

[DESCRIPTION]

[TITLE OF INVENTION]

METHOD FOR ESTIMATING LEVEL OF UNPLEASANT ODOR COMPONENTS
IN BREATH, DEVICE FOR ESTIMATING LEVEL OF UNPLEASANT ODOR
COMPONENTS IN BREATH, PROGRAM, AND BAD BREATH CARE METHOD

[Technical Field]

[0001]

The present invention relates to a method for estimating a level of unpleasant odor components in breath, a device for estimating the level of the unpleasant odor components in breath, a program, and a bad breath care method.

Priority is claimed on Japanese Patent Application No. 2017-251952, filed on Dec. 27, 2017, the content of which is incorporated herein by reference.

[Background Art]

[0002]

Among oral-related problems, there are many concerns about bad breath. Although various care products are released for the bad breath, it is difficult to be aware of effects thereof. Therefore, a technique for visualizing the bad breath for eliminating anxiety about effects is desired.

Until now, a lot of bad breath checking products are marketed. However, the products have problems in that a component, such as fragrance, other than unpleasant components of the bad breath is detected, and an accuracy is not sufficient.

On the other hand, gas chromatography is used as a method for specifically and accurately detecting the unpleasant components of the bad breath. Patent Document 1 discloses a gas chromatograph device capable of stabilizing a baseline of a detection output of a detector and performing highly reliable measurement.

[Citation List]

[Patent Literature]

[0003]

[Patent Document 1]

Japanese Unexamined Patent Application No. 2003-254956

[Summary of Invention]

[Technical Problem]

[0004]

A method described in Patent Document 1 has major problems in a versatility aspect with respect to general consumers as in that a considerably expensive analytical instrument is required and a high-level specialized knowledge is required even when setting analysis conditions.

[0005]

The present invention has been made in view of the above-mentioned problems of the related art, and has an object to provide a method for estimating a level of unpleasant odor components in breath, a device for estimating the level of the unpleasant odor components in breath, a program, and a bad breath care method, in which it is possible to estimate the level of the unpleasant odor components in breath using a simple method.

[Solution to Problem]

[0006]

The present inventors and the like find that it is possible to simply and accurately discriminate a level of unpleasant odor components in breath without requiring an expensive analysis device by capturing a determination portion of a tongue body under certain specific conditions, and completes the present invention.

[0007]

According to the present invention, there is provided a method for estimating a level of unpleasant odor components in breath, the method including: an acquisition step of acquiring an image including a determination portion of a tongue body of a subject; and an estimation step of estimating the level of the unpleasant odor components in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired in the acquisition step and a relationship between the color of the determination portion of the tongue body and the level of the unpleasant odor components in breath, in which the determination portion includes a median tongue groove.

[0008]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, a ratio of an area of the determination portion included in the image to an area of a central tongue portion included in the image may be equal to or more than 0.3 and may be equal to or less than 1.8.

[0009]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the image including the determination portion of the tongue body of the subject may be captured by a capturing device including a monitor on which a tongue body positioning guide frame and the determination portion of the tongue body of the subject are displayed, and the tongue body positioning guide frame may be displayed on the monitor such that the ratio of the area of the determination portion included in the image to the area of the central tongue portion included in the image is equal to or more than 0.3 and is equal to or less than 1.8.

[0010]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, a distance between the determination portion of the tongue body of the subject and the capturing device that is configured to capture the determination portion of the tongue body of the subject may be 5 cm to 20 cm.

[0011]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the image including the determination portion of the tongue body of the subject may be captured by the capturing device having the number of pixels of 1.2 to 13.2 million pixels.

[0012]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the level of the unpleasant odor components in breath of the subject may be estimated to be higher as redness of the determination portion of the tongue body of the subject is weaker.

[0013]

For example, although a sRGB value is used as a parameter for measuring a color and the redness, instead, other parameters, such as HSV and $L^*a^*b^*$, may be used for measuring the color and the redness in other examples.

[0014]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the level of the unpleasant odor components in breath of the subject may be estimated based on a ratio of pixels in which an sRGB value is $R-G < 50$, occupied in all pixels in the determination portion.

[0015]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, it may be estimated that a density of hydrogen sulfide in breath of the subject is equal to or more than 450 ppb when a ratio of pixels, in which an sRGB value is $R-G < 50$, occupied in all pixels in the determination portion, is equal to or more than 60%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 300 ppb and is less than 450 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion, is equal to or more than 45% and is less than 60%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 150 ppb and is less than 300 ppb when the ratio of pixels, in which the sRGB is $R-G < 50$, occupied in all pixels in the determination portion, is equal to or more than 30% and is less than 45%, and it may be estimated that the density of hydrogen sulfide in breath of the subject is less than 150 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion, is less than 30%.

[0016]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the level of the unpleasant odor components in breath of the subject may be estimated based on the ratio of pixels in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion.

