

Title of Invention: LIGHTING SYSTEM

Technical Field

[0001] The present disclosure relates to lighting systems, and specifically, to a lighting system including a plurality of light sources.

Background Art

[0002] JP 2015-46334 A (hereinafter referred to as “Document 1”) discloses an illumination device (lighting system) configured to obtain a relaxing effect from a flicker of color or brightness.

[0003] The illumination device disclosed in Document 1 includes one light source (light emitter) and a control device (controller) configured to control the one light source in accordance with a lighting signal. The lighting signal is a combined wave obtained by combining a plurality of waves having different frequencies. The control device causes the one light source to emit light in accordance with a series of repeatedly read lighting signals.

[0004] In the illumination device of Document 1, a rendering by illumination light may result in being monotonous depending on waveforms of the lighting signals.

Summary of Invention

[0005] It is an object of the present disclosure to provide a lighting system configured to easily provide a further complicated rendering (production, effect).

[0006] A lighting system according to an aspect of the present disclosure includes a plurality of light sources and a controller. The plurality of light sources at least includes a first light source and a second light source. The first light source is configured to output first illumination light. The second light source is configured to output second illumination light. The controller is configured to periodically change each of an optical property of the first illumination light and an optical property of the second illumination light. Each of the optical property of the first illumination light and the optical property of the second illumination light is a property relating to at least one of a luminous flux, a hue, or saturation.

Brief Description of Drawings

[0007] FIG. 1 is a functional block diagram of a configuration of a lighting system according to a first embodiment;

FIG. 2 is a graph of a waveform of a rendering pattern in the lighting system;

FIG. 3 is an illustrative view of an installation situation of the lighting system;

FIG. 4 is a functional block diagram of a configuration of a lighting system according to a variation of the first embodiment;

FIG. 5 is an illustrative view of an installation situation of the lighting system of the variation;

FIG. 6 is a schematic diagram of an arrangement of a first light source, a second light source, and a third light source in a light source unit of the lighting system of the variation;

FIG. 7A is a graph of illuminance of the first illumination light at an irradiation surface in the lighting system of the variation;

FIG. 7B is a graph of illuminance of the second illumination light at the irradiation surface in the lighting system of the variation;

FIG. 7C is a graph of illuminance of the third illumination light at the irradiation surface in the lighting system of the variation;

FIG. 8 is a $u'v'$ chromaticity diagram illustrating operation of a lighting system according to a second embodiment;

FIG. 9 is an xy chromaticity diagram illustrating operation of a lighting system according to a third embodiment;

FIG. 10 is a graph illustrating a waveform of a rendering pattern in the lighting system of the third embodiment;

FIG. 11 is a view of a constant-hue plane for explaining operation of a lighting system according to a fourth embodiment;

FIG. 12A is a graph of a waveform of saturation of a rendering pattern in a lighting system according to a fifth embodiment;

FIG. 12B is a graph of a waveform of a luminous flux of the rendering pattern in the lighting system of the fifth embodiment;

FIG. 13 is a functional block diagram of a configuration of a lighting system according to a seventh embodiment;

FIG. 14 is a functional block diagram of a configuration of a lighting system according to an eighth embodiment; and

FIG. 15 is a functional block diagram of a configuration of a lighting system according to a ninth embodiment.

Description of Embodiments

[0008] Lighting systems of embodiments will be described below with reference to the drawings. However, each drawing described in the embodiments below are schematic views, and the ratio of sizes and the ratio of thicknesses of components are not necessarily reflecting actual dimensional ratios of the components. Note that the configurations described in the following embodiments are mere examples of the present disclosure. The present disclosure is not limited to the following embodiments, and various modifications may be made depending on design and the like as long as the effect of the present disclosure is provided.

[0009] (First Embodiment)

1. Lighting System

A configuration of a lighting system 1 according to a first embodiment will be described with reference to FIG. 1.

[0010] The lighting system 1 according to the first embodiment includes a control device 10 and a light source 20.

[0011] 2. Components of Lighting System

Components of the lighting system 1 according to the first embodiment will be described below.

(1) Control Device

[0012] As shown in FIG. 1, the control device 10 includes a controller 11, a storage 12, and an input section 13.

[0013] The controller 11 performs lighting control of the light source 20. More specifically, the controller 11 controls the light source 20 such that an optical property of illumination light output from each of a first light source 21 and a second light source 22 included in the light source 20 periodically changes. In the following description, information showing how the optical property of the illumination light changes is referred to as a rendering pattern. In the first embodiment, the optical property of the illumination light is a luminous flux of the illumination light. More specifically, a luminous flux L_{f1} of illumination light which is the optical property of the first illumination light sinusoidally changes with time as shown in FIG. 2.

[0014] The controller 11 outputs a control signal based on the rendering pattern to each of the first light source 21 and the second light source 22. The control signal is, for example, a Pulse Width Modulation (PWM) signal including information on a magnitude (voltage value) of a voltage applied to a light-emitting element included in the first light source 21 or the second light source 22.

[0015] The storage 12 is a storage medium which stores a plurality of rendering patterns. As described above, in the storage 12, each rendering pattern is shown by, for example, a combination of a maximum value L_{fmax} of the luminous flux, a minimum value L_{fmin} of the luminous flux, and a change frequency. Here, the change frequency is a frequency representing a change in the optical property (here, luminous flux) of the illumination light with time. Moreover, a range of values, which the luminous flux L_{f1} may take, from the maximum value L_{fmax} of the luminous flux to the minimum value L_{fmin} of the luminous flux is also referred to as a control range of the luminous flux in the following description. The controller 11 acquires the combination of the maximum value L_{fmax} of the luminous flux, the minimum value L_{fmin} of the luminous flux, and the change frequency from the storage 12 and calculates the value of the luminous flux with respect to time as shown in FIG. 2.

[0016] The input section 13 is an input section which receives an input of information for determining rendering patterns to be applied to the first light source 21 and the second light source 22 from a worker. The worker is, for example, an installation business operator of the lighting system 1 or a facility administrator of a facility where the lighting system 1 is installed. The input section 13 is, for example, a touch panel.

[0017] The control device 10 includes a computer system. The computer system includes a processor and memory as main hardware components. The processor executes a program stored in the memory of the computer system, thereby implementing functions as the control device 10 in the present disclosure. The program may be stored in advance in the memory of the computer system. Alternatively, the program may also be downloaded over a telecommunications network or be distributed after having been recorded in some non-transitory storage medium such as a memory card, an optical disc, or a hard disk drive, any of which is readable for the computer system. The processor of the computer system may be implemented as a single or a plurality of electronic circuits including a semiconductor integrated circuit (IC) or a large-scale integrated circuit (LSI). As used herein, the “integrated circuit” such as an IC or an LSI is called by a different name depending on the degree of integration thereof. Examples of the integrated circuits include a system LSI, a very large-scale integrated circuit (VLSI), and an ultra-large scale integrated circuit (ULSI). Optionally, a field-programmable gate array (FPGA) to be programmed after an LSI has been fabricated or a reconfigurable logic device allowing the connections or circuit sections inside of an LSI to be reconfigured may also be adopted as the processor. Those electronic circuits may be either integrated together on a single chip or distributed on multiple chips, whichever is appropriate. Those multiple chips may be integrated

together in a single device or distributed in multiple devices without limitation. As used herein, the “computer system” includes a microcontroller including one or more processors and one or more memories. Thus, the microcontroller may also be implemented as a single or a plurality of electronic circuits including a semiconductor integrated circuit or a large-scale integrated circuit.

[0018] Also, the plurality of functions of the control device 10 are integrated together in a single housing, but this is not an essential configuration for the control device 10. Alternatively, the plurality of functions of the control device 10 may be distributed in multiple different housings. Still alternatively, at least some functions of the control device 10 (e.g., some functions of the controller 11) may be implemented as a cloud computing system as well.

[0019] In contrast, at least some functions of the control device 10 distributed in multiple different housings in an embodiment may be integrated together in a single housing. For example, some functions of the control device 10 distributed in the controller 11 and the input section 13 may be integrated together in a single housing.

[0020] (2) Light Source

As shown in FIG. 1, the light source 20 includes a plurality of first light sources 21 and a plurality of second light sources 22. The first light sources 21 and the second light sources 22 are, for example, as shown in FIG. 3, used for applications that provide a rendering lighting (gradation lighting) by indirect lighting to a wall surface of a meeting room, a wall surface of a path of a commercial facility, and wall surfaces of other places frequently viewed by people. The first light sources 21 and the second light sources 22 are installed at an upper part of an irradiation surface 32 which is, for example, a wall surface. Each first light source 21 outputs first illumination light L1 to the irradiation surface 32. Each second light source 22 outputs second illumination light L2 to the irradiation surface 32.

[0021] Each of the first light sources 21 is a light source unit including a plurality of four different light colors (e.g., red (R), green (G), blue (B), and white (W)) of light-emitting diodes (LEDs). Note that the LEDs included in each first light source 21 are not limited to the LEDs in four colors, R, G, B, and W but may further include an LED(s) in a color(s) other than W or does not have to include the LED in W.

[0022] Each of the second light sources 22 is a light source unit including a plurality of four different light colors (e.g., R, G, B, and W) of LEDs. Note that the LEDs included in each second light source 22 are not limited to the LEDs in four colors, R, G, B, and W but may further include an LED(s) in a color(s) other than W or does not have to include the LED in W.

[0023] The first light sources 21 and the second light sources 22 are fixed to a ceiling surface

such that their optical axes are tilted toward the irradiation surface 32. Note that on an opposite side of the first light sources 21 and the second light sources 22 from the irradiation surface 32, a shielding panel 31 is disposed. More specifically, the shielding panel 31 suppresses a user who uses a place where the first light sources 21 and the second light sources 22 are installed from directly viewing the first light sources 21 and the second light sources 22. Note that an installation state of the first light sources 21 and the second light sources 22 is not limited to this example, and, for example, the first light sources 21 and the second light sources 22 may be disposed in a groove formed in the ceiling surface in contact with the irradiation surface 32.

