PERSON DETECTION RESULT DETERMINING METHOD AND PERSON DETECTION RESULT DETERMINING APPARATUS

Background

[0001] The present invention relates to a person detection result determining technique for determining a detection result of a person present in a target space.

[0002] According to a known person detection system, the system detects thermographies of a target space by using a plurality of infrared sensors attached on walls and a ceiling of the target space, searches the thermographies for a person region indicating a person's skin temperature, and thereby detects a person in the target space (for example, see Japanese Patent Application Laid-open No. 2012-057840, and the like). As a result, it is possible to control a space with a person to realize a comfortably air-conditioned environment, and it is possible to stop air-conditioning or turn off a lighting device in a space with no person, for example. In this way, it is possible to automatically control the environment of the target space.

[0003] A thermopile array sensor is one of infrared sensors that detect thermographies. Thermopile array sensors are arranged on a ceiling. The temperature distribution of the floor-surface is measured. Then a person, i.e., a heat-generating object, is detected, whose temperature is higher than the temperature of the floor-surface. By using thermopile array sensors having high resolutions, it is possible to obtain person-position information every 10 cm (approximately). Therefore by measuring the temperature distribution at a

certain frame rate continuously, it is possible to track a person moving, and detected position information in real time.

[0004] However, according to such a known person detecting technique, affected by noise components in a thermography, a determined person area may sometimes be false. Therefore, in order to improve the performance of the person detecting technique, it is necessary to execute the person detection system in a certain target space for a long time, and confirm true-or-false of obtained person detection results.

[0005] Meanwhile, as a method of determining whether or not a person detection result is true, there is known a method of comparing a person detection result with a correct value. It means that this method requires a correct value. Typically, it is necessary for a person to watch thermographies or images captured by a monitoring camera, which is separately provided, to determine and generate a correct value. However, an enormously large work burden is required to do this work using images stored for a long period of time.

[0006] The present invention has been made in view of the aforementioned circumstances, and it is desirable to provide a person detection result determining technique capable of determining true-or-false of a person detection result extremely easily without the need of an enormously large work burden.

Summary

[0007] In view of the above-mentioned circumstances, according to an embodiment of the present invention, there is provided a person detection result determining

method of determining true-or-false of a person detection result about a target space obtained by a person detection system, including: a person detection result obtaining step executed by a person detection result obtaining unit, the step including obtaining the person detection result from the person detection system; and a true-or-false determining step executed by a true-or-false determining unit, the step including comparing a presence status of a person with a predetermined status that is preset, the obtained person detection result representing the presence status, and determining true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.

[0008] Further, according to an embodiment of the person detection result determining method of the present invention, the true-or-false determining step includes, where the presence status indicates that a person appears, determining true-or-false of the person detection result on a basis of whether or not an appearance position, at which the appearance is detected, is in a predetermined area that is preset in the target space.

[0009] Further, according to an embodiment of the person detection result determining method of the present invention, the true-or-false determining step includes, where the presence status indicates that a person disappears, determining true-or-false of the person detection result on a basis of whether or not a disappearance position, at which the disappearance is detected, is in a predetermined area that is preset in the target space.

[0010] Further, according to an embodiment of the present invention, there is provided a person detection result determining apparatus that determines true-or-false of a person detection result about a target space obtained by a person detection system, including: a person detection result obtaining unit that obtains the person detection result from the person detection system; and a true-or-false determining unit that compares a presence status of a person with a predetermined status that is preset, the obtained person detection result representing the presence status, and determines true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.

[0011] Typically, it is necessary for a person to watch thermographies or images captured by a monitoring camera, which is separately provided, to determine and generate a correct value. It requires an enormously large work burden. To the contrary, according to the present invention, it is possible to determine true-or-false of a person detection result extremely easily without the need of an enormously large work burden. As a result, it is possible to improve the performance of the person detecting technique of the person detection system on a basis of the obtained true-or-false determination result.

