

[DESCRIPTION]

[Title of Invention] INTELLECTUAL WORK ASSISTANCE SYSTEM AND
INTELLECTUAL WORK ASSISTANCE METHOD

[Technical Field]

5 [0001]

The present invention relates to an intellectual work assistance system and an intellectual work assistance method.

[Background Art]

[0002]

10 It has been known that the work efficiency of users who carry out intellectual work, such as clerical tasks and learning, is affected by degrees of attention (hereinafter called "concentration levels"). Moreover, concentration levels of the users change depending on various environmental factors. For this reason, techniques have
15 been proposed for controlling the environmental factors that affect the concentration levels of users.

[0003]

Patent Literature (PTL) 1 discloses a technique for adding single-wavelength light to a lighting device that emits white light to
20 enhance work efficiency by increasing an arousal level. The technique disclosed by PTL 1 can enhance work efficiency without requiring excessive energy.

[0004]

PTL 2 discloses a technique for setting an illuminance during a
25 time period after lunchtime higher than a normal illuminance and setting an illuminance during the rest of the day lower than the normal illuminance. The technique disclosed by PTL 2 can enhance work efficiency during the time period after lunchtime and can also reduce the total energy consumption.

30 [Citation List]

[Patent Literature]

[0005]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2009-59677

35 [PTL 2] Japanese Unexamined Patent Application Publication No.

2003-245356

[Summary of Invention]

[Technical Problem]

[0006]

5 The present invention provides an intellectual work assistance system, etc., that can assist intellectual work carried out by a user.

[Solution to Problem]

[0007]

10 An intellectual work assistance system according to one aspect of the present invention includes: a first determiner that determines a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work; a second determiner that determines a time length for which the restorative stimulus is given; and a controller that controls an actuator to give
15 the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

[0008]

20 An intellectual work assistance method according to one aspect of the present invention is an intellectual work assistance method to be executed by a computer. The intellectual work assistance method includes: determining a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work; determining a time length for which the restorative stimulus is given; and controlling an actuator to give
25 the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

[0009]

30 A program according to one aspect of the present invention is a program for causing the computer to execute the above-described intellectual work assistance method.

[Advantageous Effects of Invention]

[0010]

35 An intellectual work assistance system, etc., according to the present invention can assist intellectual work carried out by a user.

[Brief Description of Drawings]

[0011]

[FIG. 1]

FIG. 1 is a diagram illustrating functions of an intellectual work assistance system according to an embodiment.

5 [FIG. 2]

FIG. 2 is a block diagram illustrating a functional configuration of an information processing device according to the embodiment.

[FIG. 3]

FIG. 3 is a flowchart illustrating Operation Example 1 of operations performed by the intellectual work assistance system according to the embodiment.

[FIG. 4]

FIG. 4 is a diagram illustrating one example of a restorative stimuli database used in Operation Example 1.

15 [FIG. 5]

FIG. 5 is a diagram illustrating changes in the concentration level of a user over time when restorative stimuli were given to the user.

[FIG. 6]

FIG. 6 is a flowchart illustrating Operation Example 2 of operations performed by the intellectual work assistance system according to the embodiment.

[FIG. 7]

FIG. 7 is a diagram illustrating one example of a restorative stimuli database used in Operation Example 2.

[Description of Embodiments]

[0012]

Hereinafter, embodiments will be described in detail with reference to the drawings. Note that the embodiments below each describe a general or specific example. The numerical values, shapes, materials, elements, the arrangement and connection of the elements, steps, orders of the steps, etc. presented in the embodiments below are mere examples, and are not intended to limit the present invention. Furthermore, among the elements in the

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35

claims will be described as optional elements.

[0013]

Note that the drawings are schematic diagrams, and do not necessarily provide strictly accurate illustration. Throughout the drawings, the same reference sign is given to substantially the same element, and redundant description may be omitted or simplified.

[0014]

[Embodiment]

[Configuration]

First, a configuration of an intellectual work assistance system according to an embodiment will be described. FIG. 1 is a diagram illustrating a configuration of the intellectual work assistance system according to the embodiment. Intellectual work assistance system 10 according to the embodiment is a system that can give, for refreshment, a restorative stimulus to a user who is carrying out intellectual work, such as clerical tasks (office work) and learning, to reduce a cognitive strain felt by the user. This restorative stimulus is sometimes called micro refreshment and the like.

[0015]

Note that locations at which clerical tasks and learning are carried out (spaces in which the restorative stimulus is given to a user) are not particularly limited. The locations at which clerical tasks and learning are carried out are offices, schools, and homes, but may be private booths (closed spaces capable of being used for carrying out clerical tasks or learning) in railway stations, etc.

[0016]

The cognitive strain can be paraphrased as cognitive fatigue. A reduction in the cognitive strain can be paraphrased as overcoming of cognitive fatigue, a change of pace, or the like. A reduction in the cognitive strain maintains and improves the concentration level of a user.

