the apparatus 200 in certain storage, the plant monitoring server 100b may not include the monitor information database 108.

Further, the plant monitoring server 100b of Embodiment 2 includes, as functional blocks, the user definition information obtaining unit 103, the apparatus

determining unit 104, the information extracting unit 105b, the information analyzer 109, and the monitor information updating unit 110 in addition to the receiver 113 and the sender 114. The plant monitoring server 100b of Embodiment 2 is different from that of the above-mentioned Embodiment 1 in that it does not include the speech information generator 106 and the importance decision unit 111. The plant monitoring server 100b of Embodiment 2 is further different from that of the above-mentioned Embodiment 1 in that the information extracting unit 105b extracts apparatus identification information and user definition information. The receiver 113, the user definition information obtaining unit 103, the apparatus determining unit 104, the information analyzer 109, and the monitor information updating unit 110 are similar to those of the above-mentioned Embodiment 1. So description thereof will be omitted. Hereinafter, the functional blocks different from those of the above-mentioned Embodiment 1 will be described mainly. Note that in Embodiment 2, the mobile information terminal 300 is capable of directly obtaining monitor information from the apparatus 200. Because of this, the plant monitoring server 100b may not include the information analyzer 109 or the monitor information updating unit 110.

(Information extracting unit 105b)

The information extracting unit 105b is a functional block configured to search the apparatus definition information database 102, and to extract identification information on a specified apparatus. Specifically, the apparatus determining unit 104 judges that an apparatus 200 is in the "neighborhood" or in "front". The

information extracting unit 105 searches the apparatus definition information database 102 for this apparatus 200, where its apparatus ID is an index. The information extracting unit 105 extracts and outputs the "apparatus ID" of the corresponding apparatus 200. For example, if it is judged that an apparatus 200 (temperature sensor) is in the "neighborhood", the information extracting unit 105b extracts the apparatus ID "1003" of the temperature sensor from the apparatus definition information database 102. If it is judged that an apparatus 200 (fan) is in "front", the information extracting unit 105b extracts the apparatus ID "1006" of the fan from the apparatus definition information database 102. Moreover, the information extracting unit 105b outputs user definition information, which is obtained by the user definition information obtaining unit 103, to the sender 114.

(Sender 114)

The sender 114 is configured to send apparatus identification information, which is extracted by the information extracting unit 105b, to the mobile information terminal 300b via the upper layer network 400.

The sender 114 is further configured to send user definition information, which is obtained by the user definition information obtaining unit 103, to the mobile information terminal 300b via the upper layer network 400.

(2-3. Mobile information terminal 300b)

The mobile information terminal 300b of Embodiment 2 is configured to communicate with the above-mentioned plant monitoring server 100b. The plant monitoring server 100b provides apparatus identification information on the apparatus 200b and user identification information

to the mobile information terminal 300b. The mobile information terminal 300b is configured to send part of the user definition information and the apparatus identification information to an apparatus 200b in association with the apparatus identification information, to obtain monitor information corresponding to the apparatus identification information provided by the apparatus 200b, and to generate speech information, which is used to output speech corresponding to the monitor information. The mobile information terminal 300b is a mobile computer apparatus at least including a communication function, a position-detecting function, and a speech-generating function. Similar to Embodiment 1, the mobile information terminal 300b is a wearable computer. Note that the mobile information terminal 300b may be other hardware such as an HMD, a smartphone, a notebook or laptop personal computer, a mobile phone, or a PDA.

Fig. 13 is a block diagram showing the mobile information terminal 300b of Embodiment 2. As shown in Fig. 13, the mobile information terminal 300b has a configuration of a wearable computer. The mobile information terminal 300b includes the receiver 301, the sender 302, and the memory 310. The mobile information terminal 300b further includes, as functional blocks, the speech synthesizer 303b, the image generator 305, the speech obtaining unit 306, the image obtaining unit 307, the position information obtaining unit 308, the operation information obtaining unit 309, and the apparatus communication unit 311. The mobile information terminal 300b further includes the sound source database

304a as a database.

The receiver 301, the sender 302, and the memory 310 of the mobile information terminal 300b are similar to those of the above-mentioned Embodiment 1. In addition,
5 the functional blocks of the mobile information terminal 300b, i.e., the speech synthesizer 303b, the image generator 305, the speech obtaining unit 306, the image obtaining unit 307, the position information obtaining unit 308, and the operation information obtaining unit
10 309, are similar to those of the above-mentioned Embodiment 1. Description thereof will be omitted. Hereinafter, the configuration different from that of the above-mentioned Embodiment 1 will be described.