[0024] Note that each of the first light sources 21 and the second light sources 22 does not have to be the light source unit but may be, for example, one light-emitting element or a collection of a plurality of light-emitting elements, such as an LED tape. Moreover, the first light sources 21 and the second light sources 22 may each be, for example, an LED module and may be mounted on an identical light source unit. Further, the light source 20 does not necessarily include the plurality of first light sources 21 or the plurality of second light sources 22, but, for example, the light source 20 may include one first light source 21. Similarly, for example, the light source 20 may include one second light source 22.

[0025] 3. Light Emission Control by Controller

Control of the first light source 21 and the second light source 22 in accordance with the rendering patterns will be described in further detail below.

[0026] The worker inputs the hue of the first illumination light L1 and the hue of the second illumination light L2 to the input section 13. The controller 11 reads, from the storage 12, a rendering pattern corresponding to the hue of the first illumination light L1 thus input. The rendering pattern is, for example, a first rendering pattern that the maximum value of the luminous flux is 100% of a maximum luminous flux of the first light source 21, the minimum value of the luminous flux is 50% of the maximum luminous flux of the first light source 21, and the change frequency is 0.3 Hz. Moreover, the controller 11 reads, from the storage 12, a rendering pattern corresponding to the hue of the second illumination light L2 thus input. The rendering pattern is, for example, a second rendering pattern that the maximum value of the luminous flux is 80% of a maximum luminous flux of the second light source 22, the minimum value of the luminous flux is 60% of the maximum luminous flux of the second light source 22, and the change frequency is 0.1 Hz. Note that the change frequency of the first rendering pattern is preferably different from the change frequency of the second rendering pattern. Thus, the first illumination light L1 and the second illumination light L2 provide a rendering of shimmering of different periods, thereby

realizing various types of rendering patterns as compared with the case of using a single light source.

[0027] The controller 11 outputs a dimming signal based on the first rendering pattern to the first light sources 21. Similarly, the controller 11 outputs a dimming signal based on the second rendering pattern to the second light sources 22.

[0028] 4. Effects

In the lighting system 1 according to the first embodiment, the luminous flux, which is the optical property of each of the first illumination light L1 and the second illumination light L2, is periodically controlled based on the rendering patterns in indirect lighting using the light source 20 including the first light source 21 and the second light source 22. This produces a periodical fluctuation in the luminous flux of each of the first illumination light L1 and the second illumination light L2, which enables a rendering to be provided by using illumination light producing a relaxing effect or a refreshing effect. Further, the rendering pattern of the first light source and the rendering pattern of the second light source are made different, thereby increasing variations of the rendering by the illumination light by using the first illumination light L1 and the second illumination light L2.

[0029] Moreover, in the lighting system 1 according to the first embodiment, the rendering pattern corresponding to the hue is applied to each of the first illumination light L1 and the second illumination light L2. Thus, the hue and the rendering pattern are appropriately combined with each other, which enables an appropriate rendering compliant with purposes to be provided.

[0030] (Variation)

As shown in FIG. 4, in a lighting system 1 according to a variation of the first embodiment, a light source 20 includes a plurality of light source units 24. Each of the light source units 24 is controlled as any of the first light source 21, the second light source 22, or a third light source 23.

[0031] Each of the light source units 24 is a light source unit including a plurality of four different light colors (e.g., R, G, B, and W) of light-emitting diodes (LEDs). Note that the LEDs included in the light source units 24 are not limited to the LEDs in four colors, R, G, B, and W but may further include an LED(s) in a color(s) other than W or does not have to include the LED in W.

[0032] The light source units 24 are individually connected to the control device 10. The control device 10 controls each of the light source units 24 as the first light source 21, the second light source 22, or the third light source 23. For example, as shown in FIG. 5, the light source units 24 are used for an application that provides a rendering lighting (gradation lighting) by

indirect lighting. The light source units 24 controlled as first light sources 21 each output first illumination light L1 to the irradiation surface 32. The light source units 24 controlled as second light sources 22 each output second illumination light L2 to the irradiation surface 32. The light source units 24 controlled as third light sources 23 each output third illumination light L3 to the irradiation surface 32.

[0033] A control method of each of the light source units 24 will be described below in further detail.

[0034] In the control device 10 according to the variation of the first embodiment, the input section 13 receives an input about the number of light source units 24 from the worker. The control device 10 determines, in accordance with the number of light source units 24 input by the worker, whether each of the plurality of light source units 24 is controlled as any of the first light source 21, the second light source 22, or the third light source 23. The light source units 24 controlled as the first light sources 21 each emit the first illumination light L1 in accordance with the first rendering pattern. The light source units 24 controlled as the second light sources 22 each emit the second illumination light L2 in accordance with the second rendering pattern. The light source units 24 controlled as the third light sources 23 each emit the third illumination light in accordance with the third pattern. That is, the control device 10 assigns any one of the three rendering patterns to each of the plurality of light source units 24.

[0035] The control device 10 determines, based on a spatial frequency of the first light sources 21, a spatial frequency of the second light sources 22, and a spatial frequency of the third light sources 23, the rendering pattern of the first light sources 21, the rendering pattern of the second light sources 22, and the rendering pattern of the third light sources 23. Before the rendering patterns are explained, the spatial frequency of the first light source 21, the spatial frequency of the second light sources 22, and the spatial frequency of the third light sources 23 will be described in detail below.

[0036] In the light source 20 according to the variation of the first embodiment, some of the light source units 24 aligned as shown in FIG. 5 are shown in FIG. 6. More specifically, of the plurality of light source units 24 arranged at equal intervals on one straight line, seven light source units 24 including a light source unit 24 (24a) at the left end of FIG. 5 are shown in FIG. 6. The distance between the centers of the light source units 24 adjacent to each other is a distance d_0 .

[0037] FIG. 7A shows illuminance of the first illumination light L1 at a virtual line SL1 on the irradiation surface 32 of FIG. 5. That is, FIG. 7A shows the illuminance at the virtual line SL1 on the irradiation surface 32 when the first light sources 21 are turned on and the second light

sources 22 and the third light sources 23 are turned off. As shown in FIG. 7A, each of peaks of the illuminance occurs for a corresponding one of the first light sources 21. In this case, as shown in FIG. 6, the distance between the center of the first light source 21 (light source unit 24a) and the center of the first light source 21 (light source unit 24e) is four times the distance d_0 . Thus, between two different first light sources 21, irradiation areas of the first illumination light L1 do not overlap each other. Thus, the distance between centers of the irradiation areas of the first illumination light L1 on the irradiation surface 32 corresponds to a distance d_1 between the center of a first light source 21 (light source unit 24a) and the center of another first light source 21 (light source unit 24e). Here, the distance d_1 between the center of one first light source 21 (light source unit 24a) and the center of another first light source 21 (light source unit 24e) is referred to as a “distance d_1 between the light emission areas of the first light sources 21”.

[0038] Moreover, FIG. 7B shows illuminance of the second illumination light L2 on the virtual line SL1 on the irradiation surface 32 of FIG. 5. That is, FIG. 7B shows the illuminance on the virtual line SL1 on the irradiation surface 32 when the second light sources 22 are turned on and the first light sources 21 and the third light sources 23 are turned off. As shown in FIG. 7B, each of peaks of the illuminance occurs for a corresponding one of the second light sources 22. In this case, as shown in FIG. 6, the distance between the center of the second light source 22 (light source unit 24b) and the center of the second light source 22 (light source unit 24g) is five times the distance d_0 . Thus, between two different second light sources 22, irradiation areas of the second illumination light L2 do not overlap each other. Thus, the distance between the centers of the irradiation areas of the second illumination light L2 on the irradiation surface 32 corresponds to a distance d_2 between the center of a second light source 22 (light source unit 24b) and the center of another second light source 22 (light source unit 24g). Here, the distance d_2 between the center of a second light source 22 (light source unit 24b) and the center of another second light source 22 (light source unit 24g) is referred to as a “distance d_2 between the light emitting areas of the second light sources 22”.

[0039] Further, FIG. 7C shows illuminance of the third illumination light L3 on the virtual line SL1 on the irradiation surface 32 of FIG. 5. That is, FIG. 7C shows the illuminance on the virtual line SL1 on the irradiation surface 32 when the third light sources 23 are turned on and the first light sources 21 and the second light sources 22 are turned off. As shown in FIG. 7C, each of peaks of the illuminance occurs for a corresponding one of the third light sources 23. Here, a distance between the center of the third light source 23 (light source unit 24c) and the center of the third light source 23 (light source unit 24d) is as short as the distance d_0 , and therefore, irradiation

areas of the third illumination light L3 overlap each other between the light source unit 24c and the light source unit 24d. Here, “the irradiation areas of the third illumination light L3 overlap each other between the light source unit 24c and the light source unit 24d” means that part of an area in which the illuminance of the third illumination light L3 emitted from the light source unit 24c is greater than or equal to 50% of its maximum illuminance and part of an area in which the illuminance of the third illumination light L3 emitted from the light source unit 24d is greater than or equal to 50% of its maximum illuminance overlap each other. In this case, one peak of illuminance on the virtual line SL1 on the irradiation surface 32 corresponds to the light source unit 24c and the light source unit 24d. That is, the light source unit 24c and the light source unit 24d form one light emission area of the third light sources 23. Thus, the distance between the centers of the irradiation areas of the third illumination light on the irradiation surface 32 corresponds to a distance d3 between the center of third light sources 23 (center between the light source unit 24c and the light source unit 24d) and the center of another third light source 23 (light source unit 24f). Here, the between the center of third light sources 23 (center between the light source unit 24c and the light source unit 24d) and the center of another third light source 23 (light source unit 24f) is referred to as a “distance d3 between the light emission areas of the third light sources 23”.

[0040] Here, a spatial density of peaks of the illuminance of the first illumination light L1 is referred to as a spatial frequency of the first light sources 21. Saying that “the spatial frequency of the first light sources 21 is high” means that the spatial density of the first light sources 21 is high. In other words, saying that “the spatial frequency of the first light sources 21 is high” means that the spatial density of locations where the illuminance of the first illumination light L1 peaks is high. Moreover, saying that “the spatial frequency of the first light sources 21 is low” means that the spatial density of locations where the illuminance of the first illumination light L1 peaks is low. That is, as the distance d1 between the light emission areas of the first light sources 21 increases, the spatial frequency of the first light sources 21 decreases, whereas, as the distance d1 between the light emission areas of the first light sources 21 decreases, the spatial frequency of the first light sources 21 increases.

