

TITLE OF INVENTION: LIGHTING SYSTEM

Technical Field

[0001] The present disclosure generally relates to a lighting system, and more particularly relates to a lighting system including a plurality of light sources.

Background Art

[0002] JP 2019-102156 A discloses lighting equipment (lighting system) including a red light emission means, a blue light emission means, and a green light emission means. The lighting equipment of JP 2019-102156 A may, for example, arouse the user by, for example, increasing the amount of luminescence of the blue light emission means while keeping the sum of the amounts of luminescence of the three light emission means substantially constant.

Summary of Invention

[0003] In recent years, people tend to perform work more and more frequently while watching the display screen of an electrical device. Thus, there have been increasing demands for a working environment (a lighting environment) that is specially designed to improve the efficiency of such work.

[0004] It is therefore an object of the present disclosure to provide a lighting system that allows the user to perform his or her work more efficiently while watching the display screen of an electrical device.

[0005] A lighting system according to an aspect of the present disclosure includes a first light source, a second light source, a control unit, and an information detection unit. The first light source irradiates a first irradiation region of an irradiation surface with first lighting light. The second light source irradiates a second irradiation region of the irradiation surface with second lighting light. The irradiation surface is located behind an electrical device having a display screen. The control unit controls the first light source and the second light source. The information detection unit detects biometric information of a user of the electrical device. The first irradiation region is narrower than the second irradiation region. At least a part of the first irradiation region overlaps with the second irradiation region. The control unit changes, in accordance with the user's biometric information detected by the information detection unit, a light quantity of the first lighting light in a light quantity variation period in a predetermined cycle.

Brief Description of Drawings

[0006] FIG. 1 illustrates a configuration for a lighting system according to a first embodiment;
 FIG. 2 schematically illustrates an installation environment of the lighting system;
 FIG. 3 is a schematic representation illustrating an exemplary application of the lighting system;

FIG. 4 schematically illustrates an irradiation region formed on an irradiation surface by the lighting system;

FIG. 5 is a chromaticity diagram illustrating how the lighting system operates;

FIG. 6 is a graph showing how the amplitude gain changes with the time frequency in the lighting system;

FIG. 7 is a graph showing how the luminance on an irradiation surface changes with time in the lighting system in a situation where the luminance is caused to vary in a first cycle in a first period;

FIG. 8 is a graph showing how the luminance on the irradiation surface changes with time in the lighting system in a situation where the luminance is caused to vary in a second cycle in the first period;

FIG. 9 is a graph showing how the luminance on the irradiation surface changes with time in the lighting system in a situation where the luminance is caused to vary in a third cycle in the first period;

FIG. 10A is a graph showing how the light quantity of first lighting light emitted from a first light source of a lighting system according to a second embodiment changes with time;

FIG. 10B is a graph showing how the light quantity of second lighting light emitted from a second light source of the lighting system changes with time;

FIG. 11A is a graph showing how the light quantity of first lighting light emitted from a first light source of a lighting system according to a first variation of the second embodiment changes with time;

FIG. 11B is a graph showing how the light quantity of second lighting light emitted from a second light source of the lighting system changes with time;

FIG. 12A is a graph showing how the light quantity of first lighting light emitted from a first light source of a lighting system according to a second variation of the second embodiment changes with time; and

FIG. 12B is a graph showing how the light quantity of second lighting light emitted from

a second light source of the lighting system changes with time.

Description of Embodiments

[0007] Lighting systems according to first and second embodiments will now be described with reference to the accompanying drawings. The drawings to be referred to in the following description of the first and second embodiments are all schematic representations. Thus, the ratio of the dimensions (including thicknesses) of respective constituent elements illustrated on the drawings does not always reflect their actual dimensional ratio. Also, the first and second embodiments to be described below are only exemplary ones of various embodiments of the present disclosure and should not be construed as limiting. Rather, the first and second exemplary embodiments may be readily modified in various manners depending on a design choice or any other factor without departing from the scope of the present disclosure.

[0008] (First embodiment)

(1) Overview

First, an overview of a lighting system 10 according to a first embodiment will be described with reference to FIGS. 1–3.

[0009] A lighting system 10 according to the first embodiment may be used, for example, to indirectly illuminate an electrical device 6 from behind the electrical device 6 in a situation where the user of the electrical device 6 (hereinafter referred to as a “worker 300”) is performing work while watching the display screen 61 (refer to FIG. 3) of the electrical device 6 as shown in FIG. 2. The electrical device 6 may be, for example, a laptop personal computer. As shown in FIG. 3, the lighting system 10 according to the first embodiment irradiates an irradiation surface S1 which is located behind the electrical device 6, with first lighting light 101 emitted from a first light source 1A (refer to FIG. 1) and second lighting light 102 emitted from a second light source 1B (refer to FIG. 1), thereby indirectly illuminating the electrical device 6 located in front of the irradiation surface S1. In the lighting system 10 according to the first embodiment, the irradiation surface S1 may be, for example, the surface (front surface) of a partition 200 for forming a workspace WS1 (refer to FIG. 2).

[0010] The lighting system 10 according to the first embodiment is designed to provide a working environment (i.e., a lighting environment) that makes it easier for the worker 300 to concentrate on the display screen 61 of the electrical device 6 to allow the worker 300 to work more efficiently while watching the display screen 61 of the electrical device 6. For this purpose, the lighting system 10 according to the first embodiment adopts the configuration to be described below.

[0011] A lighting system 10 according to the first embodiment includes a first light source 1A, a second light source 1B, a control unit 3, and an information detection unit 5. The first light source 1A irradiates a first irradiation region R1 of an irradiation surface S1 with first lighting light 101. The second light source 1B irradiates a second irradiation region R2 of the irradiation surface S1 with second lighting light 102. The irradiation surface S1 is located behind an electrical device 6 having a display screen 61. The control unit 3 controls the first light source 1A and the second light source 1B. The information detection unit 5 detects biometric information of a user (worker 300) of the electrical device 6. The first irradiation region R1 is narrower than the second irradiation region R2. At least a part of the first irradiation region R1 overlaps with the second irradiation region R2. The control unit 3 changes, in accordance with the user's biometric information detected by the information detection unit 5, a light quantity of the first lighting light 101 in a light quantity variation period (e.g., the first period T1 shown in FIG. 7) in a predetermined cycle.

[0012] The lighting system 10 according to the first embodiment irradiates the irradiation surface S1, which is located behind the electrical device 6, with the first lighting light 101 and the second lighting light 102. The first irradiation region R1 irradiated with the first lighting light 101 is narrower than the second irradiation region R2 irradiated with the second lighting light 102. At least a part of the first irradiation region R1 overlaps with the second irradiation region R2. The control unit 3 changes, in accordance with the result of detection by the information detection unit 5, the light quantity of the first lighting light 101 in the light quantity variation period in a predetermined cycle. This enables heightening the worker's 300 consciousness compared to a situation where the light quantity of the first lighting light 101 is not changed in the predetermined cycle. Consequently, this makes it easier for the worker 300 to concentrate on the display screen 61 of the electrical device 6, thus allowing him or her to work more efficiently using the electrical device 6.

[0013] In addition, in the lighting system 10 according to the first embodiment, at least a part of the first irradiation region R1 overlaps with the second irradiation region R2. This makes the luminance difference gradient gentler compared to a situation where the first irradiation region R1 does not overlap with the second irradiation region R2, thus alleviating the worker's 300 sense of discomfort.

[0014] (2) Details

Next, a configuration for a lighting system 10 according to the first embodiment will be described with reference to FIGS. 1 and 2.

[0015] As shown in FIG. 1, the lighting system 10 according to the first embodiment includes

the first light source 1A, the second light source 1B, a first driving unit 2A, a second driving unit 2B, the control unit 3, an input acceptance unit 4, and the information detection unit 5.

[0016] (2.1) First light source

As shown in FIG. 1, the first light source 1A includes a first light emitter 111 and a first optical member 112.

[0017] The first light emitter 111 may include, for example, four types of light-emitting diodes (LEDs) emitting light rays in four different colors (e.g., red, green, blue, and white). The first light emitter 111 includes a plurality of LEDs in each of these four different colors. The plurality of LEDs in the same color are preferably mounted on a board to be electrically connected in series. In the following description, the plurality of LEDs in the same color mounted on the board will be hereinafter sometimes referred to as an “LED module.”