(Apparatus communication unit 311)

15 The plant monitoring server 100b provides apparatus identification information and user definition information to the mobile information terminal 300b. The apparatus communication unit 311 is a functional block configured to send part of the user definition
20 information and the apparatus identification information to the apparatus 200b to be monitored, and to communicate with the apparatus 200b in association with the identification information via a communication network 402. Specifically, the apparatus communication unit 311
25 refers to user identification information, and judges if an apparatus 200b identified by apparatus identification information is to be monitored or not. If it is judged that the apparatus 200b is to be monitored, the apparatus communication unit 311 sends the apparatus ID to the
30 apparatus 200b to be monitored. Specifically, a user has registered his concern in the "preference". For example,

information identifying the apparatus 200b to be monitored is registered in the "preference". The apparatus communication unit 311 refers to "preference" of user definition information. If the apparatus 200b identified by apparatus identification information is registered in the "preference" as an apparatus to be monitored by a user, this apparatus 200b is to be monitored. Moreover, for example, a user can register a plurality of groups of the apparatuses 200b to be monitored. Specifically, "measuring apparatus" or "control apparatus" is registered in the "preference" as apparatuses to be monitored. When a group is registered, if an apparatus 200b identified by apparatus identification information belongs to a group registered in the "preference", this apparatus 200b is to be monitored. For example, if "measuring apparatus" is registered in the "preference", a "measuring apparatus" (apparatus 200b) such as a pressure sensor, a temperature sensor, or flow rate sensor is to be monitored.

If the apparatus 200b side receives the apparatus identification information, the apparatus 200b recognizes that it is to be monitored, and causes the mobile information terminal 300b to send its monitor information to the apparatus 200b. Note that preferably, the communication network 402 between the mobile information terminal 300b and the apparatus 200 meets the above-mentioned near field communication standard. Alternatively, the communication network 402 may meet another communication standard.

(Speech synthesizer 303b)

The speech synthesizer 303b is a functional block

configured to obtain monitor information provided by the apparatus 200b to be monitored, and to generate speech information, which is used to output speech corresponding to the monitor information. Specifically, similar to the speech synthesizer 303 of the above-mentioned Embodiment 1, if monitor information is sent, the speech synthesizer 303b refers to the sound source database 304a, and synthesizes speech by using waveform data. As a result, the speech synthesizer 303b generates speech information, which is used to output speech corresponding to the monitor information. The speaker 321 of the headset 320 provides speech corresponding to speech information to a user, who wears the headset 320.

(2-4. Behavior)

Fig. 13 is a flowchart illustrating the behavior of Embodiment 2. In Fig. 13, the plant monitoring server 100b executes Steps S121 to S127, the mobile information terminal 300b executes Steps S321 to S326, and the apparatus 200b executes Steps S201 to S202. The series of processes of the flowchart are executed again and again regularly or whenever a user chooses. Note that the process of each of the following steps is merely an example. The order of the steps may be changed. A plurality of steps may be processed as one step. One step may be divided into a plurality of steps and processed.

In Fig. 13, a user, who is an operator of the mobile information terminal 300b, powers on or resets the terminal. Then he inputs his user identification information by using the operation portion 333. The memory 310 stores the user identification information.

The mobile information terminal 300b sends the user identification information to the plant monitoring server 100b at a given point in time prior to the monitoring task.

5 In Step S121, the plant monitoring server 100b judges if the plant monitoring server 100b has obtained user identification information. If the plant monitoring server 100b has obtained user identification information (Step S121: YES), in Step S122, the user definition
10 information obtaining unit 103 refers to the user definition information database 101 to thereby obtain user definition information.

 Note that a user, who wears a mobile information terminal 300b, walks about a plant. When the user walks
15 about the plant, the mobile information terminal 300b obtains a new current position. In other words, in Step S321, the mobile information terminal 300b judges if the position information obtaining unit 308 has obtained new position information or not. If the position information
20 obtaining unit 308 has obtained new position information (Step S321: YES), in Step S322, the mobile information terminal 300b sends the obtained new position information to the plant monitoring server 100b (latitude N, longitude E, and direction D).

