

LIGHTING CONTROL METHOD AND LIGHTING CONTROLLER APPARATUS

Background

[0001] According to a known person detection system,
5 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
10 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
15 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.

[0002] A thermopile array sensor is one of infrared
sensors that detect thermographies. Thermopile array
20 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
25 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
30 real time.

[0003] Such a known technique automatically controls a

lighting device arranged on a ceiling on a basis of whether or not a person is in a lighting area of the lighting device. In this case, the lighting may not be controlled smoothly only by comparing a detected position of a detected person with a lighting area, which is a problem.

[0004] For example, according to conceivable controlling idea, a lighting device is turned on if a detected position of a person is in a lighting area. The lighting device is turned off if a detected position is outside the lighting area. However, let's say that a person is working near the border of the lighting area. In such a case, the lighting device may be turned on and off again and again as the person slightly moves. If the lighting device is turned on and off again and again, not only the person may feel uncomfortable but also it may shorten the life of the lighting device.

[0005] There may be used a so-called off-delay control method to reduce occurrence of such frequent turning on and off. According to the off-delay control method, a lighting device is turned off late. According to the off-delay control method, for example, a lighting device is turned off not immediately after a person moves outside a lighting area. Instead, a lighting device is turned off after a certain monitoring time without a person passes. However, according to the off-delay control method, it is necessary to provide a monitoring time of about several minutes to several tens of minutes in order to reliably control a lighting device. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is less attained.

[0006] The present invention has been made in view of the aforementioned circumstances, and it is desirable to provide a lighting control technique capable of efficiently and automatically controlling a lighting device on a basis of a person detection result without needless monitoring time.

Summary

[0007] In view of the above-mentioned circumstances, according to an embodiment of the present invention, there is provided a lighting control method of on/off-controlling a lighting device arranged in a target space on a basis of a person-detected position obtained from a thermography of the target space, the lighting control method including: storing a lighting area position and a buffer area position by a memory unit, the lighting area position representing a lighting area preassigned to the lighting device, the buffer area position representing a buffer area having a band shape arranged at an outer circumference of the lighting area, the target space including the lighting area and the buffer area; and controlling the lighting device by a lighting controller unit, the step of controlling the lighting device including comparing the lighting area position and the buffer area position with the person-detected position, turning on the lighting device where a person is in the lighting area, turning off the lighting device where no person is in the lighting area and the buffer area, and maintaining a latest controlled status of the lighting device where no person is in the lighting area and a person is in the buffer area.

[0008] Further, according to an embodiment of the

lighting control method of the present invention, the lighting device includes first and second lighting devices adjacent to each other, and the first lighting device and the second lighting device are arranged such that a first buffer area of the first lighting device and a second buffer area of the second lighting device are adjacent to each other.

[0009] Further, according to an embodiment of the lighting control method of the present invention, the lighting device includes first and second lighting devices adjacent to each other, and the first lighting device and the second lighting device are arranged such that a first buffer area of the first lighting device and a second buffer area of the second lighting device overlap each other.

[0010] Further, according to an embodiment of the lighting control method of the present invention, the lighting device includes first and second lighting devices adjacent to each other, and an area between a first lighting area of the first lighting device and a second lighting area of the second lighting device is used as a shared buffer area shared by the first and second lighting devices.

[0011] Further, according to an embodiment of the lighting control method of the present invention, the buffer area has a width equal to or larger than a size of a person region that appears in the thermography, the person region representing a skin temperature of a person.

[0012] Further, according to an embodiment of the lighting control method of the present invention, the step of controlling the lighting device includes, by the

lighting controller unit, determining whether it is necessary to turn on the lighting device or not by using a first person-detected position obtained by detecting a person at a preset first sensitivity, and determining whether it is necessary to turn off the lighting device or not by using a second person-detected position obtained by detecting a person at a second sensitivity, the second sensitivity being higher than the first sensitivity.

[0013] Further, according to an embodiment of the lighting control method of the present invention, the step of turning on the lighting device by the lighting controller unit includes turning on the lighting device when confirming that a person is in the lighting area in a preset first determination time period without interruption, and the step of turning off the lighting device by the lighting controller unit includes turning off the lighting device when confirming that no person is in the lighting area and the buffer area in a second determination time period without interruption, the second determination time period being longer than the first determination time period.