[0017]

Intellectual work assistance system 10 gives a restorative stimulus for a very short period of time to a user who is carrying out intellectual work to reduce a cognitive strain. A time length for

which the restorative stimulus is given ranges from about several seconds to several hundred seconds (between one second and 300 seconds, both inclusive), and typically ranges from one second to 30 seconds. The restorative stimulus is given to a user while the user continues to carry out intellectual work, and is far different from an action such as taking a 20-minute break when the user finishes their intellectual work.

[0018]

Techniques for arousing a user by giving a stimulus have been known, taking a reduction in the concentration level as a reduction in the arousal level. However, intellectual work assistance system 10 is not a system for arousing a user, and the restorative stimulus is not a stimulus for arousing the user.

[0019]

For example, when light emitted by a lighting device is used to give a stimulus to a user and arousal of the user is the purpose of doing so, light having high brightness and a high color temperature has been considered appropriate. In contrast to the above, a restorative stimulus is a stimulus to reduce a cognitive strain by diverting (distracting) a cognitive resource (attention) away from a task that a user is working on for a short period of time, and is implemented by, for example, temporarily changing the brightness and color (color temperature) of light emitted by a lighting device. Specifically, a reduction in a color temperature of light emitted by the lighting device for a short period of time while a user is carrying out intellectual work can reduce a cognitive strain. In addition, as a restorative stimulus, a change in the distribution of light emitted by the lighting device or a change in the position of a light source may be made, to change a light emission pattern in a region in the user's field of view.

[0020]

Moreover, when an airflow generated by an airflow generation device is used to give a stimulus to a user and arousal of the user is the purpose of doing so, a high-velocity airflow is typically directed at the user. In contrast to the above, a restorative stimulus is

implemented by generating a gentle (low-velocity) airflow or a fluctuating airflow over a wide area.

[0021]

When a scent released by a scent generating device is used to
5 give a stimulus to a user and arousal of the user is the purpose of
doing so, a scent having an arousal effect, such as the scent of
lemons and the scent of peppermint, is used. In contrast to the
above, a restorative stimulus is implemented by a scent having a
relatively weak stimulus, such as the scent of Japanese cypress and
10 the scent of lavender.

[0022]

As illustrated in FIG. 1, intellectual work assistance system 10
includes camera 20, information processing device 30, and actuator
40.

15 [0023]

Camera 20 is a camera provided in a space in which a user who
is carrying out intellectual work is located, and captures a dynamic
image of the user who is carrying out the intellectual work. Camera
20 transmits image data on the captured dynamic image to
20 information processing device 30. Note that camera 20 may be a
high-performance camera called an artificial intelligence (AI) camera
or the like, and may perform, on behalf of information processing
device 30, a process of calculating a concentration level which will be
described later in the embodiment. In this case, the process of
25 calculating a concentration level can be omitted from information
processing device 30.

[0024]

Information processing device 30 performs information
processing to give, to a user who is carrying out intellectual work, a
30 restorative stimulus to reduce a cognitive strain felt by the user.
Information processing device 30 is, for example, a personal
computer, but may be a dedicated controller provided for a server
device or actuator 40. Although information processing device 30 is
provided in a space in which a user is located in FIG. 1, information
35 processing device 30 may be provided outside the space.

[0025]

FIG. 2 is a block diagram illustrating a functional configuration of information processing device 30. As illustrated in FIG. 2, information processing device 30 includes obtainer 31 that obtains a
5 condition of a user, first determiner 32 that determines a start timing of giving a restorative stimulus, second determiner 33 that determines a time length for which the restorative stimulus is given, controller 34 that controls actuator 40 to give the restorative stimulus to the user, storage 35, and input receiver 36.

10 [0026]

Obtainer 31, first determiner 32, second determiner 33, and controller 34 are functional elements, and functions of obtainer 31, first determiner 32, second determiner 33, and controller 34 are
15 implemented by a microcomputer or a processor (a hardware product) included in information processing device 30 executing computer programs (software programs) stored in storage 35, for example.

[0027]

Storage 35 is a storage device that stores the
20 above-mentioned computer programs and various information items necessary for giving restorative stimuli. The information items necessary for giving restorative stimuli include a restorative stimuli database. Storage 35 is implemented by a semiconductor memory, a hard disk drive (HDD), or the like.

25 [0028]

Input receiver 36 receives an input of information from a user. The user inputs information as initial settings to start using intellectual work assistance system 10, and input receiver 36 receives the information. Input receiver 36 is implemented by, for
30 example, a mouse and a keyboard.

[0029]

The information to be input by a user includes at least one of the following information items: an attribute of the user, the content of intellectual work to be performed by the user from the time
35 onward, an environment of a space in which the user is located

(stated differently, a space in which the user carries out the intellectual work), a type of actuator 40 (actuator 40 to be controlled) which is provided in the space in which the user is located, etc.

5 [0030]

The attribute of a user includes, specifically, the age, gender, and job title of the user. The content of intellectual work is specified by, for example, a concentration level necessary for the work. The content of intellectual work is selected from among alternatives prepared in advance, such as work that requires a high concentration level in a short period of time and work that requires a general concentration level in a long period of time, for example.