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

[0012] Fig. 1 is a block diagram showing a configuration of a person detection result determining apparatus;

Fig. 2 shows an example of the structure of the person detection result;

Fig. 3 is a flowchart showing a person detection result determining process;

Fig. 4 illustrates a person detection result determining example (when a person appears); and

Fig. 5 illustrates a person detection result determining example (when a person disappears).

Detailed Description of Embodiments

[0013] Hereinafter, an embodiment of the present technology will be described with reference to the drawings.

[Person detection result determining apparatus]

Firstly, with reference to Fig. 1, the person detection result determining apparatus 10 of an embodiment of the present invention will be described. Fig. 1 is a block diagram showing a configuration of a person detection result determining apparatus.

The person detection result determining apparatus 10 as a whole is an information processing apparatus such as a server apparatus and a controller for industrial purposes. The person detection result determining apparatus 10 determines true-or-false on a basis of a person detection result about the target space R obtained by the person detecting system 20.

[0014] The person detecting system 20 is a typical system. The infrared sensors SP are infrared sensors

such as thermopile array sensors attached on walls and the ceiling of the target space R. The infrared sensors SP detect thermographies of the inside of the target space R. The person detecting system 20 obtains the thermographies from the infrared sensors SP via the communication line L2, and searches the thermographies for person regions, each person region representing a skin temperature of the person. As a result, the person detecting system 20 detects the person in the target space R.

[0015] As shown in Fig. 1, the person detection result determining apparatus 10 mainly includes, as functional units, the communication I/F unit 11, the operation input unit 12, the display unit 13, the memory unit 14, the person detection result obtaining unit 15, and the true-or-false determining unit 16. A central processing unit (CPU) executes programs to realize the person detection result obtaining unit 15 and the true-or-false determining unit 16 out of those functional units.

[0016] The communication I/F unit 11 has a function of sending and receiving data to and from the person detecting system 20 via the communication line L1.

The operation input unit 12 includes operation input devices such as a keyboard, a mouse, and a touch panel. The operation input unit 12 has a function of detecting and outputting operations input by an operator.

The display unit 13 is a display device such as an LCD. The display unit 13 has a function of displaying various information screens such as a menu screen, a configuration setting screen, and a determination result screen.

[0017] The memory unit 14 includes memory devices such as a hard disk and a semiconductor memory. The memory unit 14 has a function of storing programs and various information-to-be-processed used for the person detection result determining process such as person detection results, predetermined area positions, and determine results.

The person detection result obtaining unit 15 has functions of obtaining person detection results obtained by the person detecting system 20 via the communication I/F unit 11, and storing the person detection results in the memory unit 14.

Fig. 2 shows an example of the structure of the person detection result. In this example, a detected position, at which a person is detected, is registered for each detection date/time.

[0018] The true-or-false determining unit 16 has functions of comparing a presence status of a person with a predetermined status that is preset, the person detection result obtained from the memory unit 14 representing the presence status, and determining true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.

[0019] Specifically, the true-or-false determining unit 16 has a function of, where the presence status indicates that a person appears, determining true-or-false of the person detection result on a basis of whether or not an appearance position, at which the appearance is detected, is in a predetermined area Q that is preset in the target space R. The true-or-false

determining unit 16 has a function of, where the presence status indicates that a person disappears, determining true-or-false of the person detection result on a basis of whether or not a disappearance position, at which the disappearance is detected, is in a predetermined area Q that is preset in the target space R.

[0020] [Behavior of embodiment]

Next, with reference to Fig. 3, a behavior of the person detection result determining apparatus 10 of the present embodiment will be described. Fig. 3 is a flowchart showing a person detection result determining process.

The person detection result determining apparatus 10 executes the person detection result determining process of Fig. 3 in response to operations input by an operator and detected by the operation input unit 12 and in response to instructions from an external apparatus (not shown).