[0017]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, when the ratio of the pixels, in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion, is equal to or more than 30%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 450 ppb. When the ratio of pixels, in which the sRGB value is

R-G < 30, occupied in all pixels in the determination portion, is equal to or more than 20% and is less than 30%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 300 ppb and is less than 450 ppb. When the ratio of the pixels, in which the sRGB value is R-G < 30, occupied in all pixels in the determination portion, is equal to or more than 10% and is less than 20%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 150 ppb and is less than 300 ppb. When the ratio of the pixels, in which the sRGB value is R-G < 30, occupied in all pixels in the determination portion, is less than 10%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 150 ppb.

[0018]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, the level of the unpleasant odor components in breath of the subject may be estimated based on the ratio of pixels, in which the sRGB value over all the pixels in the determination portion is shown by (R, G, B) = (255 to 180, 255 to 180, and 255 to 180).

[0019]

In the method for estimating a level of unpleasant odor components in breath according to the present invention, when the ratio of pixels, in which the sRGB value over all the pixels in the determination portion is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180), is equal to or more than 60%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 450 ppb. When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180), is equal to or more than 45% and is less than 60%, it may be estimated that the density of hydrogen sulfide in breath of

the subject is equal to or more than 300 ppb and is less than 450 ppb. When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion is shown by $(R, G, B) = (255 \text{ to } 180, 255 \text{ to } 180, 255 \text{ to } 180)$, is equal to or more than 30% and is less than 45%, it may be estimated that the density of hydrogen sulfide in breath of the subject is equal to or more than 150 ppb and is less than 300 ppb. When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion is shown by $(R, G, B) = (255 \text{ to } 180, 255 \text{ to } 180, 255 \text{ to } 180)$ is less than 30%, it may be estimated that the density of hydrogen sulfide in breath of the subject is less than 150 ppb.

[0020]

According to the present invention, there is provided a device for estimating a level of unpleasant odor components in breath, the device including: an acquisition unit that is configured to acquire an image including a determination portion of a tongue body of a subject; and an estimation unit that is configured to estimate the level of the unpleasant odor components in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired by the acquisition unit and a relationship between the color of the determination portion of the tongue body and the level of the unpleasant odor components in breath.

[0021]

According to the present invention, there is provided a program causing a computer to execute an acquisition step of acquiring an image including a determination portion of a tongue body of a subject; and an estimation step of estimating a level of unpleasant odor components in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired in the acquisition step and a relationship between the color of the determination portion of the tongue body and the level of the unpleasant odor components in breath.

[0022]

According to the present invention, a bad breath care method may use the method for estimating a level of unpleasant odor components in breath.

[Advantageous Effects of Invention]

[0023]

According to the present invention, it is possible to provide a method for estimating a level of unpleasant odor components in breath, a device for estimating the level of the unpleasant odor components in breath, a program, and a bad breath care method, in which it is possible to estimate the level of the unpleasant odor components in breath using a simple method.

[Brief Description of Drawings]

[0024]

Fig. 1 is a diagram showing an example of a device for estimating a level of unpleasant odor components in breath according to an embodiment.

Fig. 2 is a diagram showing a relationship between a color of a determination portion of a tongue body and the level of the unpleasant odor components in breath.

Fig. 3 is a diagram showing an application example of the device for estimating the level of the unpleasant odor components in breath shown in Fig. 1.

Fig. 4 is a diagram showing an example of a capturing device shown in Fig. 3.

Fig. 5 is a diagram showing an image including the tongue body of a subject captured by a capturing unit of the capturing device.

Fig. 6 is a flowchart showing an example of a process performed by a capturing device in which the device for estimating the level of the unpleasant odor components in breath is embedded.

[Description of Embodiments]

[0025]

Hereinafter, with reference to the accompanying drawings, embodiments of a method for estimating a level of unpleasant odor components in breath, a device for estimating the level of the unpleasant odor components in breath, a program, and a bad breath care method of the present invention will be described.

Note that, in the drawings below, in order to make each component be seen easier, a scale of a dimension may be different depending on the component.

[0026]

Fig. 1 is a diagram showing an example of a device 1 for estimating the level of the unpleasant odor components in breath according to the embodiment.

In the example shown in Fig. 1, the device 1 for estimating the level of the unpleasant odor components in breath includes, for example, an acquisition unit 11 and an estimation unit 12. The acquisition unit 11 acquires an image including a determination portion of a tongue body of a subject. The estimation unit 12 estimates the level of the unpleasant odor components in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired by the acquisition unit 11 and a relationship between the color of the tongue body of the determination portion of the tongue body and the level of the unpleasant odor components in breath.

[0027]

Fig. 2 is a diagram showing the relationship between the color of the determination portion of the tongue body and the level of the unpleasant odor components in breath. In Fig. 2, a horizontal axis indicates the color of the determination portion of the tongue body. More specifically, the horizontal axis indicates strength and weakness of redness in the determination portion of the tongue

body. A vertical axis indicates the level of the unpleasant odor components in breath. In the example shown in Fig. 2, the weaker the redness of the determination portion of the tongue body, the higher the level of the unpleasant odor components in breath, and the stronger the redness of the determination portion of the tongue body, the lower the level of the unpleasant odor components in breath.