25 In Step S123, the plant monitoring server 100b judges if the plant monitoring server 100b has obtained new position information from the mobile information terminal 300b or not. If the plant monitoring server 100b has obtained new position information (Step S123:
30 YES), the plant monitoring server 100b starts Step S124. In Step S124, the apparatus determining unit 104 searches

the apparatus definition information database 102 for an apparatus 200b, which has a predetermined positional relation with the current position of the mobile information terminal 300b identified by the obtained position information (latitude N, longitude E, and direction D). For example, as the apparatus 200b having a predetermined positional relation, an apparatus 200b, which is in the "neighborhood" or in "front" of the current position, is searched for.

Then, in Step S125, the plant monitoring server 100b judges if there exists an apparatus 200b, which has a predetermined positional relation with the current position of the mobile information terminal 300b, or not.

If there exists an apparatus 200b, which has a predetermined positional relation, (Step S125: YES), the plant monitoring server 100b starts Step S126. In Step S126, the information extracting unit 105b searches the apparatus definition information database 102, and extracts an "apparatus ID", which is apparatus identification information on the apparatus 200b having a predetermined positional relation. Moreover, the information extracting unit 105b transfers "affiliation", "job", and "preference" (see Fig. 4) of a record in association with the "user ID" of the user. Each of "affiliation", "job", and "preference" is the user definition information obtained by the user definition information obtaining unit 103. In Step S127, the sender 114 sends the extracted apparatus identification information and the user definition information to the mobile information terminal 300b.

Note that if the plant monitoring server 100b

obtains no new position information in Step S123 (Step S123: NO), the plant monitoring server 100b finishes the process routine. Moreover, if there exists no apparatus 200b having a predetermined positional relation in Step S125 (Step S125: NO), the plant monitoring server 100b finishes the process routine.

In Step S323, the mobile information terminal 300b judges if the plant monitoring server 100b has sent apparatus identification information and user definition information to the mobile information terminal 300b or not. If the plant monitoring server 100b has sent apparatus identification information and user identification information to the mobile information terminal 300b (Step S323: YES), in Step S324, the apparatus communication unit 311 refers to the user definition information, and judges if the apparatus 200b identified by the apparatus identification information is to be monitored or not. For example, the apparatus communication unit 311 refers to "preference" of the user definition information, and judges if the apparatus 200b having a predetermined positional relation is registered in the "preference" as an apparatus to be monitored that a user has a concern or not. If the apparatus 200b is to be monitored (Step S324: YES), in Step S325, the apparatus communication unit 311 sends for example an apparatus ID as apparatus identification information on an apparatus to be monitored. Note that the apparatus communication unit 311 sends apparatus identification information in order that the apparatus 200b side may prepare for communication. The apparatus communication unit 311 does not necessarily send the apparatus

identification information. For example, the mobile information terminal 300b may send and the apparatus 200b may receive communication establishment information instead of the apparatus identification information. The communication establishment information shows that the mobile information terminal 300b wishes to directly communicate with the apparatus 200b. Moreover, the mobile information terminal 300b may request for direct monitor information (S326).

In Step S201, the apparatus 200b receives the apparatus identification information. Then the apparatus 200b knows that the apparatus 200b is to be monitored, and makes the necessary preparations for sending monitor information.

In Step S326, the apparatus communication unit 311 of the mobile information terminal 300b sends the apparatus 200b a command to request for monitor information. The apparatus 200b receives the command to request for monitor information. Then, in Step S202, the apparatus 200b sends its monitor information to the mobile information terminal 300b. For example, if the apparatus 200b to be monitored is a measuring apparatus, the apparatus 200b sends the latest measured value. Moreover, if the apparatus 200b to be monitored is a control apparatus, the apparatus 200b sends the current behavior status.

The mobile information terminal 300b receives the monitor information. Then, in Step S327, the speech synthesizer 303b synthesizes and generates speech information, which is used to inform a user of the monitor information. The speech synthesizer 303b

supplies the synthesized and generated speech information to the speaker 321 of the headset 320. The speaker 321 provides speech, which informs a user of monitor information, to the user.

5 Note that the image generator 305 may be configured to generate image information, i.e., monitor information provided as speech information, and to output the generated image information to the display 322 of the headset 320. The display 322 displays the image
10 information. The mobile information terminal 300 provides an image of monitor information, which is the same as speech information, to a user. As a result, even if the user by any chance fails to hear speech, which informs him of monitor information, because of a noise
15 around him, the mobile information terminal 300 is capable of informing the user of monitor information by means of an image and reliably notifying him of monitor information for sure.