[0041] Similarly, a spatial density of peaks of the illuminance of the second illumination light L2 is referred to as a spatial frequency of the second light sources 22. As shown in FIG. 6, the distance d2 between the light emitting areas of the second light sources 22 is longer than the distance d1 between the light emission areas of the first light sources 21. Thus, the spatial frequency of the second light sources 22 is lower than the spatial frequency of the first light sources

21.

[0042] Similarly, a spatial density of peaks of the illuminance of the third illumination light L3 is referred to as a spatial frequency of the third light sources 23. As shown in FIG. 6, the distance d3 between the light emission areas of the third light sources 23 is shorter than the distance d1 between the light emission areas of the first light sources 21 and shorter than the distance d2 between the light emitting areas of the second light sources 22. Thus, the spatial frequency of the third light sources 23 is higher than the spatial frequency of the first light sources 21 and higher than the spatial frequency of the second light sources 22.

[0043] Next, the control device 10 determines the rendering pattern of the first light sources 21, the rendering pattern of the second light sources 22, and the rendering pattern of the third light sources 23. Each rendering pattern includes information on a maximum value, a minimum value, and a change frequency of the optical property of illumination light. The change frequency of the optical property is preferably greater than or equal to 0.05 Hz and less than or equal to 1.0 Hz. Thus, a fluctuation in the optical property is sensed, a relaxing effect and the like are produced, and a feeling of discomfort is suppressed from being caused due to a violent change in the optical property.

[0044] Here, for the first light sources 21, the second light sources 22, and the third light sources 23, the control device 10 makes lower the change frequency of the optical property of the illumination light of the light sources having a higher spatial frequency, whereas the control device 10 makes higher the change frequency of the optical property of the illumination light of the light sources having a lower spatial frequency. This is because in the case of the same change frequencies of an optical property of illumination light, a fluctuation in the optical property of illumination light of light sources having higher space frequencies is more easily recognized. That is, a fluctuation in the optical property of illumination light of light sources having a high spatial frequency is easily recognized, and thus, to prevent a feeling of discomfort from being caused, a change frequency of the optical property of the illumination light of the light sources having the high spatial frequency is preferably low. On the other hand, a fluctuation in the optical property of illumination light of light sources having a low spatial frequency rarely causes a feeling of discomfort, and therefore, a change frequency of the optical property of the illumination light of the light sources having the low spatial frequency may be increased.

[0045] As described above, the spatial frequency of the third light sources 23 is higher than the spatial frequency of the first light sources 21 and higher than the spatial frequency of the second light sources 22. Thus, the change frequency of the rendering pattern of the third light sources

23 is reduced to be lower than each of the change frequency of the rendering pattern of the first light sources 21 and the change frequency of the rendering pattern of the second light sources 22. Moreover, the spatial frequency of the second light sources 22 is lower than the spatial frequency of the first light sources 21. Thus, the change frequency of the rendering pattern of the second light sources 22 is increased to be higher than the change frequency of the rendering pattern of the first light sources 21. The control device 10 controls, for example, such that the change frequency of the rendering pattern of the first light sources 21, the change frequency of the rendering pattern of the second light sources 22, and the change frequency of the rendering pattern of the third light sources 23 are respectively 0.2 Hz, 0.3 Hz, and 0.1 Hz.

[0046] The lighting system 1 according to the variation of the first embodiment controls, in indirect lighting using the light source 20 including the plurality of light source units 24, each of the light source units 24 as the first light source 21, the second light source 22, or the third light source 23. Moreover, the lighting system 1 according to the variation of the first embodiment periodically changes, for each of the first illumination light L1, the second illumination light L2, and the third illumination light, the luminous flux, which is the optical property of the illumination light, in accordance with the rendering pattern. This enables a rendering to be provided by using illumination light producing a relaxing effect or a refreshing effect.

[0047] Moreover, the lighting system 1 according to the variation of the first embodiment controls, based on the number of light source units 24 included in the light source 20, each of the light source units 24 as the first light source 21, as the second light source 22, or the third light source 23. This enables an appropriate rendering to be provided in accordance with the number of light source units 24. Moreover, in an increase or a decrease in the number of light source units 24 or in a rearrangement in a room where the lighting system 1 is installed, the arrangement of the first light sources 21, the second light sources 22, and the third light sources 23 can be changed by the control device 10, and therefore, wiring between the light source 20 and the control device 10 does not have to be changed. Further, for example, a ratio between the number of first light sources 21 and the number of second light sources 22 may be changed in accordance with the rendering pattern.

[0048] Moreover, in the lighting system 1 according to the variation of the first embodiment, for the first light sources 21, the second light sources 22, and the third light sources 23, the control device 10 makes lower the change frequency of the optical property of the illumination light of the light sources having a higher spatial frequency, whereas the control device 10 makes higher the change frequency of the optical property of the illumination light of the light sources having a

lower spatial frequency. This enables a rendering with a high change frequency to be provided while a feeling of discomfort is suppressed from being caused, thereby providing an appropriate rendering in accordance with purposes.

[0049] Note that in the lighting system 1 according to the variation of the first embodiment, the plurality of light source units 24 include the first light sources 21, the second light sources 22, and the third light sources 23, but the plurality of light source units 24 does not have to include the third light sources 23. Also in this case, the plurality of light source units 24 can provide two different types of rendering patterns. Moreover, the plurality of light source units 24 may further include a fourth light source(s) and may further include a fifth light source(s).

[0050] (Second Embodiment)

In a lighting system 1 according to a second embodiment, the hue of first illumination light L1 and the hue of second illumination light L2 are determined based on a reference color.

[0051] In the lighting system 1 according to the second embodiment, an input section 13 receives an input of the reference color from a worker. More specifically, a controller 11 causes the input section 13, which is, for example, a touch panel, to display a plurality of sample colors to prompt the worker to select any one of the sample colors. Note that an input method of the reference color is not limited to this example but may be, for example, a method of prompting the worker to select the name of a color or a method of prompting the worker to input the name of a color.

[0052] The controller 11 determines, based on the reference color thus input, the hue of the first illumination light L1 and the hue of the second illumination light L2. The controller 11 determines, for example, a similar hue of the reference color to be the hue of the first illumination light L1. Moreover, the controller 11 determines, for example, the reference color to be the hue of the second illumination light L2.

[0053] FIG. 8 is a CIE 1976 UCS chromaticity diagram (hereinafter referred to as a “u’v’ chromaticity diagram”). In the u’v’ chromaticity diagram shown in FIG. 8, a color W0 represents an equal energy white point. Moreover, a color C0 is the reference color. Here, in the u’v’ chromaticity diagram, assume that a line segment L10 connects the color W0 to the reference color C0 and that a half-line L21 and a half-line L22 each have one end at the color W0. The angle between the half-line L21 and the line segment L10 is an angle θ_1 . Moreover, the angle between the half-line L22 and the line segment L10 is an angle θ_1 . Each of the angles θ_1 is 43° . In this case, in the u’v’ chromaticity diagram, colors on an outer perimeter of, and within, an area AR1 between the half-line L21 and the half-line L22 are similar hues of the reference color C0. Here, the angle between the line segment L10 and a line segment connecting a color located on the outer

perimeter of, or within, the area AR1 to the color W0 is smaller than or equal to 43° . For example, in the case of a color C11 included in the area AR1, the angle between the line segment L10 and a line segment connecting the color W0 to the color C11 is smaller than or equal to 43° , and the color C11 is thus a similar hue of the reference color C0. Thus, the controller 11 determines a color included in the area AR1 to be the hue of the first illumination light L1. For example, the controller 11 determines any one of the color C11, a color C12, a color C21, and a color C22 to be the hue of the first illumination light L1. Note that the color C11, the color C12, the color C21, and the color C22 are examples of the similar hues of the reference color C0, and the controller 11 may determine an arbitrary color included in the area AR1 to be the hue of the first illumination light L1.

[0054] Processes described above result in that the hue of the first illumination light L1 and the hue of the second illumination light L2 are similar to each other. Thus, a rendering provided by illumination light of a first light source 21 and a rendering provided by illumination light of a second light source 22 are easily harmonized with each other, thereby easily providing a rendering which produces the relaxing effect or the refreshing effect.

[0055] Note that in the lighting system 1, the hue of the first illumination light L1 may be the reference color C0, and the hue of the second illumination light L2 may be the similar hue of the reference color C0.

[0056] Moreover, when a light source 20 includes a third light source 23, the hue of illumination light of the third light source 23 may be the similar hue of the reference color C0. Here, the hue of the first illumination light L1, the hue of the second illumination light L2, and the hue of the illumination light of the third light source 23 are preferably different from one another. For example, the hue of the first illumination light L1 may be the color C11, the hue of the second illumination light L2 may be the reference color C0, and the hue of the illumination light of the third light source 23 may be the color C12. With this configuration, the illumination light of the first light source 21, the illumination light of the second light source 22, and the illumination light of the third light source 23 are different from one another, and are similar to one another, in terms of the hue. This easily provides a rendering which produces the relaxing effect or the refreshing effect.

[0057] (First Variation)

In a lighting system 1 according to a first variation of the second embodiment, the hue of the first illumination light L1 and the hue of the second illumination light L2 are determined based on the reference color.

[0058] The controller 11 determines the hue of the first illumination light L1 and the hue of the second illumination light L2 in accordance with the reference color. The controller 11 determines, for example, a similar color of the reference color to be the hue of the first illumination light L1. Moreover, the controller 11 determines, for example, the reference color to be the hue of the second illumination light L2.

[0059] In the u'v' chromaticity diagram shown in FIG. 8, assume that a half-line L31 and a half-line L32 each have one end at the color W0 with respect to the line segment L10. The angle between the half-line L31 and the line segment L10 is an angle θ_2 . Moreover, the angle between the half-line L32 and the line segment L10 is an angle θ_2 . Each of the angles θ_2 is 25° . In this case, colors located on an outer perimeter of, and within, an area AR2 between the half-line L31 and the half-line L32 are similar colors of the reference color C0. Here, the angle between the line segment L10 and a line segment connecting a color located on the outer perimeter of, or within, the area AR2 to the color W0 is smaller than or equal to 25° . For example, in the case of the color C21 included in the area AR2, the angle between the line segment L10 and a line segment connecting the color W0 to the color C21 is smaller than or equal to 25° , and the color C21 is thus a similar color of the reference color C0. Thus, the controller 11 determines a color included in the area AR2 to be the hue of the first illumination light L1. For example, the controller 11 determines any one of the color C21 or the color C22 to be the hue of the first illumination light L1. Note that the color C21 and the color C22 are examples of the similar colors of the reference color C0, and an arbitrary color included in the area AR2 may be determined as the hue of the first illumination light L1.