[0018] The first optical member 112 is disposed in front of the first light emitter 111. The first optical member 112 includes, for example, a diffusion sheet. The diffusion sheet may be made of, for example, a synthetic resin having a light transmitting property such as an acrylic resin or a polycarbonate resin. Thus, the light rays emitted from the first light emitter 111 are diffused and combined by the diffusion sheet to turn into a bundle of rays having a light color corresponding to the ratio of the respective light quantities of the LED modules (i.e., the first lighting light 101). That is to say, the first optical member 112 causes the light rays emitted from the first light emitter 111 to be diffused and emerge as the first lighting light 101. Optionally, the first light source 1A may further include a lens unit. The lens unit preferably includes a plurality of lenses corresponding one to one to the plurality of LEDs included in each LED module.

[0019] In addition, the first light source 1A further includes a housing 11A as shown in FIG. 2. The housing 11A is made of either a metal or a synthetic resin. The housing 11A is formed in the shape of a box, of which one surface (upper surface in FIG. 2) is open (hereinafter referred to as an “aperture”). The first light emitter 111 is housed in the housing 11A with the LEDs facing toward the aperture. The first optical member 112 is attached to the housing 11A to close the aperture.

[0020] The first light source 1A irradiates, with the first lighting light 101, the first irradiation region R1 (refer to FIG. 4) of the irradiation surface S1 that is located behind the electrical device 6 having the display screen 61. The first irradiation region R1 will be described in further detail later.

[0021] (2.2) Second light source

As shown in FIG. 1, the second light source 1B includes a second light emitter 121 and a second optical member 122.

[0022] The second light emitter 121, as well as the first light emitter 111, may include, for example, four types of LEDs emitting light rays in four different colors (e.g., red, green, blue, and white). The second light emitter 121 includes a plurality of LEDs in each of these four different colors. The plurality of LEDs in the same color are preferably mounted on a board to be electrically connected in series. In the following description, the plurality of LEDs in the same color mounted on the board will be hereinafter sometimes referred to as an “LED module.”

[0023] The second optical member 122 is disposed in front of the second light emitter 121. The second optical member 122 includes, for example, a linear Fresnel lens. The linear Fresnel lens may be made of, for example, a synthetic resin having a light transmitting property such as an acrylic resin or a polycarbonate resin. Thus, the light rays emitted from the second light emitter 121 are condensed and combined by the linear Fresnel lens to turn into a bundle of rays having a light color corresponding to the ratio of the respective light quantities of the LED modules (i.e., the second lighting light 102). That is to say, the second optical member 122 causes the light rays emitted from the second light emitter 121 to be condensed and emerge as the second lighting light 102.

[0024] In addition, the second light source 1B further includes a housing 11B as shown in FIG. 2. The housing 11B is made of either a metal or a synthetic resin. The housing 11B is formed in the shape of a box, of which one surface (upper surface in FIG. 2) is open (hereinafter referred to as an “aperture”). The second light emitter 121 is housed in the housing 11B with the LEDs facing toward the aperture. The second optical member 122 is attached to the housing 11B to close the aperture.

[0025] The second light source 1B irradiates, with the second lighting light 102, the second irradiation region R2 (refer to FIG. 4) of the irradiation surface S1 that is located behind the electrical device 6 having the display screen 61. The second irradiation region R2 will be described in further detail later.

[0026] (2.3) First driving unit

The first driving unit 2A includes, for example, a power converter circuit for converting AC power supplied from a commercial power grid into DC power and four constant current circuits. The four constant current circuits correspond one to one to the four LED modules of the first light emitter 111.

[0027] The power converter circuit includes, for example, a full-wave rectifier circuit, a step-up chopper circuit, and a smoothing capacitor. The full-wave rectifier circuit may be implemented as, for example, a diode bridge. The power converter circuit converts the AC voltage (e.g., an AC voltage having a power supply frequency of 60 Hz and an effective value of 100 V) supplied

from the power grid into a DC voltage higher than a peak voltage of the AC voltage.

[0028] Each of the four constant current circuits includes, for example, a back converter. The back converter may be, for example, a step-down chopper circuit. Each constant current circuit operates to have the DC voltage supplied from the power converter circuit stepped down by the back converter and to make the output current to be supplied to an associated LED module match a target current value. For example, each constant current circuit may receive, from the control unit 3, a digital signal compliant with the communications protocol DMX (Digital Multiplex) 512 and control the back converter in accordance with the digital signal. Alternatively, each constant current circuit may also perform pulse width modulation (PWM) control on the back converter in accordance with a light quantity target value and a light color target value provided by the control unit 3.

[0029] The first driving unit 2A is electrically connected to the first light source 1A via four electric cables, for example. The four electric cables electrically connect the respective output terminals of the four constant current circuits of the first driving unit 2A to the respective input terminals of the four LED modules of the first light source 1A.

[0030] (2.4) Second driving unit

The second driving unit 2B, as well as the first driving unit 2A, includes, for example, a power converter circuit for converting AC power supplied from a commercial power grid into DC power and four constant current circuits. The power converter circuit and four constant current circuits included in the second driving unit 2B each have the same circuit configuration as its counterpart of the power converter circuit and four constant current circuits included in the first driving unit 2A, and description thereof will be omitted herein.

[0031] The second driving unit 2B is electrically connected to the second light source 1B via four electric cables, for example. The four electric cables electrically connect the respective output terminals of the four constant current circuits of the second driving unit 2B to the respective input terminals of the four LED modules of the second light source 1B.

[0032] (2.5) Control unit

The control unit 3 includes, as a major constituent element, a computer system including one or more processors and one or more memories. In this lighting system 10, the functions of the control unit 3 are performed by making the one or more processors execute a program stored in the memory. The program may be stored in advance in the memory. The program may also be downloaded via a telecommunications line such as the Internet or distributed after having been stored in a non-transitory storage medium such as a memory card.

[0033] The control unit 3 controls the first light source 1A and the second light source 1B. More

specifically, the control unit 3 controls the light quantity and light color of the first lighting light 101 emitted from the first light source 1A and the light quantity and light color of the second lighting light 102 emitted from the second light source 1B. In a specific implementation, the control unit 3 controls the light quantity and light color of the first lighting light 101 by giving first light quantity target values and first light color target values to the first driving unit 2A. In the same way, the control unit 3 controls the light quantity and light color of the second lighting light 102 by giving second light quantity target values and second light color target values to the second driving unit 2B.

[0034] In this case, in accordance with the first light quantity target values and the first light color target values, the first lighting light 101 is transformed into respective light intensity control values of the four LED modules, which are then transformed into the respective target current values of the four constant current circuits. Thus, the control unit 3 gives, as the first light quantity target values and the first light color target values, the target current values of the respective constant current circuits to the first driving unit 2A.

[0035] In the same way, in accordance with the second light quantity target values and the second light color target values, the second lighting light 102 is transformed into respective light intensity control values of the four LED modules, which are then transformed into the respective target current values of the four constant current circuits. Thus, the control unit 3 gives, as the second light quantity target values and the second light color target values, the target current values of the respective constant current circuits to the second driving unit 2B.

[0036] Note that if the constant current circuits are subjected to PWM control, then the control unit 3 may convert the average value per unit time of the output current of each of the constant current circuits into a duty cycle of the PWM control that needs to be performed to make the average value agree with each target current value and provide the duty cycle for the first driving unit 2A and the second driving unit 2B.

[0037] (2.6) Input acceptance unit

The input acceptance unit 4 accepts input information specifying the first light quantity target values and the first light color target values. In addition, the input acceptance unit 4 also accepts input information specifying the second light quantity target values and the second light color target values.

[0038] The input acceptance unit 4 may be implemented as, for example, a computer system. The computer system may be, for example, a desktop or laptop personal computer or a tablet computer in which an input device such as a touchscreen panel is installed in a thin plate housing, whichever is appropriate.

[0039] The input acceptance unit 4 may have a chromaticity diagram (such as an xy chromaticity diagram of an XYZ color system) displayed on a monitor screen and accept an arbitrary chromaticity point, which is selected with a mouse pointer, a stylus pen, or a fingertip on the chromaticity diagram displayed on the monitor screen, as input information specifying the light color target value. In addition, the input acceptance unit 4 may also have a graphical user interface (GUI) such as a fader or a slider displayed on the monitor screen and accept an arbitrary numerical value, which is selected by operating the GUI with a mouse pointer, a stylus pen, or a fingertip, as input information specifying the light quantity target value.

