

PERSON DETECTION APPARATUS AND METHOD OF DETECTING A
PERSON

Technical Field

5 [0001] The present invention relates to a person
detection technique of detecting a person-position of a
person in a division on a basis of thermographies
detected in the division.

Background

10 [0002] In the past, as an air-conditioning control
system, there is proposed a technique of determining a
division with a person and
controlling an air-conditioning environment to be
comfortable, and stopping air-conditioning and lighting
15 in a division with no person (for example, see Japanese
Patent Application Laid-open No. 2012-057840, Japanese
Patent Application Laid-open No. 2016-070756, and the
like). Such a system employs a technique of detecting a
person in a division as follows.

20 [0003] The system detects thermographies of the
division by using a plurality of infrared sensors
attached on walls and a ceiling, extracts a person region
indicating a person's skin temperature from the obtained
temperature distribution of the floor-surface of the
25 division, and thereby detects the person.

 [0004] Thermographies are detected at a certain frame
rate, and the temperature distribution of the floor-
surface of the division is measured continuously. As a
result, it is possible to track a person moving, and
30 detect person-position information in the division in
real time.

[0005] However, it is an object of the aforementioned person detection technique of the prior art to control equipment such as air-conditioning equipment and lighting equipment in a division. Therefore an obtained person
5 detection result is only a person-position including coordinate values in an X-Y coordinate system set in a division. Therefore it is not possible to determine the person at each position coordinates, which is a problem.

[0006] The present invention has been made in view of
10 the aforementioned circumstances, and it is desirable to provide a person detection technique capable of easily determining the person in the division and the person-position.

Summary

[0007] In view of the above-mentioned circumstances,
15 according to an embodiment of the present invention, there is provided a person detection apparatus that detects a person-position of a person in a division from thermographies detected by a thermography sensor arranged
20 in the division, the person detection apparatus including: a thermography obtaining unit that obtains thermographies detected by the thermography sensor at regular intervals; a person tracking unit that image-processes the obtained thermographies in time series,
25 tracks a high-temperature part, whose temperature is higher than a floor-surface temperature of the division, and thereby detects the person-position of the person in the division; a memory unit that stores person detection information registered for each person in the division,
30 the person detection information including a pair of the person-position of the person detected by the person

tracking unit and person identifying information identifying the person; and a person determining unit that registers in the person detection information, in response to a detection request from a mobile terminal connected via a communication line, a pair of a person-position of a person detected in a person determining area in the division and person identifying information in the detection request.

[0008] Further, according to the person detection apparatus of an embodiment of the present invention, the thermography obtaining unit obtains a new thermography from the thermography sensor in response to the detection request, the person tracking unit detects a person-position of a new person in the person determining area from the new thermography, and the person determining unit registers, in the person detection information, a pair of a person-position of the new person and person identifying information in the detection request.

[0009] Further, according to an embodiment of the present invention, the person detection apparatus further includes a transmission processing unit that searches, in response to a confirmation request from a user terminal connected via a communication line, the person detection information of the division for a person-position corresponding to specified person identifying information, and transmits confirmation data indicating the obtained person-position to the user terminal.

[0010] Further, according to the person detection apparatus of an embodiment of the present invention, the transmission processing unit transmits, where the person-position corresponding to the specified person

identifying information is not registered in the person detection information of the division, confirmation data indicating that a person-position is unknown to the user terminal.

5 [0011] Further, according to an embodiment, there is provided a method of detecting a person, the method being used by a person detection apparatus that detects a person-position of a person in a division from thermographies detected by a thermography sensor arranged
10 in the division, the method including: by a thermography obtaining unit, obtaining thermographies detected by the thermography sensor at regular intervals; by a person tracking unit, image-processing the obtained thermographies in time series, tracking a high-
15 temperature part, whose temperature is higher than a floor-surface temperature of the division, and thereby detecting the person-position of the person in the division; by a memory unit, storing person detection information registered for each person in the division,
20 the person detection information including a pair of the person-position of the person detected by the person tracking unit and person identifying information identifying the person; and by a person determining unit, registering in the person detection information, in
25 response to a detection request from a mobile terminal connected via a communication line, a pair of a person-position of a person detected in a person determining area in the division and person identifying information in the detection request.