[0014] Further, according to the present invention, there is provided a lighting controller apparatus that on/off-controls a lighting device arranged in a target space on a basis of a person-detected position represented by a person detection result of the target space, the lighting controller apparatus including: a memory unit that stores a lighting area position and a buffer area position, the lighting area position representing a lighting area preassigned to the lighting

device, the buffer area position representing a buffer area having a band shape arranged at an outer circumference of the lighting area, the target space including the lighting area and the buffer area; and a lighting controller unit that compares the lighting area position and the buffer area position with the person-detected position, turns on the lighting device where a person is in the lighting area, turns off the lighting device where no person is in the lighting area and the buffer area, and maintains a latest controlled status of the lighting device where no person is in the lighting area and a person is in the buffer area.

[0015] According to the present invention, even if the person stops near the border of the lighting area or the outer border of the buffer area, the lighting device is not turned on and off again and again, and the person may not feel uncomfortable. Further, immediately after the person goes outside the buffer area, the lighting device is turned off. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is attained. Therefore it is possible to efficiently and automatically control a lighting device on a basis of a person detection result without needless monitoring time.

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

[0016] Fig. 1 is a block diagram showing a configuration of a lighting controller apparatus;

Fig. 2 shows an example of lighting area settings;

Fig. 3 shows an example of the structure of the person detection result;

Fig. 4 is a flowchart showing a lighting control process;

Fig. 5 illustrates an example of the lighting control behavior (single);

Fig. 6 illustrates an example of the lighting control behavior (adjacent or partly overlapping);

Fig. 7 illustrates an example of the lighting control behavior (completely overlapping); and

Fig. 8 illustrates an example of person detecting determination.

Detailed Description of Embodiments

[0017] Hereinafter, embodiments of the present technology will be described with reference to the drawings.

[First embodiment]

Firstly, with reference to Fig. 1, the lighting controller apparatus 10 of a first embodiment of the present invention will be described. Fig. 1 is a block diagram showing a configuration of a lighting controller apparatus of the first embodiment.

The lighting controller apparatus 10 as a whole is an information processing apparatus such as a server apparatus and a controller for industrial purposes. The lighting controller apparatus 10 controls, on a basis of a person detection result about the target space R obtained by the person detecting system 20, the lighting devices Q arranged in the target space R.

[0018] 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 U. As a result, the person detecting system 20 detects the person U in the target space R. Note that in an example of the present embodiment described below, the person detecting system 20 detects a person in the target space R. Alternatively, the lighting controller apparatus 10 may detect a person.

[0019] Fig. 2 shows an example of lighting area settings. The infrared sensors SP and the plurality of lighting devices Q are arranged on the ceiling of the target space R. The lighting devices Q have the lighting areas S on the floor surface of the target space R. Light from the lighting devices Q reaches the floor surface. The center of the lighting area S is the arrangement position of the lighting device Q. The lighting controller apparatus 10 automatically on/off-controls the lighting devices Q on a basis of presence/absence of a person in the lighting areas S.

According to the present invention, the buffer area K having a band shape is arranged at an outer circumference of the lighting area S. The lighting device Q is controlled on a basis of a person in not only the lighting area S but also the buffer area K.

[0020] In an example of Fig. 2, the lighting area S

substantially has a square shape, the lighting device Q being the center. The buffer area K has a band shape and a constant width, and is arranged at the outer circumference of the buffer area K. The width W of the buffer area K is equal to or larger than the size of the person region M representing the skin temperature of a person that appears in a thermography. As described later, where a person is in the buffer area K, even if no person is in the lighting area S, the latest controlled status of the lighting device Q is maintained. So it is supposed that the light from the lighting device Q reaches the buffer area K. So the outer border of the width W may be the range, in which the brightness of the light from the lighting device Q reaches a predetermined level or more.

[0021] As shown in Fig. 1, the lighting controller 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 lighting controller unit 16. A central processing unit (CPU) executes programs to realize the person detection result obtaining unit 15 and the lighting controller unit 16 out of those functional units.

[0022] 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 communication I/F unit 11 has a function of sending and receiving data to and from the lighting devices Q arranged in the target space R via the communication line L3.

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.

5 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 lighting control screen.