In the examples shown in Figs. 1 and 2, the estimation unit 12 estimates that the level of the unpleasant odor components in breath of the subject is higher as the redness of the determination portion of the tongue body of the subject included in the image acquired by the acquisition unit 11 is weaker. In addition, the estimation unit 12 estimates that the level of the unpleasant odor components in breath of the subject is low as the redness of the determination portion of the tongue body of the subject included in the image acquired by the acquisition unit 11 is strong.

[0028]

Fig. 3 is a diagram showing an application example of the device 1 for estimating the level of the unpleasant odor components in breath shown in Fig. 1.

In the example shown in Fig. 3, the device 1 for estimating the level of the unpleasant odor components in breath shown in Fig. 1 according to the embodiment is embedded in a capturing device A such as a smartphone owned by the subject. The capturing device A includes a capturing unit A1 such as a lens, a display unit A2 such as a monitor, and a control unit A3. The capturing unit A1 captures an image or the like of the tongue body of the subject. The display unit A2 displays, for example, the image or the like of the tongue body of the subject captured by the capturing unit A1. The control unit A3 controls the capturing unit A1 and the display unit A2. The device 1 for estimating the level of the unpleasant odor components in breath is embedded in the control unit A3.

In another example, the device 1 for estimating the level of the unpleasant odor components in breath according to the embodiment may be configured by a device other than the smartphone.

[0029]

Fig. 4 is a diagram showing an example of the capturing device A shown in Fig. 3. Specifically, (A) of Fig. 4 is a perspective view showing the capturing device A when an application for estimating the level of the unpleasant odor components in breath is not activated, the application being embedded in the capturing device A. (B) of Fig. 4 is a perspective view showing the capturing device A while the application for estimating the level of the unpleasant odor components in breath is being activated. (C) of Fig. 4 is a diagram showing a relationship between the capturing device A and a tongue body B1 of a subject B when the tongue body B1 of the subject B is captured. (D) of Fig. 4 is a diagram showing a screen or the like of the display unit A2 (monitor) of the capturing device A when the tongue body B1 of the subject B is captured.

In the example shown in Fig. 4, the capturing device A has, for example, the number of pixels of 1.2 to 13.2 million pixels. As shown in (A) of Fig. 4, when the application for estimating the level of the unpleasant odor components in breath is not activated, a tongue body positioning guide frame A21 is not displayed on the display unit A2 of the capturing device A. As shown in (B) of Fig. 4, for example, when the application for estimating the level of the unpleasant odor components in breath is activated by the subject B, the tongue body positioning guide frame A21 is displayed on the display unit A2 of the capturing device A. As shown in (C) and (D) of Fig. 4, when the tongue body B1 of the subject B is captured, the subject B makes an outline of the tongue body B1 of the subject B on the screen of the display unit A2 match the tongue body positioning guide frame A21. The capturing unit A1 captures an image of the

tongue body B1 of the subject B in a state in which the outline of the tongue body B1 of the subject B on the screen of the display unit A2 matches the tongue body positioning guide frame A21.

[0030]

Fig. 5 is a diagram showing an image C of the tongue body B1 of the subject B captured by the capturing unit A1 of the capturing device A.

In an example shown in Fig. 5, the image C captured by the capturing unit A1 of the capturing device A includes a determination portion B10 of the tongue body B1 of the subject B. The determination portion B10 is an area including at least a part of a median tongue groove B11. The median tongue groove B11 is a line (or a virtual line) that is located on an upper surface of the tongue body B1, that extends in a vertical direction of Fig. 5 from a terminal sulcus (a boundary between a tongue base (not shown) and the tongue body B1) to a tongue tip B13, and that divides the tongue body B1 into approximately two regions in a horizontal direction of Fig. 5.

That is, in the examples shown in Figs. 4 and 5, when the capturing unit A1 captures the image C of the tongue body B1 of the subject B in a state in which the outline of the tongue body B1 of the subject B on the screen of the display unit A2 matches the tongue body positioning guide frame A21, the determination portion B10 including at least a part of the median tongue groove B11 is included in the image C.

Preferably, the image C of the tongue body B1 of the subject B captured by the capturing unit A1 includes a central tongue portion B12.

In the present specification, the “central tongue portion” is a portion corresponding to 1/4 to 2/4 from the tongue tip B13 when the tongue body is divided into four regions from the terminal sulcus to the tongue tip B13 in a vertical direction, and indicates two regions (that is, a region surrounded by a broken line in Fig. 5 and is

denoted by reference numeral B12) on a central side when the tongue body B1 is divided into four regions in the horizontal direction from the middle.

Preferably, a ratio of an area of the determination portion B10 of the tongue body B1 of the subject B included in the image C to the central tongue portion B12 of the tongue body B1 of the subject B included in the image C is equal to or more than 0.3 and is equal to or less than 1.8.

When the image C of the tongue body B1 of the subject B is captured by the capturing unit A1, the image C of the tongue body B1 of the subject B may be captured such that the capturing unit A1 can specify a region which is surrounded by a dashed line in Fig. 5 and is indicated by reference numeral B12. The capturing unit A1 may perform capturing such that the region is included in the image C of the tongue body B1 of the subject B.