[0040] The input acceptance unit 4 is compliant with a communications protocol such as DMX 512 and is connected to the control unit 3 to be ready to communicate with the control unit 3 bidirectionally through a communications line. The input acceptance unit 4 transmits the input information thus accepted (such as the xy coordinates of the chromaticity point selected and the numerical value of the fader) to the control unit 3 through the communications line.

[0041] (2.7) Information detection unit

The information detection unit 5 detects the biometric information of the user (worker 300) of the electrical device 6 (refer to FIG. 3). The information detection unit 5 may include, for example, a camera provided separately from the electrical device 6. The information detection unit 5 may make the camera capture an image of a predetermined area, including the face, for example, of the worker 300 and output the image thus captured to the control unit 3.

[0042] The control unit 3 extracts a feature quantity of the worker 300 from the captured image acquired from the information detection unit 5. The feature quantity of the worker 300 may be, for example, the size of the worker's 300 eyes. As used herein, the size of the worker's 300 eyes refers to, for example, the area or the number of pixels of a part, representing the worker's 300 eyes, of the captured image. When finding the size of the worker's 300 eyes extracted from the captured image equal to or less than a reference value, the control unit 3 decides that the worker 300 be sleepy. On the other hand, when finding the size of his or her eyes greater than the reference value, the control unit 3 decides that the worker 300 be awake (i.e., aroused). When deciding that the worker 300 be sleepy, the control unit 3 performs a fluctuation operation (to be described later). Specifically, the control unit 3 changes, in accordance with the user's biometric information detected by the information detection unit 5, the light quantity of the first lighting light 101 in a light quantity variation period (i.e., the first period T1 to be described later) in a predetermined cycle. In the first embodiment, the information detection unit 5 detects the worker's 300 face as the biometric information of the worker 300.

[0043] (3) Installation environment for lighting system

Next, an exemplary installation environment for the lighting system 10 according to the first embodiment will be described with reference to FIGS. 2 and 3. In the following description, the direction in which the display screen 61 of the electrical device 6 and the irradiation surface S1 are arranged side by side will be defined to be the forward/backward direction D1, the horizontal direction (corresponding to the longitudinal axis of the display screen 61 in the example illustrated in FIG. 3) will be defined to be the rightward/leftward direction D2, and the direction (corresponding to the latitudinal axis of the display screen 61 in the example illustrated in FIG. 3) perpendicular to both the forward/backward direction D1 and the rightward/leftward direction D2 will be defined as the upward/downward direction D3. However, these directions should not be construed as limiting the directions in which the lighting system 10 should be used. Also, the arrows indicating these directions D1, D2, and D3 are shown on the drawings just for the sake of description and are insubstantial ones. Furthermore, in FIG. 3, to make the display screen 61 of the electrical device 6, the first irradiation region R1, and the second irradiation region R2 easily recognizable, the rest of the drawing, other than the display screen 61, the first irradiation region R1, and the second irradiation region R2, is shaded in dark grey. That is to say, it is appreciated that the rest of the environment other than the display screen 61, the first irradiation region R1, and the second irradiation region R2 does not actually have the dark grey color shown in FIG. 3. Also, in FIG. 3, the second irradiation region R2 is shaded by dot hatching to make the first irradiation region R1 and the second irradiation region R2 easily distinguishable from each other. That is to say, the dot hatching shown in FIG. 3 does not indicate a cross section.

[0044] As shown in FIG. 2, the lighting system 10 is installed in an installation stand 7 provided under the irradiation surface S1. The irradiation surface S1 may be, for example, the surface (front surface) of the partition 200 provided to form the workspace WS1. On the ceiling surface of the workspace WS1, mounted is a lighting fixture 8 to illuminate the workspace WS1. The lighting fixture 8 may be, for example, a ceiling-mounted light but may also be a ceiling-embedded light. The lighting fixture 8 casts third lighting light 103, having a different light color from the first lighting light 101 and the second lighting light 102, toward the workspace WS1.

[0045] The installation stand 7 includes a bottom panel 70, a front panel 71, a rear panel 72, and a pair of side panels 73. The bottom panel 70 has the shape of a flat plate and arranged to be perpendicular to the irradiation surface S1. The front panel 71, as well as the bottom panel 70, has the shape of a flat plate and protrudes upward from one end (front end) of the bottom panel 70 in the forward/backward direction. The rear panel 72, as well as the bottom panel 70, has the shape of a flat plate and protrudes upward from the other end (rear end) of the bottom panel 70 in the forward/backward direction. The pair of side panels 73 protrude upward from both ends of

the bottom panel 70 in the rightward/leftward direction D2 (i.e., the direction perpendicular to the paper sheet on which FIG. 2 is drawn). That is to say, the installation stand 7 is formed in the shape of an elongate box in which the space over the bottom panel 70 is open. Note that in FIG. 2, one side panel 73 (located closer to the reader who is looking at FIG. 2) out of the pair of side panels 73 is not illustrated. Each of the bottom panel 70, the front panel 71, the rear panel 72, and the pair of side panels 73 is preferably made of a metal, wood, or a synthetic resin.

[0046] The first light source 1A is installed in the internal space (i.e., the space surrounded with the bottom panel 70, the front panel 71, the rear panel 72, and the pair of side panels 73) of the installation stand 7. More specifically, the first light source 1A is fixed to the pair of side panels 73 such that the aperture of the housing 11A (i.e., the aperture through which the first lighting light 101 emerges) faces upward in the internal space of the installation stand 7. In addition, the first optical member 112 is displaced (i.e., rotated) with respect to the housing 11A to have its optical axis oriented toward the irradiation surface S1 such that the first lighting light 101 emitted from the first light source 1A is directed toward the irradiation surface S1. That is to say, in the forward/backward direction D1 in which the display screen 61 of the electrical device 6 and the irradiation surface S1 are arranged side by side, the first light source 1A is located between an installation surface S2 on which the electrical device 6 is installed and the irradiation surface S1 (refer to FIG. 2).

[0047] The second light source 1B is fixed to the pair of side panels 73 such that the aperture of the housing 11B (i.e., the aperture through which the second lighting light 102 emerges) faces upward. In addition, the second light source 1B is installed more distant from the irradiation surface S1 than the first light source 1A is in the internal space of the installation stand 7. That is to say, in the example illustrated in FIG. 2, the first light source 1A and the second light source 1B are arranged in this order in the forward/backward direction D1 such that the first light source 1A is located backward of the second light source 1B.

[0048] In the first light source 1A, the aperture (through which the first lighting light 101 emerges) of the housing 11A thereof is located, in the upward/downward direction D3, under the upper end of the front panel 71 as shown in FIG. 2. Likewise, in the second light source 1B, the aperture (through which the second lighting light 102 emerges) of the housing 11B thereof is located, in the upward/downward direction D3, under the upper end of the front panel 71 as shown in FIG. 2. Thus, respective light components, traveling forward, of the first lighting light 101 emerging from the first light source 1A and the second lighting light 102 emerging from the second light source 1B are cut off by the front panel 71 of the installation stand 7 and are invisible directly for the worker 300 who is performing work using the electrical device 6 put on the installation

surface S2. This enables reducing the glare that would be caused by the first lighting light 101 emerging from the first light source 1A and the second lighting light 102 emerging from the second light source 1B. Furthermore, to reduce the glare and allow the incoming light to be incident on the irradiation surface S1 more efficiently, an emergent surface of the light sources 1A, 1B is preferably tilted with respect to the irradiation surface S1.

[0049] (4) Irradiation regions of irradiation surface

Next, the first irradiation region R1 and the second irradiation region R2 defined on the irradiation surface S1 will be described with reference to FIGS. 3 and 4.