30 [0012] According to the present invention, it is only necessary for a user to operate the mobile terminal in

the person determining area in the division. Then the person detection apparatus establishes correspondence between the person-position of the user and the person identifying information of the user. Therefore the person detection apparatus is capable of determining the person at the person-position detected in the division.

These and other objects, features and advantages of the present disclosure will become more apparent in light of the following detailed description of best mode embodiments thereof, as illustrated in the accompanying drawings.

Brief Description of Drawings

[0013] Fig. 1 is a block diagram showing a configuration of a person detection system;

Fig. 2 shows an example of persons detected in a division;

Fig. 3 shows an example of data structure of person detection information;

Fig. 4 is a sequence diagram showing a person detection behavior and a person detection start behavior;

Fig. 5 shows an example of persons detected in a division after adding a pair;

Fig. 6 shows an example of data structure of person detection information after adding the pair;

Fig. 7 is a sequence diagram showing a confirmation data transmission behavior; and

Fig. 8 shows an example of the confirmation data displayed on the screen.

Detailed Description of Embodiments

[0014] Hereinafter, embodiments of the present technology will be described with reference to the

drawings.

[First embodiment]

Firstly, with reference to Fig. 1, the person detection system 1 of a first embodiment of the present invention will be described. Fig. 1 is a block diagram showing a configuration of a person detection system.

The person detection system 1 is provided in facilities such as an office, in which people use a plurality of divisions. The person detection system 1 provides a person detection result, which is based on thermographies obtained in the respective divisions, to a user. In the present embodiment described here, a person-position of a certain person in a division is transmitted to a user.

[0015] The person detection system 1 includes the plurality of thermography sensors T and the person detection apparatus 10.

The thermography sensors T are typical thermography sensors such as thermopile sensors. The thermography sensors T are sensor terminals arranged on the ceiling S or walls (not shown) of the division D, and detects thermographies of the floor-surface of the division D. In this case, for example, the thermography sensors T are arranged in a matrix on the ceiling of the division D at certain intervals such that the imaging areas of the thermography sensors T overlap with each other.

Note that, if there are a plurality of divisions D, in each of which the thermography sensors T are arranged, the plurality of divisions D are treated as detection targets of the person detection system 1.

[0016] The person detection apparatus 10 as a whole is

an information processing apparatus such as a server apparatus. The person detection apparatus 10 obtains thermographies obtained from the thermography sensors T via the communication line L1. The person detection apparatus 10 detects a person-position of a person in the division D from the thermographies.

The user terminal 20 is an information processing terminal such as a PC, a tablet, and a smartphone. For example, the user terminal 20 has functions of accessing the person detection apparatus 10 via the communication line L2 in response to an operation input in a browser by a user, thereby obtaining a person-position of an arbitrary person in an arbitrary division D, and displaying the person-position on a screen.

[0017] The mobile terminal 22 is a mobile terminal such as a tablet and a smartphone. The mobile terminal 22 has a function of wirelessly sending, depending on a detection request operation input by a user, a detection request including a preset person identifying information of a user.

The wireless base station 21 is connected to the person detection apparatus 10 via the communication line L2. The wireless base station 21 has functions of receiving a detection request wirelessly sent from the mobile terminal 22, and transferring the detection request to the person detection apparatus 10.

[0018] [Person detection apparatus]

The person detection apparatus 10 mainly includes, as functional units, the sensor I/F unit 11, the communication I/F unit 12, the memory unit 13, the thermography obtaining unit 14, the person tracking unit

15, the person determining unit 16, and the transmission processing unit 17. A central processing unit (CPU) executes programs to realize the thermography obtaining unit 14, the person tracking unit 15, the person
5 determining unit 16, and the transmission processing unit 17 out of those functional units.

[0019] The sensor I/F unit 11 has a function of sending and receiving data to and from the thermography sensors T arranged in the division D via the
10 communication line L1.

The communication I/F unit 18 has a function of sending and receiving data to and from the user terminal 20 via the communication line L2.

[0020] The memory unit 13 includes memory devices such as a hard disk and a semiconductor memory. The memory
15 unit 13 has a function of storing various information-to-be-processed and programs used for a person detection process of the person detection apparatus 10.

Examples of such information-to-be-processed mainly
20 include thermographies obtained from the thermography sensors T, and person detection information indicating a person detection result of a person in the division D.

