temperature satisfies a predetermined condition does not necessarily lead to a state in which the user is sleepy.

Embodiments of the present disclosure are directed to providing an environmental equipment control apparatus and an environmental equipment control system that are capable of relieving sleepiness of a user.

Solution to Problem

According to a first aspect of the present disclosure, there is provided an environmental equipment control apparatus for controlling environmental equipment and includes a grasping unit and a control unit. The grasping unit grasps physical-and-mental-state information about a physical and mental state of a user. The control unit changes a control state of the environmental equipment in a case where the physical-and-mental-state information satisfies a predetermined state condition, wherein the control unit restores the control state of the environmental equipment to a state before change within a predetermined change time period after changing the control state of the environmental equipment, wherein the environmental equipment includes an air conditioning apparatus capable of changing a temperature of a space where the user is present, and in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit

causes the air conditioning apparatus to operate with a set temperature being decreased and then causes the air conditioning apparatus to operate with the set temperature that is a set temperature before being changed, wherein in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit causes the air conditioning apparatus to operate with the set temperature being decreased by a predetermined temperature value and then the control unit repeats a process of causing the air conditioning apparatus to operate with the set temperature being increased by a temperature value smaller than the predetermined temperature value until the set temperature is back to the previous set temperature that is a set temperature before being decreased, or the control unit increases a degree of decrease in the set temperature of the air conditioning apparatus more as an outdoor temperature decreases.

The physical-and-mental-state information about the physical and mental state of the user is not limited, and various types of information may be used, for example, a drowsiness scale, the degree of arousal, an autonomic nerve balance such as LF/HF, the degree of sleepiness, the degree of tension, the degree of sweating, a body temperature, a temperature on a body surface, voice, and the like.

Here, the degree of arousal is not limited, but may be, for example, determined on the basis of the state of heartbeats of the

user, the temperature of a skin of the user, the number of times of breathing per unit time of the user, brain waves of the user, or a combination thereof.

In this aspect of the environmental equipment control apparatus, it is possible to relieve sleepiness of the user.

In an embodiment of the environmental equipment control apparatus, the control unit restores the control state of the environmental equipment to a state before change within a predetermined change time period after changing the control state of the environmental equipment.

In this embodiment of the environmental equipment control apparatus, it is possible to suppress uncomfortableness of the user caused by the control for relieving sleepiness.

In an embodiment of the environmental equipment control apparatus, the predetermined change time period is 30 minutes or less.

In this embodiment of the environmental equipment control apparatus, it is possible to more reliably suppress uncomfortableness of the user caused by the control for relieving sleepiness.

In an embodiment of the environmental equipment control apparatus, the environmental equipment includes an air conditioning apparatus capable of changing a temperature of a space where the user is present. In a case where the physical-and-

mental-state information satisfies the predetermined state condition, the control unit causes the air conditioning apparatus to operate with a set temperature being decreased and then causes the air conditioning apparatus to operate with the set temperature that is a set temperature before being changed.

In this embodiment of the environmental equipment control apparatus, it is possible to suppress uncomfortableness of the user caused by the change in temperature by the control for relieving sleepiness.

In an embodiment of the environmental equipment control apparatus, in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit causes the air conditioning apparatus to operate with the set temperature being decreased by a predetermined temperature value and then the control unit repeats a process of causing the air conditioning apparatus to operate with the set temperature being increased by a temperature value smaller than the predetermined temperature value until the set temperature is back to the previous set temperature that is a set temperature before being decreased.

In this embodiment of the environmental equipment control apparatus, sleepiness of the user can be easily relieved by performing operation in a state in which the set temperature is decreased by the predetermined temperature value, which is the

control with a greater change in the set temperature per unit time than in the case of back to the set temperature that is a set temperature before being changed.

In an embodiment of the environmental equipment control apparatus, in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit increases a degree of decrease in the set temperature of the air conditioning apparatus more as an outdoor temperature decreases.

In this embodiment of the environmental equipment control apparatus, when the outdoor temperature is low, the user has adapted to the low-temperature environment, and the set temperature is significantly decreased at such a time, so that sleepiness can be more reliably relieved.

In an embodiment of the environmental equipment control apparatus, the air conditioning apparatus is capable of adjusting a blow-out direction of conditioned air. In a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit controls the blow-out direction of the conditioned air of the air conditioning apparatus to a predetermined downward state in a case of causing the air conditioning apparatus to operate with the set temperature being decreased.

In this embodiment of the environmental equipment control

apparatus, sleepiness can be easily relieved by particularly decreasing the temperature of a lower-half body of the user.

In an embodiment of the environmental equipment control apparatus, the air conditioning apparatus is capable of changing a speed of conditioned air to be supplied to the user. The control unit controls the air conditioning apparatus to cause variation in the speed of the conditioned air to be supplied to the user when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control apparatus, sleepiness of the user is more reliably relieved by causing variation in air speed at the same time of decreasing the set temperature.