[0060] Processes described above result in that the hue of the first illumination light L1 and the hue of the second illumination light L2 are in a similar color relationship. Thus, a rendering provided by the illumination light of the first light source 21 and a rendering provided by the illumination light of the second light source 22 are further easily harmonized with each other as compared with the second embodiment, thereby easily providing a rendering which produces the relaxing effect or the refreshing effect.

[0061] Note that in the lighting system 1, the hue of the first illumination light L1 may be the reference color C0, and the hue of the second illumination light L2 may be the similar color of the reference color C0.

[0062] Moreover, when the light source 20 includes the third light source 23, the hue of the illumination light of the third light source 23 may be the similar color of the reference color C0. Here, the hue of the first illumination light L1, the hue of the second illumination light L2, and the

hue of the illumination light of the third light source 23 are preferably different from one another. For example, the hue of the first illumination light L1 may be the color C21, the hue of the second illumination light L2 may be the reference color C0, and the hue of the illumination light of the third light source 23 may be the color C22. With this configuration, the illumination light of the first light source 21, the illumination light of the second light source 22, and the illumination light of the third light source 23 are different from one another, and are in a similar color relationship with one another, in terms of the hue. This easily provides a rendering which produces the relaxing effect or the refreshing effect.

[0063] (Second Variation)

In a lighting system 1 according to a second variation of the second embodiment, the hues of the first light source 21 and the second light source 22 are determined based on the reference color.

[0064] The controller 11 determines the hue of the first illumination light L1 and the hue of the second illumination light L2 in accordance with the reference color. The controller 11 determines, for example, a color which is not the similar hue of the reference color to be the hue of the first illumination light L1. Moreover, the controller 11 determines the reference color to be the hue of the second illumination light L2.

[0065] In the u'v' chromaticity diagram in FIG. 8, colors in an area AR3 which is an entire area outside the area AR1 are not in a similar hue relationship with the reference color C0. Here, the angle between the line segment L10 and a line segment connecting a color located in the area AR3 to the color W0 is larger than 43° and smaller than or equal to 180° . For example, in the case of a color C31 included in the area AR3, the angle between the line segment L10 and a line segment connecting the color W0 to the color C31 is larger than 43° and smaller than or equal to 180° , and the C31 is not in the similar hue relationship with the reference color C0. Thus, the controller 11 determines a color included in the area AR3 to be the hue of the first illumination light L1. For example, the controller 11 determines the color C31 or a color C32 to be the hue of the first illumination light L1. Note that the color C31 and the color C32 are examples of the colors which are not similar hues of the reference color C0, and an arbitrary color included in the area AR3 may be determined to be the hue of the first illumination light L1.

[0066] Processes described above result in that the hue of the first illumination light L1 and the hue of the second illumination light L2 are not similar to each other. Thus, a rendering provided by the illumination light of the first light source 21 and a rendering provided by the illumination light of the second light source 22 provide completely different impressions, thereby easily

providing an effect which is highly entertaining and spectacular.

[0067] Note that in the lighting system 1, the hue of the first illumination light L1 may be the reference color C0, the hue of the second illumination light L2 may be a color other than the similar hue of the reference color C0.

[0068] Moreover, when the light source 20 includes the third light source 23, the hue of the illumination light of the third light source 23 may be a color other than the similar hue of the reference color C0. Here, the hue of the first illumination light L1, the hue of the second illumination light L2, and the hue of the illumination light of the third light source 23 are preferably different from one another. Moreover, the hue of the first illumination light L1 and the hue of the illumination light of the third light source 23 are preferably not in the similar hue relationship with each other. For example, the hue of the first illumination light L1 may be the color C31, the hue of the second illumination light L2 may be the reference color C0, and the hue of the illumination light of the third light source 23 may be the color C32. With this configuration, the illumination light of the first light source 21, the illumination light of the second light source 22, and the illumination light of the third light source 23 are different from one another, and are not in the similar hue relationship with one another, in terms of the hue. Thus, the lighting system 1 easily provides a highly entertaining and spectacular effect.

[0069] (Third Embodiment)

A lighting system 1 according to a third embodiment controls a light source 20 such that saturation as an optical property of each of first illumination light L1 and second illumination light L2 periodically changes. The controller 11 outputs a control signal based on a rendering pattern to each of a first light source 21 and a second light source 22. The control signal output to the first light source 21 is, for example, a PWM signal including information on the magnitude (voltage value) of a voltage applied to each of four colors of, that is, R, G, B, and W, LEDs included in the first light source 21.

[0070] The rendering pattern is, for example, information representing the saturation of illumination light with respect to time. As shown in FIG. 10, in the third embodiment, saturation S1 of illumination light which is the optical property of the first illumination light L1 sinusoidally changes with time. The rendering pattern is, for example, data representing the saturation S1 of the first illumination light L1 with respect to time. Alternatively, the rendering pattern may be represented by, for example, a combination of a maximum value Smax of the saturation, a minimum value Smin of the saturation, and a change frequency. Here, the change frequency is a frequency representing a change in the optical property (here, saturation) of the illumination light

with time.

[0071] The controller 11 determines, based on the hue of the first illumination light L1 and the hue of the second illumination light L2, the maximum value S_{max} of the saturation, the minimum value S_{min} of the saturation, and the change frequency for each of the first light source 21 and the second light source 22. The controller 11 reads, for example, from a storage 12, the change frequency corresponding to each of the hue of the first illumination light L1 and the hue of the second illumination light L2. Note that the controller 11 may determine the change frequency with reference to, for example, a spatial frequency of first light sources 21 and a spatial frequency of second light sources 22.

[0072] Moreover, the controller 11 reads, from the storage 12, the maximum value S_{max} of the saturation and the minimum value S_{min} of the saturation corresponding to each of the hue of the first illumination light L1 and the hue of the second illumination light L2. Here, the maximum value S_{max} and the minimum value S_{min} of the saturation corresponding to each hue are determined such that these values satisfy the following condition.

[0073] FIG. 9 is a CIE 1931 xy chromaticity diagram (hereinafter referred to as a “xy chromaticity diagram”). In the xy chromaticity diagram of FIG. 9, a first area D1 is an area defined as being white in JIS Z 8110. Moreover, a second area D2 is an area which satisfies the following condition. That is, the second area D2 includes, on its outer perimeter, the following eleven points: Cr, Cp, Crv, Cv, Cbv, Cb, Cbg, Cg, Cyg, Cy, and Cyr. The outer perimeter of the second area D2 is, for example, hendecagonal. Each of the eleven points has coordinates shown in the following table.

[Table 1]

Point	x Coordinate	y Coordinate
Cr	0.52	0.36
Cp	0.502	0.295
Crv	0.423	0.205
Cv	0.275	0.148
Cbv	0.212	0.144
Cb	0.157	0.16
Cbg	0.158	0.314
Cg	0.241	0.458
Cyg	0.351	0.525
Cy	0.479	0.475

Cyr	0.522	0.401
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The maximum value S_{max} of the saturation corresponding to the hue is determined such that a color C2 which is a combination of the maximum value S_{max} of the saturation and the hue is present on the outer perimeter of the second area D2, or in the second area D2 and outside the first area D1, in the xy chromaticity diagram shown in FIG. 9. Moreover, the minimum value S_{min} of the saturation corresponding to the hue is determined such that a color C1 which is a combination of the minimum value S_{min} of the saturation and the hue is present on the outer perimeter of the first area D1, or in the second area D2 and outside the first area D1, in the xy chromaticity diagram shown in FIG. 9.

[0074] The reason for this will be described. To make a color fluctuation perceptible, a change width of the saturation is preferably increased. However, due to chromatic adaptation which is a human visual feature, a great change of a light color from a chromatic color to an achromatic color makes a viewer perceive a complementary afterimage. For example, when a chromatic color which is red is changed to white which is an achromatic color, a person may perceive green which is a complementary color of red. This complementary afterimage presents an uncomfortable look, and therefore, the change range of the saturation of the illumination light preferably falls within a change range from a red area to just before a white area (outside the first area D1).

[0075] Thus, colors of both the first illumination light L1 and the second illumination light L2 vary within a range larger than or equal to the first area D1 and smaller than or equal to the second area D2, thereby providing a preferable color fluctuation.

[0076] Moreover, in the third embodiment, the color of the first illumination light L1 and the color of the second illumination light L2 are present on the outer perimeter of, or within, the second area D2 in the xy chromaticity diagram, and therefore, a feeling of discomfort can be suppressed from being caused due to excessively high saturation. That is, the lighting system 1 is capable of providing a rendering which is perceptible and comfortably viewable.

[0077] (Fourth Embodiment)

A lighting system 1 according to a fourth embodiment controls a light source 20 such that a luminous flux as an optical property of illumination light changes in accordance with rendering patterns of a first light source 21 and a second light source 22.

[0078] A controller 11 determines, based on the hue of first illumination light L1 and the hue of second illumination light L2, a maximum value L_{fmax} , a minimum value L_{fmin} , and a change frequency of the luminous flux for each of the first light source 21 and the second light source 22.

The controller 11 reads, for example, from a storage 12, the change frequency corresponding to each of the hue of the first illumination light L1 and the hue of the second illumination light L2. Note that the controller 11 may determine the change frequency with reference to, for example, a spatial frequency of first light sources 21 and a spatial frequency of second light sources 22.

[0079] Moreover, the controller 11 reads, from the storage 12, the maximum value L_{fmax} and the minimum value L_{fmin} of the luminous flux corresponding to each of the hue of the first illumination light L1 and the hue of the second illumination light L2. Here, the maximum value L_{fmax} of the luminous flux corresponding to the hue is determined such that the maximum value L_{fmax} satisfies the following condition.