[0031]

The environment of a space in which a user is located indicates, for example, an environment of an open space or a closed space or an environment of a private room or a shared space. Stated differently, the environment of a space indicates the type of a space. The environment of the space in which a user is located is selected from among alternatives prepared in advance. Note that the environment of a space may include information such as a temperature of the space (whether an area that the space belongs is a warm-weather area) and the like.

[0032]

The type of actuator 40 indicates which of devices, which will be described later in the embodiment, is actuator 40. The type of the actuator is selected from among alternatives prepared in advance, for example.

[0033]

Actuator 40 is a stimulus providing device (stimulus presenting device) that gives a restorative stimulus to a user under the control of controller 34. In the example shown in FIG. 1, actuator 40 is an indirect lighting device that gives a restorative stimulus to a user by emitting light onto region R that is a part of a wall and is located in front of the user (stated differently, region R is a part of the wall which is in the field of view of a user who is carrying

out the intellectual work).

[0034]

Note that actuator 40 is not limited to an indirect lighting device, and may be an ambient lighting device, a task lighting device,
5 an airflow generation device, an air-conditioning device, a scent generating device, a sound source reproduction device, an electric blind, an image projection device, etc.

[0035]

The ambient lighting device illuminates the entire space in
10 which a user is located to provide basic brightness of the space. The task lighting device illuminates a spot, namely only a user and the vicinity of the user. Both the ambient lighting device and the task lighting device give a restorative stimulus to a user by emitting light.

[0036]

The airflow generation device is an air blower without a
15 temperature regulation function. The airflow generation device may give a restorative stimulus to a user by directing an airflow at a spot of the user or by generating an airflow in the entire space in which the user is located. The air-conditioning device has a temperature
20 regulation function. The air-conditioning device gives a restorative stimulus to a user by blowing temperature-regulated air to regulate the temperature of the entire space in which the user is located.

[0037]

The sound source reproduction device gives a restorative
25 stimulus to a user by reproducing a sound source (i.e., emission of a sound). The electric blind gives a restorative stimulus to a user by making a transition from the closed state to open state. In this case, the restorative stimulus has a purpose of either allowing outside light into a space in which a user is located or showing outside views to the
30 user. The image projection device gives a restorative stimulus to a user by projecting an image.

[0038]

Note that controller 34 gives a restorative stimulus by
controlling actuator 40 to make a change in a surrounding
35 environment of a user. In other words, actuator 40 is a device that

makes a change in a surrounding environment (light environment, air quality environment, or the like) of the user, but actuator 40 may be a device that directly affects the user (transmission of vibration, etc.).

5 [0039]

In the embodiment below, what type of an operation is to be performed by actuator 40 (e.g., emission of blue monochromatic light by an indirect lighting device) to give a restorative stimulus may be described as a mode of a restorative stimulus.

10 [0040]

[Operation Example 1]

Next, Operation Example 1 of operations performed by intellectual work assistance system 10 will be described. FIG. 3 is a flowchart illustrating Operation Example 1 of operations performed by intellectual work assistance system 10 according to the embodiment.

[0041]

First, input receiver 36 receives, from a user, inputs of information items, such as an attribute of the user, the content of intellectual work to be performed by the user from the time onward, an environment of a space in which the user is located, a type of actuator 40 provided in the space in which the user is located, etc. (S11). These input information items are stored in storage 35 as setting information items. The user starts carrying out the intellectual work after the information items are input. The intellectual work is, for example, clerical tasks or learning.

[0042]

Next, obtainer 31 obtains (calculates) a concentration level of the user who is carrying out the intellectual work (S12). The concentration level is a parameter that indicates a degree of user concentration on the intellectual work. The concentration level is repeatedly obtained in real time. The real time here is not real time in a strict sense, and may include a time error. This time error includes a time required to perform information processing for obtaining the concentration level.

[0043]

Specifically, obtainer 31 obtains a dynamic image (image data) of the user from camera 20, and performs image processing on the dynamic image to calculate features for obtaining the concentration level. The features here are a movement of a line of sight, a posture, a hand movement, a head movement, an eye movement, a facial expression, the number of blinks, etc. Obtainer 31 inputs these features into a machine learning model to obtain the concentration level from the machine learning model. The machine learning model is prestored in storage 35.

[0044]

The machine learning model is, for example, a model to which logistic regression is applied, and is a trained model built using, as a learning set (learning data), data in which features of a large number of test subjects are associated with subjective evaluation results or third-party evaluation results (concentrated: 1, not concentrated: 0) which have been obtained by evaluating whether the test subjects each were concentrated or not. The machine learning model outputs a concentration level numerically, from 0% (not concentrated) to 100% (concentrated).

[0045]

Note that it is not essential that the logistic regression is applied. Since various indicators showing the concentration level have been proposed in recent years, the machine learning model may be a trained model built using, as a learning set (learning data), data in which features of a large number of test subjects are associated with the indicators showing concentration levels of the user. In addition, the machine learning model may be a model to which deep learning is applied, and may be a model that can estimate the concentration level using images (dynamic image) as inputs.

