Fig. 4 shows an example of information stored in a storage unit 150.

Fig. 5 shows an example of operation flow S10 of the mobile apparatus 10.

Fig. 6 schematically shows the exterior of another mobile apparatus 12.

Fig. 7 schematically shows function blocks of still another mobile apparatus 16.

Fig. 8(a) schematically shows the exterior of the front of still another mobile apparatus 50.

Fig. 8(b) schematically shows the exterior of a side of still another mobile apparatus 50.

Fig. 9(a) schematically shows the exterior of the front of still another mobile apparatus 52.

Fig. 9(b) schematically shows the exterior of a side of still another mobile apparatus 52.

Fig. 10(a) schematically shows the exterior of the front of still another mobile apparatus 54.

Fig. 10(b) schematically shows the exterior of a side of still another mobile apparatus 54.

Fig. 11(a) schematically shows the exterior of the front of still another mobile apparatus 56.

Fig. 11(b) schematically shows the exterior of a side of still another mobile apparatus 56.

Fig. 12 schematically shows function blocks of a food characteristics determination system 22 according to the second embodiment.

Fig. 13(a) shows an example of determining “Color 1” as a characteristic of “Tomato” as a kind of a food product using the mobile apparatus 10 according to the first embodiment.

Fig. 13(b) shows an example of determining “Color 1” as a characteristic of “Tomato” as a kind of a food product using the mobile apparatus 10 according to the first embodiment.

Fig. 13(c) shows an example of determining “Color 1” as a characteristic of “Tomato” as a kind of a food product using the mobile apparatus 10 according to the first embodiment.

Fig. 14 shows an example of determining “Sugar content” as a characteristic of “Muscat” as a kind of a food product using the mobile apparatus 10 according to the first embodiment.

Fig. 15 shows an example of determining “Acidity” as a characteristic of “Muscat” as a kind of a food product using the mobile apparatus 10 according to the first embodiment.

[0023] The storage unit 150 is configured to store a kind of food product, a characteristic of the food product, and information about light in association with each other. The determination unit 160 is configured to determine a characteristic of the food product to output the characteristic of the food product, by referring to the storage unit 150, based on the measured value output from the spectroscope 120 and the kind of the food product identified by the identification unit 140.

[0024] Fig. 4 shows an example of information stored in the storage unit 150. As described above, the kinds of food products, characteristics of the food products, and information about light are associated with each other.

[0025] The kinds of food products are greengrocery products such as a tomato, an apple, and a pumpkin, for example. The characteristics of food products include at least any of color, sugar content, acidity, maturity, firmness, or a functional ingredient amount. In the example in Fig. 4, in association with “Tomato” as a kind of a food product, color 1, color 2, sugar content, acidity, maturity, firmness, functional ingredient amount 1, and functional ingredient amount 2 are associated as characteristics of the food product. Examples of color 1 and 2 are red and green. Examples of functional ingredient amount 1 and 2 are the amount of chlorophyll and the amount of lycopene. The characteristic of the food product to be determined may be different for each kind of the food product. In the example in Fig. 4, although sugar content, acidity, and maturity are associated with “Apple” as a kind of a food product, functional ingredient amount 1 and 2 are not associated with it.

[0026] The information about light may be an amount of light at a specific wavelength such as for color 1 or may be a calibration curve representing the correlation between a value of a food product and a measured value such as for the sugar content. In the example in Fig. 4,

apparatus 12, in addition to the effects of the mobile apparatus 10. Note that, instead of the entire spectroscopy unit 14 being detachable, the radiating unit 110 and/or the spectroscope 120 may be detachable from the body 100 individually. In addition, a part of the radiating unit 110, a source of light in the near-infrared band and/or the ultraviolet band may be detachable.

[0042] Fig. 7 schematically shows function blocks of still another mobile apparatus 16. The mobile apparatus 16 is the same as the mobile apparatus 10 except for parts that will be described in particular.