[0031]

Specifically, in the examples shown in Figs. 4 and 5, when the tongue body B1 of the subject B is captured, the tongue body positioning guide frame A21 and the determination portion B10 of the tongue body B1 of the subject B are displayed on the display unit A2 of the capturing device A, as shown in (D) of Fig. 4. In addition, in this state, the image C (see Fig. 5) including the determination portion B10 of the tongue body B1 of the subject B is captured by the capturing unit A1. As a result, a ratio of an area of the determination portion B10 to an area of the central tongue portion B12 included in the image C is equal to or more than 0.3 and is equal to or less than 1.8.

In addition, in the examples shown in Figs. 4 and 5, when the tongue body B1 of the subject B is captured, a distance between the determination portion B10 of the tongue body B1 of the subject B and the capturing device A is 5 cm to 20 cm.

[0032]

Fig. 6 is a flowchart showing an example of a process executed by the capturing device A embedded with the device 1 for estimating the level of the unpleasant odor components in breath.

In the example shown in Fig. 6, in step S10, the application for estimating the level of the unpleasant odor components in breath, the application being embedded in the capturing device A, is activated, and the display unit A2 of the capturing device A displays the tongue body positioning guide frame A21.

In step S11, the subject B causes the outline of the tongue body B1 of the subject B on the screen of the display unit A2 to match the tongue body positioning guide frame A21, and the capturing unit A1 of the capturing device A captures the image C including the determination portion B10 of the tongue body B1 of the subject B. The image C captured by the capturing unit A1 is stored in, for example, a storage unit (not shown).

In step S12, the acquisition unit 11 of the control unit A3 of the capturing device A acquires the image C including the determination portion B10 of the tongue body B1 of the subject B captured by the capturing unit A1. Specifically, the acquisition unit 11 acquires the image C by reading out the image C stored in, for example, the storage unit.

In step S13, the estimation unit 12 of the control unit A3 of the capturing device A estimates the level of the unpleasant odor components in breath of the subject B based on the color of the determination portion B10 of the tongue body B1 included in the image C acquired by the acquisition unit 11 and the relationship shown in Fig. 2.

In step S14, for example, the display unit A2 of the capturing device A outputs a result of the estimation of the level of the unpleasant odor components in breath of the subject B by the estimation unit 12.

[0033]

As described above, in the example shown in Fig. 3, the device 1 for estimating the level of the unpleasant odor components in breath is embedded in the capturing device A. In another example, the device 1 for estimating the level of the unpleasant odor components in breath may be provided, for example, on an outside of the capturing device A such as a cloud.

[0034]

As described above, according to the device 1 for estimating the level of the unpleasant odor components in breath of the embodiment, it is not necessary to use an extremely expensive analyzer such as gas chromatography, and it is possible to estimate the level of the unpleasant odor components in breath by a simple method.

In addition, in the above-described example to which the device 1 for estimating the level of the unpleasant odor components in breath of the embodiment is applied, the subject B does not need to use the extremely expensive analyzer such as the gas chromatography, and is capable of recognizing the level of the unpleasant odor components in breath of the subject B.

[0035]

Hereinafter, although the present invention will be described in detail with reference to examples, the present invention is not limited to the following examples, appropriate modifications are possible without departing from the scope of the invention.

In the following examples, although an sRGB value is used as a parameter for measuring the color and the redness, other parameters, such as HSV and $L^*a^*b^*$, are used for measuring the color and the redness in other examples.

[0036]

[Examples 1 to 9 and Comparative Examples 1 to 4]

One panelist is fixed, the determination portion B10 including the median tongue groove B11 is captured while changing a time zone, and the tongue body B1 is ranked based on the following reference. In addition, breath of the panelist is analyzed by the gas chromatography (product name: Oral Chroma, manufactured by FIS, Inc), and the bad breath is ranked according to the following reference. Note that, oral chroma is analyzed according to a procedure manual attached to a device.

As a result of check performed on matching characters of results of A-a, B-b, C-c, and D-d for a rank of a tongue and a rank of the bad breath, the rank of the tongue matches the rank of the bad breath when the median tongue groove B11 is included in the determination portion B10 and an area ratio of the determination portion B10 to the central tongue portion B12 is included in a range of Examples 1 to 9. On the other hand, when the determination portion B10 does not include the median tongue groove B11, the rank of the tongue does not match any state of the rank of the bad breath.

From this, in order to improve a determination accuracy of the bad breath, it is considered that it is important to cause a whole or a part of the median tongue groove B11 to be included in the determination portion B10. Note that, in this examination, the tongue body B1 is captured using iphone7 (manufactured by Apple Inc.) as a capturing machine in a self-portrait mode using an in-camera. Capturing is performed under an indoor environment with an illuminance of 500 to 1200 lux.

Table 1 represents the rank of the tongue and the rank of the bad breath according to Examples 1 to 9. Table 2 represents the rank of the tongue and the rank of the bad breath according to Comparative Examples 1 to 4.

[0037]

<Reference of Rank of Tongue>

A: A ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels

in the determination portion B10, is equal to or more than 60% (the redness of the tongue body B1 is less).

B: The ratio of the pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is equal to or more than 45% and is less than 60% (the redness of the tongue body B1 is slightly less).

C: The ratio of the pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is equal to or more than 30% and is less than 45% (the redness of the tongue body B1 is slightly large).