[0046]

Moreover, in step S12, the concentration level may be obtained without using the machine learning model. Since an indicator showing the concentration level based on an algorithm not using a machine learning model has been proposed, obtainer 31 may

use the algorithm to obtain (calculate) the indicator as the concentration level.

[0047]

Next, first determiner 32 determines whether the obtained
5 concentration level of the user is greater than or equal to a preset
value (S13). The preset value is, for example, 80%, but is not
particularly limited. When first determiner 32 determines that the
concentration level is greater than or equal to the preset value (Yes
10 in S13), a restorative stimulus is considered not necessary since the
user is considered to be sufficiently concentrated on carrying out the
intellectual work. In this case, a restorative stimulus is not given,
and the concentration level is continued to be obtained (S12). As
described above, intellectual work assistance system 10 can
15 maintain and improve the concentration level of the user by not
giving a restorative stimulus when the concentration level of the user
is high.

[0048]

Alternatively, when first determiner 32 determines that the
concentration level is less than the preset value (No in S13), first
20 determiner 32 determines whether there is a tendency for a
reduction in the concentration level (S14). Since the obtaining of
the concentration level in step S12 is repeatedly performed in real
time, first determiner 32 can obtain the most recent time-series data
on the concentration level. First determiner 32 can determine
25 whether there is a tendency for a reduction in the concentration level
from an inclination in the most recent time-series data on the
concentration level (or an inclination in the average of shifts in the
concentration level). Note that such a determination method of
determining whether there is a tendency for a reduction in the
30 concentration level is a mere example, and the determination
method of determining whether there is a tendency for a reduction in
the concentration level is not particularly limited.

[0049]

Moreover, in step S14, whether there is a sign of a reduction in
35 the concentration level may be determined instead of determining

whether there is a tendency for a reduction in the concentration level. For example, if (i) a fluctuation pattern in time-series data on the concentration level of the user shown just before the concentration level is greatly reduced or (ii) a user movement (habit) made just before the concentration level is greatly reduced is identified (learned) in advance, first determiner 32 can determine whether there is a sign of a reduction in the concentration level based on the fluctuation pattern or the movement (habit). Note that such a determination method of determining whether there is a sign of a reduction in the concentration level is a mere example, and the determination method of determining whether there is a sign of a reduction in the concentration level is not particularly limited.

[0050]

When first determiner 32 determines that there is no tendency for a reduction in the concentration level (or no sign of a reduction in the concentration level) (No in S14), a restorative stimulus is considered not necessary. In such a case, a restorative stimulus is not given and the concentration level is continued to be obtained (S12).

[0051]

Alternatively, when first determiner 32 determines that there is a tendency for a reduction in the concentration level (or a sign of a reduction in the concentration level) (Yes in S14), first determiner 32 determines whether a preset interval time period has elapsed since a restorative stimulus was given the last time (S15). The preset interval time period is, for example, a time period of from 5 minutes to 10 minutes. Note that the interval time period is a fixed time period irrespective of types of actuator 40, but may be changed depending on the types of actuator 40. In addition, the interval time period may be changed depending on the most recent concentration level of the user. In this case, the interval time period shortens as the concentration level of the user decreases.

[0052]

When first determiner 32 determines that the interval time period has not elapsed (No in S15), a restorative stimulus is

considered not necessary. In this case, a restorative stimulus is not given and the concentration level is continued to be obtained (S12). In other words, a restorative stimulus is not given by controller 34 during a time period until the preset interval time period elapses.

5 As described above, intellectual work assistance system 10 does not give a restorative stimulus before the interval time period elapses (stated differently, intellectual work assistance system 10 gives a restorative stimulus at least after the interval time period has elapsed). In this way, intellectual work assistance system 10 can

10 effectively give a restorative stimulus.

[0053]

Alternatively, when first determiner 32 determines that the interval time period has elapsed (Yes in S15), first determiner 32 determines the current timing to be the start timing of giving a

15 restorative stimulus (S16). In other words, first determiner 32 determines, as the start timing, a timing at which a tendency for a reduction in the concentration level of the user is detected (or a timing at which a sign of a reduction in the concentration level of the user is detected), based on the obtained concentration level of the

20 user. Note that the timing at which a tendency for a reduction in the concentration level of the user is detected (or the timing at which a sign of a reduction in the concentration level of the user is detected) is considered to be displayed earlier than a timing at which the user feels sleepy.

25 [0054]

Next, second determiner 33 determines a time length for which a restorative stimulus is given (S17). By consulting a restorative stimuli database prestored in storage 35, second determiner 33 can determine a time length suitable for the user

30 based on the information items input in step S11. FIG. 4 is a diagram illustrating one example of the restorative stimuli database used in Operation Example 1. Based on at least one of the attribute of the user, the content of the intellectual work, the environment of the space in which the user is located, and the type of actuator 40

35 which have been input in step S11, second determiner 33 can

determine, out of one or more (basically a plurality of) preset time lengths included in the restorative stimuli database, a time length for which a restorative stimulus is given.