[0043] In the case of the mobile apparatus 16, the information stored in the storage unit 150 of the mobile apparatus 10 is stored in an external server 18. The mobile apparatus 16 is configured to refer to the information stored in the server 18 by communicating with the server 18 via a communication unit 170. The server 18 is a server serving the Agricultural Data Collaboration Platform (WAGRI), for example.

[0044] Thus, the mobile apparatus 16 has its effect of allowing utilizing the latest, large amounts of information stored in the server 18, in addition to the effects of the mobile apparatus 10. Note that, some pieces of the information stored in the storage unit 150 of the mobile apparatus 10, such as a piece of information that may be often used and a piece of information that was used in the past, may be stored in the mobile apparatus 16.

[0045] Fig. 8 (a) and Fig. 8(b) schematically show the exteriors of the front and a side of still another mobile apparatus 50. The mobile apparatus 50 is the same as the mobile apparatus 10 except for parts that will be described in particular.

[0046] In the mobile apparatus 50, the spectroscope 120 is arranged in an opposing position to the radiating unit 110 by an arm 124 having an arc shape extending from the sample holder

102. This allows the spectroscope 120 to perform spectroscopy and measurement of specularly transmitted light, which is light of the radiating unit 110 transmitted through the food product 32. In this case, information in the storage unit 150 in Fig. 4 is preferably information corresponding to measured quantities obtained by performing spectroscopy of the specularly transmitted light. Note that, the arm 124 may be hard so that the shape does not change or may be soft so that the shape can change. Note that, in the sample holder 102, an optical system 126 such as a lens is arranged.

[0047] Fig. 9(a) and Fig. 9(b) schematically show the exteriors of the front and a side of still another mobile apparatus 52. The mobile apparatus 52 is the same as the mobile apparatus 50 except for parts that will be described in particular.

[0048] In the mobile apparatus 52, the spectroscope 120 is arranged sideways relative to the radiating unit 110 by the arm 124 having an arc shape extending from the sample holder 102. This allows the spectroscope 120 to perform spectroscopy and measurement of diffusely transmitted light, which is light of the radiating unit 110 transmitted through the food product 32. In this case, information of the storage unit 150 in Fig. 4 is preferably information corresponding to measured quantities obtained by performing spectroscopy of the diffusely transmitted light.

[0049] Fig. 10(a) and Fig. 10(b) schematically show the exteriors of the front and a side of still another mobile apparatus 54. The mobile apparatus 54 is the same as the mobile apparatus 10 except for parts that will be described in particular.

[0050] In the mobile apparatus 54, in addition to the spectroscope 120, another spectroscope 122 is provided, and the spectroscope 122 is arranged in an opposing position to the radiating unit 110 by the arm 124 having an arc shape extending from the sample holder

102. This allows the spectroscope 120 to perform spectroscopy of scattered light of the food product 32 and additionally allows the spectroscope 122 to perform spectroscopy and measurement of specularly transmitted light transmitted through the food product 32.

[0051] In this case, information about light in the storage unit 150 in Fig. 4 is preferably stored in further association with the distinction between scattered light and specularly transmitted light. The determination unit 160 is configured to determine a characteristic of the food product 32 further based on whether a measured value is of scattered light or specularly transmitted light.

[0052] Fig. 11(a) and Fig. 11(b) schematically show the exteriors of the front and a side of still another mobile apparatus 56. The mobile apparatus 56 is the same as the mobile apparatus 54 except for parts that will be described in particular.

[0053] In the mobile apparatus 56, in addition to the spectroscope 120, another spectroscope 122 is provided, and the spectroscope 122 is arranged sideways relative to the radiating unit 110 by the arm 124 having an arc shape extending from the sample holder 102. This allows the spectroscope 120 to perform spectroscopy of scattered light of the food product 32 and additionally allows the spectroscope 122 to perform spectroscopy and measurement of diffusely transmitted light transmitted through the food product 32.