D: The ratio of the pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is less than 30% (the redness of the tongue body B1 is large).

[0038]

<Reference of Rank of Bad Breath>

a: A hydrogen sulfide density in breath is equal to or more than 450 ppb.

b: The hydrogen sulfide density in breath is equal to or more than 300 ppb and is less than 450 ppb.

c: The hydrogen sulfide density in breath is equal to or more than 150 ppb and is less than 300 ppb.

d: The hydrogen sulfide density in breath is less than 150 ppb.

[0039]

That is, in the examples 1 to 9, the estimation unit 12 estimates the level of the unpleasant odor components in breath of the subject B based on the ratio of the pixels in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10.

[0040]

[Table 1]

	Example								
	1	2	3	4	5	6	7	8	9
Capturing distance (cm)	10	10	10	10	10	10	10	10	10
Image resolution (10000 pixels)	700	700	700	700	700	700	700	700	700
Existence/non-existence of median tongue groove in determination portion	Existence	Existence	Existence	Existence	Existence	Existence	Existence	Existence	Existence
Area of determination portion/area of central tongue portion	1	1	1	1	1.2	1.5	1.8	0.8	0.4
Rank of tongue	A	B	C	D	B	B	B	B	B
Rank of bad breath	a	b	c	d	b	b	b	b	b

[0041]

[Table 2]

	Comparative Example			
	1	2	3	4
Capturing distance (cm)	10	10	10	10
Image resolution (10000 pixels)	700	700	700	700
Existence/non-existence of median tongue groove in determination portion	Non-existence	Non-existence	Non-existence	Non-existence
Area of determination portion/area of central tongue portion	0.4	0.4	0.4	0.4
Rank of tongue	C	C	D	A
Rank of bad breath	a	b	c	d

[0042]

The same results are obtained even when an index “R-B” is used instead of the above-described index “R-G”.

[0043]

[Examples 10 to 17]

The number of panelists is set to 5, and the tongue body B1 of each person is captured and the bad breath (the hydrogen sulfide density in breath) is measured 10 number of times while changing the time zone.

Based on a probability of matching A-a (that is, a probability that the density of hydrogen sulfide in breath of the subject B is equal to or more than 450 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is equal to or more than 60%), a probability of matching B-b

(that is, a probability that the density of hydrogen sulfide in breath of the subject B is equal to or more than 300 ppb and is less than 450 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is equal to or more than 45% and is less than 60%), a probability of matching C-c (that is, a probability that the density of hydrogen sulfide in breath of the subject B is equal to or more than 150 ppb and is less than 300 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is equal to or more than 30% and is less than 45%), and a probability of matching D-d (that is, a probability that the density of hydrogen sulfide in breath of the subject B is less than 150 ppb when the ratio of pixels, in which the sRGB value is $R-G < 50$, occupied in all pixels in the determination portion B10, is less than 30%), the matching character is ranked according to the following reference.

As a result, when the ratio of the area of the determination portion B10 included in the image C to the area of the central tongue portion B12 included in the image C is equal to or more than 0.3 and is equal to or less than 1.8, a high matching character is exhibited. Specifically, when the ratio of the area of the determination portion B10 included in the image C to the central tongue portion B12 included in the image C is equal to or more than 0.4 and is equal to or less than 1.5, a higher matching character is exhibited. When the ratio of the area of the determination portion B10 included in the image C to the central tongue portion B12 included in the image C is equal to or more than 0.6 and is equal to or less than 1.2, a further higher matching character is exhibited.

Note that, in this examination, the tongue body B1 is captured using the iPhone7 (manufactured by Apple Inc.) in the self-portrait mode using the in-camera. Capturing is performed under the indoor environment with an illuminance of 500 to 1200 lux.

Table 3 represents the matching characters, matching ratios, and the like of Examples 10 to 17.

[0044]

<Matching Character>

AA: A matching ratio of the rank of the tongue to the rank of the bad breath is equal to or more than 75%.

BB: The matching ratio of the rank of the tongue to the rank of the bad breath is equal to or more than 60 and is less than 75%.

CC: The matching ratio of the rank of the tongue to the rank of the bad breath is equal to or more than 45 and is less than 60%.

DD: The matching ratio of the rank of the tongue to the rank of the bad breath is equal to or more than 30 and is less than 45%.

EE: The matching ratio of the rank of the tongue to the rank of the bad breath is less than 30%.

In this examination, the matching ratio which is equal to or more than CC is accepted.

[0045]

[Table 3]

	Example							
	10	11	12	13	14	15	16	17
Capturing distance (cm)	10	10	10	10	10	10	10	10
Image resolution (10000 pixels)	700	700	700	700	700	700	700	700
Existence/non-existence of median tongue groove in determination portion	Existence	Existence	Existence	Existence	Existence	Existence	Existence	Existence
Area of determination portion/area of central tongue portion	0.3	0.4	0.6	0.8	1	1.2	1.5	1.8
Matching character	CC	BB	AA	AA	AA	AA	BB	CC
Matching ratio	56	70	76	84	90	82	74	58

[0046]

[Examples 18 to 22]

The area ratio of the determination portion B10 to the central tongue portion B12 is set to 1 (that is, the area ratio of the central tongue portion B12 to the determination portion B10 is set to 1), and the same experiment is performed while changing the cameras. As a result, the high matching character is exhibited in a range of 1.2 million to 13.2 million pixels. Specifically, the matching character is high in 2 to 12 million pixels, and the matching character is higher in 5 to 10 million pixels. Table 4 represents the matching characters, the matching ratios, and the like of Examples 18 to 22.