In an embodiment of the environmental equipment control apparatus, the air conditioning apparatus is capable of changing a humidity of the space where the user is present. The control unit decreases a set humidity of the air conditioning apparatus when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control apparatus, sleepiness of the user is more reliably relieved by decreasing the humidity at the same time of decreasing the set

temperature.

In an embodiment of the environmental equipment control apparatus, the environmental equipment further includes aroma equipment that provides an aroma to the space where the user is present. The control unit causes the aroma equipment to start providing an aroma or increases an amount of aroma to be provided by the aroma equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control apparatus, sleepiness of the user is more quickly relieved by causing the aroma equipment to start providing an aroma or increasing the amount of aroma to be provided by the aroma equipment at the same time of decreasing the set temperature.

In an embodiment of the environmental equipment control apparatus, the environmental equipment includes ventilating equipment capable of ventilating the space where the user is present. The control unit increases a ventilation amount of the ventilating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control

apparatus, sleepiness of the user is more reliably relieved by increasing the ventilation amount of the ventilating equipment at the same time of decreasing the set temperature.

In an embodiment of the environmental equipment control apparatus, the environmental equipment includes illuminating equipment capable of changing an illuminance of the space where the user is present. The control unit increases an illuminance of the illuminating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control apparatus, sleepiness of the user is more quickly relieved by increasing the illuminance of the illuminating equipment at the same time of decreasing the set temperature.

In an embodiment of the environmental equipment control apparatus, the environmental equipment includes illuminating equipment capable of changing a color temperature of the space where the user is present. The control unit increases a color temperature of the illuminating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

In this embodiment of the environmental equipment control

apparatus, sleepiness of the user is more quickly relieved by increasing the color temperature of the illuminating equipment at the same time of decreasing the set temperature.

In an embodiment, the environmental equipment control apparatus further includes a storage unit. The control unit is capable of changing a manner of changing the control state of the environmental equipment every time the physical-and-mental-state information satisfies the predetermined state condition. The storage unit stores correspondence information in which changes in the control state of the environmental equipment are associated with changes in the physical-and-mental-state information of the user grasped by the grasping unit in accordance with the changes in the control state of the environmental equipment. The control unit is capable of selecting a change satisfying a predetermined change condition from among the changes in the physical-and-mental-state information of the user and executing a change in the control state of the environmental equipment stored in association with the selected change.

In this embodiment of the environmental equipment control apparatus, it is possible to select and execute control details which are actually effective for relieving sleepiness among past control operations.

In an embodiment of the environmental equipment control apparatus, the physical-and-mental-state information includes a

drowsiness scale of the user.

In this embodiment of the environmental equipment control apparatus, it is possible to more reliably relieving sleepiness of the user.

In an embodiment of the environmental equipment control apparatus, in a case where the drowsiness scale of the user is greater than or equal to a predetermined sleepiness reference value, the control unit changes the control state of the environmental equipment.

According to a second aspect of the present disclosure, there is provided an environmental equipment control system including the above environmental equipment control apparatus, and the environmental equipment.

Brief Description of Drawings

[Fig. 1] Fig. 1 is a schematic configuration diagram of an entire environmental equipment control system.

[Fig. 2] Fig. 2 is a block configuration diagram of an

CLAIMS

[Claim 1]

An environmental equipment control apparatus (100) for controlling an environmental equipment (10, 20, 30), comprising:

a grasping unit (60, 66) that grasps physical-and-mental-state information about a physical and mental state of a user; and

a control unit (90) that changes a control state of the environmental equipment in a case where the physical-and-mental-state information satisfies a predetermined state condition,

wherein the control unit restores the control state of the environmental equipment to a state before change within a predetermined change time period after changing the control state of the environmental equipment,

wherein

the environmental equipment includes an air conditioning apparatus capable of changing a temperature of a space where the user is present, and

in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit causes the air conditioning apparatus to operate with a set temperature being decreased and then causes the air conditioning apparatus to operate with the set temperature that is a set temperature before being changed,

wherein in a case where the physical-and-mental-state information satisfies the predetermined state condition,

the control unit causes the air conditioning apparatus to operate with the set temperature being decreased by a predetermined temperature value and then the control unit repeats a process of causing the air conditioning apparatus to operate with the set temperature being increased by a temperature value smaller than the predetermined temperature value until the set temperature is back to the previous set temperature that is a set temperature before being decreased, or

the control unit increases a degree of decrease in the set temperature of the air conditioning apparatus more as an outdoor temperature decreases.