[0021] Fig. 2 shows an example of persons detected in a division. In this detection example, the persons "P11",
25 "P12", "P13", and "P14" are in the division D. Further, the division D has the person determining area N at a position near the entrance, for example. The person determining area N has such a size that the capacity of the area is about one person.

[0022] Fig. 3 shows an example of data structure of person detection information. Person detection
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information is registered for each person ID identifying a person, the person detection information including person identifying information, an X coordinate value, and a Y coordinate value. The X, Y coordinate values indicating a seat-position are coordinate values in a preset X-Y coordinate system in the division D based on an origin O.

For example, the name "AAA" is registered as the person identifying information for the person "P11".

"X11", "Y11" is registered as the person-position of this person. It means that the person "AAA" is at the person-position "X11", "Y11".

[0023] The thermography obtaining unit 14 has functions of obtaining thermographies detected by the thermography sensors T at regular intervals via the sensor I/F unit 11 and the communication line L1, and storing the thermographies in the memory unit 13.

The person tracking unit 15 has functions of image-processing the thermographies stored in the memory unit 13 in time series, tracking a high-temperature part, whose temperature is higher than a floor-surface temperature of the thermographies, thereby detecting the person-position of the person in the division D, and updating the person-position in the person detection information stored in the memory unit 13 on a basis of the detected person-position. A known tracking method disclosed in Japanese Patent Application Laid-open No. 2016-070756 or the like, for example, may be used.

[0024] The person determining unit 16 has a function of registering in the person detection information stored in the memory unit 13, in response to a detection request

from the mobile terminal 22 connected via the communication line L2, a pair of a person-position of a person detected in the person determining area N in the division D and person identifying information in the detection request.

The transmission processing unit 17 has a function of transmitting various data to the user terminal 20 via the communication I/F unit 12 and the communication line L2.

[0025] [Behavior of first embodiment]

Next, with reference to Fig. 4, a behavior of the person detection apparatus 10 of the present embodiment will be described. Fig. 4 is a sequence diagram showing a person detection behavior and a person detection start behavior.

[0026] [Person detection behavior]

Firstly, a person detection behavior will be described.

When it reaches the thermography sending timing (Step 100), the thermography sensor T detects a thermography of the division D (Step 101), and sends the detected thermography to the person detection apparatus 10 (Step 102).

At this time, the thermography sensor T may, in response to a request obtained from the person detection apparatus 10, return the detected thermography to the person detection apparatus 10.

[0027] The thermography obtaining unit 14 receives thermographies autonomously sent from the thermography sensors T. The thermography obtaining unit 14 thus obtains the thermographies of the division D, and stores

the thermographies in the memory unit 13 (Step 103).

The person tracking unit 15 executes a person tracking process, in which the person tracking unit 15 image-processes thermographies stored in the memory unit 13 in time series, tracks a high-temperature part, whose temperature is higher than a floor-surface temperature, as a person, and thereby detects the person-position of the person in the division D (Step 104).

After that, the person tracking unit 15 updates the person-position in the person detection information stored in the memory unit 13 on a basis of the obtained person-position (Step 105). A series of the person detection behavior is finished.

[0028] [Person detection start behavior]

Next, a person detection start behavior will be described.

For example, when a user enters the division D, the user moves to the person determining area N, and inputs a detection request operation in the mobile terminal 22 that the user has (Step 110). Then the mobile terminal 22 wirelessly sends a detection request. The wireless base station 21 receives the detection request, and then transfers the detection request to the person detection apparatus 10 via the communication line L2 (Step 111).

[0029] The thermography obtaining unit 14 of the person detection apparatus 10 receives the detection request from the mobile terminal 22 via the communication I/F unit 12. In this case, the thermography obtaining unit 14 sends an obtaining request to each thermography sensor T via the sensor I/F unit 11 and the communication line L1. The obtaining request indicates a request to

obtain a new thermography (Step 112).

The thermography sensor T receives the obtaining request from the person detection apparatus 10. In this case, the thermography sensor T detects a new
5 thermography of the division D (Step 113), and sends the detected new thermography to the person detection apparatus 10 (Step 114).

