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(71) Applicant 000005496
Fuji Xerox Co., Ltd.
2-17-22 Akasaka, Minato-ku, Tokyo

(72) Inventor Yoshiharu Hibi
Fuji Xerox Co., Ltd.
2274 Hongo, Ebina-shi, Kanagawa

(72) Inventor Yu Okutsu
Fuji Xerox Co., Ltd.
2274 Hongo, Ebina-shi, Kanagawa

(74) Agent 100101948
Patent Attorney Masao Yanagisawa

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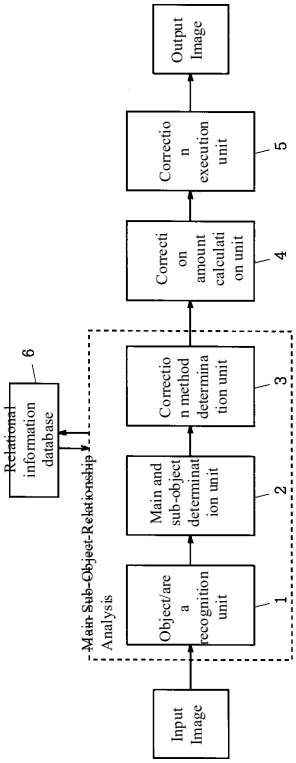
(54) [Title of the Invention] Image processing device, image processing method, image processing program, and storage medium

(57) [Summary]

[Problem] To provide an image processing device and an image processing method that can achieve a more preferable correction to an image.

[Means for Solving] The object is recognized by the object/area recognition unit 1 from the entered image, and the main object and the sub-object are determined by the main and sub-object determination unit 2 from the recognized object. Then, based on the determined relationship between the main object and the sub-objects, the correction method determination unit 3 determines a correction method to apply such as what kind of correction to which object using the feature amount of which object. In addition, the correction amount calculation unit 4 determines the correction amount when applying the correction. Based on these, the correction execution unit 5 actually performs the determined correction processing on each object or the entire image. This makes it possible to perform optimal correction depending on the scene, for example, even if the image is of the same "person", whether the background is the ocean, the mountain, or the sky.



[Scope of Patent Claims]

GOOGLE EXHIBIT 1006

[Claim 1] An image processing device for correcting an image, characterized in that the device has a recognition means for recognizing a plurality of objects from the image, and a correction method determination means for recognizing the scene of the image and determining a correction method for each of the respective objects based on the recognition result.

[Claim 2] An image processing device for correcting an image, characterized in that the device has a recognition means for recognizing a plurality of objects from the image, an object determination means for determining a main object and a sub-object from the plurality of objects, and a correction method determination means for determining a correction method for the respective image from the relationship between the main object and the sub-object.

[Claim 3] The image processing device according to claim 2, characterized in that the correction method determination means uses a combination of the type of main object and the type of sub-object as a relationship between the respective main object and the respective sub-object.

[Claim 4] The image processing device according to claim 2, characterized in that the respective correction method determination means uses at least one relationship of the positions, sizes, and weights of the two objects as the relationship between the respective main object and the respective sub-object.

[Claim 5] The image processing device according to any one of claims 2 to 4, characterized in that the respective correction method determination means determines how to correct the entire image or each object.

[Claim 6] The image processing device according to any one of claims 2 to 4, characterized in that the respective correction method determination means determines a correction method based on at least one feature of the main object, the sub-object, the non-recognition target area, and the feature of the entire image.

[Claim 7] The image processing device according to any one of claims 2 to 4, characterized in that the respective correction method determination means determines a correction method based on the relationship between the attribute information of the main object and the attribute information of the sub-object.

[Claim 8] The image processing device according to any one of claims 2 to 7, characterized in that the respective correction method determination means determines a correction method including color tone and definition.

[Claim 9] An image processing device for categorizing an image, characterized in that the device has a recognition means for recognizing a plurality of objects from the image, an object determination means for determining a main object and a sub-object from the plurality of objects, and a category information determination means for determining category information of the respective image from the relationship between the attribute information of the respective main object and the attribute information of the respective sub-object.