 Moreover, synthesized and generated speech
20 information may be simple. For example, a measured value or a status, i.e., monitor information sent from the apparatus 200b, is output as it is. Alternatively, synthesized and generated speech information may not be simple as the speech information generator 106 of the
25 plant monitoring server 100 of the above-mentioned Embodiment 1 synthesizes and generates. In this configuration, the speech synthesizer 303b further includes a sentence template database. Moreover, similar to the above-mentioned Embodiment 1, the speech
30 synthesizer 303b may be configured to change a speech mode depending on importance. In this configuration, an

importance definition database and a speech mode database are further provided.

In Step S328, if a user operates the operation portion 333 and instructs to further provide monitor
5 information (Step S328: NO), the mobile information terminal 300b executes the process of Steps S326 to S327.

The apparatus 200b further replies monitor information in response (Step S202). If the mobile information terminal 300b finishes monitoring the apparatus 200b
10 (Step S328: YES), the process is finished.

Note that if apparatus identification information and user definition information is not sent to the mobile information terminal 300b (Step S323: NO), the process is once finished. In addition, if it is determined that the
15 apparatus 200b is not to be monitored based on user definition information (Step S324: NO), the process is once finished.

(2-5. Effect)

Embodiment 2 has the following advantages.

(1) According to Embodiment 2, the mobile
20 information terminal 300b is configured to directly communicate with the apparatus 200b and to obtain monitor information. The mobile information terminal 300b communicates with the plant monitoring server 100b only
25 if the current position of a user is changed (Fig. 14: Step S321). As a result, the communication volume between the plant monitoring server 100b and the mobile information terminal 300b can be decreased, and the processing load of the plant monitoring server 100b can
30 be decreased. This embodiment is effective if the information processing capacity of the mobile information

terminal 300b is relatively high.

(2) According to Embodiment 2, an apparatus 200b to be monitored is selected based on user definition information. Because of this, if a user preregisters at least one apparatus 200b to be monitored particularly, every time a predetermined positional relation is established between the user and the at least one apparatus 200b (for example, every time the user passes by its "neighborhood"), monitor information on the apparatus 200b is output in speech. As a result, a user is capable of obtaining necessary monitor information only by walking around a plant as he like without previously researching the position of the apparatus 200b to be monitored.

(3) According to Embodiment 2, necessary and sufficient monitor information is provided to a user in speech. Because of this, the user can understand the necessary and sufficient monitor information while observation or confirmation with his hand and foot during a monitoring task is not disturbed.

(6. Modification example)

The present invention is not limited to the above-mentioned embodiment. The present invention may be variously modified within the gist of the present invention. For example, the present invention may be modified as follows.

(6-1) In the above-mentioned embodiments, the apparatus 200 to be monitored is a measuring apparatus such as a flow rate sensor, a temperature sensor, or a pressure sensor, or a control apparatus such as a valve, a heater, a pump, or a fan. Alternatively, an

apparatus/machine capable of outputting information that a user can use may be monitored even if it is conceptually different from a measuring apparatus and a control apparatus. For example, a machine tool, a rolling mill, and a printer each including a computer apparatus, or an arbitrary apparatus may be monitored.

(6-2) In the above-mentioned embodiments, "user ID", "affiliation", "job", and "preference", i.e., user definition information, are stored in the user definition information database 101, for example. Alternatively, other information on user characteristics, which defines a user based on other social, technological, and objective concepts may be used.

(6-3) In the above-mentioned embodiments, "apparatus ID", "installation position", "type", "measurement control target", "optimum range", and "unit", i.e., the apparatus definition information, are stored in the apparatus definition information database 102, for example. Alternatively, information on characteristics of an apparatus may be used in addition to such information or instead of part of such information. Part of such information partly overlaps with information stored in the monitor information database 108. So overlapping information may be omitted.

(6-4) In the above-mentioned embodiments, "apparatus ID", "type", "measurement control target", "measured value", and "status", i.e., monitor information, are stored in the monitor information database 108, for example. Alternatively, information that the apparatus 200 can output may be used in addition to such information or instead of part of such information. Part

of such information partly overlaps with information stored in the monitor information database 108. So overlapping information may be omitted.

(6-5) In the above-mentioned Embodiment 1, a sentence for a measuring apparatus and a sentence for a control apparatus are stored in the sentence template database 107, for example. However, those sentences are merely examples. As a matter of course, different sentences may be stored. The number of sentence templates may be further increased depending on the type or the situation of an apparatus. Moreover, the plant monitoring server 100 may be configured to retrieve a different sentence template depending on importance, and to generate sentence information. For example, if an emergency arises (for example, the working condition of an apparatus is NG), a sentence capable of calling special attention to a user may be used.