[0030] The thermography obtaining unit 14 receives the new thermography sent from the thermography sensor T, and
10 stores the new thermography in the memory unit 13 (Step 115).

The person tracking unit 15 image-processes the new thermography stored in the memory unit 13, and detects a person-position of a user (new person) in the person
15 determining area N in the division D in a similar way to the person tracking process (Step 116).

[0031] After that, the person determining unit 16 adds, in the person detection information stored in the memory unit 13, a pair of the person-position of the user
20 detected by the person tracking unit 15 and the person identifying information in the detection request from the mobile terminal 22 (Step 117), and sends person detection start information to the mobile terminal 22 via the communication line L2 (Step 118). The person detection
25 start information indicates that the person detection apparatus 10 has started the person detection process.

The mobile terminal 22 receives the person detection start information sent from the person detection apparatus 10, and displays the person detection start
30 information on the screen (Step 119). A series of the person detection start behavior is finished.

[0032] Fig. 5 shows an example of persons detected in a division after adding a pair. Fig. 6 shows an example of data structure of person detection information after adding the pair. In the situation of Fig. 5, where the person detection apparatus 10 receives a detection request from the mobile terminal 22, the person detection apparatus 10 detects the person-position of the user "P15" in the person determining area N, and obtains the person identifying information of a user in the detection request. The person detection apparatus 10 registers a pair of the person-position of the user and the person identifying information in the person detection information stored in the memory unit 13. As a result, as shown in Fig. 6, the person identifying information "EEE" of the user "P15" and the person-position "X15", "Y15" are additionally registered in the person detection information. Then the person detection apparatus 10 starts to track the user in the division D.

[0033] [Effects of first embodiment]

As described above, according to the present embodiment, the person tracking unit 15 image-processes the obtained thermographies in time series, tracks a high-temperature part, and thereby detects the person-position of the person in the division. The memory unit 13 stores person detection information registered for each person in the division D, the person detection information including a pair of the person-position of the person detected by the person tracking unit 15 and person identifying information identifying the person. The person determining unit 16 registers in the person detection information, in response to a detection request

from the mobile terminal 22 connected via the communication line L2, a pair of a person-position of a person detected in the person determining area N in the division D and person identifying information in the detection request.

[0034] More specifically, the thermography obtaining unit 14 obtains a new thermography from the thermography sensor T in response to the detection request, the person tracking unit 15 detects a person-position of a new person in the person determining area N from the new thermography, and the person determining unit 16 registers, in the person detection information, a pair of a person-position of the new person and person identifying information in the detection request.

[0035] As a result, it is only necessary for a user to operate the mobile terminal 22 in the person determining area N. Then the person detection apparatus 10 establishes correspondence between the person-position of the user and the person identifying information of the user. Therefore the person detection apparatus 10 is capable of determining the person at the person-position detected in the division D.

[0036] [Second embodiment]

Next, the person detection apparatus 10 of a second embodiment of the present invention will be described.

In the present embodiment described below, the person detection apparatus 10 transmits, in response to a confirmation request from the user terminal 20, a person-position of specified person identifying information to the user terminal 20.

[0037] The transmission processing unit 17 has a

function of searching, in response to a confirmation request received from the user terminal 20 via the communication line L2 and the communication I/F unit 12, the person detection information stored in the memory unit 13 for the person-position corresponding to the specified person identifying information. The transmission processing unit 17 has a function of transmitting confirmation data indicating the obtained person-position to the user terminal 20, which has sent the request. The confirmation data may be transmitted to the user terminal 20 via a Web screen, which is created by using a description language such as HTML, via an email, or via a message.

[0038] [Behavior of second embodiment]

Next, with reference to Fig. 7, a behavior of the person detection apparatus 10 of the present embodiment will be described. Fig. 7 is a sequence diagram showing a confirmation data transmission behavior.

Hereinafter, a confirmation data transmission behavior will be described. Note that the person detection behavior and the person detection start behavior are the same as those described with reference to Fig. 4, and will not be described here.

[0039] [Confirmation data transmission behavior]

A user inputs a confirmation request operation in a browser of the user terminal 20, for example, to confirm the person-position of an arbitrary person in the division D (Step 200). Then the user terminal 20 sends a confirmation request to the person detection apparatus 10 via the communication line L2 (Step 201).