[0047]

<Used camera>

5 million pixels: iPhone6s manufactured by Apple Inc.)

8 million pixels: ZTE BLADE V7 Lite (manufactured by ZTE Japan Corporation)

13.2 million pixels: XperiaXZ (manufactured by Sony Corporation)

2.2 million pixels: Xperia A4 (manufactured by Sony Corporation)

1.2 million pixels: iPhone6 (manufactured by Apple Inc.)

[0048]

[Table 4]

	Example				
	18	19	20	21	22
Capturing distance (cm)	10	10	10	10	10
Image resolution (10000 pixels)	500	800	1320	220	120
Existence/non-existence of median tongue groove in determination portion	Existence	Existence	Existence	Existence	Existence
Area of determination portion/area of central tongue portion	1	1	1	1	1
Matching character	AA	AA	BB	BB	CC
Matching ratio	88	88	74	70	54

[0049]

[Examples 23 to 26]

The same experiment is performed while changing a capturing distance. The capturing machine used is iPhone7. The matching character is high when the distance is 5 to 20 cm, and the matching character is higher when the distance is 15 cm. Table 5 represents the matching characters, the matching ratios, and the like of Examples 23 to 26.

[0050]

[Table 5]

	Example			
	23	24	25	26
Capturing distance (cm)	15	20	30	5
Image resolution (10000 pixels)	700	700	700	700
Existence/non-existence of median tongue groove in determination portion	Existence	Existence	Existence	Existence
Area of determination portion/area of central tongue portion	1	1	1	1
Matching character	AA	BB	CC	BB
Matching ratio	88	72	54	74

[0051]

[Comparative Examples 5 to 8]

When the median tongue groove B11 is not included in the determination portion B10, sufficient accuracy is not obtained in any case. Table 6 represents the matching characters, the matching ratios, and the like of comparative examples 5 to 8.

[0052]

[Table 6]

	Comparative Example			
	5	6	7	8
Capturing distance (cm)	10	5	10	10
Image resolution (10000 pixels)	700	700	120	700
Existence/non-existence of median tongue groove in determination portion	Non-existence	Non-existence	Non-existence	Non-existence
Area of determination portion/area of central tongue portion	0.4	0.4	0.4	0.3
Matching character	DD	EE	EE	EE
Matching ratio	44	28	22	28

[0053]

<Determination Portion B10>

The above-described determination portion B10 is a determination portion (a portion used for estimation), and it is possible to randomly adjust a range thereof. The range of the determination portion B10 is not particularly limited except that the determination portion B10 includes the median tongue groove B11. Preferably, the ratio of the area of the determination portion B10 included in the image C to the area of the central tongue portion B12 included in the image C is equal to or more than 0.3 and is equal to or less than 1.8. More preferably, the ratio of the area of the determination portion B10 included in the image C to the area of the central tongue portion B12 included in the image C is equal to or more than 0.4 and is equal to or less than 1.5. More preferably, the ratio of the area of the determination portion B10 included in the image C to the area of the central tongue portion B12 included in the image C is equal to or more than 0.6 and is equal to or less than 1.2. In a case where the ranges are set, a high determination accuracy (estimation accuracy) is maintained.

[0054]

The determination portion B10 may include the whole or a part of the median tongue groove B11.

Although a method for cutting out the determination portion B10, the shape of the determination portion B10, and the like are not particularly limited, a shape which is difficult to protrude from an outer diameter shape (outline) of the tongue body B1 may be used. A polygon more than a quadrangle is preferred.

[0055]

<Number of Pixels>

Although the number of pixels of the capturing machine (capturing device A) used in the present specification is not particularly limited, 1.2 million to 13.2 million pixels are preferable, 2.2 million to 8 million pixels are more preferable, and 5 million to 8 million pixels are further more preferable. In a case where the ranges are set, a high determination accuracy is maintained.

In addition, it is preferable that an image sensor of the capturing machine used in the present specification is equal to or less than f2.8.

[0056]

<Description of Unpleasant Components of Bad Breath>

The unpleasant components of the bad breath the present specification is a volatile sulfur compound. The components include hydrogen sulfide, methyl mercaptan, and dimethyl sulfoxide. The hydrogen sulfide and the methyl mercaptan among the components are preferable from a viewpoint of the matching character. Among the components, the hydrogen sulfide is most preferable.

[0057]

<Measurement Environment>

Although the capturing environment is not particularly limited, it preferable to perform measurement in an indoor environment having illuminance which is equal to or more than 150 lux, and it is more preferable to perform measurement with illumination

which is equal to or more than 300 lux. Although there is no particular upper limit, in an environment which is equal to or more than 100000 lux, reflection by saliva on the tongue body B1 is likely to occur, thereby lowering a measurement accuracy.