(6-6) In the above-mentioned Embodiment 1, setting stored in the importance definition database 112 is merely an example. Alternatively, user definition information or monitor information in association with each importance may be selected arbitrarily. Moreover, importance "1" to "3" (three levels) is merely an example.

Importance may have more than three levels or only two levels.

(6-7) In the above-mentioned Embodiment 1, a speech mode is changed depending on "tone", "number of times", and "volume", i.e., speech mode identification information, for example. Alternatively, other acoustic elements may be added if a user can recognize difference of importance by changing the acoustic elements. For

example, the speed of reproduced speech may be changed. Alarm sounds, sound effects, and the like may be added to speech.

(6-8) In the above-mentioned Embodiment 2, the mobile information terminal 300b is configured to send position information on the apparatus 200b. The plant monitoring server 100b is configured to send apparatus identification information and user definition information, i.e., tag information, on the apparatus 200b to be monitored based on position information.

Alternatively, the plant monitoring server 100b may send other information, which the mobile information terminal 300b requires, to the mobile information terminal 300b. For example, the plant monitoring server 100b may send a past measured value or a past status of the apparatus 200b to be monitored. The mobile information terminal 300b may provide the past measured value and the past status information to a user in speech. In this configuration, a user can compare the current measured value and status of the apparatus 200b to be monitored with the past measured value and status thereof. The user can recognize how the measured value is changed and how the status is changed. As a result, the user can know and evaluate the working condition of the apparatus 200b more accurately.

(6-9) In the above-mentioned Embodiment 2, the mobile information terminal 300b is configured to send user identification information and position information.

The plant monitoring server 100b is configured to send apparatus identification information and user definition information, i.e., tag information. Alternatively, if

the information processing capacity of the mobile information terminal 300b is higher, the mobile information terminal 300b may execute all or part of the process of the plant monitoring server 100b. For example, the mobile information terminal 300b may store information corresponding to the user definition information database 101, the apparatus definition information database 102, and the monitor information database 108. Alternatively, a cloud server may store such information, and may be accessible from the mobile information terminal 300b. In this configuration, the mobile information terminal 300b is capable of directly communicating with the apparatus 200b via no plant monitoring server 100b, and obtaining necessary monitor information.

(6-10) In the above-mentioned Embodiment 1, the plant monitoring server 100 is configured to generate sentence information (text). The mobile information terminal 300 is configured to synthesize and generate speech information (speech data) corresponding to the sentence information. Alternatively, for example, the plant monitoring server 100 side may be configured to synthesize and generate speech information, and to send the speech information. The mobile information terminal 300 side may be configured to output the speech information. According to this configuration, the information processing load of the mobile information terminal 300 can be reduced.

The present invention is suitable for monitoring various apparatuses installed in a plant. Alternatively, the present invention is applicable to a purpose of

obtaining some information from an apparatus or a machine
by using a mobile information terminal. For example, the
present invention is applicable to a construction site, a
maintenance site, or a construction site, which is not
5 defined as a "plant" in general. Moreover, the present
invention is applicable to an exhibition, an exposition,
or each of various theme parks, if it is necessary for a
user to obtain some information by using a mobile
information terminal on site.

10

What is claimed is:

1. A plant monitoring server capable of communicating with a mobile information terminal carried by a user, the plant monitoring server comprising:

5 a user definition information database configured to store user definition information;

an apparatus definition information database configured to store identification information on an apparatus to be monitored;

10 a monitor information database configured to store monitor information in association with the apparatus to be monitored;

a user definition information obtaining unit configured

15 to obtain user identification information from the mobile information terminal,

to search the user definition information database, and

20 to obtain user definition information in association with the user identification information;

an apparatus determining unit configured

to obtain position information from the mobile information terminal,

25 to search the apparatus definition information database, and

to determine the apparatus having a predetermined positional relation with the mobile information terminal;

an information extracting unit configured

30 to search the monitor information database, and to extract monitor information on the

determined apparatus to be output based on the obtained user definition information; and

a speech information generator configured to generate speech information based on the extracted monitor information, the speech information corresponding to speech to be output by the mobile information terminal.

