

MEANS TO SOLVE THE PROBLEMS

[0009a]

In accordance with an aspect of the present invention, there is provided an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein the on-site operation management system comprises a plurality of imaging cameras for remote monitoring installed at all locations within the facility where security management is required, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a user of the facility, and recognizes in real-time an existence and a position of the user based on wireless signals from the beacon terminal; a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to move by following the user based on a recognition result of the tracking recognition unit; and a highly directional microphone which collects sounds of an ambient environment, wherein the integrated control unit, upon receiving sound signals representing the collected sounds of the highly directional microphone from the autonomous mobile body and determining that it is a requisite state based on the collected sounds, recognizes a position of the autonomous mobile body within the facility, and captures images of the autonomous mobile body, in which the position was recognized, with at least one or more of the imaging cameras so that the autonomous mobile body is centered in the captured images.

[0010]

There is disclosed an autonomous mobile body which moves freely within a facility, comprising: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a target object,

and recognizes in real-time an existence and a position of the target object based on wireless signals from the beacon terminal; and a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to move by following the target object based on a recognition result of the tracking recognition unit, wherein the drive control unit causes the autonomous mobile body to enter a standby state once the target object enters a specified area designated as being off limits within the facility, and thereafter causes the autonomous mobile body to enter a movable state of following the target object once again once the target object leaves the specified area and wireless signals from the beacon terminal become receivable.

[0011]

According to the autonomous mobile body described above, it is possible to follow the target object (user) while accurately comprehending the existence and position (access point) of the target object, and, by causing the autonomous mobile body to enter a standby state while the target object is within a specified area, it is possible to constantly follow the target object within the facility without losing sight of the target object.

[0012]

There is disclosed an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein the on-site operation management system comprises a plurality of imaging cameras installed within the facility, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or

three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a target object, and recognizes in real-time an existence and a position of the target object based on wireless signals from the beacon terminal; and a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to move by following the target object based on a recognition result of the tracking recognition unit, wherein the integrated control unit, upon receiving wireless signals representing a request from the autonomous mobile body, recognizes a position of the autonomous mobile body within the facility, and captures images of the autonomous mobile body with at least one or more of the imaging cameras so that the autonomous mobile body is centered in the captured images.

[0013]

According to the on-site operation management system described above, it is possible to remarkably improve the efficiency of remote monitoring (security enhancement) by coordinating with a plurality of imaging cameras, which are used for remote monitoring, upon moving the autonomous mobile robots.

[0014]

There is disclosed an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein the on-site operation management system comprises a plurality of air conditioners installed for climate control, including heating and cooling, of the overall facility, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a target object, and recognizes in real-time an existence and a position of the target object based on wireless signals from the beacon terminal; a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into

contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to move by following the target object based on a recognition result of the tracking recognition unit; and a temperature humidity sensor which is mounted at a predetermined height position from a floor surface for measuring a temperature and a humidity of an ambient environment, wherein the integrated control unit, upon receiving wireless signals including a measurement result of the temperature humidity sensor from the autonomous mobile body, recognizes a position of the autonomous mobile body within the facility, and controls each of the corresponding air conditioners so as to maintain the ambient temperature and humidity of the autonomous mobile body in an optimal state.

[0015]

In the on-site operation management system described above, the autonomous mobile body can detect in real-time the sensible temperature/humidity at a location that is close to the perceived temperature of humans while it is moving even when the air conditioning within the facility is being managed collectively, and it is thereby possible to constantly maintain a comfortable environment for the target object (user) based on dynamic HVAC control.

[0016]

There is disclosed an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein an inspection area including a first inspection gate for inspecting luggage placed on the autonomous mobile body and a second inspection gate for inspecting the target object is provided, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a target object, and recognizes in real-time an existence and a position of the target object based on wireless signals from the beacon terminal; and a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to

move by following the target object based on a recognition result of the tracking recognition unit, wherein the integrated control unit: permits the target object to exit the inspection area only when inspection results of both the first and second inspection gates are determined as being all clear; and causes the autonomous mobile body to stand by at a predetermined standby position until the target object arrives when an inspection result of the first inspection gate is determined as being problematic.