[0050] The lighting system 10 according to the first embodiment irradiates the irradiation surface S1 with the first lighting light 101 emitted from the first light source 1A, thereby defining the first irradiation region R1 on the irradiation surface S1. In addition, the lighting system 10 according to the first embodiment irradiates the irradiation surface S1 with the second lighting light 102 emitted from the second light source 1B, thereby defining the second irradiation region R2 on the irradiation surface S1. As used herein, the “first irradiation region R1” refers to a region of the irradiation surface S1 that comes to have luminance equal to or greater than 30% of the maximum luminance when irradiated with the first lighting light 101 in a situation where only the first light source 1A is turned ON out of the first light source 1A and the second light source 1B. Also, as used herein, the “second irradiation region R2” refers to a region of the irradiation surface S1 that comes to have luminance equal to or greater than 30% of the maximum luminance when irradiated with the second lighting light 102 in a situation where only the second light source 1B is turned ON out of the first light source 1A and the second light source 1B. For example, in the left one of the two graphs shown in FIG. 4, the range on the left of a first threshold value Th1 is a range where the luminance becomes equal to or greater than 30% of the maximum luminance. The upper and lower limit positions of the first irradiation region R1 in the upward/downward direction D3 are determined based on this graph. Also, in the right one of the two graphs shown in FIG. 4, the range on the left of a second threshold value Th2 is a range where the luminance becomes equal to or greater than 30% of the maximum luminance. The upper and lower limit positions of the second irradiation region R2 in the upward/downward direction D3 are determined based on this graph. Furthermore, in a state where the electrical device 6 is put on the installation surface S2, when the display screen 61 of the electrical device 6 and the irradiation surface S1 are viewed from in front of the display screen 61 and the irradiation surface S1, a part (lower part) of the display screen 61 of the electrical device 6 overlaps with the first irradiation region R1 (refer to FIG. 4). In this case, to give stimulus that increases the degree of arousal adequately to the worker 300 to the extent that his or her work using the eyes is not disturbed, it is preferable that

30% or more of the display screen 61 fall within the first irradiation region R1.

[0051] In the example illustrated in FIG. 4, the first irradiation region R1 is narrower than the second irradiation region R2. More specifically, the dimension of the first irradiation region R1 as measured in the rightward/leftward direction D2 is equal to the dimension of the second irradiation region R2 as measured in the rightward/leftward direction D2. However, the dimension of the first irradiation region R1 as measured in the upward/downward direction D3 is smaller than the dimension of the second irradiation region R2 as measured in the upward/downward direction D3.

[0052] In addition, at least a part of the first irradiation region R1 overlaps with the second irradiation region R2. In the example shown in FIG. 4, the first irradiation region R1 overlaps in its entirety with the second irradiation region R2. More specifically, the first irradiation region R1 overlaps with a lower part of the second irradiation region R2. Thus, the lighting system 10 according to the first embodiment provides the first lighting light 101 as point lighting such that the first lighting light 101 is superposed on the second lighting light 102 as base lighting. This enables raising a luminance difference threshold (i.e., the minimum value of the luminance difference between the first lighting light 101 and the second lighting light 102) compared to a situation where the second irradiation region R2 of the irradiation surface S1 is not irradiated with the second lighting light 102. This may reduce the intervening stimulus caused by the fluctuation operation (to be described later). That is to say, the lighting system 10 according to this embodiment may alleviate the worker's 300 sense of discomfort to be caused by the fluctuation operation (as an intervening stimulus) to be described later. In this case, to further raise the luminance difference threshold, it is preferable that the luminance in the lower part of the second irradiation region R2 (i.e., the part overlapping with the first irradiation region R1) be higher than the luminance in any other part of the second irradiation region R2. Furthermore, to allow the fluctuation operation (to be described later) to increase the degree of arousal more effectively, the first lighting light 101 preferably has a higher saturation than the second lighting light 102. In addition, the area of the first irradiation region R1 is preferably one-third or less of the area of the second irradiation region R2.

[0053] In this embodiment, when the display screen 61 of the electrical device 6 and the irradiation surface S1 are viewed from in front of the display screen 61 and the irradiation surface S1, the dimension L1 of the first irradiation region R1 defined on the irradiation surface S1 by the first lighting light 101 emitted from the first light source 1A as measured in the rightward/leftward direction D2 is preferably twice or more as large as the dimension L2 of the display screen 61 of the electrical device 6 as measured in the rightward/leftward direction D2. For example, if the

dimension L2 of the display screen 61 of the electrical device 6 as measured in the rightward/leftward direction D2 is 265 mm, then the dimension L1 of the first irradiation region R1 as measured in the rightward/leftward direction D2 is preferably equal to or greater than 693 mm. This allows the first irradiation region R1 to be defined to cover the stable field of fixation of the worker 300 who is performing work using the electrical device 6. As used herein, the “stable field of fixation” refers to a range in which information may be received effortlessly and includes not only an effective visual field in which information may be received by shifting the gaze but also a range in which information may be received effortlessly by moving the head (hereinafter referred to as an “information receivable range”). The information receivable range may be defined by an angle equal to or less than 45 degrees with respect to the front in the horizontal direction, an angle equal to or less than 30 degrees upward with respect to the front, and an angle equal to or less than 40 degrees downward with respect to the front. For example, if the information receivable range is defined by 30 degrees to the right with respect to the front and 30 degrees to the left with respect to the front, then the stable field of fixation of the worker 300 falls within the first irradiation region R1 having the dimension L1 as measured in the rightward/leftward direction D2.

[0054] Also, in general, the average luminance on the display screen 61 of the electrical device 6 is set at a value equal to or greater than 100 cd/m^2 and equal to or less than 350 cd/m^2 , irrespective of the size of the display screen 61. Thus, it is preferable that the average luminance in the first irradiation region R1 be controlled at a value equal to or greater than 100 cd/m^2 and equal to or less than 350 cd/m^2 to make the average luminance in the first irradiation region R1 of the irradiation surface S1 closer to the average luminance on the display screen 61 of the electrical device 6.

[0055] (5) Light color ranges of first lighting light and second lighting light

Next, the light color ranges of the first lighting light 101 and the second lighting light 102 will be described with reference to FIG. 5. FIG. 5 is an xy chromaticity diagram in the CIE 1931 color space.

[0056] In the above-described workspace WS1 (refer to FIG. 2), light having a relatively high saturation is not preferred but light having a relatively low saturation is preferred. Thus, it is preferable that the respective light color ranges of the first lighting light 101 and the second lighting light 102 fall within a region R3 inside an ellipse E1 as shown in FIG. 5. The ellipse E1 is defined by an elliptic equation, of which the center coordinates are $(x, y) = (0.3333, 0.3333)$, the major radius is 0.1796, the minor radius is 0.1227, and the tilt of the major axis A1 with respect to the x-axis (i.e., the angle θ_1 formed between the x-axis and the major axis A1) is 40.984 degrees.

That is to say, the control unit 3 preferably controls the first light source 1A and the second light source 1B such that in the xy chromaticity diagram in the CIE 1931 color space, the respective chromaticity values of the first lighting light 101 and the second lighting light 102 fall within the region R3 inside the ellipse E1 defined by the elliptic equation described above.

[0057] More preferably, the light color ranges of the first lighting light 101 and the second lighting light 102 fall within a region R4 inside an ellipse E2 as shown in FIG. 5. The ellipse E2 is defined by an elliptic equation, of which the center coordinates are $(x, y) = (0.3333, 0.3333)$, the major radius is 0.1409, the minor radius is 0.0722, and the tilt of the major axis A1 with respect to the x-axis (i.e., the angle θ_1 formed between the x-axis and the major axis A1) is 40.984 degrees.

[0058] In FIG. 5, P0 denotes the center point of the ellipses E1, E2 and P11 and P12 denote chromaticity points corresponding to the chromaticity of the first lighting light 101 in the fluctuation operation to be described later. More specifically, P11 shown in FIG. 5 denotes a chromaticity point having a first chromaticity (hereinafter referred to as a “first chromaticity point”) and corresponding to the maximum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 (refer to FIG. 7). Meanwhile, P12 shown in FIG. 5 denotes a chromaticity point having a second chromaticity (hereinafter referred to as a “second chromaticity point”) and corresponding to the minimum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1. The first period T1 is a period in which the fluctuation operation to be described later is performed and corresponds to a light quantity variation period. In the example shown in FIG. 5, the first chromaticity point P11 and the second chromaticity point P12 fall within the region R4 inside the ellipse E2. Note that the second chromaticity at the second chromaticity point P12 is also the chromaticity of the first irradiation region R1 irradiated with the first lighting light 101 in a second period T2 (refer to FIG. 7) in which the fluctuation operation to be described later is not performed.