[0055]

5 Note that the one or more preset time lengths included in the restorative stimuli database have been empirically, experimentally, or logically determined by the designers, etc., of intellectual work assistance system 10. As has been described above, a time length for which a restorative stimulus is given ranges from about several
10 seconds to several hundred seconds (between one second and 300 seconds, both inclusive), and typically ranges from one second to 30 seconds.

[0056]

 Next, controller 34 controls actuator 40 to give a restorative
15 stimulus to the user (S18). The restorative stimulus is given for the duration of the time length determined in step S17, starting from the start timing determined in step S16. Controller 34 can give the restorative stimulus by transmitting a control signal to actuator 40.

[0057]

20 For example, when actuator 40 is an indirect illumination device, this indirect illumination device emits blue monochromatic light onto region R (shown in FIG. 1) in front of the user. The indirect illumination device is normally turned OFF, and emits blue monochromatic light only for the above-described duration of the
25 time length. With this, intellectual work assistance system 10 can reduce a cognitive strain felt by the user who is carrying out intellectual work.

[0058]

 As has been described above, intellectual work assistance
30 system 10 obtains the concentration level in real time, and gives a restorative stimulus to the user at a timing at which a tendency for a reduction in the concentration level of the user is detected (or the timing at which a sign of a reduction in the concentration level of the user is detected). FIG. 5 is a diagram illustrating changes in the
35 concentration level of a user over time when restorative stimuli were

given to the user. As illustrated in FIG. 5, intellectual work assistance system 10 gives a restorative stimulus before the concentration level is greatly reduced. This prevents cognitive strain saturation, and thus the concentration level of the user can be maintained and improved.

[0059]

In addition, intellectual work assistance system 10 can give a restorative stimulus to the user during a time period optimized by the designers, etc., using the restorative stimuli database. The use of the restorative stimuli database allows ease of giving a highly versatile restorative stimulus.

[0060]

[Operation Example 2]

In Operation Example 1, intellectual work assistance system 10 has determined the start timing of giving a restorative stimulus based on the concentration level of a user. Here, intellectual work assistance system 10 can determine the start timing of giving a restorative stimulus without using the concentration level of the user, when the concentration level of the user cannot be obtained (such as when intellectual work assistance system 10 does not include camera 20). Hereinafter, Operation Example 2 as described above will be described. FIG. 6 is a flowchart illustrating Operation Example 2 of operations performed by intellectual work assistance system 10.

[0061]

First, input receiver 36 receives, from a user, inputs of information items such as an attribute of the user, the content of intellectual work to be performed by the user from the time onward, an environment of a space in which the user is located, a type of actuator 40 provided in the space in which the user is located, etc. (S11). The processing performed in step S11 is the same as the processing performed in Operation Example 1.

[0062]

Next, first determiner 32 determines the start timing of giving a restorative stimulus (S16a). By consulting a restorative stimuli database prestored in storage 35, first determiner 32 can determine

a start timing suitable for the user (time intervals at which a restorative stimulus is to be given) based on the information items input in step S11. FIG. 7 is a diagram illustrating one example of the restorative stimuli database used in Operation Example 2. Note that the one or more preset timings (time intervals) included in the restorative stimuli database have been empirically, experimentally, or logically determined by the designers, etc., of intellectual work assistance system 10.

[0063]

Next, second determiner 33 determines a time length for which a restorative stimulus is given (S17). By consulting the restorative stimuli database (FIG. 7) prestored in storage 35, second determiner 33 can determine a time length suitable for the user based on the information items input in step S11. The processing performed in step S17 is the same as the processing performed in Operation Example 1.

[0064]

Next, controller 34 controls actuator 40 to give a restorative stimulus to the user (S18). The restorative stimulus is given for the duration of the time length determined in step S17, starting from the start timing determined in step S16a. Controller 34 can give the restorative stimulus by transmitting a control signal to actuator 40. The processing performed in step S18 is the same as the processing performed in Operation Example 1.

[0065]

As described above, intellectual work assistance system 10 can give a restorative stimulus to the user at a timing that is optimized by the designers, etc., using the restorative stimuli database. The use of the restorative stimuli database allows ease of giving a highly versatile restorative stimulus.

[0066]

[Variation of User Condition]

In the above-described embodiment, the concentration level of a user has been obtained in real time to determine the start timing of giving a restorative stimulus. The concentration level of a user is

one example of conditions of a user. Here, in order to determine the start timing, a condition of a user other than the concentration level may be obtained in real time.

[0067]

5 Feelings felt by a user exemplify the condition of a user other than the concentration level. Techniques for estimating feelings felt by a user from images of their face (facial expressions) have been known, and such techniques are used when feelings felt by a user are obtained. First determiner 32 can determine, as the start timing of
10 giving a restorative stimulus, a timing at which a cognitive fatigue of a user is considered to be saturated by estimating a feeling felt by the user.