[0080] FIG. 11 shows a constant-hue plane of hue 5R in the Munsell color system. Note that the constant-hue plane of FIG. 11 shows, for a combination of a value and chroma, information on whether or not the combination of the value and the chroma is present. In FIG. 11, white quadrangles each show that there is a combination of the value and the chroma. For example, a quadrangle defined by chroma 14 and value 4 shows that there is a color of hue 5R, chroma 14, value 4. On the other hand, in FIG. 11, a combination of the value and the chroma for which no quadrangle is shown means that there is no color represented by a combination of the value, the chroma, and 5R as the hue. That is, for example, there is no color of hue 5R, chroma 6, value 9.

[0081] In the lighting system 1 according to the fourth embodiment, the maximum value L_{fmax} of the luminous flux is set to a maximum value of a representative color for each hue. A relationship between the hue and the maximum value corresponding to the representative color of the hue is shown below.

[Table 2]

Hue	Maximum Value
5R	4
5YR	7
5Y	8
5GY	8
5G	6
5BG	7
5B	6
5PB	5
5P	4
5PR	5

10RP	5
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The maximum value L_{fmax} of the luminous flux is set such that the value corresponding to the hue is proportional to the maximum value corresponding to the representative color of the hue. That is, for example, the ratio of values between the maximum value L_{fmax} of the luminous flux corresponding to hue 5R and the maximum value L_{fmax} of the luminous flux corresponding to hue 5YR is 4:7. Moreover, for example, the maximum value L_{fmax} of the luminous flux corresponding to hue 5Y and the maximum value L_{fmax} of the luminous flux corresponding to hue 5GY are equal to each other.

[0082] The maximum values L_{fmax} of the luminous fluxes corresponding to the hues have the relationship described above, and thus, when the luminous fluxes of the first light source 21 and the second light source 22 are changed, the hue or the chroma of the first illumination light L1 and the second illumination light L2 can be suppressed from changing along with the change in the luminous fluxes. Thus, the luminous fluxes can be easily changed without changing the hue or the chroma of the first illumination light L1 and the second illumination light L2. This enables the lighting system 1 to provide a rendering that only the luminous fluxes are easily changed.

[0083] (Fifth Embodiment)

A lighting system 1 according to a fifth embodiment controls a light source 20 such that both a luminous flux and saturation as optical properties of illumination light change in accordance with rendering patterns of a first light source 21 and a second light source 22. More specifically, a controller 11 periodically changes the luminous flux and the saturation of first illumination light L1 in accordance with an identical change frequency. Similarly, the controller 11 periodically changes the luminous flux and the saturation of the second illumination light L2 in accordance with an identical change frequency.

[0084] The controller 11 determines, based on the hue of the first illumination light L1 and the hue of the second illumination light L2, a maximum value L_{fmax} and a minimum value L_{fmin} of the luminous flux, a maximum value S_{max} of the saturation, a minimum value S_{min} of the saturation, a change frequency, and a phase difference between the luminous flux and the saturation for each of the first illumination light L1 and the second illumination light L2.

[0085] Here, the phase difference between the luminous flux and the saturation will be described. As typical examples of the phase difference between the luminous flux and the saturation, an example of 0 degrees and an example of 180 degrees will be described. For example, when the phase difference between the luminous flux and the saturation is set to 0 degrees, the saturation

and the luminous flux of illumination light simultaneously become maximum, and the saturation and the luminous flux simultaneously become minimum. In this case, due to the Helmholtz-Kohlrausch (K-K) effect that a color having higher saturation appears brighter, a small luminous flux appears as bright as it actually is, whereas a large luminous flux appears brighter than it actually is. Therefore, a change width of the luminous flux appears larger than an actual change width of the luminous flux. That is, when the phase difference between the luminous flux and the saturation is 0 degrees, the change width of the luminous flux is perceived as being emphasized. In contrast, for example, when the phase difference between the luminous flux and the saturation is 180 degrees, saturation S3 has the minimum value S_{min} at timings t_0 and t_1 as shown in FIG. 12A, and a luminous flux Lf_3 has the maximum value Lf_{max} at the timings t_0 and t_1 as shown in FIG. 12B. That is, the luminous flux Lf_3 of the illumination light has the minimum value Lf_{min} when the saturation S3 has the maximum value S_{max} , and the luminous flux Lf_3 of the illumination light has the maximum value Lf_{max} when the saturation S3 has the minimum value S_{min} . In this case, due to the H-K effect, a small luminous flux appears brighter than it actually is, whereas a large luminous flux appears as bright as it actually is. Therefore, the change width of the luminous flux appears smaller than an actual change width of the luminous flux. That is, when the phase difference between the luminous flux and the saturation is 180 degrees, the change width of the luminous flux is perceived as being small.

[0086] For example, when the spatial frequency of the first light sources 21 is higher than the spatial frequency of the second light sources 22, the controller 11 makes the phase difference between the luminous flux and the saturation in the first illumination light L1 close to 180°. This suppresses the first light sources 21 having a high spatial frequency, that is, being spatially dense from providing an excessive rendering. Alternatively, the controller 11 may change both the luminous flux and the saturation of the second illumination light L2 and may change only one of the luminous flux or the saturation of the first light source 21, for example, when the spatial frequency of the first light sources 21 is higher than the spatial frequency of the second light sources 22.

[0087] Note that human vision is sensitive to a change in color in the front of a visual field and is sensitive to a change in brightness in the periphery of the visual field. Thus, regarding lighting in a room, when the first light source 21 is arranged in the front of the visual field of a person and the second light source 22 is arranged in the periphery of the visual field, the luminous flux of the first light source may be changed, and the saturation of the second light source may be changed. In this way, the person in the room is less likely to have a feeling of discomfort caused due to a

periodical change in the saturation or a periodical change in the luminous flux, and an appropriate rendering can be easily provided.

[0088] (Sixth Embodiment)

A lighting system 1 according to a sixth embodiment determines, based on space rendering images, a reference color for determining the hue of first illumination light L1 and the hue of second illumination light L2.

[0089] A storage 12 of the lighting system 1 stores a combination of the space rendering images, the hue of the first illumination light L1, and the hue of the second illumination light L2. The space rendering images are, for example, images which evoke concrete scenery such as sea, sunbeams streaming through leaves, and the like. Moreover, the space rendering images may be, for example, images which show purposes, such as relaxing, refreshing, meeting, recital, of a space rendering. The storage 12 stores the hue of the first illumination light L1 and the hue of the second illumination light L2 corresponding to each of the space rendering images as a table. Note that the storage 12 may store a reference color corresponding to each of the space rendering images as a table.

[0090] An input section 13 receives an input of the space rendering images from a worker. A controller 11 causes the input section 13, which is, for example, a touch panel, to display a list of the space rendering images, and the controller 11 prompts the worker to select one of the space rendering images. The controller 11 reads, from the storage 12, the hue of the first illumination light L1 and the hue of the second illumination light L2 corresponding to the space rendering image input by the worker, and based on the hue of the first illumination light L1 and the hue of the second illumination light L2 thus read, the controller 11 provides a rendering using a first light source 21 and a second light source 22. Note that the controller 11 may read, from the storage 12, for example, a reference color corresponding to the space rendering image input by the worker. In this case, the controller 11 determines, based on the reference color, the hue of the first illumination light L1 and the hue of the second illumination light L2, thereby providing the rendering using the first light source 21 and the second light source 22.

[0091] The lighting system 1 according to the sixth embodiment allows the worker to determine, based on the space rendering image, contents of the rendering to be provided by the lighting system 1. Thus, the worker can easily provide a rendering compliant with the space rendering image without directly specifying the hue of the first illumination light L1, the hue of the second illumination light L2, or the reference color.

[0092] (Seventh Embodiment)

A lighting system 1a according to a seventh embodiment allows a user to select the intensity of a rendering to be provided by using a first light source 21 and a second light source 22.

[0093] As shown in FIG. 13, the lighting system 1a according to the seventh embodiment includes a control device 10a in place of the control device 10. The control device 10a includes a controller 11a, a storage 12, and an input section 13, and a rendering intensity input section 14.

[0094] The rendering intensity input section 14 receives an input of the rendering intensity of a rendering to be provided by using a light source 20 from a user. The user is, for example, a user of a facility where the lighting system 1a is installed. Moreover, the rendering intensity shows the range of a change width of the optical property of illumination light. The rendering intensity input section 14 includes, for example, a rotating or sliding knob. Note that the rendering intensity input section 14 may be a combination of an indicator for showing a current rendering intensity, a switch for increasing the rendering intensity, and a switch for reducing the rendering intensity.

[0095] The controller 11a dynamically changes contents of a rendering in accordance with the rendering intensity input via the rendering intensity input section 14. The rendering intensity is indicated as a ratio to the change width of the optical property of the illumination light specified by a rendering pattern read from the storage 12. For example, when the rendering intensity is 75%, the controller 11a changes a maximum value and a minimum value of a luminous flux such that a difference between the maximum value and the minimum value of the luminous flux is 75% of a difference between a maximum value and a minimum value of a luminous flux specified by the rendering pattern read from the storage 12. More specifically, for example, when the maximum value of the luminous flux is 100% of the maximum luminous flux of the first light source 21 and the minimum value of the luminous flux is 20% of the maximum luminous flux of the first light source 21, the maximum value of the luminous flux is changed to 90% of the maximum luminous flux of the first light source 21, and the minimum value of the luminous flux is changed to 30% of the maximum luminous flux of the first light source 21. Similarly, for example, when the rendering intensity is 75%, the controller 11a changes a maximum value and a minimum value of saturation such that a difference between the maximum value and the minimum value of the saturation is 75% of a difference between a maximum value and a minimum value of saturation specified by the rendering pattern read from the storage 12.

[0096] The lighting system 1a according to the seventh embodiment enables the intensity of a rendering by using the light source 20 to be intensified or attenuated depending on user's

preferences. Thus, for example, when a user is sensitive to a change in the luminous flux and/or the saturation, the intensity of the rendering may be attenuated so that no feeling of discomfort due to the rendering is caused. Moreover, for example, when a user is less likely to notice the change in the luminous flux and/or the saturation, the intensity of the rendering may be intensified so that the user visually recognize the rendering.