2. The plant monitoring server according to claim 1, wherein

the speech information generator includes a sentence template database configured to store a sentence template of speech to be provided to a user, and

the speech information generator is configured to search the sentence template database, and to generate sentence information corresponding to the extracted monitor information.

3. The plant monitoring server according to claim 1 or 2, further comprising:

an importance decision unit configured to decide importance of the sentence information based on the user definition information and the extracted monitor information, wherein

the speech generated based on the speech information is to be output in a mode corresponding to the decided importance.

4. The plant monitoring server according to any one of claims 1 to 3, further comprising:

an information analyzer configured to analyze speech information and/or image information sent from the mobile information terminal; and

a monitor information updating unit configured to update the monitor information database based on monitor

information corresponding to the analyzed speech
information and/or image information.

5. A plant monitoring server capable of communicating
with a mobile information terminal carried by a user, the
5 plant monitoring server comprising:

a user definition information database configured to
store user definition information, the identification
information including attribute information on a user;

10 an apparatus definition information database
configured to store identification information on an
apparatus to be monitored;

a monitor information database configured to store
monitor information in association with the apparatus to
be monitored;

15 a user definition information obtaining unit
configured

to obtain user identification information from
the mobile information terminal,

20 to search the user definition information
database, and

to obtain user definition information in
association with the user identification information;

25 an apparatus determining unit configured
to obtain position information from the mobile
information terminal,

to search the apparatus definition information
database, and

30 to determine an apparatus having a
predetermined positional relation with the mobile
information terminal;

an information extracting unit configured

to search the apparatus definition information database, and

to extract identification information on the determined apparatus; and

5 a sender configured to provide identification information on the apparatus and the user definition information to the mobile information terminal.

6. The plant monitoring server according to claim 5, further comprising:

10 an information analyzer configured to analyze speech information and/or image information sent from the mobile information terminal; and

 a monitor information updating unit configured to update the monitor information database based on monitor
15 information corresponding to the analyzed speech information and/or image information.

7. A mobile information terminal capable of communicating with the plant monitoring server according to any one of claims 1 to 4, the mobile information
20 terminal comprising:

 a speech synthesizer configured to generate speech information based on the sentence information, the speech information being used to output speech corresponding to the sentence information.

25 8. A mobile information terminal capable of communicating with the plant monitoring server according to claim 5 or 6, the mobile information terminal comprising:

 an apparatus communication unit configured
30 to send part of the provided user definition information and the provided identification information

on the apparatus, and

to communicate with an apparatus in association with the identification information; and

a speech synthesizer configured

5 to obtain monitor information provided by the apparatus, and

to generate speech information, the speech information being used to output speech corresponding to the monitor information.

10 9. A plant monitoring method executed by a mobile information terminal carried by a user and by a plant monitoring server,

the plant monitoring server including

a user definition information database

15 configured to store user definition information,

an apparatus definition information database configured to store identification information on an apparatus to be monitored, and

20 a monitor information database configured to store monitor information in association with the apparatus to be monitored,

the plant monitoring method comprising:

25 obtaining user identification information from the mobile information terminal, searching the user definition information database, and obtaining user definition information in association with the user identification information;

30 obtaining position information from the mobile information terminal, searching the apparatus definition information database, and determining the apparatus having a predetermined positional relation with the

mobile information terminal;

searching the monitor information database, and
extracting monitor information on the determined
apparatus to be output based on the obtained user
5 definition information; and

generating speech information based on the extracted
monitor information, the speech information corresponding
to speech to be output by the mobile information terminal.

10. A plant monitoring method executed by a mobile
10 information terminal carried by a user and by a plant
monitoring server,

the plant monitoring server including

a user definition information database
configured to store user definition information, the
15 identification information including attribute
information on a user,

an apparatus definition information database
configured to store identification information on an
apparatus to be monitored, and

20 a monitor information database configured to
store monitor information in association with the
apparatus to be monitored,

the plant monitoring method comprising:

obtaining user identification information from the
25 mobile information terminal, searching the user
definition information database, and obtaining user
definition information in association with the user
identification information;

obtaining position information from the mobile
30 information terminal, searching the apparatus definition
information database, and determining an apparatus having

a predetermined positional relation with the mobile
information terminal;

searching the apparatus definition information
database, and extracting identification information on
5 the determined apparatus;

sending part of the user definition information and
identification information on the apparatus, and
communicating with an apparatus in association with the
identification information; and

10 obtaining monitor information provided by the
apparatus, and generating speech information, the speech
information being used to output speech corresponding to
the monitor information.

15