[0059] Also, in the example shown in FIG. 5, the shorter the distance to the center point P0 of the ellipses E1, E2 is, the lower the saturation is. That is why the saturation at the first chromaticity point P11 located more distant from the center point P0 of the ellipses E1, E2 is higher than the saturation at the second chromaticity point P12 located closer to the center point P0. Thus, irradiating the irradiation surface S1 with the first lighting light 101 having the higher saturation through the fluctuation operation to be described later enables heightening the consciousness of the worker 300 who is looking at the first lighting light 101 that irradiates the irradiation surface S1. In addition, in the lighting system 10 according to the first embodiment, the first irradiation region R1 overlaps in its entirety with the second irradiation region R2 as shown in FIG. 4, and therefore, the first lighting light 101 and the second lighting light 102 are

combined with each other in the first irradiation region R1. This enables lowering the excitation purity of the first lighting light 101 compared to a situation where the first irradiation region R1 is irradiated with only the first lighting light 101. Consequently, this allows the light color to vary more gently under the first lighting light 101, thus alleviating the sense of discomfort to be caused by intense excitation.

[0060] (6) Fluctuation operation

Next, the fluctuation operation to be performed when the control unit 3 decides that the worker 300 feel sleepy will be described with reference to FIGS. 6–9. As used herein, the “fluctuation operation” refers to the operation of changing, in a predetermined cycle, the light quantity of the first lighting light 101 emitted from the first light source 1A toward the irradiation surface S1 (refer to FIG. 3) in the light quantity variation period (e.g., the first period T1).

[0061] In FIG. 6, the abscissa indicates the time frequency of the first lighting light 101 in the first period T1 and the ordinate indicates the amplitude gain of the first lighting light 101. Also, in FIG. 6, the solid line a1 indicates a polygon graph representing the upper limit values of the amplitude gains at the respective time frequencies, and the dotted line a2 indicates a polygon graph representing the lower limit values of the amplitude gains at the respective time frequencies. In this case, the amplitude gain is defined to be the ratio of a luminance, of which the magnitude is a half as large as the magnitude of variation to be caused when the light quantity of the first lighting light 101 is changed, to the average luminance on the irradiation surface S1 irradiated with the first lighting light 101 through the fluctuation operation. Also, the first period T1 is a period in which the light quantity of the first lighting light 101 is changed in a predetermined cycle and corresponds to the light quantity variation period.

[0062] If the amplitude gain were too small (i.e., if the magnitude of variation in the light quantity of the first lighting light 101 were too small), then the variation in the luminance in the first irradiation region R1 on the irradiation surface S1 would also be too insignificant to be sensed by the worker 300. On the other hand, if the amplitude gain were too large (i.e., if the magnitude of variation in the light quantity of the first lighting light 101 were too large), then the variation in the luminance in the first irradiation region R1 on the irradiation surface S1 would be so significant as to possibly make the worker 300 feel uncomfortable. In general, a human being will breathe a deep breath four to six times per minute. Thus, the time frequency is preferably equal to or higher than 0.06 Hz and equal to or lower than 1.0 Hz to give a certain amplitude tolerance as can be seen from FIG. 6. A human being will normally breathe ten to twenty-four times per minute. Thus, it is preferable that the time frequency be equal to or higher than 0.16 Hz and equal to or lower than 0.4 Hz.

[0063] FIG. 7 is a graph showing how the luminance changes in the first irradiation region R1 in a situation where the time frequency is 0.1 Hz. In FIG. 7, the abscissa indicates the time, and the ordinate indicates the luminance in the first irradiation region R1. Also, in FIG. 7, T1 denotes the first period and T2 denotes the second period. In this case, the second period T2 is a period in which the first lighting light 101 has a constant light quantity. That is to say, in the second period T2, the light quantity of the first lighting light 101 is constant as shown in FIG. 7 and may be, for example, 93 cd/m². Also, in the example shown in FIG. 7, the first period T1 has a duration of 30 seconds. That is to say, in the example shown in FIG. 7, the light quantity of the first lighting light 101 is changed for 30 seconds at a time frequency of 0.1 Hz. Thus, in the example shown in FIG. 7, a fluctuation corresponding to three cycles is given to the worker 300 in the first period T1.

[0064] In the example shown in FIG. 7, in the second period T2 in which the fluctuation operation is not performed, the average luminance in the first irradiation region R1 is 93 cd/m². On the other hand, in the example shown in FIG. 7, in the first period T1 in which the fluctuation operation is performed, the maximum luminance in the first irradiation region R1 is 207 cd/m² and the minimum luminance is 93 cd/m². Thus, in the first period T1, the average luminance in the first irradiation region R1 is 150 cd/m². That is to say, the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 is higher than the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the second period T2 in which the light quantity of the first lighting light 101 is constant.

[0065] Also, the luminance variation in the first period T1 is defined to be the percentage of the luminance that is one half of the difference between a maximum luminance and a minimum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 to an average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1. In the example shown in FIG. 7, the luminance variation in the first period T1 is $\{(207 - 93)/2\} / 150 \times 100 = 38\%$.

[0066] FIG. 8 is a graph showing how the luminance changes in the first irradiation region R1 in a situation where the time frequency is 0.5 Hz. In FIG. 8, the abscissa indicates the time, and the ordinate indicates the luminance in the first irradiation region R1. Also, in FIG. 8, T1 denotes the first period and T2 denotes the second period. In this case, the second period T2 is a period in which the first lighting light 101 has a constant light quantity. That is to say, in the second period T2, the light quantity of the first lighting light 101 is constant as shown in FIG. 8 and may be, for example, 131 cd/m². Also, in the example shown in FIG. 8, the first period T1 has a duration of 6 seconds. That is to say, in the example shown in FIG. 8, the light quantity of the

first lighting light 101 is changed for 6 seconds at a time frequency of 0.5 Hz. Thus, in the example shown in FIG. 8, a fluctuation corresponding to three cycles is given to the worker 300 in the first period T1.

[0067] In the example shown in FIG. 8, in the second period T2 in which the fluctuation operation is not performed, the average luminance in the first irradiation region R1 is 131 cd/m^2 . On the other hand, in the example shown in FIG. 8, in the first period T1 in which the fluctuation operation is performed, the maximum luminance in the first irradiation region R1 is 168 cd/m^2 and the minimum luminance is 132 cd/m^2 . Thus, in the first period T1, the average luminance in the first irradiation region R1 is 150 cd/m^2 . That is to say, the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 is higher than the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the second period T2 in which the light quantity of the first lighting light 101 is constant.

[0068] Also, the luminance variation in the first period T1 is defined to be the percentage of the luminance that is one half of the difference between a maximum luminance and a minimum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 to an average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1. In the example shown in FIG. 8, the luminance variation in the first period T1 is $\{(168 - 132)/2\} / 150 \times 100 = 12\%$.

[0069] FIG. 9 is a graph showing how the luminance changes in the first irradiation region R1 in a situation where the time frequency is 1.0 Hz. In FIG. 9, the abscissa indicates the time, and the ordinate indicates the luminance in the first irradiation region R1. Also, in FIG. 9, T1 denotes the first period and T2 denotes the second period. In this case, the second period T2 is a period in which the first lighting light 101 has a constant light quantity. That is to say, in the second period T2, the light quantity of the first lighting light 101 is constant as shown in FIG. 9 and may be, for example, 142 cd/m^2 . Also, in the example shown in FIG. 9, the first period T1 has a duration of 3 seconds. That is to say, in the example shown in FIG. 9, the light quantity of the first lighting light 101 is changed for 3 seconds at a time frequency of 1.0 Hz. Thus, in the example shown in FIG. 9, a fluctuation corresponding to three cycles is given to the worker 300 in the first period T1.

[0070] In the example shown in FIG. 9, in the second period T2 in which the fluctuation operation is not performed, the average luminance in the first irradiation region R1 is 142 cd/m^2 . On the other hand, in the example shown in FIG. 9, in the first period T1 in which the fluctuation operation is performed, the maximum luminance in the first irradiation region R1 is 158 cd/m^2 and the minimum luminance is 142 cd/m^2 . Thus, in the first period T1, the average luminance in the first

irradiation region R1 is 150 cd/m^2 . That is to say, the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 is higher than the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the second period T2 in which the light quantity of the first lighting light 101 is constant.

[0071] Also, the luminance variation in the first period T1 is defined to be the percentage of the luminance that is one half of the difference between a maximum luminance and a minimum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 to an average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1. In the example shown in FIG. 9, the luminance variation in the first period T1 is $\{(158 - 142)/2\} / 150 \times 100 = 5\%$.