It is preferable that no shadow appears on the tongue body B1 when capturing is performed. A flash may be used. In the present invention, use of the flash does not particularly influence the determination accuracy (estimation accuracy).

Although the capturing distance is not particularly limited, it is preferable to perform capturing at a distance of 5 to 30 cm from the determination portion B10 of the tongue body B1, it is more preferable to perform capturing at a distance of 5 to 20 cm, and it is still more preferable to perform capturing at 10 to 15 cm. When the distance is too close, the shadow is likely to occur, and thus there is a possibility of influencing the determination accuracy (estimation accuracy). In order to maintain the capturing distance constant, it is preferable to provide the tongue body positioning guide frame A21 for specifying the position of the tongue body B1 on the display unit A2 of the capturing device A. In addition, when the capturing distance is separated in order to exclude an influence of the shadow, it is also effective to use a zoom function for stabilizing analysis accuracy (estimation accuracy).

[0058]

<Classification on Bad Breath Level>

When determining (estimating) a bad breath level, it is preferable to perform classification into 3 to 4 levels in terms of accuracy.

[0059]

<Method for Ranking Tongue>

A method for ranking the tongue is not limited to the method obtained from the ratio of the pixels in which the sRGB value is $R-G < 50$, occupied in all pixels in the

determination portion B10. In addition, an excellent determination accuracy (matching character) of the bad breath level may be obtained even using a method obtained from the ratio of pixels shown by $R-B < 50$.

[0060]

In another example, the level of the unpleasant odor components in breath of the subject B is estimated based on the ratio of the pixels in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion B10.

Specifically, when the ratio of the pixels, in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion B10, is equal to or more than 30%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 450 ppb.

When the ratio of pixels, in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion B10, is equal to or more than 20% and is less than 30%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 300 ppb and is less than 450 ppb.

When the ratio of pixels, in which the sRGB value is $R-G < 30$, occupied in all pixels in the determination portion B10, is equal to or more than 10% and is less than 20%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 150 ppb and is less than 300 ppb.

When the ratio of pixels having an sRGB value is $R-G < 30$, occupied in all pixels in the determination portion B10, is less than 10%, it is estimated that the density of hydrogen sulfide in breath of the subject B is less than 150 ppb.

Even in this example, the subject B does not need to use the extremely expensive analytical instrument such as the gas chromatography, and is capable of recognizing the level of the unpleasant odor components in breath of the subject B.

The same results are obtained when the index “R-B” is used instead of the above-described index “R-G”.

[0061]

In further another example, based on the ratio of pixels, in which the sRGB value over all the pixels in the determination portion B10 is shown by (R, G, B) = (255 to 180, 255 to 180, and 255 to 180), the level of the unpleasant odor components in breath of the subject B is estimated.

Specifically, when the ratio of pixels, in which the sRGB value over all the pixels in the determination portion B10 is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180), is equal to or more than 60%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 450 ppb.

When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion B10 is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180), is equal to or more than 45% and is less than 60%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 300 ppb and is less than 450 ppb.

When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion B10 is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180), is equal to or more than 30% and is less than 45%, it is estimated that the density of hydrogen sulfide in breath of the subject B is equal to or more than 150 ppb and is less than 300 ppb.

When the ratio of pixels, in which the sRGB value over all the pixels in the determination portion B10 is shown by (R, G, B) = (255 to 180, 255 to 180, 255 to 180) is less than 30%, it is estimated that the density of hydrogen sulfide in breath of the subject B is less than 150 ppb.

Even in this example, the subject B does not need to use the extremely expensive analytical instrument such as the gas chromatography, and is capable of recognizing the level of the unpleasant odor components in breath of the subject B.

In the example, it is preferable that brightness of the external environment is equal to or more than 500 lux. In addition, it is desired that the capturing machine does not use the flash.

[0062]

In a case where the method for estimating the level of the unpleasant components in breath according to the present invention, it is possible to appropriately suppress the bad breath. It is preferable to use the method of the present invention when suppressing physiological bad breath in the bad breath.

[0063]

As a preferred bad breath care preparation for checking the bad breath suppression effect using the method of the present invention, a preparation containing an odor masking component such as a fragrance is preferable. When the method of the present invention is used with the preparation, it is possible to correctly check a suppression effect of the physiological bad breath without being influenced by the masking component. Although a dosage form is not particularly limited in a case where a flavor component is contained, a sheet or a tablet is particularly preferable.

[0064]

Hereinabove, although the preferred embodiment according to the present invention is described with reference to the accompanying drawings, it is apparent that the present invention is not limited to the examples. It is clear that those skilled in the art can conceive various change examples or modification examples in the scope of the

technical idea described in the claims, and it is understood that the examples belong to the technical scope of the present invention.

[0065]

Note that, all or a part of the functions of the respective units included in the device 1 for estimating the level of the unpleasant odor components in breath in the above-described embodiment may be realized by recording a program for realizing the functions in a computer-readable recording medium and by causing a computer system to read and execute the program recorded on the recording medium. Note that, here, the “computer system” includes an OS and hardware such as peripheral devices.

