indicates that the subject concentrates. Moreover, in the case where the subject alternately sees a reference book and a notebook in learning, the information processing apparatus in the related art calculates a low concentration level although the situation indicates that the subject concentrates on learning. Thus, the information processing apparatus in the related art has a problem of low accuracy in calculation of the concentration level.

[0005]

Accordingly, embodiments of the present disclosure provide a concentration level calculation system and a concentration level calculation method which can calculate a concentration level with higher accuracy.

[Solution to Problem]

[0006]

According to a first aspect of the present disclosure, there is provided a concentration level calculation system including: an image obtainer which obtains an image stream in which images of a subject are captured; a region obtainer which obtains concentration target regions each corresponding to a different one of concentration target objects to be watched by the subject; and a concentration level calculator which calculates a concentration level of the subject. Here, the concentration level calculator calculates an orientation of a face or line of sight of the subject from the image stream obtained; determines, based on the orientation of the face or line of sight of the subject calculated and the concentration target regions obtained, whether the subject in a watching state where the subject is watching any one of the concentration target objects; and calculates the concentration level of the subject based on a result of the determination, and outputs the concentration level, wherein when the concentration level calculator determines that the subject is not in the watching state, the concentration level calculator further determines whether the subject is in a transition state where the line of sight transits between two of the concentration target objects, and calculates the concentration level of the subject based on a result of the determination.

[0007]

According to a second aspect of the present disclosure, there is provided a concentration level calculation method including: obtaining an image stream in which images of a subject are captured; obtaining concentration target regions each corresponding to a different one of concentration target objects to be watched by the subject; calculating an orientation of a face or line of sight of the subject from the image stream obtained; determining, based on the orientation of the face or line of sight of the subject calculated and the concentration target regions obtained, whether the subject is in a watching state where the subject is watching any one of the concentration target objects; and calculating a concentration level of the subject based on a result of the determination, and outputting the concentration level, wherein when the step of calculating the orientation of the face or the line of sight of the subject determines that the subject is not in the watching state, the step of calculating the concentration level of the subject further determines whether the

subject is in a transition state where the line of sight transits between two of the concentration target objects, and calculates the concentration level of the subject based on the result of the determination.

[0008]

According to a third aspect of the present disclosure, there is provided a program for causing a computer to execute the above method. Alternatively, a concentration level calculation method according to an embodiment of the present disclosure can be implemented as a computer-readable recording medium having recorded thereon the program for causing a computer to execute the above method.

[0008a]

Disclosed herein is a concentration level calculation system including: an image obtainer which obtains an image stream in which images of a subject are captured; a region obtainer which obtains concentration target regions each corresponding to a different one of concentration target objects to be watched by the subject; and a concentration level calculator which calculates a concentration level of the subject, wherein the concentration level calculator calculates the concentration level of the subject by inputting the image stream and the concentration target regions to a concentration level calculation model trained by machine learning of a correlation among the image stream, the concentration target regions, and the concentration level of the subject.

[0008b]

Disclosed herein is a concentration level calculation model generation system including: a model generator which generates the above concentration level calculation model.

[Advantageous Effects of Invention]

[0009]

Embodiments of the present disclosure can calculate the concentration level with higher accuracy.

[Brief Description of Drawings]

[0010]

[FIG. 1]

FIG. 1 is a diagram illustrating a usage example of the concentration level calculation system according to an embodiment.

[FIG. 2]

FIG. 2 is a block diagram illustrating the configuration of the concentration level calculation system according to the embodiment.

[FIG. 3]

FIG. 3 is a diagram for illustrating the concentration target region according to the embodiment.

[FIG. 4]

FIG. 4 is a flowchart illustrating the concentration level calculation method according to an embodiment.

[FIG. 5]

FIG. 5 is a diagram for illustrating determination of the watching state according to the embodiment.

[CLAIMS]

1. A concentration level calculation system comprising:

an image obtainer which obtains an image stream in which images of a subject are captured;

a region obtainer which obtains concentration target regions each corresponding to a different one of concentration target objects to be watched by the subject; and

a concentration level calculator which calculates a concentration level of the subject,

wherein the concentration level calculator:

calculates an orientation of a face or line of sight of the subject from the image stream obtained;

determines, based on the orientation of the face or line of sight of the subject calculated and the concentration target regions obtained, whether the subject in a watching state where the subject is watching any one of the concentration target objects; and

calculates the concentration level of the subject based on a result of the determination, and outputs the concentration level,

wherein when the concentration level calculator determines that the subject is not in the watching state, the concentration level calculator further determines whether the subject is in a transition state where the line of sight transits between two of the concentration target objects, and calculates the concentration level of the subject based on a result of the determination.