[0097] Note that the rendering intensity may exceed, for example, 100%. That is, in the lighting system 1a, the change width of the optical property can be increased to be larger than the change width of the optical property of the illumination light specified by the rendering pattern. In this way, for example, in the rendering pattern stored in the storage 12, the change width of the optical property of the illumination light is set to a small width so that no user has a feeling of discomfort, and a user for whom the rendering is unsatisfactory can increase the intensity of the rendering.

[0098] (Eighth Embodiment)

A lighting system 1b according to an eighth embodiment can control an environment device 30 in synchrony with a rendering provided by using a first light source 21 and a second light source 22.

[0099] As shown in FIG. 14, the lighting system 1b according to the eighth embodiment further includes the environment device 30. Moreover, the lighting system 1b according to the eighth embodiment includes a control device 10b in place of the control device 10. The control device 10b includes a controller 11b, a storage 12b, and an input section 13.

[0100] The environment device 30 is, for example, a device which is to be installed in a room the same as a light source 20 and is configured to provide a rendering by using things except for light. Examples of the environment device 30 include an air conditioner and an essential oil diffuser.

[0101] The storage 12b stores, for example, an operation instruction which is to be given to the environment device 30 and which corresponds to each of rendering patterns of the first light source 21 and the second light source 22. The controller 11b transmits the operation instruction to the environment device 30 in addition to the rendering according to the rendering patterns of the first light source 21 and the second light source 22. For example, when the environment device 30 is an air conditioner, the controller 11b gives an instruction to the air conditioner such that an air volume is controlled to a prescribed intensity in a time slot in which the saturation of the first illumination light L1 is higher than a prescribed saturation. Moreover, for example, when the environment device 30 is an essential oil diffuser, the controller 11b gives an instruction to the essential oil diffuser such that an essential oil corresponding to the hue of the first illumination

light L1 is sprayed in a time slot in which the luminous flux of the first illumination light L1 is larger than a prescribed luminous flux.

[0102] The lighting system 1b according to the eighth embodiment can combine light and an environment, except for the light, in a room with each other to provide a rendering with reference to an environment in the entire room.

[0103] (Ninth Embodiment)

A lighting system 1c according to a ninth embodiment changes control aspects of a first light source 21 and a second light source 22 by using information on a user.

[0104] As shown in FIG. 15, the lighting system 1c according to the ninth embodiment includes a control device 10c in place of the control device 10. The control device 10c includes a sensor part 15 in addition to a controller 11c, a storage 12, and an input section 13.

[0105] The sensor part 15 includes: a sensor for acquiring information for estimating a feeling state and an action state of the user; and an analysis device which outputs the feeling state or the action state of the user in accordance with the information acquired from the sensor. The sensor part 15 includes, for example, a camera and a microphone. Note that the sensor part 15 may include a biological sensor for acquiring biological information on a specific user and is, for example, a heartbeat sensor or a brain wave sensor. The biological sensor may be, for example, a wearable sensor such as a smartwatch.

[0106] The analysis device of the sensor part 15 analyzes the information acquired from the sensor part 15, thereby estimating the feeling state or the action state of the user. More specifically, for example, the analysis device estimates the feeling state of the user from his/her heart rate or brain wave. Moreover, for example, the analysis device analyzes an image acquired from the camera or a voice acquired from the microphone, thereby estimating whether or not the user is taking action.

[0107] When the control device 10c detects that the feeling state or the action state of the user acquired from the sensor part 15 does not change, the control device 10c changes the aspects of a rendering using the first light source 21 and the second light source 22. For example, when a rendering pattern intended for relaxation is executed by the first light source 21 and the second light source 22, the sensor part 15 detects, as a change in the feeling state of the user, that the user enters a relaxing state. Thus, when the feeling state of the user does not change, it means that the rendering using the first light source 21 and the second light source 22 is not producing a relaxing effect, and therefore, the control device 10c causes the first light source 21 and the second light source 22 to execute another rendering pattern.

[0108] Moreover, when the action state of the user does not change, the control device 10c changes the aspects of the rendering using the first light source 21 and the second light source 22. For example, in the lighting system 1c, when a rendering pattern intended for smoothly conducting a meeting is executed by the first light source 21 and the second light source 22, the sensor part 15 detects a speech action, when the user gives a speech, as a change in the action state of the user. Thus, when the action state of the user does not change, it means that the rendering using the first light source 21 and the second light source 22 is not smoothing the meeting, and therefore, the control device 10c causes the first light source 21 and the second light source 22 to execute another rendering pattern.

[0109] The lighting system 1c according to the ninth embodiment changes, based on the feeling or the action of the user, an aspect of the rendering using the illumination light when the effect of a rendering using illumination light is not being obtained. Thus, the aspect of the rendering can be changed such that the effect of the rendering using the illumination light can be obtained.

[0110] (Variation)

A lighting system 1c according to a variation of the ninth embodiment changes control aspects of the first light source 21 and the second light source 22 in accordance with information on a user.

[0111] The sensor part 15 is a biological sensor for acquiring information for estimating a feeling state of the user. Examples of the sensor part 15 include a heartbeat sensor, a respiration sensor, and a brain wave sensor. The sensor part 15 may be, for example, a wearable sensor such as a smartwatch.

[0112] The control device 10c synchronizes, based on the information acquired from the sensor part 15, a biological rhythm of the user with a rendering by illumination light. More specifically, for example, the control device 10c extracts a frequency as a biological frequency from the heart rate, the respiration speed, or the brain wave. The control device 10c makes a change frequency, at which the luminous flux or saturation of the illumination light is changed, consistent with the biological frequency.

[0113] According to the lighting system 1c according to the variation of the ninth embodiment, the biological rhythm of the user is consistent with the change frequency of the optical property of the illumination light. Thus, the user can obtain a special relaxing feeling and the like from the biological rhythm being consistent with shimmering of the illumination light.

[0114] (Other Variations of Embodiments)

(1) In the first to ninth embodiments and the variations thereof, the lighting system 1, 1a,

1b, 1c periodically changes at least one of the luminous flux or the saturation, or both the luminous flux and the saturation, as the optical property, or the optical properties, of the illumination light. However, the optical properties of the illumination light are not limited to the luminous flux and the saturation. The lighting system 1 may periodically change, for example, the hue as the optical property of the illumination light. In this case, a range within which the hue changes may be, for example, the range of a similar color or the range of a similar hue described in the second embodiment or the variations thereof. This moderates the change in the hues of the first illumination light L1 and the second illumination light L2, thereby producing the relaxing effect or the refreshing effect.

[0115] (2) In the first to ninth embodiments and the variations thereof, the lighting system 1, 1a, 1b, 1c sinusoidally changes at least one of the luminous flux or the saturation, or both the luminous flux and the saturation, as the optical property, or the optical properties, of the illumination light. However, the optical property(ies) of the illumination light is at least periodically changed, and the aspect of the change is not limited to being sinusoidal. For example, when the change frequency is 0.1 Hz, the luminous flux as the optical property of the illumination light may change such that a pattern having a time length of 10 seconds and being set forth in advance is repeated.

[0116] (3) In the first embodiment, the second embodiment, the fourth to ninth embodiments, and the variations thereof, the lighting system 1, 1a, 1b, 1c performs dimming control of the first light source 21 or the second light source 22, thereby periodically changing the luminous flux as the optical property of the illumination light. However, an adjustment method of the luminous flux is not limited to the dimming control of the first light source 21 or the second light source 22. For example, when the lighting system 1 includes a plurality of first light sources 21, the adjustment method of the luminous flux may be a method of stopping lighting of some of the plurality of first light sources 21. More specifically, the lighting system 1 controls, for example, such that of twelve first light sources 21, six first light sources 21 are always on and the remaining six first light sources 21 periodically blink. This method enables the luminous fluxes output from all of the plurality of first light sources 21 to be changed.

[0117] (Summary)

A lighting system (1; 1a; 1b; 1c) of a first aspect includes a plurality of light sources and a controller (11; 11a; 11b; 11c). The plurality of light sources at least includes a first light source (21) and a second light source (22). The first light source (21) is configured to output first illumination light (L1). The second light source (22) is configured to output second illumination light (L2). The controller (11; 11a; 11b; 11c) is configured to periodically change each of an

optical property of the first illumination light (L1) and an optical property of the second illumination light (L2). Each of the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2) is a property relating to at least one of a luminous flux, a hue, and saturation.

[0118] According to the lighting system (1; 1a; 1b; 1c) of this aspect, at least one of the luminous flux, the hue, the saturation of each of the first illumination light (L1) and the second illumination light (L2) periodically changes. This enables the first illumination light (L1) and the second illumination light (L2) to produce a relaxing effect, a refreshing effect, or an entertaining effect.

[0119] In a lighting system (1; 1a; 1b; 1c) of a second aspect referring to a first aspect, the controller (11; 11a; 11b; 11c) is configured to change the optical property of the first illumination light (L1) at a first frequency. The controller (11; 11a; 11b; 11c) is further configured to change the optical property of the second illumination light (L2) at a second frequency. The first frequency and the second frequency are different from each other.

[0120] According to the lighting system (1; 1a; 1b; 1c) of this aspect, a change frequency of the optical property is different between the first illumination light (L1) and the second illumination light (L2). This enables shimmering aspects of first illumination light (L1) and the second illumination light (L2) to be easily made complex. Therefore, the relaxing effect, the refreshing effect, or the entertaining effect by the first illumination light (L1) and the second illumination light (L2) can be intensified.

[0121] In a lighting system (1; 1a; 1b; 1c) of a third aspect referring to the first or second aspect, the controller (11; 11a; 11b; 11c) is configured to keep the luminous flux constant and periodically change at least one of the hue or the saturation for each of the first illumination light (L1) and the second illumination light (L2) to periodically change each of the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2).

[0122] The lighting system (1; 1a; 1b; 1c) of this aspect enables a feeling of discomfort from being caused due to the periodical change in the luminous fluxes of the first illumination light (L1) and the second illumination light (L2). Moreover, the periodical change in the hue or the saturation of each of the first illumination light (L1) and the second illumination light (L2) produces the relaxing effect, the refreshing effect, or the entertaining effect.