10 [0023] 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
15 results, lighting area positions, buffer 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
20 I/F unit 11, and storing the person detection results in the memory unit 14.

 Fig. 3 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
25 for each detection date/time.

 [0024] The lighting controller unit 16 has a function of comparing the position of the lighting area S and the position of the buffer area K with the person-detected position. The lighting controller unit 16 has functions
30 of controlling the lighting device Q via the communication I/F unit 11, the functions of controlling

the lighting device Q including turning on the lighting device Q where a person U is in the lighting area S, turning off the lighting device Q where no person U is in the lighting area S and the buffer area K, and
5 maintaining a latest controlled status of the lighting device Q where no person U is in the lighting area S and a person U is in the buffer area K.

[0025] [Behavior of first embodiment]

Next, with reference to Fig. 4, a behavior of the
10 lighting controller apparatus 10 of the present embodiment will be described. Fig. 4 is a flowchart showing a lighting control process.

The lighting controller apparatus 10 executes the lighting control process of Fig. 4 at predetermined
15 intervals. Note that the memory unit 14 prestores the position of the lighting area S and the position of the buffer area K for each lighting device Q.

[0026] Firstly, the person detection result obtaining unit 15 obtains the newest person detection result from
20 the person detecting system 20 via the communication I/F unit 11, stores the newest person detection result in the memory unit 14 (Step 100), and selects an unselected lighting device Q from the lighting devices Q (Step 101).

Next, the lighting controller unit 16 compares the
25 person detection result read from the memory unit 14 with the position of the lighting area S of the selected lighting device Q, which is prestored in the memory unit 14. As a result, the lighting controller unit 16 confirms presence/absence of a person in the lighting
30 area S (Step 102).

[0027] Then, where a person is in the lighting area S

(Step 102: YES), the lighting controller unit 16 controls the lighting device Q via the communication I/F unit 11 to turn on the lighting device Q (Step 103).

Meanwhile, where no person is in the lighting area S (Step 102: NO), the lighting controller unit 16 compares the person detection result with the position of the buffer area K of the selected lighting device Q, which is prestored in the memory unit 14. As a result, the lighting controller unit 16 confirms presence/absence of a person in the buffer area K (Step 104).

[0028] Then, where no person is in the buffer area K (Step 104: NO), the lighting controller unit 16 controls the lighting device Q via the communication I/F unit 11 to turn off the lighting device Q (Step 105).

Further, where a person is in the buffer area K (Step 104: YES), the lighting controller unit 16 maintains the latest controlled status of the lighting device Q (Step 106).

After that, the lighting controller unit 16 confirms whether or not all the lighting devices Q are selected (Step 107). Where there is an unselected lighting device Q (Step 107: NO), the lighting controller unit 16 returns to Step 101. Meanwhile, where all the lighting devices Q are selected (Step 107: YES), the lighting controller unit 16 finishes a series of the lighting control process.

[0029] [Example of lighting control behavior (single)]

Next, with reference to Fig. 5, an example of the lighting control behavior of the lighting controller apparatus 10 of the present embodiment will be described. In this example, the lighting control behavior for the buffer area K of a single lighting device Q will be

described. Fig. 5 illustrates an example of the lighting control behavior (single). (a) of Fig. 5 shows an arrangement example of a lighting area and a buffer area. (b) of Fig. 5 shows a controlled status of a lighting device as a person moves.

[0030] In this example, only one person U is in the lighting area S of the lighting device Q. In the initial status, the lighting device Q is turned on. The person U goes out from the lighting area S, passes through the buffer area K of the lighting device Q, and goes outside the buffer area K. This situation is assumed. Note that no person is in the buffer area K.

[0031] Firstly, the person U at the position P1 in the lighting area S is detected. The lighting device Q is controlled and is turned on. At the border position P2 between the lighting area S and the buffer area K, the person U in the lighting area S is undetected. However, the person U in the buffer area K is detected. Therefore the latest controlled status of the lighting device Q, i.e., the turn-on status, is maintained. Consequently, at the outer border position P3 of the buffer area K, the person U in the buffer area K is undetected. Therefore the lighting device Q is controlled and is turned off. The same applies to the position P4 outside the buffer area K.