[0021] In this example, determination-target person detection results are prestored in the memory unit 14 in time series before executing the person detection result determining process. Further, the predetermined area Q is preset in the memory unit 14. The predetermined area Q is in the target space R, and is an area in which a person may appear or disappear. For example, the predetermined area Q is near an entrance where a person moves to and fro. Note that, in the following description, the person detection results are searched in time series, and appearance or disappearance of a person is thereby confirmed. Instead, if the person detection result by itself includes data indicating appearance or

disappearance of a person, true-or-false of the person detection result indicating appearance or disappearance of a person may be determined on a basis of that data.

[0022] Firstly, the true-or-false determining unit 16 obtains the determination-target person detection results from the memory unit 14, searches the person detection results in time series, and thereby confirms appearance or disappearance of a person (Step 100).

In the search, if it is detected for the first time that a person is present at a certain time point and appearance of a person is confirmed (Step 101: YES), the true-or-false determining unit 16 compares the appearance position (coordinate position) of a person with the predetermined area (coordinate position) Q preset in the memory unit 14 (Step 102).

[0023] At this time, if the appearance position is in the predetermined area Q, and if the presence status (a person appears in the predetermined area Q) is not inconsistent with the predetermined status (the predetermined area Q is the area in which a person appears) (Step 103: YES), the true-or-false determining unit 16 determines that the person detection result indicating appearance of a person is true (Step 104).

[0024] Meanwhile, if the appearance position is not in the predetermined area Q, and if the presence status (a person appears outside the predetermined area Q) is inconsistent with the predetermined status (the predetermined area Q is the area in which a person appears) (Step 103: NO), the true-or-false determining unit 16 determines that the person detection result indicating appearance of a person is false (Step 105).

[0025] Further, in Step 101, if appearance of a person is not confirmed (Step 101: NO), and if presence of a person is undetected at a certain time point and disappearance of a person is confirmed (Step 108: YES), the true-or-false determining unit 16 compares the disappearance position (coordinate position) of the person with the predetermined area (coordinate position) Q preset in the memory unit 14 (Step 109).

[0026] At this time, if the disappearance position is in the predetermined area Q, and if the presence status (a person disappears in the predetermined area Q) is not inconsistent with the predetermined status (the predetermined area Q is the area in which a person disappears) (Step 110: YES), the true-or-false determining unit 16 determines that the person detection result indicating disappearance of a person is true (Step 104).

[0027] Meanwhile, if the disappearance position is not in the predetermined area Q, and if the presence status (a person disappears outside the predetermined area Q) is inconsistent with the predetermined status (the predetermined area Q is the area in which a person disappears) (Step 110: NO), the true-or-false determining unit 16 determines that the person detection result indicating disappearance of a person is false (Step 105).

[0028] In this way, the true-or-false determining unit 16 determines true-or-false of the person detection result. After that, the true-or-false determining unit 16 stores the obtained determination result in the memory unit 14 (Step 106), and confirms whether or not the search of person detection results is finished (Step 107).

In Step 107, if the search is not completed and an unsearched person detection result remains (Step 107: NO), the true-or-false determining unit 16 returns to Step 100. Note that, in Step 108, if disappearance of a person is not confirmed (Step 108: NO), the true-or-false determining unit 16 proceeds to Step 107.

Further, if the search is completed and no unsearched person detection result remains (Step 107: YES), the true-or-false determining unit 16 finishes a series of the person detection result determining process.

[0029] [Example]

Fig. 4 illustrates a person detection result determining example (when a person appears). In Fig. 4, (a) to (c) show detected thermographies of the target space R and person detection results in time series from the time 1 to the time 3. In this example, the predetermined area Q is preset at a part (lower right) of the target space R, for example, near an entrance of the target space R. In the predetermined area Q, a person may appear or disappear.

[0030] Firstly, at the time t1, as shown in (a) of Fig. 4, the persons P1 and P2 are already detected near the center of the target space R. After that, at the time t2, as shown in (b) of Fig. 4, the person P3 is newly detected in the predetermined area Q, and appearance of the person P3 is confirmed. In this case, since the appearance position of the person P3 is in the predetermined area Q, it is determined that the person detection result about appearance of the person P3 is true. Further, after that, at the time t3, as shown in (c) of Fig. 4, the person P4 is newly detected outside

the predetermined area Q, and appearance of the person P4 is confirmed. In this case, since the appearance position of the person P4 is outside the predetermined area Q, it is determined that the person detection result about appearance of the person P4 is false.