[0068]

 Moreover, what type of work a user is carrying out (the state of
15 work carried out by the user) also exemplifies the condition of a user other than the concentration level. First determiner 32 can determine, as the start timing of giving a restorative stimulus, a timing or the like at which the user starts carrying out work irrelevant to intellectual work, for example.

20 [0069]

 The fatigue level or the like of a user also exemplifies the condition of a user other than the concentration level. Techniques for estimating the fatigue level of a user from the user's posture that is to be captured by a camera have been known, and such techniques
25 are used when the fatigue level of a user is obtained. First determiner 32 can determine, as the start timing of giving a restorative stimulus, a timing at which the fatigue level of a user reaches a preset value, for example.

[0070]

30 [Variation of Determination of Mode of Restorative Stimulus]

 As for modes of a restorative stimulus, one control parameter suitable for maintaining and improving the concentration level is specified for, for example, each of types of actuator 40 in the above-described embodiment. In other words, a mode of a
35 restorative stimulus is naturally determined by a type of actuator 40

input in step S11.

[0071]

Here, if a plurality of preset modes of a restorative stimulus are specified in the above-described restorative stimuli databases, a mode of a restorative stimulus can also be determined out of the plurality of preset modes included in the restorative stimuli databases. In other words, controller 34 may determine a mode of a restorative stimulus out of the plurality of preset modes, based on the restorative stimuli databases.

10 [0072]

In this case, one or more preset modes included in the restorative stimuli databases have been empirically, experimentally, or logically determined by, for example, the designers, etc., of intellectual work assistance system 10.

15 [0073]

In addition, when a condition of a user, such as the concentration level of the user, can be obtained in real time, controller 34 may determine a mode of a restorative stimulus based on the obtained condition of the user. For example, when actuator 40 is an indirect illumination device, the color (or the color temperature) of light to be emitted by the indirect illumination device may be changed depending on the concentration level obtained just before the start of giving the restorative stimulus. In this case, suitable light colors in accordance with concentration levels are to be empirically, experimentally, or logically determined by the designers, etc., of intellectual work assistance system 10.

[0074]

[Variation of Determination of Time Length for which Restorative Stimulus is Given]

30 In the above-described embodiment, a time length for which a restorative stimulus is given is determined using the restorative stimuli databases. However, when a condition of a user, such as the concentration level of the user, can be obtained in real time, second determiner 33 may determine a time length for which a restorative stimulus is given, based on the obtained condition of the user. For

example, a time length for which a restorative stimulus is given may be changed depending on the concentration level obtained just before the start of giving the restorative stimulus. In this case, suitable time lengths in accordance with concentration levels are to be empirically, experimentally, or logically determined by the designers, etc., of intellectual work assistance system 10.

[0075]

[Advantageous Effects, etc.]

Inventions to be derived from the disclosures of the present Description are, for example, the following inventions. Hereinafter, the inventions to be derived from the disclosures of the present Description will be described together with advantageous effects, etc., to be produced by these inventions.

[0076]

Invention 1 is intellectual work assistance system 10 that includes: first determiner 32 that determines a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work; second determiner 33 that determines a time length for which the restorative stimulus is given; and controller 34 that controls actuator 40 to give the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

[0077]

The above-described intellectual work assistance system 10 can assist intellectual work carried out by a user.

[0078]

Invention 2 is intellectual work assistance system 10 according to the invention, where the time length ranges from one second to 300 seconds.

[0079]

The above-described intellectual work assistance system 10 can assist intellectual work carried out by a user by giving a restorative stimulus for a short period of time.

[0080]

Invention 3 is intellectual work assistance system 10

according to invention 1 or 2, where first determiner 32 determines the start timing out of one or more preset timings.

[0081]

5 The above-described intellectual work assistance system 10 can easily give a highly versatile restorative stimulus.

[0082]

10 Invention 4 is intellectual work assistance system 10 according to invention 3, where first determiner 32 determines the start timing out of the one or more preset timings, based on at least one of an attribute of the user, content of the intellectual work, an environment of a space in which the user is located, and a type of the actuator.

[0083]

15 The above-described intellectual work assistance system 10 can give a restorative stimulus based on at least one of an attribute of a user, the content of intellectual work, an environment of a space in which the user is located, and the type of an actuator.

[0084]

20 Invention 5 is intellectual work assistance system 10 according to invention 1 or 2 which further includes obtainer 31 that obtains a condition of the user in real time. In the invention, first determiner 32 determines the start timing, based on the condition of the user which has been obtained.

[0085]

25 The above-described intellectual work assistance system 10 can give a restorative stimulus based on the condition of a user.

[0086]

30 Invention 6 is intellectual work assistance system 10 according to invention 5, where the condition of the user includes a concentration level of the user.

[0087]

The above-described intellectual work assistance system 10 can give a restorative stimulus based on the concentration level of a user.