[0032] After that, the person U returns in the direction toward the lighting area S. In this case, at the outer border position P5 of the buffer area K, the person U in the buffer area K is detected. However, the latest controlled status of the lighting device Q, i.e., the turn-off status, is maintained. Consequently, at the

border position P6 between the buffer area K and the lighting area S, the person U in the buffer area K is undetected. However, the person U in the lighting area S is detected. Therefore the lighting device Q is controlled and is turned on.

[0033] As a result, even if the person U goes outside the lighting area S, where the person U is in the buffer area K, the lighting device Q is still kept turned on. At a time when the person U goes outside the buffer area K, the lighting device Q is turned off. After that, after the person U returns to the buffer area K, the lighting device Q is still kept turned off. At a time when the person U enters the lighting area S, the lighting device Q is turned on.

Therefore, even if the person U in the lighting area S goes to the border of the lighting area S, stops near the border, and then moves slightly, the lighting device Q is still kept turned on. As a result, the lighting device Q is not turned on and off again and again, and the person may not feel uncomfortable. Further, immediately after the person U goes outside the buffer area K, the lighting device Q is turned off. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is attained.

[0034] Further, where the person U goes outside the buffer area K once, even if the person U returns to the buffer area K, the lighting device Q is not turned on. Therefore, even if the person U stops near the outer border of the buffer area K and then moves slightly, the lighting device Q is still kept turned off. As a result, the lighting device Q is not turned on and off again and

again, and the person may not feel uncomfortable.

Further, immediately after the person U returns to the lighting area S, the lighting device Q is turned on. Therefore, even if the person U stops near the outer
5 border of the lighting area S and then moves slightly, the lighting device Q is still kept turned on. As a result, the lighting device Q is not turned on and off again and again, and the person may not feel uncomfortable.

10 [0035] [Example of lighting control behavior (adjacent or partly overlapping)]

Next, with reference to Fig. 6, an example of the lighting control behavior of the lighting controller apparatus 10 of the present embodiment will be described.

15 In this example, the lighting device Q1 (first lighting device) is arranged adjacent to the lighting device Q2 (second lighting device). The buffer area K1 (first buffer area) of the lighting device Q1 is adjacent to or partly overlaps the buffer area K2 (second buffer area)
20 of the lighting device Q2. Fig. 6 illustrates an example of the lighting control behavior (adjacent or partly overlapping). (a) of Fig. 6 shows an arrangement example of lighting areas and buffer areas. (b) of Fig. 6 shows a controlled status of lighting devices as a person moves.

25 [0036] In this example, the buffer area K1 of the lighting device Q1 is arranged adjacent to the buffer area K2 of the lighting device Q2. Only one person U is in the lighting area S1 (first lighting area) of the lighting device Q1. In the initial status, the lighting
30 device Q1 is turned on. The person U goes out from the lighting area S1, passes through the buffer area K1 of

the lighting device Q1 and the buffer area K2 of the lighting device Q2, and enters the lighting area S2 (second lighting area) of the lighting device Q2. This situation is assumed. Note that no person is in the buffer area K1, the buffer area K2, and the lighting area S2. The lighting device Q2 is turned off.

[0037] Firstly, the person U at the position P1 in the lighting area S1 is detected. The lighting device Q1 is controlled and is turned on. At the border position P2 between the lighting area S1 and the buffer area K1, the person U in the lighting area S1 is undetected. However, the person U in the buffer area K1 is detected.

Therefore the latest controlled status of the lighting device Q1, i.e., the turn-on status, is maintained.

Consequently, at the border position P3 between the buffer area K1 and the buffer area K2, the person U in the buffer area K1 is undetected. Therefore the lighting device Q1 is controlled and is turned off. Meanwhile, the person U in the buffer area K2 is detected. However, the latest controlled status of the lighting device Q2, i.e., the turn-off status, is maintained.

[0038] After that, at the border position P4 between the buffer area K2 and the lighting area S2, the person U in the buffer area K2 is undetected. However, the person U in the lighting area S2 is detected. Therefore the lighting device Q2 is controlled and is turned on. The same applies to the position P5 in the lighting area S2.

[0039] As a result, where the buffer area K1 is adjacent to the buffer area K2, even if the person U once goes outside the buffer area K1 and then returns to the buffer area K1, the lighting device Q1 is controlled and

is turned on similar to Fig. 5. Therefore, even if the person U stops near the border of the lighting area S1 or near the outer border of the buffer area K1, the lighting device Q1 is not turned on and off again and again, and the person may not feel uncomfortable. Further, immediately after the person U goes outside the buffer area K1, the lighting device Q1 is turned off. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is attained.