In addition, the “computer-readable recording medium” refers to a portable medium such as a flexible disk, a magneto-optical disk, a ROM, and a CD-ROM, and a storage unit such as a hard disk built in a computer system. Further, the “computer-readable recording medium” may include a medium which dynamically holds a program for a short time like a communication line in a case of transmitting the program through a network such as the Internet or a communication line such as a telephone line, and a medium which holds a program for a certain period of time like a volatile memory in a computer system serving as a server or a client in the case. In addition, the above-mentioned program may be provided to realize a part of the above-mentioned functions, or may be realized by combining the above-mentioned functions with a program already recorded in the computer system.

[Reference Signs List]

[0066]

- 1 Device for estimating level of unpleasant odor components in breath
- 11 Acquisition unit
- 12 Estimation unit

A: Capturing device

A1 Capturing unit

A2 Display unit

A21 Tongue body positioning guide frame

A3 Control unit

B Subject

B1 Tongue body

B10 Determination portion

B11 Median tongue groove

B12 Central tongue portion

B13 Tongue tip

C Image

[CLAIMS]

What is claimed is:

[Claim 1]

A method for estimating a level of volatile sulfur compound in breath, the method comprising:

an acquisition step of acquiring an image including a determination portion of a tongue body of a subject; and

an estimation step of estimating the level of the volatile sulfur compound in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired in the acquisition step and a relationship between the color of the determination portion of the tongue body and the level of the volatile sulfur compound in breath,

wherein the level of the volatile sulfur compound in breath of the subject is estimated to be higher as redness of the determination portion of the tongue body of the subject is weaker,

wherein the determination portion includes a median tongue groove included in a central tongue portion that is a portion corresponding to $1/4$ to $2/4$ from a tongue tip when the tongue body is divided into four regions from a terminal sulcus to the tongue tip in a vertical direction, and

wherein a ratio of an area of the determination portion included in the image to an area of the central tongue portion included in the image is equal to or more than 0.3 and is equal to or less than 1.8.

[Claim 2]

The method for estimating a level of volatile sulfur compound in breath according to claim 1,

wherein the image including the determination portion of the tongue body of the subject is captured by a capturing device including a monitor on which a tongue body positioning guide frame and the determination portion of the tongue body of the subject are displayed, and

wherein the tongue body positioning guide frame is displayed on the monitor such that the ratio of the area of the determination portion included in the image to the area of the central tongue portion included in the image is equal to or more than 0.3 and is equal to or less than 1.8.

[Claim 3]

The method for estimating a level of volatile sulfur compound in breath according to claim 2,

wherein a distance between the determination portion of the tongue body of the subject and the capturing device that is configured to capture the determination portion of the tongue body of the subject is 5 cm to 20 cm.

[Claim 4]

The method for estimating a level of volatile sulfur compound in breath according to claim 3,

wherein the image including the determination portion of the tongue body of the subject is captured by the capturing device having the number of pixels of 1.2 to 13.2 million pixels.

[Claim 5]

The method for estimating a level of volatile sulfur compound content in breath according to claim 4,

wherein the level of the volatile sulfur compound in breath of the subject is estimated based on a ratio of pixels in which an sRGB value is $R-G < 50$, occupied in all pixels in the determination portion.

[Claim 6]

A device for estimating a level of volatile sulfur compound in breath, the device comprising:

an acquisition unit that is configured to acquire an image including a determination portion of a tongue body of a subject; and

an estimation unit that is configured to estimate the level of the volatile sulfur compound in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired by the acquisition unit and a relationship between the color of the determination portion of the tongue body and the level of the volatile sulfur compound in breath,

wherein the level of the volatile sulfur compound in breath of the subject is estimated to be higher as redness of the determination portion of the tongue body of the subject is weaker,

wherein the determination portion includes a median tongue groove included in a central tongue portion that is a portion corresponding to $1/4$ to $2/4$ from a tongue tip when the tongue body is divided into four regions from a terminal sulcus to the tongue tip in a vertical direction, and

wherein a ratio of an area of the determination portion included in the image to an area of the central tongue portion included in the image is equal to or more than 0.3 and is equal to or less than 1.8.

[Claim 7]

A program causing a computer to execute

an acquisition step of acquiring an image including a determination portion of a tongue body of a subject; and

an estimation step of estimating a level of volatile sulfur compound in breath of the subject based on a color of the determination portion of the tongue body included in the image acquired in the acquisition step and a relationship between the color of the determination portion of the tongue body and the level of the volatile sulfur compound in breath,

wherein the level of the volatile sulfur compound in breath of the subject is estimated to be higher as redness of the determination portion of the tongue body of the subject is weaker,

wherein the determination portion includes a median tongue groove included in a central tongue portion that is a portion corresponding to $1/4$ to $2/4$ from a tongue tip when the tongue body is divided into four regions from a terminal sulcus to the tongue tip in a vertical direction, and

wherein a ratio of an area of the determination portion included in the image to an area of the central tongue portion included in the image is equal to or more than 0.3 and is equal to or less than 1.8.

[Claim 8]

A bad breath care method using the method for estimating a level of volatile sulfur compound in breath according to any one of claims 1 to 7.