The transmission processing unit 17 of the person

detection apparatus 10 receives the confirmation request from the user terminal 20 via the communication I/F unit 12. Then the transmission processing unit 17 obtains the person detection information of the division D specified in the confirmation request from the memory unit 13 (Step 202).

[0040] After that, the transmission processing unit 17 searches the person detection information for the person-position corresponding to the person identifying information specified in the confirmation request (Step 203), and transmits the confirmation data to the user terminal 20, which has sent the request (Step 204). The confirmation data indicates the obtained person-position.

Note that, in some cases, a person-position corresponding to the specified person identifying information may not be registered in the person detection information of the division D. In this case, the transmission processing unit 17 transmits confirmation data, which indicates that the person-position is unknown, to the user terminal 20.

[0041] The user terminal 20 receives the confirmation data transmitted from the person detection apparatus 10. Then the user terminal 20 displays the received confirmation data on the screen via the browser (Step 205). A series of the confirmation data transmission behavior is finished.

[0042] Fig. 8 shows an example of the confirmation data displayed on the screen. In this example, the positions of persons in the division D are displayed with the graphic symbols. The person identifying information is displayed near the graphic symbol showing the person

corresponding to the specified person identifying information. With this display, a user can confirm the position in the division D of the person corresponding to the specified person identifying information very easily.

5 [0043] [Effects of second embodiment]

As described above, according to the present embodiment, the transmission processing unit 17 searches, in response to a confirmation request from the user terminal 20, the person detection information of the division for a person-position corresponding to specified person identifying information, and transmits confirmation data indicating the obtained person-position to the user terminal 20.

15 [0044] As a result, the confirmation data is automatically transmitted to the user terminal 20. As a result, it is possible to reduce a burden of a user's operation necessary to confirm the confirmation data.

[0045] [Extension of embodiments]

20 It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

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What is claimed is:

1. A person detection apparatus that detects a person-position of a person in a division from thermographies detected by a thermography sensor arranged in the division, the person detection apparatus comprising:

a thermography obtaining unit that obtains thermographies detected by the thermography sensor at regular intervals;

a person tracking unit that image-processes the obtained thermographies in time series,

tracks a high-temperature part, whose temperature is higher than a floor-surface temperature of the division, and thereby

detects the person-position of the person in the division;

a memory unit that stores person detection information registered for each person in the division, the person detection information including a pair of the person-position of the person detected by the person tracking unit and person identifying information identifying the person; and

a person determining unit that registers in the person detection information, in response to a detection request from a mobile terminal connected via a communication line, a pair of a person-position of a person detected in a person determining area in the division and person identifying information in the detection request.

2. The person detection apparatus according to claim 1, wherein

the thermography obtaining unit obtains a new thermography from the thermography sensor in response to the detection request,

the person tracking unit detects a person-position of a new person in the person determining area from the new thermography, and

the person determining unit registers, in the person detection information, a pair of a person-position of the new person and person identifying information in the detection request.

3. The person detection apparatus according to claim 1 or claim 2, further comprising:

a transmission processing unit that searches, in response to a confirmation request from a user terminal connected via a communication line, the person detection information of the division for a person-position corresponding to specified person identifying information, and

transmits confirmation data indicating the obtained person-position to the user terminal.

4. The person detection apparatus according to claim 3, wherein

the transmission processing unit transmits, where the person-position corresponding to the specified person identifying information is not registered in the person detection information of the division, confirmation data indicating that a person-position is unknown to the user terminal.

5. A method of detecting a person, the method being used by a person detection apparatus that detects a person-position of a person in a division from

thermographies detected by a thermography sensor arranged in the division, the method comprising:

by a thermography obtaining unit, obtaining thermographies detected by the thermography sensor at regular intervals;

by a person tracking unit, image-processing the obtained thermographies in time series,

tracking a high-temperature part, whose temperature is higher than a floor-surface temperature of the division, and thereby

detecting the person-position of the person in the division;

by a memory unit, storing person detection information registered for each person in the division, the person detection information including a pair of the person-position of the person detected by the person tracking unit and person identifying information identifying the person; and

by a person determining unit, registering in the person detection information, in response to a detection request from a mobile terminal connected via a communication line, a pair of a person-position of a person detected in a person determining area in the division and person identifying information in the detection request.