[0040] Further, the lighting control of the lighting device Q2 is similar to the aforementioned lighting control of the lighting device Q1. As a result, behaviors and effects similar to the aforementioned behaviors and effects are realized for the lighting device Q2. Therefore, even if the buffer area K1 of the lighting device Q1 is arranged adjacent to the buffer area K2 of the lighting device Q2, the lighting control is realized reliably and effectively for both the lighting device Q1 and the lighting device Q2. Therefore, it is possible to provide the buffer areas K without a gap in the target space R.

[0041] Note that, where the adjacent buffer area K1 and buffer area K2 partly overlap each other, the person U in the buffer area K2 is detected at not the border position P3 but the outer border G2 of the buffer area K2. In addition, the person U in the buffer area K1 is undetected at not the border position P3 but the outer border G1 of the buffer area K1. As a result, the lighting device Q1 is controlled and is turned off at not the border position P3 but the outer border G1. However, the lighting control is similar to the lighting control

where the buffer area K1 does not overlap the buffer area K2. Even if the buffer area K1 partly overlaps the buffer area K2, the lighting control is realized reliably and effectively for both the lighting device Q1 and the lighting device Q2. Therefore, it is possible to provide the buffer areas without a gap in the target space R.

[0042] [Example of lighting control behavior (completely overlapping)]

Next, with reference to Fig. 7, an example of the lighting control behavior of the lighting controller apparatus 10 of the present embodiment will be described. In this example, the lighting device Q1 is arranged adjacent to the lighting device Q2. The buffer area K1 of the lighting device Q1 completely overlaps the buffer area K2 of the lighting device Q2. Fig. 7 illustrates an example of the lighting control behavior (completely overlapping). (a) of Fig. 7 shows an arrangement example of lighting areas and buffer areas. (b) of Fig. 7 shows a controlled status of lighting devices as a person moves.

[0043] In this example, the buffer area K1 of the lighting device Q1 completely overlaps the buffer area K2 of the lighting device Q2. The completely overlapping area is the shared buffer area G. Only one person U is in the lighting area S1 of the lighting device Q1. In the initial status, the lighting device Q1 is turned on. The person U goes out from the lighting area S1, passes through the shared buffer area G shared by the lighting device Q1 and the lighting device Q2, and enters the lighting area S2 of the lighting device Q2. This situation is assumed. Note that no person is in the shared buffer area G and the lighting area S2. The

lighting device Q2 is turned off.

[0044] Firstly, the person U at the position P1 in the lighting area S1 is detected. The lighting device Q1 is controlled and is turned on. At the border position P2 between the lighting area S1 and the buffer area K1, the person U in the lighting area S1 is undetected. However, the person U in the shared buffer area G is detected. Therefore the latest controlled status of the lighting device Q1, i.e., the turn-on status, is maintained. In addition, the latest controlled status of the lighting device Q2, i.e., the turn-off status, is maintained.

Consequently, at the border position P3 between the shared buffer area G and the buffer area K2, the person U in the shared buffer area G is undetected. Therefore the lighting device Q1 is controlled and is turned off. Meanwhile, the person U in the lighting area S2 is detected. So the lighting device Q2 is controlled and is turned on. The same applies to the position P4 in the lighting area S2.

[0045] As a result, where the buffer area K1 completely overlaps the buffer area K2 as the shared buffer area G, and where the buffer area K1 of the lighting device Q1 and the buffer area K2 of the lighting device Q2 shares the shared buffer area G, even if the person U once goes outside the shared buffer area G and then returns to the shared buffer area G, the lighting device Q1 is controlled and is turned on similar to Fig. 5. Therefore, even if the person U stops near the border of the lighting area S1 or near the outer border of the shared buffer area G, the lighting device Q1 is not turned on and off again and again, and the person may not

feel uncomfortable. Further, immediately after the person U goes outside the shared buffer area G, the lighting device Q1 is turned off. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is attained.