[0123] In a lighting system (1; 1a; 1b; 1c) of a fourth aspect referring to the first or second aspect, the controller (11; 11a; 11b; 11c) is configured to keep the hue and the saturation constant and periodically change the luminous flux for each of the first illumination light (L1) and the second illumination light (L2) to periodically change each of the optical property of the first illumination

light (L1) and the optical property of the second illumination light (L2).

[0124] The lighting system (1; 1a; 1b; 1c) of this aspect enables a feeling of discomfort to be suppressed from being caused due to a periodical change in colors of the first illumination light (L1) and the second illumination light (L2). Moreover, the periodical change in the luminous fluxes of the first illumination light (L1) and the second illumination light (L2) produces the relaxing effect, the refreshing effect, or the entertaining effect.

[0125] In a lighting system (1; 1a; 1b; 1c) of a fifth aspect referring to the first or second aspect, the controller (11; 11a; 11b; 11c) is configured to periodically change the luminous flux and at least one of the hue or the saturation for each of the first illumination light (L1) and the second illumination light (L2) to periodically change each of the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2).

[0126] The lighting system (1; 1a; 1b; 1c) of this aspect periodically changes both the color and the luminous flux of each of the first illumination light (L1) and the second illumination light (L2), thereby intensifying the relaxing effect, the refreshing effect, or the entertaining effect.

[0127] In a lighting system (1; 1a; 1b; 1c) of a sixth aspect referring to the fifth aspect, the controller (11; 11a; 11b; 11c) is configured to, for at least one of the optical property of the first illumination light (L1) or the optical property of the second illumination light (L2), periodically change the saturation and the luminous flux in a same period and make a timing at which the saturation is maximum and a timing at which the luminous flux is maximum different from each other.

[0128] According to the lighting system (1; 1a; 1b; 1c) of this aspect, suppresses a change in the luminous flux from being excessively felt due to the saturation and the luminous flux being maximum at the same time and being minimum at the same time. This suppresses a feeling of discomfort from being caused due to an effect which is to be felt excessively spectacular.

[0129] A lighting system (1; 1a; 1b; 1c) of a seventh aspect referring to any one of the first to sixth aspects further includes a storage (12). The storage (12) is configured to store at least one of a control range of saturation or a control range of a luminous flux for each of hues. The controller (11; 11a; 11b; 11c) is configured to periodically change, based on the hue of each of the first illumination light (L1) and the second illumination light (L2), each of the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2) by using at least one of the control range of the saturation or the control range of the luminous flux stored in the storage (12).

[0130] The lighting system (1; 1a; 1b; 1c) of this aspect facilitates suitable fluctuation control of

at least one of the saturation or the luminous flux of each of the first illumination light (L1) and the second illumination light (L2).

[0131] In a lighting system (1; 1a; 1b; 1c) of an eighth aspect referring to any one of the first to seventh aspects, the controller (11; 11a; 11b; 11c) is configured to select, based on a number of light sources included in the plurality of light sources, the first light source (21) and the second light source (22) from the plurality of light sources.

[0132] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the first light source (21) and the second light source (22) are dynamically selectable with respect to the plurality of light source. This enables spatial design of the first illumination light (L1) and the second illumination light (L2) to be easily controlled based on the number of light sources.

[0133] In a lighting system (1; 1a; 1b; 1c) of a ninth aspect referring to the eighth aspect, the controller (11; 11a; 11b; 11c) is configured to change the optical property of the first illumination light (L1) at a first frequency. The controller (11; 11a; 11b; 11c) is further configured to change the optical property of the second illumination light (L2) at a second frequency. The first frequency and the second frequency are each higher than or equal to 0.05 Hz and lower than or equal to 1.0 Hz.

[0134] The lighting system (1; 1a; 1b; 1c) of this aspect suppresses a feeling of discomfort from being caused due to a change in the optical properties of the first illumination light (L1) and the second illumination light (L2) and enables a suitable rendering to be provided.

[0135] In a lighting system (1; 1a; 1b; 1c) of a tenth aspect referring to the ninth aspect, the plurality of light sources include a plurality of the first light sources (21) and a plurality of the second light sources (22). A shortest distance (d2) between the plurality of second light sources (22) is greater than a shortest distance (d1) between the plurality of first light sources (21). The second frequency is higher than the first frequency.

[0136] According to the lighting system (1; 1a; 1b; 1c) of this aspect, a change frequency of the optical properties of the second light sources (22) spatially sparsely arranged is higher than a change frequency of the optical properties of the first light sources (21) spatially densely arranged. This suppresses a feeling of discomfort from being caused due to a change in the optical property of the first illumination light (L1) and enables an intense rendering to be provided by the optical property of the second illumination light (L2).

[0137] In a lighting system (1; 1a; 1b; 1c) of an eleventh aspect referring to the ninth aspect, the plurality of light sources include a plurality of the first light sources (21) and a plurality of the second light sources (22). A distance (d2) between light emission areas of the plurality of second

light sources (22) is greater than a distance (d1) between light emission areas of the first light sources (21). The second frequency is higher than the first frequency.

[0138] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the distance (d2) between the light emission areas of the second light sources (22) is greater than the distance (d1) between the light emission areas of the first light sources (21), and therefore, the spatial frequency of the second light sources (22) is lower than the spatial frequency of the first light sources (21). Thus, increasing the second frequency to be higher than the first frequency suppresses a feeling of discomfort from being caused due to a change in the optical property of the first illumination light (L1) and enables a high intensity rendering to be provided by the optical property of the second illumination light (L2).

[0139] A lighting system (1; 1a; 1b; 1c) of a twelfth aspect referring to any one of the first to eleventh aspects further includes an input section (13). The input section (13) is configured to receive an input of a reference color (C0). The controller (11; 11a; 11b; 11c) is configured to determine, based on the reference color (C0), the hue as the optical property of the first illumination light and the hue as the optical property of the second illumination light.

[0140] The lighting system (1; 1a; 1b; 1c) of this aspect enables the hue of the first illumination light (L1) and the hue of the second illumination light (L2) to be suitably determined in a range based on the reference color (C0).

[0141] The lighting system (1; 1a; 1b; 1c) of a thirteenth aspect referring to the first to eleventh aspects further includes a storage (12) and an input section (13). The storage (12) is configured to store a reference color (C0) in association with a space rendering image. The input section (13) is configured to receive an input of the space rendering image. The controller (11; 11a; 11b; 11c) is configured to determine, based on the reference color (C0) stored in association with the space rendering image in the storage (12), the hue as the optical property of the first illumination light (L1) and the hue as the optical property of the second illumination light (L2).

[0142] The lighting system (1; 1a; 1b; 1c) of this aspect enables the hue of the first illumination light (L1) and the hue of the second illumination light (L2) to be determined such that these hues conform to the space rendering image.

[0143] In a lighting system (1; 1a; 1b; 1c) of a fourteenth aspect referring to the twelfth or thirteenth aspects, in a u'v' chromaticity diagram, an angle between a line segment connecting the hue of the first illumination light (L1) to an equal energy white point (W0) and a line segment (L10) connecting the reference color (C0) to the equal energy white point (W0) is 43 degrees or less.

[0144] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the hue of the first illumination light (L1) is present in a range of a similar hue to the reference color (C0). Thus, a moderate rendering by the lighting system (1; 1a; 1b; 1c) becomes possible and the relaxing effect and/or the refreshing effect by the rendering can be improved.

[0145] In a lighting system (1; 1a; 1b; 1c) of a fifteenth aspect referring to the fourteenth aspect, in the u'v' chromaticity diagram, the angle between the line segment connecting the hue of the first illumination light (L1) to the equal energy white point (W0) and the line segment (L10) connecting the reference color (C0) to the equal energy white point (W0) is 25 degrees or less.

[0146] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the hue of the first illumination light (L1) is present in a range of a similar color to the reference color (C0). Thus, a moderate rendering by the lighting system (1; 1a; 1b; 1c) becomes possible, and the relaxing effect and/or the refreshing effect by the rendering can be improved.

[0147] In a lighting system (1; 1a; 1b; 1c) of a sixteenth aspect referring to the twelfth or thirteenth aspect, in a u'v' chromaticity diagram, an angle between a line segment connecting the hue of the first illumination light (L1) to an equal energy white point (W0) and a line segment (L10) connecting the reference color (C0) to the equal energy white point (W0) is greater than or equal to 43 degrees and less than or equal to 180 degrees.

[0148] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the hue of the first illumination light (L1) is not in a range of a similar hue to the reference color (C0). This enables the lighting system (1; 1a; 1b; 1c) to provide a spectacular effect, thereby improving an entertaining property of the rendering.

[0149] A lighting system (1; 1a; 1b; 1c) of a seventeenth aspect referring to any one of the first to sixteenth aspects further includes a storage (12). The storage (12) is configured to store a control range of saturation for each of hues. In an xy chromaticity diagram, a lower limit value of the control range of the saturation is on an outer perimeter of a first area (D1). Moreover, in the xy chromaticity diagram, an upper limit value of the control range of the saturation is on an outer perimeter of a second area (D2). The first area (D1) is a white area based on JIS Z 8110. The outer perimeter of the second area (D2) includes points represented by coordinates (x, y) = (0.52, 0.36), (0.502, 0.295), (0.423, 0.205), (0.275, 0.148), (0.212, 0.144), (0.2157, 0.16), (0.158, 0.314), (0.241, 0.458), (0.351, 0.525), (0.479, 0.475), and (0.522, 0.401).

[0150] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the color of the first illumination light (L1) and the color of the second illumination light (L2) are in a chromatic color range and are controlled within a suitable range. This suppresses a feeling of discomfort from

being caused due to a complementary afterimage and enables the relaxing effect, the refreshing effect, or the entertaining effect to be provided by a rendering.

[0151] A lighting system (1; 1a; 1b; 1c) of an eighteenth aspect referring to any one of the first to seventeenth aspects further includes a storage (12). The storage (12) is configured to store a control range of a luminous flux for each of hues. An upper limit value of the control range of the luminous flux is a maximum value for each of hues in Munsell color system. The controller (11; 11a; 11b; 11c) is configured to make a ratio between a luminous flux of the first illumination light (L1) and a luminous flux of the second illumination light (L2) equal to a ratio between the upper limit value of the control range of the luminous flux corresponding to the hue of the first illumination light (L1) and the upper limit value of the control range of the luminous flux corresponding to the hue of the second illumination light (L2).