[0054] In this case, information about light in the storage unit 150 in Fig. 4 is preferably stored in further association with the distinction between scattered light and diffusely transmitted light. The determination unit 160 is configured to determine a characteristic of the food product 32 based on whether a measured value is of scattered light or diffusely transmitted light.

light range, and the ultraviolet band. Instead, only light in a band corresponding to a measured value corresponding to a characteristic to be determined may be radiated. Also, only a measured value corresponding to a characteristic to be determined may be output from the spectroscopes 120, 122.

[0066] Also, in any of the embodiments described above, image-capturing of a food product and identification of the kind may be performed before or may be performed after radiation of light and measurement of spectroscopy. Also, in any of the embodiments described above, the mobile apparatus may be a special-purpose apparatus for determining a characteristic of a food product instead of a general-purpose information communication terminal.

[0067] [Example 1]

Fig. 13(a), Fig. 13(b), and Fig. 13(c) show an example of determining “Color 1” as a characteristic of “Tomato” as a kind of a food product using the mobile apparatus 10 according to the first embodiment. Fig. 13(a) is a picture on day 1 of the exteriors of tomatoes, each of which is individually identified by numbers 1 to 8, and Fig. 13(b) is a picture on day 11 of the exteriors of the same tomatoes.

[0068] Fig. 13(c) shows the measurement result of color 1 of each tomato described above. While the developments of color 1, which is redness, of all of the tomatoes as the days passed are shown in the same figure, it can be read about the result that each of them converges at values like limit values.

[0069] [Example 2]

Fig. 14 shows an example of determining “Sugar content” as a characteristic of “Muscat” as a kind of a food product using the mobile apparatus 10 according to the first

WHAT IS CLAIMED IS:

1. A mobile apparatus, comprising:

a radiating unit configured to radiate light;

a spectroscope configured to perform spectroscopy of light entered to output a measured value;

an identification unit configured to identify a kind of a food product corresponding to the light entered the spectroscope; and

a determination unit configured to determine a characteristic of the food product to output the characteristic of the food product, by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output from the spectroscope and the kind of the food product identified by the identification unit;

the spectroscope includes a first spectroscope measuring a transmitted light transmitted through the food product and a second spectroscope measuring a scatterd light scattered by the food product, the first spectroscope and the second spectroscope are located in different places from each other.

2. A mobile apparatus, comprising:

a radiating unit configured to radiate light;

a spectroscope configured to perform spectroscopy of light entered to output a measured value;

an identification unit configured to identify a kind of a food product corresponding to the light entered the spectroscope; and

a determination unit configured to determine a characteristic of the food product to output the characteristic of the food product, by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output from the spectroscope and the kind of the food product identified by the identification unit;

the spectroscope includes an arc-shaped arm capable of measuring a transmitted light through the food product.

3. The mobile apparatus according to claims 1 or 2, wherein the mobile apparatus is a general-purpose information communication terminal configured to fulfill a function corresponding to an installed application.

4. The mobile apparatus according to claim 3, wherein the spectroscope is detachable.

5. The mobile apparatus according to claim 3 or 4, wherein the radiating unit is detachable.

6. The mobile apparatus according to any one of claims 1 to 5, further comprising:

an image-capturing unit configured to generate an image by image-capturing, wherein

the identification unit is configured to identify the kind of the food product based on the image.

7. The mobile apparatus according to claim 6, wherein

the information about light is stored in the storage unit in further association with a part of the food product,

the identification unit is configured to identify the part of the food product based on the image, and

the determination unit is configured to determine the characteristic of the food product further based on the part of the food product.

8. The mobile apparatus according to any one of claims 1 to 7, wherein the characteristic of the food product includes at least any one of color, sugar content, acidity, maturity, firmness, or a functional ingredient amount.

9. The mobile apparatus according to any one of claims 1 to 8, wherein the radiating unit is configured to radiate light in a visible light band, and the spectroscope is configured to have sensitivity to the visible light band.

10. The mobile apparatus according to any one of claims 1 to 8, wherein the radiating unit is configured to radiate light in a near-infrared band, and the spectroscope is configured to have sensitivity to the near-infrared band.

11. The mobile apparatus according to any one of claims 1 to 10, wherein the radiating unit is configured to radiate light in an ultraviolet band, and the spectroscope is configured to have sensitivity to the ultraviolet band.