[0046] Further, the lighting control of the lighting device Q2 is similar to the aforementioned lighting control of the lighting device Q1. As a result, behaviors and effects similar to the aforementioned behaviors and effects are realized for the lighting device Q2. Therefore, even if the completely overlapping shared buffer area G of the lighting device Q1 and the lighting device Q2 is arranged, the lighting control is realized reliably and effectively for both the lighting device Q1 and the lighting device Q2. Therefore, it is possible to provide the buffer areas K in the target space R extremely efficiently. Further, when the person U moves from the lighting area S1 via the shared buffer area G to the lighting area S2, the lighting device Q1 is controlled and is turned off and the lighting device Q2 is controlled and is turned on simultaneously. Therefore it is possible to control the lighting device Q1 and the lighting device Q2 extremely smoothly as the person U moves.

[0047] [Effects of first embodiment]

As described above, according to the present embodiment, the lighting controller unit 16 compares the lighting area S position and the buffer area K position with the person-detected position, turns on the lighting device Q where a person U is in the lighting area S, turns off the lighting device Q where no person U is in

the lighting area S and the buffer area K, and maintains a latest controlled status of the lighting device Q where no person U is in the lighting area S and a person U is in the buffer area K.

5 [0048] Therefore, even if the person U stops near the border of the lighting area S or the outer border of the buffer area K, the lighting device Q is not turned on and off again and again, and the person U may not feel uncomfortable. Further, immediately after the person U
10 goes outside the buffer area K, the lighting device Q is turned off. As a result, the original purpose of the automatic lighting control, i.e., energy saving, is attained. Therefore it is possible to efficiently and automatically control the lighting device Q on a basis of
15 a person detection result without needless monitoring time.

[0049] [Second embodiment]

Next, the lighting controller apparatus 10 of a second embodiment of the present invention will be
20 described.

Typically, person detection results involve errors. There are two kinds of errors. One error is that "a person exists but is undetected", and the other error is that "no person exists but a person is detected". In
25 most cases, adjustment of tendency depends on adjustment of parameters of a person detection method, e.g., parameters of the sensitivity of person detecting determination.

[0050] According to the "low-sensitivity person
30 detection" adjustment, the error that "a person exists but is undetected" occurs slightly more. According to

this adjustment, to the contrary, the error that "no person exists but a person is detected" occurs less. Meanwhile, according to the "high-sensitivity person detection" adjustment, the error that "no person exists but a person is detected" occurs slightly more.

According to this adjustment, to the contrary, the error that "a person exists but is undetected" occurs less.

[0051] Typically, the person detection behavior is executed at the frequency of several times to several tens of times per second. For example, in order to accurately determine whether or not it is necessary to turn on a lighting device at a time when a person enters a lighting area, it is not necessary to confirm that the person is in the lighting area on a basis of all a plurality of person detection results obtained in the first several seconds from that time. Rather, it is better to reliably confirm, even only once, that the person is in the lighting area. To the contrary, if no person exists but a person is detected by error and a lighting device is then turned on, it is waste of energy. Therefore, in order to determine whether it is necessary to turn on a lighting device, it is better to use the "low-sensitivity person detection".

[0052] Similarly, in order to accurately determine whether or not it is necessary to turn off a lighting device at a time when a person goes out from the lighting area S and the buffer area K, it is not necessary to confirm that no person is the lighting area S and the buffer area K on a basis of all a plurality of person detection results obtained in the first several seconds from that time. Rather, it is better to reliably confirm,

even only once, that no person is in the lighting area S and the buffer area K. To the contrary, if a person exists but is undetected by error and a lighting device is then turned off, a person in the room may feel uncomfortable. Therefore, in order to determine whether it is necessary to turn off a lighting device, it is better to use the "high-sensitivity person detection".

[0053] With regard to the person detection sensitivity, as described above, adjustment of tendency depends on adjustment of parameters of a person detection method, e.g., parameters of the sensitivity of person detecting determination. For example, in order to detect a mass of heat in a thermography as a person, the person detecting system 20 calculates a determined value (evaluated value) about the mass of heat, compares the determined value (evaluated value) with a preset threshold, and thereby determines presence/absence of a person. Therefore it is possible to adjust the sensitivity by changing the threshold. It is possible to obtain person-detected positions (person detection results) of different sensitivities by using two kinds of thresholds.