[0031] Fig. 5 illustrates a person detection result determining example (when a person disappears). In Fig. 5, (a) to (c) show detected thermographies of the target space R and person detection results in time series from the time 1 to the time 3. In this example, the predetermined area Q is preset at a part (lower right) of the target space R, for example, near an entrance of the target space R. In the predetermined area Q, a person may appear or disappear.

[0032] Firstly, at the time t1, as shown in (a) of Fig. 5, the persons P1, P2, and P3 are already detected near the center of the target space R. The person P4 is already detected in the predetermined area Q. After that, at the time t2, as shown in (b) of Fig. 5, the person P4 is undetected in the predetermined area Q, and disappearance of the person P4 is confirmed. In this case, since the disappearance position of the person P4 is in the predetermined area Q, it is determined that the person detection result about disappearance of the person P4 is true. Further, after that, at the time t3, as shown in (c) of Fig. 5, the person P3 is undetected outside the predetermined area Q, and disappearance of the person P3 is confirmed. In this case, since the disappearance position of the person P3 is outside the predetermined area Q, it is determined that the person detection result about disappearance of the person P3 is

false.

[0033] [Effects of embodiment]

As described above, according to the present embodiment, the person detection result obtaining unit 15 obtains a person detection result from the person detection system 20. The true-or-false determining unit 16 compares presence status of a person with a predetermined status that is preset, the person detection result obtained from the memory unit 14 representing the presence status, and determines true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.

Specifically, the true-or-false determining unit 16, where the presence status indicates that a person appears, determines true-or-false of the person detection result on a basis of whether or not an appearance position, at which the appearance is detected, is in a predetermined area Q that is preset in the target space R. The true-or-false determining unit 16, where the presence status indicates that a person disappears, determines true-or-false of the person detection result on a basis of whether or not a disappearance position, at which the disappearance is detected, is in a predetermined area Q that is preset in the target space R.

[0034] Typically, it is necessary for a person to watch thermographies or images captured by a monitoring camera, which is separately provided, to determine and generate a correct value. It requires an enormously large work burden. To the contrary, according to the present embodiment, it is possible to determine true-or-

false of a person detection result extremely easily without the need of an enormously large work burden. As a result, it is possible to improve the performance of the person detecting technique of the person detection system 20 on a basis of the obtained true-or-false determination result.

[0035] [Extension of embodiment]

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.

What is claimed is:

1. A person detection result determining method of determining true-or-false of a person detection result about a target space obtained by a person detection system, comprising:

a person detection result obtaining step executed by a person detection result obtaining unit, the step including obtaining the person detection result from the person detection system; and

a true-or-false determining step executed by a true-or-false determining unit, the step including

comparing a presence status of a person with a predetermined status that is preset, the obtained person detection result representing the presence status, and

determining true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.

2. The person detection result determining method according to claim 1, wherein

the true-or-false determining step includes, where the presence status indicates that a person appears, determining true-or-false of the person detection result on a basis of whether or not an appearance position, at which the appearance is detected, is in a predetermined area that is preset in the target space.

3. The person detection result determining method according to claim 1 or claim 2, wherein

the true-or-false determining step includes, where the presence status indicates that a person disappears, determining true-or-false of the person detection result

on a basis of whether or not a disappearance position, at which the disappearance is detected, is in a predetermined area that is preset in the target space.

4. A person detection result determining apparatus that determines true-or-false of a person detection result about a target space obtained by a person detection system, comprising:

a person detection result obtaining unit that obtains the person detection result from the person detection system; and

a true-or-false determining unit that

compares a presence status of a person with a predetermined status that is preset, the obtained person detection result representing the presence status, and

determines true-or-false of the person detection result on a basis of whether or not the presence status is inconsistent with the predetermined status.