[0017]

According to the on-site operation management system described above, as a result of the target object (user) and the autonomous mobile body separately undergoing inspections at separate inspection gates, it is possible to alleviate the burden (stress) of the target object having to wait in line until reaching the inspection gate while carrying one's luggage.

[0018]

There is disclosed an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part; and a highly directional microphone which collects sounds of an ambient environment, wherein the integrated control unit, upon receiving sound signals representing the collected sounds of the highly directional microphone from the autonomous mobile body and determining that it is a requisite state based on the collected sounds, recognizes a position of the autonomous mobile body within the facility.

[0019]

According to the on-site operation management system described above, remote monitoring based on sounds alone is enabled by determining a requisite state such as an emergency situation based on the collected sounds of the ambient environment and locating the position thereof upon moving the autonomous mobile robot. In

addition, by coordinating with a plurality of imaging cameras, it is possible to remarkably improve the efficiency of remote monitoring (security enhancement).

[0020]

Furthermore, the integrated control unit, upon determining that the collected sounds based on sound signals received from each of the plurality of autonomous mobile bodies are of a same sound source, estimates the sound source position, and captures images of the estimated sound source position with at least one or more of the imaging cameras so that the estimated sound source position is centered in the captured images. According to this on-site operation management system, it is possible to further improve the efficiency of remote monitoring by instantaneously identifying and capturing images of the position of the sound source that caused the requisite state.

[0021]

There is disclosed an on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication, wherein the autonomous mobile body comprises: a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility; a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part; and a cartridge-type first battery which is detachably mounted as a driving source, wherein the on-site operation management system comprises: a power supply station which is installed within the facility and uses a commercial power source as its supply source; and a power supply mobile body which is disposed to move freely within the facility and equipped with a plurality of detachable cartridge-type second batteries configured in the same manner as the first battery, wherein, when the integrated control unit causes the power supply mobile body to reach the power supply station, the integrated control unit charges the power from the commercial power source in each of the second batteries via the power supply station, and, upon receiving wireless signals from the autonomous mobile body representing that a remaining charge amount of the first battery has fallen below a predetermined amount, moves and

positions the power supply mobile body to a position near the autonomous mobile body, thereafter removes the first battery mounted in the autonomous mobile body, and replaces the removed first battery with one among the plurality of second batteries mounted in the power supply mobile body.

[0022]

According to the on-site operation management system described above, even when the remaining power of the first battery mounted in the autonomous mobile body is low, the original state can be restored in a relatively short period simply by replacing the first battery with a second battery retained in the power supply mobile body, and it is thereby possible to avoid the considerable loss of time that results from having to return to the charging process as with conventional methods.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0023]

According to embodiments of the present invention, by coordinating with at least one or more autonomous mobile bodies, it is possible to realize an autonomous mobile body and an on-site operation management system capable of performing various types of management and maintenance in facilities in a manner that is remarkably more efficient in comparison to conventional methods.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

[Fig. 1]

Fig. 1 is a conceptual diagram showing the overall configuration of the airport operation management system according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a perspective view and a side view showing the exterior configuration of the autonomous mobile robot according to the same embodiment.

[Fig. 3]

Fig. 3 is a block diagram showing the functional configuration of the autonomous mobile robot according to the same embodiment.

[Fig. 4]

Fig. 4 is a flowchart showing the processing routine of the user recognition function.

[Fig. 5]

CLAIMS

[Claim 1]

An on-site operation management system in which at least one or more autonomous mobile bodies which move freely within a facility are arranged, and which includes an integrated control unit which sends and receives various types of information to and from the autonomous mobile bodies via wireless communication,

wherein the on-site operation management system comprises a plurality of imaging cameras for remote monitoring installed at all locations within the facility where security management is required,

wherein the autonomous mobile body comprises:

- a SLAM function part which creates a planar or three-dimensional environmental map simultaneously with estimating its own position relative to an external environment within the facility;
- a tracking recognition unit which retains a beacon terminal, which is unique to the autonomous mobile body, in a user of the facility, and recognizes in real-time an existence and a position of the user based on wireless signals from the beacon terminal;
- a drive control unit which suitably changes a travel path of the autonomous mobile body so that the autonomous mobile body does not come into contact with peripheral objects based on an output of the SLAM function part while causing the autonomous mobile body to move by following the user based on a recognition result of the tracking recognition unit; and
- a highly directional microphone which collects sounds of an ambient environment,

wherein the integrated control unit, upon receiving sound signals representing the collected sounds of the highly directional microphone from the autonomous mobile body and determining that it is a requisite state based on the collected sounds, recognizes a position of the autonomous mobile body within the facility, and captures images of the autonomous mobile body, in which the position was recognized, with at least one or more of the imaging cameras so that the autonomous mobile body is centered in the captured images.

[Claim 2]

The on-site operation management system according to claim 1,

wherein the integrated control unit, upon determining that the collected sounds based on sound signals received from each of the plurality of autonomous mobile bodies are of a same sound source, estimates a position of the sound source, and captures images of

the estimated position of the sound source with at least one or more of the imaging cameras so that the estimated position of the sound source is centered in the captured images.

[Claim 3]

The on-site operation management system according to claim 1 or claim 2, further comprising:

a plurality of air conditioners installed for climate control, including heating and cooling, of the overall facility,

wherein the autonomous mobile body comprises:

a temperature humidity sensor which is mounted at a height position of a predetermined height from a floor surface for measuring a temperature and a humidity of an ambient environment; and

an infrared thermography for measuring a body surface temperature of the user, wherein the integrated control unit, upon receiving wireless signals including a measurement result of the temperature humidity sensor from the autonomous mobile body, recognizes a position of the autonomous mobile body within the facility, and controls each of the corresponding air conditioners so as to maintain the ambient temperature and humidity of the autonomous mobile body in an optimal state, and estimates a skin temperature of the user whose body temperature is a predetermined temperature or higher based on a relationship of the temperature of the ambient environment as a measurement result of the temperature humidity sensor and a body surface temperature of the user as a measurement result of the infrared thermography.

[Claim 4]

The on-site operation management system according to claim 3,

wherein the autonomous mobile body comprises a microorganism sensor which measures an amount of microorganisms floating in the air, and

wherein the integrated control unit, upon receiving wireless signals including a measurement result of the microorganism sensor from the autonomous mobile body, recognizes a position of the autonomous mobile body within the facility, and controls each of the corresponding air conditioners so as to maintain an ambient air cleanliness of the autonomous mobile body in an optimal state.

[Claim 5]

The on-site operation management system according to any one of claims 1 to 4,

wherein the autonomous mobile body comprises a cartridge-type first battery which is detachably mounted as a driving source,

wherein the on-site operation management system comprises:

a power supply station which is installed within the facility and uses a commercial power source as its supply source; and

a power supply mobile body which is disposed to move freely within the facility and equipped with a plurality of detachable cartridge-type second batteries configured in the same manner as the first battery,

wherein, when the integrated control unit causes the power supply mobile body to reach the power supply station, the integrated control unit charges the power from the

commercial power source in each of the second batteries via the power supply station,

and, upon receiving wireless signals from the autonomous mobile body representing that a remaining charge amount of the first battery has fallen below a predetermined amount,

moves and positions the power supply mobile body to a position near the autonomous

mobile body, thereafter removes the first battery mounted in the autonomous mobile

body, and replaces the removed first battery with one among the plurality of second

batteries mounted in the power supply mobile body.

[Claim 6]

The on-site operation management system according to claim 5,

wherein the power supply mobile body preferentially replaces the removed first battery

with the second battery having the largest remaining charge amount among the plurality of second batteries.

[Claim 7]

The on-site operation management system according to claim 5,

wherein the power supply station charges the power from the commercial power source in the plurality of second batteries mounted in the power supply mobile body via

contactless power supply.

[Claim 8]

The on-site operation management system according to claim 5,

wherein the integrated control unit designates the positioning of the power supply mobile

body while comprehending an operational status of the plurality of autonomous mobile

bodies.