[0054] Fig. 8 illustrates an example of person detecting determination. The horizontal axis represents time, and the vertical axis represents determined values (evaluated values). Further, the time period X represents a time period in which no person exists actually, and the time period Y represents a time period in which a person exists actually.

Presence/absence of a person is determined by using the threshold V. In this case, it is determined that no person exists where the determined value $E \leq$ the

threshold V. It is determined that a person exists where the determined value $E >$ the threshold V. As a result, if a spike-shaped peak value of the determined value E is higher than the threshold V, it is determined that a person exists by error even in the time period X. To the contrary, if a spike-shaped peak value of the determined value E is equal to or lower than the threshold V, it is determined that no person exists by error even in the time period Y.

[0055] In this case, if the threshold A higher than the threshold V is used, it is determined that no person exists in the entire time period X. In the time period Y, it is determined that a person exists when a spike-shaped peak value of the determined value E is higher than the threshold A. In short, by using a relatively high threshold, the detection sensitivity is low, and it is possible to accurately determine that a person exists.

Meanwhile, if the threshold B lower than the threshold V is used, in the time period X, it is determined that no person exists when a spike-shaped peak value of the determined value E is equal to or lower than the threshold B. It is determined that a person exists in the entire time period Y. In short, by using a relatively low threshold, the detection sensitivity is high, and it is possible to accurately determine that no person exists.

[0056] The present embodiment has been made on a basis of the aforementioned technical ideas. According to the present embodiment, the lighting controller unit 16 determines whether or not it is necessary to turn on the lighting device Q by using a first person-detected

position, which is obtained by detecting a person at a preset first sensitivity (corresponding to the threshold A). The lighting controller unit 16 determines whether or not it is necessary to turn off the lighting device Q by using a second person-detected position, which is obtained by detecting a person at a second sensitivity (corresponding to the threshold B), the second sensitivity being higher than the first sensitivity.

[0057] Specifically, in order to determine whether or not it is necessary to turn on the lighting device Q, in the aforementioned Step 102 of Fig. 4, as a person detection result, there is used a person detection result (first person-detected position), which is obtained by detecting a person at a first sensitivity being a relatively low sensitivity. As a result of the comparison in Step 102, where it is confirmed that a person is in the lighting area S (Step 102: YES), the lighting device Q is controlled and is turned on. Therefore it is determined whether or not it is necessary to turn on the lighting device Q on a basis of the "low-sensitivity person detection" using the first sensitivity being a relatively low sensitivity. It is possible to accurately determine that it is necessary to turn on the lighting device Q.

[0058] Further, in the aforementioned Step 102 and Step 104 of Fig. 4, as a person detection result, there is used a person detection result (second person-detected position), which is obtained by detecting a person at a second sensitivity being a relatively high sensitivity. As a result of the comparison in Step 102, where it is confirmed that no person is in the lighting area S (Step

102: NO), and subsequently as a result of the comparison in Step 104, where it is confirmed that no person is in the buffer area K (Step 104: NO), the lighting device Q is controlled and is turned off. Therefore it is

5 determined whether or not it is necessary to turn off the lighting device Q on a basis of the "high-sensitivity person detection" using the second sensitivity being a relatively high sensitivity. It is possible to accurately determine that it is necessary to turn off the
10 lighting device Q.

[0059] Note that it is possible to determine whether or not it is necessary to turn on or off the lighting device Q on a basis of two kinds of determination time periods, which are used to determine presence/absence of
15 a person in the lighting area S and the buffer area K.

In other words, when turning on the lighting device Q, the lighting controller unit 16 may turn on the lighting device Q when confirming that a person is in the lighting area in a preset first determination time period
20 without interruption. When turning off the lighting device Q, the lighting controller unit 16 may turn off the lighting device Q when confirming that no person is in the lighting area S and the buffer area K in a second determination time period without interruption, the
25 second determination time period being longer than the first determination time period.

[0060] Specifically, in order to determine whether or not it is necessary to turn on the lighting device Q, in the aforementioned Step 102 of Fig. 4, where it is
30 confirmed that a person is in the lighting area S in a relatively short first determination time period without

interruption (Step 102: YES), the lighting device Q is controlled and is turned on. Therefore it is determined whether or not it is necessary to turn on the lighting device Q on a basis of the person detection similar to the relatively "low-sensitivity person detection". It is possible to accurately determine that it is necessary to turn on the lighting device Q.

