DESCRIPTION

AGE ESTIMATION METHOD AND GENDER~~SEX~~ DETERMINATION METHOD

TECHNICAL FIELD

[0001] The present invention relates to an age estimation method, an age estimation apparatus, an age estimation program, a sex determination method, a sex determination apparatus, and a sex determination program. More specifically, the invention relates to an age estimation method, an age estimation apparatus, and an age estimation program that use spatial frequencies, and a sex determination method, a sex determination apparatus, and a sex determination program that use spatial frequencies.

BACKGROUND ART

[0002] Not only women but also all the people desire to remain young. For this reason, there are various cosmetic means, such as esthetic treatments, basic skin care products, makeup products, special makeup, health foods, or cosmetic surgeries.

Objective evaluation of the youth, especially the youth of a face, in other words, objective evaluation of the gap between an actual age and an "impression age by appearance" is extremely important in evaluating the effect of various cosmetic means such as esthetic treatments and cosmetic materials.

method of determining an age or a sex, in order to increase the evaluation accuracy, it is necessary to process information for specifying a plurality of portions of the face or to prepare a plurality of standards to increase estimation accuracy.

[0010] Therefore, embodiments~~the purpose~~ of the invention seek~~is~~ to provide a novel technology for estimating an age with a high degree of accuracy and reproducibility in the age estimation by using facial images. In addition, embodiments~~the purpose~~ of the invention seek~~is~~ to provide a novel technology for determining a sex with a high degree of accuracy and reproducibility in the sex determination by using the facial images.

MEANS FOR SOLVING PROBLEM

[0011] In view of the foregoing circumstances, as a result of a diligent effort to obtain a technology for estimating an age or determining a sex accurately, the inventors of the invention found out that there are close correlations among ages and intensities of spatial frequencies obtained from facial image data, or sexes and the intensities of the spatial frequencies. Further, as a result of analyzing the correlations, the inventors found out that various kinds of information on aging structures and characteristics of sex difference which relates to age

estimation and a sex determination is unevenly distributed per spatial frequency. Then, the inventors found out that the estimation of an age (an actual age or an impression age by appearance) and the determination of the sex may be performed with a high degree of accuracy and reproducibility by using the intensities of the spatial frequencies belonging to spatial frequency bands that are closely related to the information on the aging structure or characteristics of sex difference ~~thereby completing the invention~~.

~~Therefore, the invention is as follows.~~

[0012] Embodiments of the~~The~~ invention ~~to solve the problem~~ relate~~s~~ to an age estimation method including estimating an age of a subject from facial image data of the subject based on a correlation between ages and intensities of spatial frequencies obtained from facial image data.

According to a first aspect of the present invention, there is provided an age estimation method comprising: estimating an age of a subject from facial image data of the subject based on a correlation between ages and intensities of spatial frequencies obtained from facial image data, wherein the spatial frequencies belong to a plurality of different spatial frequency bands.

As described in an embodiment described below, since intensities of spatial frequencies have a high correlation with ages, an age of a subject may be estimated from facial image data of the subject with a high degree of accuracy and reproducibility.

[0013] In a preferred embodiment of the invention, the correlation is indicated by an equation or a model, and an estimated age of the subject is obtained by applying intensities of spatial frequencies obtained from the facial

image data of the subject to the equation or the model.

By using the equation or the model indicating the correlation, an age may be easily estimated by using a computer or the like.

[0014] According to a second aspect~~In a preferred embodiment~~ of the invention, there is provided an~~the~~ age estimation method comprising~~may include the following steps of~~:

acquiring~~obtaining~~ facial image data of a subject;

calculating intensities of spatial frequencies from the acquired~~obtained~~ facial image data; and

calculating an estimated age of the subject by applying the calculated intensities of the spatial frequencies to an equation or a model that is obtained~~prepared~~ in advance and expresses~~indicates~~ a correlation between ages and intensities of spatial frequencies obtained from the facial image data, wherein the spatial frequencies belong to a plurality of different spatial frequency bands.

[0015] In a preferred embodiment of the invention, the equation is a multiple regression equation obtained from multiple regression analysis or a prediction equation obtained from PLS.

By using the multiple regression equation or the prediction equation, an estimated age of a subject may be obtained with a higher degree of accuracy.

[0016] As the facial image data, image data of an entire face or a portion of a face may be used. That is, the age may be estimated accurately even when the used

facial image is an image of an entire face or a portion of a face.

[0017] Embodiments of the~~The~~ invention may be used in estimating an actual age and in estimating (evaluating) of an impression age by appearance. When an actual age is estimated, a correlation between actual ages and intensities of spatial frequencies may be used, and when an impression age by appearance is estimated, a correlation between impression ages by appearance and intensities of spatial frequencies may be used.

[0018] In a preferred embodiment of the invention, color image data is used as the facial image data, and the intensities of the spatial frequencies include combinations of intensities of spatial frequencies calculated from a plurality of color channels.

By using intensities of spatial frequencies calculated from color channels in combination, comparing with the case of only using intensities of spatial frequencies calculated from monochrome facial data (brightness data), an age, especially an impression age by appearance may be estimated (evaluated) with a high degree of accuracy.