[0072] As can be seen, in the lighting system 10 according to the first embodiment, the control unit 3 changes, in accordance with the user's (i.e., worker's 300) biometric information detected by the information detection unit 5, the light quantity of the first lighting light 101 in the first period (i.e., the light quantity variation period) T1 in a predetermined cycle. The percentage of the luminance that is one half of the difference between a maximum luminance and a minimum luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 to the average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 is equal to or higher than 5% and equal to or lower than 38%. In the first embodiment described above, a fluctuation (light quantity variation) corresponding to three cycles is given to the worker 300 in the first period T1. However, this is only an example and should not be construed as limiting. The fluctuation to be given to the worker 300 in the first period T1 does not have to correspond to three cycles but may also correspond to one or two cycles, or even four or five cycles. That is to say, the lighting system 10 may be configured to give a fluctuation corresponding to one to five cycles to the worker 300 in the first period T1.

[0073] (7) Comparison with comparative example

Next, a system for controlling lighting in a viewing space, where a viewer who is viewing an image displayed on a display screen of an electrical device is present, in synchronization with the image will be described as a comparative example. The system according to such a comparative example controls one or more light sources provided in the viewing space such that at least one parameter selected from the group consisting of the light quantity, light color, orientation, and direction of the lighting in the viewing space agrees with a corresponding parameter in a virtual image space imagined from the image displayed on the display screen. This enables increasing the presence of the image displayed on the display screen.

[0074] In contrast, the lighting system 10 according to the first embodiment is designed to provide a working environment (lighting environment) that makes it easier for the worker 300 to concentrate on the display screen 61 of the electrical device 6 to allow him or her to work more efficiently while watching the display screen 61 of the electrical device 6, as described above. Thus, the lighting system 10 according to the first embodiment has a different purpose from the system according to the comparative example described above.

[0075] (8) Advantages

The lighting system 10 according to the first embodiment irradiates, with the first lighting light 101 and the second lighting light 102, the irradiation surface S1 that is located behind the electrical device 6. The first irradiation region R1 irradiated with the first lighting light 101 is narrower than the second irradiation region R2 irradiated with the second lighting light 102 and at least partially overlaps with the second irradiation region R2. In addition, the control unit 3 changes, in accordance with the result of detection by the information detection unit 5, the light quantity of the first lighting light 101 in the light quantity variation period in a predetermined cycle. This enables heightening the worker's 300 consciousness compared to a situation where the light quantity of the first lighting light 101 is not changed in a predetermined cycle. Consequently, this makes it easier for the worker 300 to concentrate on the display screen 61 of the electrical device 6, thus allowing the worker 300 to perform his or her work more efficiently using the electrical device 6.

[0076] In addition, in the lighting system 10 according to the first embodiment, at least a part of the first irradiation region R1 overlaps with the second irradiation region R2. This alleviates the worker's 300 sense of discomfort, compared to a situation where the first irradiation region R1 does not overlap with the second irradiation region R2.

[0077] Furthermore, in the lighting system 10 according to the first embodiment, the first lighting light 101 has a higher saturation than the second lighting light 102. This enables further heightening the worker's 300 consciousness compared to a situation where the first lighting light 101 and the second lighting light 102 have an equal saturation.

[0078] Furthermore, in the lighting system 10 according to the first embodiment, the predetermined cycle corresponds to a frequency equal to or higher than 0.06 Hz and equal to or lower than 1.0 Hz. This reduces the chances of making the worker 300 feel uncomfortable, compared to a situation where the frequency corresponding to the predetermined cycle is higher than 1.0 Hz.

[0079] Furthermore, in the lighting system 10 according to the first embodiment, the percentage of the luminance that is one half of the difference between a maximum luminance and a minimum

luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 to an average luminance in the first irradiation region R1 irradiated with the first lighting light 101 in the first period T1 is equal to or higher than 5% and equal to or lower than 38%. This enables heightening the worker's 300 consciousness without making him or her feel uncomfortable.

[0080] (9) Variations

Note that the first embodiment is only an exemplary one of various embodiments of the present disclosure and should not be construed as limiting. Rather, the first embodiment may be readily modified in various manners depending on a design choice or any other factor without departing from the scope of the present disclosure. Next, variations of the first embodiment will be enumerated one after another. Note that the variations to be described below may be adopted in combination as appropriate.

[0081] The lighting system 10 according to the present disclosure includes a computer system. The computer system may include a processor and a memory as principal hardware components. The functions of the lighting system 10 according to the present disclosure may be performed by making the processor execute a program stored in the memory of the computer system. The program may be stored in advance in the memory of the computer system. Alternatively, the program may also be downloaded through a telecommunications line 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 made up of 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 aggregated 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.

[0082] Also, in the embodiment described above, the plurality of functions of the lighting system

10 are integrated together in a single housing. However, this is not an essential configuration for the lighting system 10. Alternatively, those constituent elements of the lighting system 10 may be distributed in multiple different housings. Still alternatively, at least some functions of the lighting system 10 (e.g., some functions of the control unit 3) may be implemented as, for example, a cloud computing system as well.

[0083] Conversely, at least some functions of the lighting system 10 that are distributed in multiple devices in the first embodiment may be aggregated together in a single housing. For example, some functions of the lighting system 10 that are distributed in the first driving unit 2A and the control unit 3 may be aggregated together in a single housing.

[0084] In the first embodiment described above, the electrical device 6 is a laptop personal computer. However, this is only an example and should not be construed as limiting. The electrical device 6 does not have to be a laptop personal computer but may also be a desktop personal computer, a tablet computer, or a smartphone. Alternatively, the electrical device 6 may also be a TV set.

[0085] In the first embodiment described above, the first light source 1A and the second light source 1B are partition lights arranged between the electrical device 6 and the irradiation surface S1 in the forward/backward direction D1. However, at least one of the first light source 1A or the second light source 1B does not have to be a partitioned light. Alternatively, at least one of the first light source 1A or the second light source 1B may be a light provided for the rear surface (i.e., the surface opposite from the surface provided with the display screen 61) of the electrical device 6, a desktop light, or a base light mounted on the ceiling surface.

[0086] In the first embodiment described above, each of the first light source 1A and the second light source 1B includes four types of LEDs. Optionally, at least one of the first light source 1A or the second light source 1B may include not only the four types of LEDs but also a different type of LEDs (such as blue LEDs with a higher saturation).

[0087] In the first embodiment described above, the first optical member 112 of the first light source 1A includes the linear Fresnel lens. Alternatively, the first optical member 112 may include a plurality of lenses, corresponding one to one to plurality of LEDs of the respective types, instead of the linear Fresnel lens. In addition, the first optical member 112 may further include a diffusion sheet.

[0088] In the first embodiment described above, the input acceptance unit 4 accepts input information specifying the light quantity target value and the light color target value and entered through the chromaticity diagram and the GUI that are displayed on the monitor screen. Alternatively, the input acceptance unit 4 may accept input information specifying the light

quantity target value and the light color target value and entered through a character-based user interface (CUI) such as a physical keyboard or a virtual keyboard displayed on the monitor screen.

[0089] In the first embodiment described above, the camera included in the information detection unit 5 is provided separately from the electrical device 6. Alternatively, the camera included in the information detection unit 5 may be built in the electrical device 6.

[0090] In the first embodiment described above, the information detection unit 5 includes a camera. Alternatively, the information detection unit 5 may include an electroencephalograph for detecting the electroencephalogram (as a type of biometric information) of the worker 300. In that case, when finding that the worker's 300 electroencephalogram detected by the electroencephalograph includes an α wave, the control unit 3 decides that the worker 300 be relaxed. On the other hand, when finding that the electroencephalogram includes no α waves, the control unit 3 decides that the worker 300 be tense. When finding the worker 300 tense, the control unit 3 performs the fluctuation operation described above.

[0091] Still alternatively, the information detection unit 5 may include a pulse wave sensor for detecting the pulse wave (as a type of biometric information) of the worker 300. In that case, when finding the worker's 300 pulse wave detected by the pulse wave sensor equal to or less than a threshold value, the control unit 3 decides that the worker 300 be relaxed. On the other hand, when finding the pulse wave greater than the threshold value, the control unit 3 decides that the worker 300 be tense. When finding the worker 300 tense, the control unit 3 performs the fluctuation operation described above.

[0092] The worker's 300 feature quantity to be extracted by the information detection unit 5 does not have to be the size of the worker's 300 eyes but may also be, for example, the proportion of the size of his or her eyes to the entire face of the worker 300.