[0061] Further, in the aforementioned Step 102 of Fig. 4, where it is confirmed that no person is in the lighting area S in a relatively long second determination time period without interruption (Step 102: NO), and subsequently as a result of the comparison in Step 104, where it is confirmed that no person is in the buffer area K in the relatively long second determination time period without interruption (Step 104: NO), the lighting device Q is controlled and is turned off. Therefore it is determined whether or not it is necessary to turn off the lighting device Q on a basis of the person detection similar to the relatively "high-sensitivity person detection". It is possible to accurately determine that it is necessary to turn off the lighting device Q.

[0062] [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 lighting control method of on/off-controlling a lighting device arranged in a target space on a basis of a person-detected position obtained from a thermography of the target space, the lighting control method comprising:

storing a lighting area position and a buffer area position by a memory unit, the lighting area position representing a lighting area preassigned to the lighting device, the buffer area position representing a buffer area having a band shape arranged at an outer circumference of the lighting area, the target space including the lighting area and the buffer area; and

controlling the lighting device by a lighting controller unit, the step of controlling the lighting device including

comparing the lighting area position and the buffer area position with the person-detected position,

turning on the lighting device where a person is in the lighting area,

turning off the lighting device where no person is in the lighting area and the buffer area, and

maintaining a latest controlled status of the lighting device where no person is in the lighting area and a person is in the buffer area, the maintaining step including maintaining a turn-on status where the latest controlled status of the lighting device is the turn-on status, and maintaining a turn-off status where the latest controlled status of the lighting device is the turn-off status.

2. The lighting control method according to claim 1, wherein

the lighting device includes first and second lighting devices adjacent to each other, and

the first lighting device and the second lighting device are arranged such that a first buffer area of the first lighting device and a second buffer area of the second lighting device are adjacent to each other.

3. The lighting control method according to claim 1, wherein

the lighting device includes first and second lighting devices adjacent to each other, and

the first lighting device and the second lighting device are arranged such that a first buffer area of the first lighting device and a second buffer area of the second lighting device overlap each other.

4. The lighting control method according to claim 1, wherein

the lighting device includes first and second lighting devices adjacent to each other, and

an area between a first lighting area of the first lighting device and a second lighting area of the second lighting device is used as a shared buffer area shared by the first and second lighting devices.

5. The lighting control method according to any one of claim 1 to claim 4, wherein

the buffer area has a width equal to a size of a person region that appears in the thermography, the person region representing a skin temperature of a person.

6. The lighting control method according to any one of claim 1 to claim 5, wherein

the step of controlling the lighting device includes, by the lighting controller unit,

determining whether it is necessary to turn on the lighting device or not by using a first person-detected position obtained by detecting a person at a preset first sensitivity, and

determining whether it is necessary to turn off the lighting device or not by using a second person-detected position obtained by detecting a person at a second sensitivity, the second sensitivity being higher than the first sensitivity.

7. The lighting control method according to any one of claim 1 to claim 5, wherein

the step of turning on the lighting device by the lighting controller unit includes turning on the lighting device when confirming that a person is in the lighting area in a preset first determination time period without interruption, and

the step of turning off the lighting device by the lighting controller unit includes turning off the lighting device when confirming that no person is in the lighting area and the buffer area in a second determination time period without interruption, the second determination time period being longer than the first determination time period.

8. A lighting controller apparatus that on/off-controls a lighting device arranged in a target space on a basis of a

person-detected position represented by a person detection result of the target space, the lighting controller apparatus comprising:

- a memory unit that stores a lighting area position and a buffer area position, the lighting area position representing a lighting area preassigned to the lighting device, the buffer area position representing a buffer area having a band shape arranged at an outer circumference of the lighting area, the target space including the lighting area and the buffer area; and

- a lighting controller unit that
 - compares the lighting area position and the buffer area position with the person-detected position,
 - turns on the lighting device where a person is in the lighting area,
 - turns off the lighting device where no person is in the lighting area and the buffer area, and
 - maintains a latest controlled status of the lighting device where no person is in the lighting area and a person is in the buffer area, the maintaining step including maintaining a turn-on status where the latest controlled status of the lighting device is the turn-on status, and maintaining a turn-off status where the latest controlled status of the lighting device is the turn-off status.