~~[Claim 2]~~

~~The environmental equipment control apparatus according to Claim 1, wherein the control unit restores the control state of the environmental equipment to a state before change within a predetermined change time period after changing the control state of the environmental equipment.~~

[Claim 2~~3~~]

The environmental equipment control apparatus according to Claim 1~~2~~, wherein the predetermined change time period is 30 minutes or less.

~~[Claim 4]~~

~~The environmental equipment control apparatus according to Claim 2 or 3, wherein~~

~~the environmental equipment includes an air conditioning apparatus capable of changing a temperature of a space where the user is present, and~~

~~in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit causes the air conditioning apparatus to operate with a set temperature being decreased and then causes the air conditioning apparatus to operate with the set temperature that is a set temperature before being changed.~~

~~[Claim 5]~~

~~The environmental equipment control apparatus according to Claim 4,~~

~~wherein in a case where the physical-and-mental-state information satisfies the predetermined state condition,~~

~~the control unit causes the air conditioning apparatus to operate with the set temperature being decreased by a predetermined temperature value and then~~

~~the control unit repeats a process of causing the air conditioning apparatus to operate with the set temperature being increased by a temperature value smaller than the predetermined temperature value until the set temperature is back to the previous set temperature that is a set temperature before being decreased.~~

~~[Claim 6]~~

~~The environmental equipment control apparatus according to Claim 4 or 5, wherein in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit increases a degree of decrease in the set temperature of the air conditioning apparatus more as an outdoor temperature decreases.~~

[Claim 3~~7~~]

The environmental equipment control apparatus according to any one of Claims 1~~4~~ to 2~~6~~, wherein

the air conditioning apparatus is capable of adjusting a blow-out direction of conditioned air, and

in a case where the physical-and-mental-state information satisfies the predetermined state condition, the control unit controls the blow-out direction of the conditioned air of the air conditioning apparatus to a predetermined downward state in a case of causing the air conditioning apparatus to operate with the set temperature being decreased.

[Claim 4~~8~~]

The environmental equipment control apparatus according to any one of Claims 1~~4~~ to 3~~7~~, wherein

the air conditioning apparatus is capable of changing a speed of conditioned air to be supplied to the user, and

the control unit controls the air conditioning apparatus to cause variation in the speed of the conditioned air to be supplied to the user when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 5~~9~~]

The environmental equipment control apparatus according to any one of Claims 1~~4~~ to 4~~8~~, wherein

the air conditioning apparatus is capable of changing a humidity of the space where the user is present, and

the control unit decreases a set humidity of the air conditioning apparatus when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 610]

The environmental equipment control apparatus according to any one of Claims 14 to 59, wherein

the environmental equipment further includes an aroma equipment that provides an aroma to the space where the user is present, and

the control unit causes the aroma equipment to start providing an aroma or increases an amount of aroma to be provided by the aroma equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 711]

The environmental equipment control apparatus according to any one of Claims 14 to 610, wherein

the environmental equipment further includes a ventilating equipment capable of ventilating the space where the user is present, and

the control unit increases a ventilation amount of the ventilating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 812]

The environmental equipment control apparatus according to any one of Claims 14 to 711, wherein

the environmental equipment further includes an illuminating equipment capable of changing an illuminance of the space where the user is present, and

the control unit increases an illuminance of the illuminating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 913]

The environmental equipment control apparatus according to any one of Claims 14 to 812, wherein

the environmental equipment further includes an illuminating equipment capable of changing a color temperature of the space where the user is present, and

the control unit increases a color temperature of the illuminating equipment when starting changing the control state of the environmental equipment in response to the physical-and-mental-state information satisfying the predetermined state condition.

[Claim 1014]

The environmental equipment control apparatus according to any one of Claims 1 to 913, wherein

the control unit is capable of changing a manner of changing the control state of the environmental equipment every time the physical-and-mental-state information satisfies the predetermined state condition,

the environmental equipment control apparatus further comprises a storage unit that stores correspondence information in which changes in the control state of the environmental equipment are associated with changes in the physical-and-mental-state information of the user grasped by the grasping unit in accordance with the changes in the control state of the environmental equipment, and

the control unit is capable of selecting a change satisfying a predetermined change condition from among the changes in the physical-and-mental-state information of the user and executing a change in the control state of the environmental equipment stored in association with the selected change.

[Claim 1~~5~~]

The environmental equipment control apparatus according to any one of Claims 1 to 1~~4~~, wherein the physical-and-mental-state information includes a drowsiness scale of the user.

[Claim 1~~6~~]

The environmental equipment control apparatus according to Claim 1~~5~~, wherein in a case where the drowsiness scale of the user is greater than or equal to a predetermined sleepiness reference value, the control unit changes the control state of the environmental equipment.

[Claim 1~~7~~]

An environmental equipment control system (1) comprising:

the environmental equipment control apparatus according to any one of Claims 1 to 12~~16~~; and

the environmental equipment.