12. The mobile apparatus according to any one of claims 1 to 11, wherein

the information about light is stored in the storage unit in further association with a distinction between scattered light and transmitted light, and

the determination unit is configured to determine the characteristic of the food product further based on whether the measured value is of scattered light or transmitted light.

13. A food characteristics determination device, comprising:

a storage unit configured to store a kind of food product, a characteristic of the food product, and information about light in association with each other;

a communication unit configured to communicate with a mobile apparatus; and

a determination unit configured to determine a characteristic of a food product by acquiring a kind of the food product and a measured value of spectroscopy from the mobile

apparatus via the communication unit and referring to the storage unit, and output the characteristic of the food product to the mobile apparatus via the communication unit;

the mobile apparatus includes a spectroscope configured to perform spectroscopy of light entered to output a measured value;

the spectroscope includes a first spectroscope measuring a transmitted light transmitted through the food product and a second spectroscope measuring a scattered light scattered by the food product, the first spectroscope and the second spectroscope are located in different places from each other.

14. A food characteristics determination device, comprising:

a storage unit configured to store a kind of food product, a characteristic of the food product, and information about light in association with each other;

a communication unit configured to communicate with a mobile apparatus; and

a determination unit configured to determine a characteristic of a food product by acquiring a kind of the food product and a measured value of spectroscopy from the mobile apparatus via the communication unit and referring to the storage unit, and output the characteristic of the food product to the mobile apparatus via the communication unit;

the mobile apparatus includes a spectroscope configured to perform spectroscopy of light entered to output a measured value;

the spectroscope includes an arc-shaped arm capable of measuring a transmitted light through the food product.

15. A food characteristics determination method, comprising:

radiating light;

performing spectroscopy of light entered to acquire a measured value;

identifying a kind of a food product corresponding to the light entered in the performing the spectroscopy; and

outputting a characteristic of the food product by determining the characteristic of the food product by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output in the performing the spectroscopy and the kind of the food product identified in the identifying, to determine the characteristic of the food product;

wherein, in the performing spectroscopy, a first spectroscope measuring a transmitted light transmitted through the food product and a second spectroscope measuring a scattered light scattered by the food product are used, and the first spectroscope and the second spectroscope are located in different places from each other.

16. A food characteristics determination method, comprising:

radiating light;

performing spectroscopy of light entered to acquire a measured value;

identifying a kind of a food product corresponding to the light entered in the performing the spectroscopy; and

outputting a characteristic of the food product by determining the characteristic of the food product by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output in the performing the spectroscopy and the kind of the food product identified in the identifying, to determine the characteristic of the food product;

wherein, in the performing spectroscopy, an arc-shaped arm capable of measuring a transmitted light through the food product is used.

17. A program for causing a mobile apparatus to perform:

radiating light from a radiating unit;

performing spectroscopy of light entered to acquire a measured value from a spectroscope;

identifying a kind of a food product corresponding to the light entered in the performing the spectroscopy; and

outputting a characteristic of the food product by determining the characteristic of the food product by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output in the performing the spectroscopy and the kind of the food product identified in the identifying, to determine the characteristic of the food product;

the spectroscope includes a first spectroscope measuring a transmitted light transmitted through the food product and a second spectroscope measuring a scattered light

scattered by the food product, the first spectroscope and the second spectroscope are located in different places from each other.

18. A program for causing a mobile apparatus to perform:

radiating light from a radiating unit;

performing spectroscopy of light entered to acquire a measured value from a spectroscope;

identifying a kind of a food product corresponding to the light entered in the performing the spectroscopy; and

outputting a characteristic of the food product by determining the characteristic of the food product by referring to a storage unit configured to store a kind of a food product, a characteristic of the food product, and information about light in association with each other, based on the measured value output in the performing the spectroscopy and the kind of the food product identified in the identifying, to determine the characteristic of the food product;

the spectroscope includes an arc-shaped arm capable of measuring a transmitted light through the food product.