[0152] According to the lighting system (1; 1a; 1b; 1c) of this aspect, the control range of the luminous flux of each of the first illumination light (L1) and the second illumination light (L2) is limited to a range in which the luminous flux can be changed without influencing the hue and the saturation. This suppresses the hue or the saturation from being unintendedly changed due to a change in the luminous flux and enables a suitable rendering to be provided.

[0153] A lighting system (1a) of a nineteenth aspect referring to any one of the first to eighteenth aspects further includes an input section (14). The input section (14) is configured to receive an input of a rendering intensity. The rendering intensity shows an extent of at least one of a control range or a change period for at least one of the optical property of the first illumination light (L1) or the optical property of the second illumination light (L2). The controller (11a) is configured to determine, based on the rendering intensity, at least one of the control range or the change period of the optical property of the first illumination light (L1) or the optical property of the second illumination light (L2).

[0154] According to the lighting system (1a) of this aspect, the intensity of a rendering by the first illumination light (L1) and the second illumination light (L2) is selectable by a user. This enables a rendering suitable for user's preference to be provided.

[0155] A lighting system (1b) of a twentieth aspect referring to any one of the first to nineteenth aspects further includes a storage (12). The storage (12) is configured to store the optical property of the first illumination light (L1) or the optical property of the second illumination light (L2) in association with control information on an environment device (30). The controller (11b) is configured to, when the storage (12) stores the control information on the environment device (30) corresponding to the optical property of the first illumination light (L1) or the optical property of

the second illumination light (L2), output the control information on the environment device (30) to the environment device (30).

[0156] The lighting system (1b) of this aspect enables a rendering using the first illumination light (L1) and the second illumination light (L2) to be synchronized with a rendering by the environment device (30). Thus, a rendering using the first light source (21), the second light source (22), and the environment device (30) becomes possible.

[0157] A lighting system (1c) of a twenty-first aspect referring to any one of the first to twentieth aspects further includes a sensor part (15). The sensor part (15) is configured to acquire information about a place where the plurality of light sources are installed. The controller (11c) is configured to control the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2) such that the information acquired from the sensor part (15) is changed.

[0158] According to the lighting system (1c) of this aspect, whether or not a rendering by the first illumination light (L1) and the second illumination light (L2) is producing a desired effect is checked based on the information acquired from the sensor part (15), and based on a check result, a rendering aspect is changed.

[0159] In a lighting system (1c) of a twenty-second aspect referring to the twenty-first aspect, the sensor part (15) is configured to acquire a biological signal of a person present in the place where the plurality of light sources are installed. The controller (11c) is configured to determine, based on the biological signal of the user, a change frequency of the optical property of the first illumination light (L1) and the optical property of the second illumination light (L2).

[0160] The lighting system (1c) of this aspect enables the change frequency of the optical properties of the first illumination light (L1) and the second illumination light (L2) to be consistent with the biological rhythm of the user. This enables a rendering particularly appropriate to a specific user to be provided.

Reference Signs List

- [0161] 1, 1a, 1b, 1c Lighting System
 11, 11a, 11b, 11c Controller
 12 Storage
 13 Input section
 14 Rendering intensity Input section (Input section)
 15 Sensor Part

21	First Light Source
22	Second Light Source
30	Environment Device
L1	First Illumination Light
L2	Second Illumination Light
D1	Shortest Distance (Distance Between Light Emission Areas)
D2	Shortest Distance (Distance Between Light Emission Areas)
D1	First Area
D2	Second Area

CLAIMS

1. A lighting system comprising:
 - a plurality of light sources at least including
 - a first light source configured to output first illumination light, and
 - a second light source configured to output second illumination light; and
 - a controller configured to periodically change each of an optical property of the first illumination light and an optical property of the second illumination light,
 - each of the optical property of the first illumination light and the optical property of the second illumination light being a property relating to at least one of a luminous flux, a hue, and saturation.
2. A lighting system of claim 1, wherein
 - the controller is configured to
 - change the optical property of the first illumination light at a first frequency and
 - change the optical property of the second illumination light at a second frequency,
 - and
 - the first frequency and the second frequency are different from each other.
3. The lighting system of claim 1 or 2, wherein
 - the controller is configured to keep the luminous flux constant and periodically change at least one of the hue or the saturation for each of the first illumination light and the second illumination light to periodically change each of the optical property of the first illumination light and the optical property of the second illumination light.
4. The lighting system of claim 1 or 2, wherein
 - the controller is configured to keep the hue and the saturation constant and periodically change the luminous flux for each of the first illumination light and the second illumination light to periodically change each of the optical property of the first illumination light and the optical property of the second illumination light.
5. The lighting system of claim 1 or 2, wherein
 - the controller is configured to periodically change the luminous flux and at least one of

the hue or the saturation for each of the first illumination light and the second illumination light to periodically change each of the optical property of the first illumination light and the optical property of the second illumination light.

6. The lighting system of claim 5, wherein

the controller is configured to, for at least one of the optical property of the first illumination light or the optical property of the second illumination light, periodically change the saturation and the luminous flux in a same period and make a timing at which the saturation is maximum and a timing at which the luminous flux is maximum different from each other.

7. The lighting system of any one of claims 1 to 6, further comprising a storage configured to store at least one of a control range of saturation or a control range of a luminous flux for each of hues, wherein

the controller is configured to periodically change, based on the hue of each of the first illumination light and the second illumination light, each of the optical property of the first illumination light and the optical property of the second illumination light by using at least one of the control range of the saturation or the control range of the luminous flux stored in the storage.

8. The lighting system of any one of claims 1 to 7, wherein

the controller is configured to select, based on a number of light sources included in the plurality of light sources, the first light source and the second light source from the plurality of light sources.

9. The lighting system of claim 8, wherein

the controller is configured to

change the optical property of the first illumination light at a first frequency and

change the optical property of the second illumination light at a second frequency,

and

the first frequency and the second frequency are each higher than or equal to 0.05 Hz and lower than or equal to 1.0 Hz.

10. The lighting system of claim 9, wherein

the plurality of light sources include a plurality of the first light sources and a plurality of

the second light sources,

a shortest distance between the plurality of second light sources is greater than a shortest distance between the plurality of first light sources, and

the second frequency is higher than the first frequency.

11. The lighting system of claim 9, wherein

the plurality of light sources include a plurality of the first light sources and a plurality of the second light sources,

a distance between light emission areas of the plurality of second light sources is greater than a distance between light emission areas of the first light sources, and

the second frequency is higher than the first frequency.

12. The lighting system of any one of claims 1 to 11, further comprising an input section configured to receive an input of a reference color, wherein

the controller is configured to determine, based on the reference color, the hue as the optical property of the first illumination light and the hue as the optical property of the second illumination light.

13. The lighting system of any one of claims 1 to 6, further comprising:

a storage configured to store a reference color in association with a space rendering image;

and

an input section configured to receive an input of the space rendering image, wherein

the controller is configured to determine, based on the reference color stored in association with the space rendering image in the storage, the hue as the optical property of the first illumination light and the hue as the optical property of the second illumination light.

14. The lighting system of claim 12 or 13, wherein

in a u^*v^* chromaticity diagram, an angle between a line segment connecting the hue of the first illumination light to an equal energy white point and a line segment connecting the reference color to the equal energy white point is 43 degrees or less.

15. The lighting system of claim 14, wherein

in the u^*v^* chromaticity diagram, the angle between the line segment connecting the hue

of the first illumination light to the equal energy white point and the line segment connecting the reference color to the equal energy white point is 25 degrees or less.

16. The lighting system of claim 12 or 13, wherein

in a $u'v'$ chromaticity diagram, an angle between a line segment connecting the hue of the first illumination light to an equal energy white point and a line segment connecting the reference color to the equal energy white point is greater than or equal to 43 degrees and less than or equal to 180 degrees.

17. The lighting system of any one of claims 1 to 6, further comprising a storage configured to store a control range of saturation for each of hues, wherein

in an xy chromaticity diagram,

a lower limit value of the control range of the saturation is on an outer perimeter of a first area, and

an upper limit value of the control range of the saturation is on an outer perimeter of a second area,

the first area is a white area based on JIS Z 8110, and

the outer perimeter of the second area includes points represented by coordinates $(x, y) = (0.52, 0.36), (0.502, 0.295), (0.423, 0.205), (0.275, 0.148), (0.212, 0.144), (0.2157, 0.16), (0.158, 0.314), (0.241, 0.458), (0.351, 0.525), (0.479, 0.475),$ and $(0.522, 0.401)$.

18. The lighting system of any one of claims 1 to 6, further comprising a storage configured to store a control range of a luminous flux for each of hues, wherein

an upper limit value of the control range of the luminous flux is a maximum value for each of hues in a Munsell color system, and

the controller is configured to make a ratio between a luminous flux of the first illumination light and a luminous flux of the second illumination light equal to a ratio between the upper limit value of the control range of the luminous flux corresponding to the hue of the first illumination light and the upper limit value of the control range of the luminous flux corresponding to the hue of the second illumination light.

19. The lighting system of any one of claims 1 to 11, further comprising an input section configured to receive an input of a rendering intensity showing an extent of at least one of a control

range or a change period for at least one of the optical property of the first illumination light or the optical property of the second illumination light, wherein

the controller is configured to determine, based on the rendering intensity, at least one of the control range or the change period of the optical property of the first illumination light or the optical property of the second illumination light.

20. The lighting system of any one of claims 1 to 6, further comprising a storage configured to store the optical property of the first illumination light or the optical property of the second illumination light in association with control information on an environment device, wherein

the controller is configured to, when the storage stores the control information on the environment device corresponding to the optical property of the first illumination light or the optical property of the second illumination light, output the control information on the environment device to the environment device.

21. The lighting system of any one of claims 1 to 20, further comprising a sensor part configured to acquire information about a place where the plurality of light sources are installed, wherein

the controller is configured to control the optical property of the first illumination light and the optical property of the second illumination light such that the information acquired from the sensor part is changed.

22. The lighting system of claim 21, wherein

the sensor part is configured to acquire a biological signal of a person present in the place where the plurality of light sources are installed, and

the controller is configured to determine, based on the biological signal, a change frequency of the optical property of the first illumination light and the optical property of the second illumination light.