35 [0088]

Invention 7 is intellectual work assistance system 10 according to invention 6, where first determiner 32 determines, as the start timing, a timing at which a tendency for a reduction in the concentration level of the user is detected or a timing at which a sign of a reduction in the concentration level of the user is detected, based on the concentration level of the user which has been obtained. The concentration level is included in the condition of the user.
[0089]

The above-described intellectual work assistance system 10 can maintain and improve the concentration level of a user, since a restorative stimulus is given before the concentration level is greatly reduced.
[0090]

Invention 8 is intellectual work assistance system 10 according to invention 6 or 7, where when the concentration level obtained is greater than or equal to a preset value, controller 34 does not give the restorative stimulus.
[0091]

The above-described intellectual work assistance system 10 can maintain and improve the concentration level of a user by preventing a restorative stimulus from interfering with the user concentration on intellectual work.
[0092]

Invention 9 is intellectual work assistance system 10 according to any one of inventions 5 to 8, where controller 34 does not give the restorative stimulus during a time period from a time at which the restorative stimulus is given until a preset interval time period elapses.
[0093]

The above-described intellectual work assistance system 10 can give a restorative stimulus at an effective timing.
[0094]

Invention 10 is intellectual work assistance system 10 according to any one of inventions 1 to 9, where second determiner 33 determines the time length for which the restorative stimulus is

given out of one or more preset time lengths.

[0095]

The above-described intellectual work assistance system 10 can easily give a highly versatile restorative stimulus.

5 [0096]

Invention 11 is intellectual work assistance system 10 according to invention 10, where second determiner 33 determines the time length for which the restorative stimulus is given out of the one or more preset time lengths, based on at least one of an attribute
10 of the user, content of the intellectual work, an environment of a space in which the user is located, and a type of the actuator.

[0097]

The above-described intellectual work assistance system 10 can give a restorative stimulus based on at least one of an attribute
15 of a user, the content of intellectual work, an environment of a space in which the user is located, and the type of an actuator.

[0098]

Invention 12 is intellectual work assistance system 10 according to any one of inventions 1 to 9 which further includes
20 obtainer 31 that obtains a condition of the user in real time. In the invention, second determiner 33 determines the time length, based on the condition of the user which has been obtained.

[0099]

The above-described intellectual work assistance system 10
25 can give a restorative stimulus based on the concentration level of a user.

[0100]

Invention 13 is intellectual work assistance system 10 according to any one of inventions 1 to 12 which further includes
30 obtainer 31 that obtains a condition of the user in real time. In the invention, controller 34 determines a mode of the restorative stimulus, based on the condition of the user which has been obtained.

[0101]

35 The above-described intellectual work assistance system 10

can give a restorative stimulus based on the concentration level of a user.

[0102]

5 Invention 14 is intellectual work assistance system 10 according to any one of inventions 1 to 13, where controller 34 controls actuator 40 to make a change in a surrounding environment of the user to give the restorative stimulus.

[0103]

10 The above-described intellectual work assistance system 10 can implement a restorative stimulus by making a change in the surrounding environment of a user.

[0104]

15 Invention 15 is an intellectual work assistance method to be executed by a computer such as intellectual work assistance system 10. The intellectual work assistance method includes: a first determination step of determining a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work; a second determination step of determining a time length for which the restorative stimulus is given; 20 and a control step of controlling actuator 40 to give the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

[0105]

25 The above-described intellectual work assistance method can assist intellectual work carried out by a user.

[0106]

[Other Embodiments]

The embodiment has been hereinbefore described, yet the present invention is not limited to the above-described embodiment.

30 [0107]

For example, in the above-described embodiment, the intellectual work assistance system is implemented by a plurality of devices. When the intellectual work assistance system is implemented by the plurality of devices, the above-described elements (particularly the functional elements) included in the 35

intellectual work assistance system may be assigned in any manner to the plurality of devices included in the intellectual work assistance system. For example, the obtainer, the first determiner, the second determiner, and the controller may be assigned to the plurality of
5 devices.

[0108]

In addition, the intellectual work assistance system may be implemented as a single device. For example, the intellectual work assistance system may be implemented as a single device
10 corresponding to the information processing device.

[0109]

The intellectual work assistance system may also be implemented as a client-server system. For example, the intellectual work assistance system may further include a cloud
15 server (server device), and some or all of processes performed by the information processing device may be performed by the cloud server. Specifically, the above-described restorative stimuli databases may be stored in the cloud server, and the cloud server may perform some or all the information processing pertaining to the
20 restorative stimuli databases.

[0110]

Moreover, the intellectual work assistance system may use a machine learning model that has learnt contents of the restorative stimuli databases to perform processes that have been described as
25 being implemented by using the restorative stimuli databases in the above-described embodiment.

[0111]

Furthermore, a method of communication used between devices in the above-described embodiment is not particularly
30 limited. A relay device that is not illustrated may be interposed between the devices for communication between the devices.

[0112]

In addition, in the above-described embodiment, a process performed by a particular processor may be performed by another
35 processor. For example, a process performed by a selector may be

performed by the controller. Moreover, the order of a plurality of processes may be changed, and the plurality of processes may be performed in parallel.