[0019] In a preferred embodiment of the invention, the spatial frequencies belong to a plurality of different spatial frequency bands.

of spatial frequencies obtained from image data of lips, and the spatial frequencies include at least three spatial frequencies that belong to respective spatial frequency bands as follows:

0 to 40 cycles/image-width;

40 to 100 cycles/image-width; and

100 cycles/image-width or more.

According to this, from limited portions of lips, the spatial frequency bands that include information on aging structure specific to the lips are used effectively, so the age may be estimated with a high degree of accuracy.

[0025] According to a third aspect of the present invention, there is provided an age estimation apparatus comprising: an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject; a storage unit that stores age correlation data expressing a correlation between ages and intensities of spatial frequencies obtained from facial image data; and an age calculating unit that calculates an estimated age of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the age correlation data stored in the storage unit, wherein the spatial frequencies belong to a plurality of different spatial frequency bands. ~~In addition, the invention to solve the problem relates to an age estimation~~

~~apparatus including an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject, a storage unit that stores age correlation data indicating a correlation between ages and intensities of spatial frequencies obtained from the facial image data, and an age calculating unit that calculates an estimated age of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the age correlation data stored in the storage unit.~~

The age estimation apparatus according to embodiments of the invention may estimate the age from the facial image data of the subject with a high degree of accuracy.

[0026] According to a fourth aspect of the present invention, there is provided an age estimation program causing a computer to function as: an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject; a storage unit that stores age correlation data that expresses a correlation between ages and intensities of spatial frequencies obtained from the facial image data; and an age calculating unit that calculates an estimated age of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the age correlation data stored in the storage unit, wherein the spatial frequencies belong to a plurality of different spatial frequency bands. ~~In addition, the invention to solve the problem relates to an age estimation program causing a computer to function as an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject, a storage unit that stores age correlation data that indicates a correlation between ages and intensities of spatial frequencies obtained from facial image data, and an age calculating unit that calculates an estimated age of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the age correlation data stored in the storage unit.~~

The age estimation program according to embodiments of the invention causes the computer to estimate the age from the facial image data of the subject with a high degree of accuracy.

[0027] Embodiments of the~~The~~ invention ~~to solve the problem~~ relate~~s~~ to a sex determination method including determining a sex of a subject from facial image data of the subject based on a correlation between sexes and intensities of spatial frequencies obtained from facial image data.

As described in the embodiment as described below, since intensities of spatial frequencies have a high correlation with sexes, a sex of a subject may be determined from facial image data of the subject with a high degree of accuracy.

calculated intensities of the spatial frequencies to a discriminant function that is prepared in advance and indicates a correlation between sex grouping variables and the intensities of the spatial frequencies obtained from the facial image data; and

determining a sex based on the obtained grouping variable.

[0032] In addition, embodiments of the invention ~~to solve the problem~~ relate~~s~~ to a sex determination apparatus including an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject, a storage unit that stores sex correlation data that indicates a correlation between sexes and intensities of spatial frequencies obtained from the facial image data, and a sex determining unit that determines a sex of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the sex correlation data stored in the storage unit.

The sex determination apparatus according to embodiments of the invention may determine~~s~~ the sex from the facial image data of the subject with a high degree of accuracy.

[0033] In addition, embodiments of the invention ~~to solve the problem~~ relate~~s~~ to a sex determination program causing a computer to function as an intensity calculating unit that calculates intensities of spatial frequencies from facial

image data of a subject, a storage unit that stores sex correlation data indicating a correlation between sexes and intensities of spatial frequencies obtained from facial image data; and a sex determining unit that determines a sex of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the sex correlation data stored in the storage unit.

The sex determination program according to embodiments of the invention may causes the computer to determine the sex from the facial image data of the subject with a high degree of accuracy.

[0034] In addition, embodiments of the invention ~~to solve the problem~~ relates to an age estimation apparatus including an intensity calculating unit that calculates intensities of spatial frequencies from facial image data of a subject, a storage unit that stores sex correlation data indicating a correlation between sex and intensities of spatial frequencies obtained from facial image data, and male age correlation data and female age correlation data indicating correlations between ages and intensities of spatial frequencies obtained from facial image data by sex, a sex determining unit that determines a sex of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the sex

correlation data stored in the storage unit, an age correlation data selecting unit that selects the male age correlation data or the female age correlation data based on the sex determined by the sex determining unit, and an age calculating unit that calculates an estimated age of the subject by matching the intensities of the spatial frequencies calculated by the intensity calculating unit with the correlation data selected by the correlation data selecting unit.

Since the age estimation apparatus according to embodiments of the invention estimates the age by using correlation data considering aging structures specific to the sex depending on the sex determination result, the age may be estimated with an extremely high degree of accuracy.

EFFECT OF THE INVENTION

[0035] According to embodiments of the invention, by using spatial frequencies obtained from facial image data, an age (an actual age or an impression age by appearance) may be estimated with a high degree of accuracy and reproducibility, or a sex may be determined with a high degree of accuracy and reproducibility.

In addition, by using an age estimating technique or a sex determining technique according to the invention, an effect of makeup or esthetic treatments or cosmetic