[0093] In the first embodiment described above, there is only one first period T1 as shown in FIGS. 7–9. However, the number of the first period T1 does not have to be one but the predetermined period may include a plurality of first periods T1. That is to say, the fluctuation operation may be performed multiple times during the predetermined period.

[0094] In the first embodiment described above, the irradiation surface S1 is not included in the lighting system 10. Alternatively, the irradiation surface S1 may be included in the lighting system 10. That is to say, the lighting system 10 may further include a member (partition 200) including the irradiation surface S1. This enables providing a lighting system 10 including the irradiation surface S1 as an integral part thereof.

[0095] (Second embodiment)

Next, a lighting system 10 according to a second embodiment will be described with

reference to FIGS. 10–12. In the following description, any constituent element of the lighting system 10 according to the second embodiment, having the same function as a counterpart of the lighting system 10 according to the first embodiment described above, will be designated by the same reference numeral as that counterpart's, and description thereof will be omitted herein.

[0096] The lighting system 10 according to the second embodiment performs not only the fluctuation operation using the first lighting light 101 but also a fluctuation operation using the second lighting light 102 as well, which is a difference from the lighting system 10 according to the first embodiment described above.

[0097] (1) Operation

In the lighting system 10 according to the second embodiment, the control unit 3 changes the light quantity of the first lighting light 101 in the first period T11. In addition, in the lighting system 10 according to the second embodiment, the control unit 3 also changes the light quantity of the second lighting light 102 in the second period T21. That is to say, the lighting system 10 according to the second embodiment performs not only the fluctuation operation using the first lighting light 101 but also the fluctuation operation using the second lighting light 102 as well. The second period T21 is a period different from the first period T11 as the light quantity variation period as shown in FIGS. 10A and 10B.

[0098] In the lighting system 10 according to the second embodiment, the first periods T11 include a period from a time t12 through a time t13, a period from a time t14 through a time t15, and a period from a time t16 through a time t17 as shown in FIG. 10A. Also, in the lighting system 10 according to the second embodiment, the second period T21 is a period from a time t11 through a time t18 as shown in FIG. 10B. That is to say, the lighting system 10 according to the second embodiment performs the fluctuation operation using the first lighting light 101 three times while performing the fluctuation operation using the second lighting light 102 once. In addition, the lighting system 10 according to the second embodiment starts performing the fluctuation operation using the first lighting light 101 at the times t12, t14, and t16 when the second lighting light 102 has mutually different light quantities. Furthermore, in the lighting system 10 according to the second embodiment, the light quantity of the second lighting light 102 decreases with the passage of time as shown in FIG. 10B. As can be seen, in the lighting system 10 according to the second embodiment, the duration of the second period T21 is longer than the duration of the first period T11. The second period T21 may have a duration of 24 hours, for example. The first period T11 may have a duration of 30 seconds, for example. That is to say, the lighting system 10 according to the second embodiment performs the fluctuation operation using the second lighting light 102 in a circadian rhythm with the second period T21 defined to be one cycle.

[0099] (2) Advantages

The lighting system 10 according to the second embodiment also changes, in accordance with the result of detection by the information detection unit 5, the light quantity of the first lighting light 101 in the first period (i.e., the light quantity variation period) T11 in a predetermined cycle. This enables heightening the worker's 300 consciousness compared to a situation where the light quantity of the first lighting light 101 is not changed in a predetermined cycle. Consequently, this makes it easier for the worker 300 to concentrate on the display screen 61 of the electrical device 6, thus allowing the worker 300 to perform his or her work more efficiently using the electrical device 6.

[0100] In addition, in the lighting system 10 according to the second embodiment, at least a part of the first irradiation region R1 overlaps with the second irradiation region R2. This alleviates the worker's 300 sense of discomfort, compared to a situation where the first irradiation region R1 does not overlap with the second irradiation region R2.

[0101] Furthermore, in the lighting system 10 according to the second embodiment, the duration of the second period T21 in which the light quantity of the second lighting light 102 is changed is longer than the duration of the first period T11 in which the light quantity of the first lighting light 101 is changed. This enables adjusting the brightness on the irradiation surface S1 while making the variation in the luminance caused by the second lighting light 102 on the irradiation surface S1 less noticeable.

[0102] (3) Variations

Next, variations of the second embodiment will be enumerated one after another. Note that the variations to be described below may be adopted in combination as appropriate.

[0103] (3.1) First variation

A lighting system 10 according to a first variation changes (e.g., increases) the light quantity of the second lighting light 102 as the sensitivity of the worker's 300 eyes decreases, which is a difference from the lighting system 10 according to the second embodiment described above. The lighting system 10 according to the first variation will be described with reference to FIGS. 11A and 11B.

[0104] In the lighting system 10 according to the first variation, the first periods T12 include a period from a time t22 through a time t23, a period from a time t24 through a time t25, and a period from a time t26 through a time t27 as shown in FIG. 11A. That is to say, the control unit 3 performs the fluctuation operation using the first lighting light 101 in each of these first periods T12. More specifically, the control unit 3 starts performing the fluctuation operation using the first lighting light 101 at the times t22, t24, and t26, at which the second lighting light 102 has

mutually different light quantities.

[0105] In addition, in the lighting system 10 according to the first variation, the control unit 3 performs the fluctuation operation using the second lighting light 102 in the second period T22 from a time t21 through a time t28 as shown in FIG. 11B. More specifically, in the period T22, the control unit 3 increases the light quantity of the second lighting light 102 as the sensitivity of the worker's 300 eyes decreases with the passage of time. That is to say, in the lighting system 10 according to the first variation, the control unit 3 also changes the light quantity of the second lighting light 102 in the second period T22, which is different from the first period T12 as the light quantity variation period. In addition, in the lighting system 10 according to the first variation, the duration of the second period T22 is longer than the duration of the first period T12. The second period T22 may have a duration of 1 hour, for example. The first period T12 may have a duration of 30 seconds, for example.

[0106] In the lighting system 10 according to the first variation, the control unit 3 changes (i.e., increases) the light quantity of the second lighting light 102 as the sensitivity of the worker's 300 eyes decreases with the passage of time, thus enabling increasing the contrast ratio of the second lighting light 102 to the first lighting light 101. Consequently, this makes the display screen 61 of the electrical device 6 more easily visible for the worker 300, thus allowing him or her to work with more efficiency.

[0107] (3.2) Second variation

A lighting system 10 according to a second variation performs a fluctuation operation using the second lighting light 102 in an ultradian rhythm in which the second period T23 is defined to be one cycle, which is a difference from the lighting system 10 according to the second embodiment. The lighting system 10 according to the second variation will now be described with reference to FIGS. 12A and 12B.

[0108] In the lighting system 10 according to the second variation, the first periods T13 include a period from a time t32 through a time t33, a period from a time t34 through a time t35, and a period from a time t36 through a time t37 as shown in FIG. 12A. That is to say, the control unit 3 performs the fluctuation operation using the first lighting light 101 in each of these first periods T13. More specifically, the control unit 3 starts performing the fluctuation operation using the first lighting light 101 at the times t32, t34, and t36, at which the second lighting light 102 has mutually different light quantities.

[0109] In addition, in the lighting system 10 according to the second variation, the control unit 3 also performs the fluctuation operation using the second lighting light 102 in a second period T23 from a time t31 through a time t38 as shown in FIG. 12B. More specifically, in the period T23,

the control unit 3 once increases, decreases for a while, and then increases again, the light quantity of the second lighting light 102. That is to say, in the lighting system 10 according to the second variation, the control unit 3 also changes the light quantity of the second lighting light 102 in the second period T23, which is different from the first period T13 as the light quantity variation period. In addition, in the lighting system 10 according to the second variation, the duration of the second period T23 is longer than the duration of the first period T13. The second period T23 may have a duration of 30 minutes to 4 hours, for example. The first period T12 may have a duration of 30 seconds, for example. That is to say, the lighting system 10 according to the second variation performs the fluctuation operation using the second lighting light 102 in an ultradian rhythm with the second period T23 defined to be one cycle.

[0110] (3.3) Other variations

Next, other variations will be enumerated one after another.