[0113]

5 In the above-described embodiment, each element may be implemented by executing a software program suitable for the element. Each element may be implemented as a result of a program execution unit, such as a central processing unit (CPU), processor or the like, loading and executing a software program
10 stored in a storage medium such as a hard disk or a semiconductor memory.

[0114]

Each element may also be implemented by a hardware product. For example, each element may be a circuit (or an integrated circuit).
15 These circuits may constitute a single circuit as a whole or may be individual circuits. These circuits may also be general-purpose circuits or dedicated circuits.

[0115]

Note that general or specific aspects of the present invention
20 may be implemented by a system, a device, a method, an integrated circuit, a computer program, or a computer-readable recording medium such as a CD-ROM. The general or specific aspects of the present invention may also be implemented by an optional combination of a system, a device, a method, an integrated circuit, a
25 computer program, and a recording medium.

[0116]

For example, the present invention may be implemented as an intellectual work assistance method to be executed by a computer, such as the intellectual work assistance system, or a program to
30 cause the computer to execute such the intellectual work assistance method. The present invention may be also implemented as a non-transitory computer-readable recording medium on which such a program is recorded.

[0117]

35 The present invention also encompasses: embodiments

achieved by applying various modifications conceivable to those skilled in the art to each embodiment; and embodiments achieved by optionally combining the structural elements and the functions of each embodiment without departing from the spirit of the present

5 invention.

[Reference Signs List]

[0118]

	10	intellectual work assistance system
	20	camera
10	30	information processing device
	31	obtainer
	32	first determiner
	33	second determiner
	34	controller
15	35	storage
	36	input receiver
	40	actuator

[CLAIMS]

[Claim 1]

An intellectual work assistance system comprising:

5 a first determiner that determines a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work;

a second determiner that determines a time length for which the restorative stimulus is given; and

10 a controller that controls an actuator to give the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

[Claim 2]

15 The intellectual work assistance system according to claim 1, wherein

the time length ranges from one second to 300 seconds.

[Claim 3]

20 The intellectual work assistance system according to claim 1 or 2, wherein

the first determiner determines the start timing out of one or more preset timings.

[Claim 4]

25 The intellectual work assistance system according to claim 3, wherein

30 the first determiner determines the start timing out of the one or more preset timings, based on at least one of an attribute of the user, content of the intellectual work, an environment of a space in which the user is located, and a type of the actuator.

[Claim 5]

The intellectual work assistance system according to claim 1 or 2, further comprising:

35 an obtainer that obtains a condition of the user in real time,

wherein

the first determiner determines the start timing, based on the condition of the user which has been obtained.

5 [Claim 6]

The intellectual work assistance system according to claim 5, wherein

the condition of the user includes a concentration level of the user.

10

[Claim 7]

The intellectual work assistance system according to claim 6, wherein

the first determiner determines, as the start timing, a timing
15 at which a tendency for a reduction in the concentration level of the user is detected or a timing at which a sign of a reduction in the concentration level of the user is detected, based on the concentration level of the user which has been obtained, the concentration level being included in the condition of the user.

20

[Claim 8]

The intellectual work assistance system according to claim 6, wherein

when the concentration level obtained is greater than or equal
25 to a preset value, the controller does not give the restorative stimulus.

[Claim 9]

The intellectual work assistance system according to claim 5,
30 wherein

the controller does not give the restorative stimulus during a time period from a time at which the restorative stimulus is given until a preset interval time period elapses.

35 [Claim 10]

The intellectual work assistance system according to claim 1 or 2, wherein

the second determiner determines the time length for which the restorative stimulus is given out of one or more preset time lengths.

[Claim 11]

The intellectual work assistance system according to claim 10, wherein

the second determiner determines the time length for which the restorative stimulus is given out of the one or more preset time lengths, based on at least one of an attribute of the user, content of the intellectual work, an environment of a space in which the user is located, and a type of the actuator.

[Claim 12]

The intellectual work assistance system according to claim 1 or 2, further comprising:

an obtainer that obtains a condition of the user in real time, wherein

the second determiner determines the time length, based on the condition of the user which has been obtained.

[Claim 13]

The intellectual work assistance system according to claim 1 or 2, further comprising:

an obtainer that obtains a condition of the user in real time, wherein

the controller determines a mode of the restorative stimulus, based on the condition of the user which has been obtained.

[Claim 14]

The intellectual work assistance system according to claim 1 or 2, wherein

the controller controls the actuator to make a change in a

surrounding environment of the user to give the restorative stimulus.

[Claim 15]

5 An intellectual work assistance method to be executed by a computer, the intellectual work assistance method comprising:

determining a start timing of giving a restorative stimulus to reduce a cognitive strain felt by a user who is carrying out intellectual work;

10 determining a time length for which the restorative stimulus is given; and

controlling an actuator to give the restorative stimulus to the user for a duration of the time length determined, starting from the start timing determined.

15 [Claim 16]

A program for causing the computer to execute the intellectual work assistance method according to claim 15.