2. The concentration level calculation system according to claim 1,

wherein each of the concentration target regions is determined based on a region determination image captured when an instruction to watch a concentration target object corresponding to the concentration target region is presented to the subject, and is preliminarily stored in a storage, and

the region obtainer refers to the storage, and obtains the concentration target regions.

3. The concentration level calculation system according to claim 2,

wherein when an instruction to watch one end and an other end of the concentration target object corresponding to the concentration target region is presented to the subject, each of the concentration target regions is determined as a region between the orientation of the face or line of sight of the subject when watching the one end of the concentration target object and the orientation of the face or line of sight of the subject when watching the other end of the concentration target object, and is preliminarily stored in the storage.

4. The concentration level calculation system according to claim 1,

wherein the concentration target regions are preliminarily set for each space used by the subject, and are stored in a storage, and

the region obtainer refers to the storage, and obtains the concentration target regions.

5. The concentration level calculation system according to claim 1,

wherein the concentration target regions are preliminarily set for each subject, and are stored in a storage, and

the region obtainer refers to the storage, and obtains the concentration target regions.

6. The concentration level calculation system according to any one of claims 1 to 5,

wherein the orientation of the face of the subject is calculated as a normal line vector of the face of the subject from the image stream obtained,

each of the concentration target regions includes a predetermined angle range with the subject centered, and

when the normal line vector calculated falls within the

predetermined angle range, the concentration level calculator determines that the subject is in the watching state where the subject is watching the concentration target object corresponding to the concentration target region including the predetermined angle range.

7. The concentration level calculation system according to claim 1,

wherein the concentration level calculator:

further calculates a performance level from the image stream obtained, the performance level being a unit concentration level of the subject; and

calculates the concentration level of the subject by multiplying the performance level by a first coefficient when the subject is determined to be in the watching state, multiplying the performance level by a second coefficient lower than or equal to the first coefficient when the subject is determined to be in the transition state, and multiplying the performance level by a third coefficient lower than the second coefficient when the subject is determined to be not in the watching state and to be not in the transition state.

8. The concentration level calculation system according to claim 1,

wherein the concentration level calculator:

further calculates a performance level at a first time point and a performance level at a second time point consecutive to the first time point from the image stream obtained, the performance level being a unit concentration level of the subject; and

calculates the concentration level of the subject by adding a first value obtained by multiplying the performance level at the first time point by a first coefficient of weight and a second value obtained by multiplying the performance level at the second time point by a second coefficient of weight which is a difference between the first coefficient of weight and 1 in a first case where the subject is determined to be in the watching state and in a second case where

the subject is determined to be neither in the watching state nor in the transition state; and by adding a third value obtained by multiplying the performance level at the first time point by a third coefficient of weight different from the first coefficient of weight and a fourth value obtained by multiplying the performance level at the second time point by a fourth coefficient of weight which is a difference between the third coefficient of weight and 1 in a third state where the subject is determined to be in the transition state, and

the first coefficient of weight and the third coefficient of weight each are a numeric value of more than 0 and less than 1.

9. The concentration level calculation system according to any one of claims 1 to 8,

wherein the orientation of the face or line of sight of the subject is calculated as an output result by inputting the image stream to an orientation calculation model trained by machine learning of a correlation between the image stream and the orientation of the face or line of sight of the subject to an imaging device which captures the image stream.

10. A concentration level calculation method comprising:

obtaining an image stream in which images of a subject are captured;

obtaining concentration target regions each corresponding to a different one of concentration target objects to be watched by the subject;

calculating an orientation of a face or line of sight of the subject from the image stream obtained;

determining, based on the orientation of the face or line of sight of the subject calculated and the concentration target regions obtained, whether the subject is in a watching state where the subject is watching any one of the concentration target objects; and

calculating a concentration level of the subject based on a result of the determination, and outputting the concentration level,

wherein when the step of calculating the orientation of the face or the line of sight of the subject determines that the subject is not in the watching state, the step of calculating the concentration level of the subject further determines whether the subject is in a transition state where the line of sight transits between two of the concentration target objects, and calculates the concentration level of the subject based on the result of the determination.

11. A program for causing a computer to execute the concentration level calculation method according to claim 10.