[0111] In the second embodiment and the first and second variations described above, the duration of the second period T21, T21, or T23 is longer than the duration of the first period T11, T12, or T13. However, this is only an example and should not be construed as limiting. Alternatively, the duration of the second period may be as long as the duration of the first period. In that case, depending on the timing when the light quantity of the first lighting light 101 is changed or the timing when the light quantity of the second lighting light 102 is changed, the magnitude of variation in the first lighting light 101 may be increased with respect to the second lighting light 102.

[0112] Optionally, the configuration described for the second embodiment (including its variations) may be adopted as appropriate in combination with the configuration described for the first embodiment (including its variations).

[0113] (Aspects)

The exemplary embodiments and their variations described above are specific implementations of the following aspects of the present disclosure.

[0114] A lighting system (10) according to a first aspect includes a first light source (1A), a second light source (1B), a control unit (3), and an information detection unit (5). The first light source (1A) irradiates a first irradiation region (R1) of an irradiation surface (S1) with first lighting light (101). The second light source (1B) irradiates a second irradiation region (R2) of the irradiation surface (S1) with second lighting light (102). The irradiation surface (S1) is located behind an electrical device (6) having a display screen (61). The control unit (3) controls the first light source (1A) and the second light source (1B). The information detection unit (5) detects biometric information of a user of the electrical device (6). The first irradiation region (R1) is

narrower than the second irradiation region (R2). At least a part of the first irradiation region (R1) overlaps with the second irradiation region (R2). The control unit (3) changes, in accordance with the user's biometric information detected by the information detection unit (5), a light quantity of the first lighting light (101) in a light quantity variation period (T1) in a predetermined cycle.

[0115] This aspect allows the user to perform his or her work more efficiently using the electrical device (6).

[0116] In a lighting system (10) according to a second aspect, which may be implemented in conjunction with the first aspect, the first lighting light (101) has a higher saturation than the second lighting light (102).

[0117] This aspect enables heightening the worker's (300) consciousness compared to a situation where the first lighting light (101) and the second lighting light (102) have an equal saturation.

[0118] In a lighting system (10) according to a third aspect, which may be implemented in conjunction with the first or second aspect, the predetermined cycle corresponds to a frequency equal to or higher than 0.06 Hz and equal to or lower than 1.0 Hz.

[0119] This aspect may reduce the chances of making the worker (300) feel uncomfortable.

[0120] In a lighting system (10) according to a fourth aspect, which may be implemented in conjunction with any one of the first to third aspects, the percentage of a luminance that is one half of a difference between a maximum luminance and a minimum luminance in the first irradiation region (R1) irradiated with the first lighting light (101) in the light quantity variation period (T1) to an average luminance in the first irradiation region (R1) irradiated with the first lighting light (101) in the light quantity variation period (T1) is equal to or higher than 5% and equal to or lower than 38%.

[0121] This aspect enables heightening the worker's (300) consciousness without making him or her feel uncomfortable.

[0122] In a lighting system (10) according to a fifth aspect, which may be implemented in conjunction with any one of the first to fourth aspects, the control unit (3) changes the light quantity of the second lighting light (102) in a second period (T21, T22, T23). The second period (T21, T22, T23) is different from a first period (T11, T12, T13) as the light quantity variation period (T11, T12, T13).

[0123] This aspect enables reducing the magnitude of variation in the first lighting light (101) with respect to the second lighting light (102), thus further alleviating the worker's (300) sense of discomfort.

[0124] In a lighting system (10) according to a sixth aspect, which may be implemented in

conjunction with the fifth aspect, a duration of the second period (T21, T22, T23) is longer than a duration of the first period (T11, T12, T13).

[0125] This aspect enables adjusting the brightness (luminance) on the irradiation surface (S1) while making the variation in the luminance caused by the second lighting light (102) on the irradiation surface (S1) less noticeable.

[0126] In a lighting system (10) according to a seventh aspect, which may be implemented in conjunction with the fifth aspect, a duration of the second period (T21, T22, T23) is as long as a duration of the first period (T11, T12, T13).

[0127] This aspect enables increasing the magnitude of variation in the first lighting light (101) with respect to the second lighting light (102).

[0128] In a lighting system (10) according to an eighth aspect, which may be implemented in conjunction with any one of the first to seventh aspects, a luminance in a lower part of the second irradiation region (R2) is higher than a luminance in any other part of the second irradiation region (R2).

[0129] This aspect enables increasing the luminance in the worker's (300) viewing direction, thus increasing the visibility of the display screen (61) of the electrical device (6).

[0130] A lighting system (10) according to a ninth aspect, which may be implemented in conjunction with any one of the first to eighth aspects, further includes a member (200) having the irradiation surface (S1).

[0131] This aspect enables providing a lighting system (10) including the irradiation surface (S1) as an integral part thereof.

[0132] In a lighting system (10) according to a tenth aspect, which may be implemented in conjunction with any one of the first to ninth aspects, the first light source (1A) includes a first light emitter (111) and a first optical member (112). The first optical member (112) is disposed in front of the first light emitter (111) and diffuses light emitted from the first light emitter (111) and lets diffused light emerge as the first lighting light (101). The second light source (1B) includes a second light emitter (121) and a second optical member (122). The second optical member (122) is disposed in front of the second light emitter (121) and condenses light emitted from the second light emitter (121) and lets condensed light emerge as the second lighting light (102).

[0133] This aspect enables forming the first irradiation region (R1) in a desired range while forming the second irradiation region (R2) in a broad range on the irradiation surface (S1).

[0134] Note that the constituent elements according to the second to tenth aspects are not essential constituent elements for the lighting system (10) but may be omitted as appropriate.

Reference Signs List

[0135]	1A	First Light Source
	1B	Second Light Source
	3	Control Unit
	5	Information Detection Unit
	6	Electrical Device
	61	Display Screen
	10	Lighting System
	101	First Lighting Light
	102	Second Lighting Light
	111	First Light Emitter
	112	First Optical Member
	121	Second Light Emitter
	122	Second Optical Member
	200	Partition (Member)
	300	Worker (User)
	R1	First Irradiation Region
	R2	Second Irradiation Region
	S1	Irradiation Surface
	T1, T11, T12, T13	First Period (Light Quantity Variation Period)
	T21, T22, T23	Second Period

CLAIMS

1. A lighting system comprising:
 - a first light source configured to irradiate a first irradiation region of an irradiation surface with first lighting light, the irradiation surface being located behind an electrical device having a display screen;
 - a second light source configured to irradiate a second irradiation region of the irradiation surface with second lighting light;
 - a control unit configured to control the first light source and the second light source; and
 - an information detection unit configured to detect biometric information of a user of the electrical device,
 - the first irradiation region being narrower than the second irradiation region,
 - at least a part of the first irradiation region overlapping with the second irradiation region,
 - the control unit being configured to change, in accordance with the user's biometric information detected by the information detection unit, a light quantity of the first lighting light in a light quantity variation period in a predetermined cycle.
2. The lighting system of claim 1, wherein
 - the first lighting light has a higher saturation than the second lighting light.
3. The lighting system of claim 1 or 2, wherein
 - the predetermined cycle corresponds to a frequency equal to or higher than 0.06 Hz and equal to or lower than 1.0 Hz.
4. The lighting system of any one of claims 1 to 3, wherein
 - percentage of a luminance that is one half of a difference between a maximum luminance and a minimum luminance in the first irradiation region irradiated with the first lighting light in the light quantity variation period to an average luminance in the first irradiation region irradiated with the first lighting light in the light quantity variation period is equal to or higher than 5% and equal to or lower than 38%.
5. The lighting system of any one of claims 1 to 4, wherein

the control unit is configured to change the light quantity of the second lighting light in a second period, the second period being different from a first period as the light quantity variation period.

6. The lighting system of claim 5, wherein
a duration of the second period is longer than a duration of the first period.
7. The lighting system of claim 5, wherein
a duration of the second period is as long as a duration of the first period.
8. The lighting system of any one of claims 1 to 7, wherein
a luminance in a lower part of the second irradiation region is higher than a luminance in any other part of the second irradiation region.
9. The lighting system of any one of claims 1 to 8, further comprising a member having the irradiation surface.
10. The lighting system of any one of claims 1 to 9, wherein
the first light source includes:
a first light emitter; and
a first optical member disposed in front of the first light emitter and configured to diffuse light emitted from the first light emitter and let diffused light emerge as the first lighting light, and
the second light source includes:
a second light emitter; and
a second optical member disposed in front of the second light emitter and configured to condense light emitted from the second light emitter and let condensed light emerge as the second lighting light.