[Claim 10] The image processing device of claims 2-9, characterized in that the respective object is an area or object, or an aggregate thereof.

[Claim 11] The image processing device of any one of claims

2-10, characterized in that the respective object determination means determines the respective main object using at least one feature of the size, position, orientation, and number of the respective object.

[Claim 12] The image processing device according to any one of claims 2-11, characterized in that the respective object determination means determines the respective main object using a weighting factor defined for each respective object.

[Claim 13] The image processing device according to any one of claims 2 to 10, characterized in that the respective object determination means determines the respective main object according to a user's instruction.

[Claim 14] The image processing device according to any one of claims 1-13, characterized in that the respective image is data described in PDL, and the respective recognition means recognizes a plurality of objects from PDL.

[Claim 15] An image processing method for correcting an image, characterized in that the method comprises recognizing a plurality of objects from the respective image, and also recognizing the scene of the respective image and determining a correction method for each of the respective object based on the scene recognition result.

[Claim 16] An image processing method for correcting an image, characterized in that the method comprises recognizing a plurality of objects from the image, determining a main object and a sub-object from the plurality of objects, and determining a correction method for the respective image from the relationship between the respective main object and the respective sub-object.

[Claim 17] The image processing method according to claim 16, characterized in that a combination of the type of main object and the type of sub-object is used as a relationship between the respective main object and the respective sub-object.

[Claim 18] The image processing method according to claim 16, characterized in that at least one relationship of the positions, sizes, and weights of the two objects are used as the relationship between the respective main object and the respective sub-object.

[Claim 19] The image processing method according to any one of claims 16 to 18, characterized in that when determining the correction method, it will be performed for the entire image or for each object.

[Claim 20] The image processing method according to any one of claims 16 to 18, characterized in that determining the correction method is based on at least one feature amount of the main object, the sub-object, the non-recognition target area, and the feature amount of the entire image.

[Claim 21] The image processing method according to any one of claims 16 to 18, characterized in that when determining the respective correction method, the correction method is determined based on the relationship between attribute information of the main object and attribute information of the sub-object.

[Claim 22] The image processing method according to any one of claims 16 to 21, characterized in that the respective correction method includes color tone and definition correction.

[Claim 23] An image processing method for categorizing an image, characterized in that the method comprises recognizing a plurality of objects from the respective image, determining a main object and a sub-object from the respective plurality of objects, and

determining category information of the respective image from the relationship between attribute information of the respective main object and attribute information of the respective sub-object.

[Claim 24] The image processing method of claims 16-23, characterized in that the respective object is an area or object, or an aggregate thereof.

[Claim 25] The image processing method according to any one of claims 16 to 24, characterized in that the respective main object is determined using at least one feature of the size, position, orientation, and number of the object.

[Claim 26] The image processing method according to any one of claims 16 to 25, characterized in that the respective main object is determined using a weighting factor defined for each object.

[Claim 27] The image processing method according to any one of claims 16 to 24, characterized in that the respective main object is determined according to a user's instruction.

[Claim 28] The image processing method according to any one of claims 15 to 27, characterized in that the respective image is data described in PDL and recognizes a plurality of objects from PDL.

[Claim 29] An image processing program, characterized in that the image processing method according to any one of claims 15 to 28 is executed on a computer.

[Claim 30] A storage medium that can be read by the respective computer, characterized in that a program for allowing a computer to execute the image processing method according to any one of claims 15 to 28 is stored.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Belongs] The present invention relates to a technology for determining a correction method to be performed in order to suitably reproduce digital images taken with a digital camera, etc., digital images obtained by inputting negative film, etc. using a film scanner, digital images obtained by inputting photographs, etc. using a reflective scanner etc., images written in Page Description Language (PDL). The present invention also relates to a technique for determining category information for categorizing images using a similar technique.

[0002]

[Prior Art] When shooting using a general digital camera, etc., the photometry system installed in the digital camera automatically sets the shooting conditions such as exposure conditions when shooting, and in many cases, a photograph is taken according to the shooting conditions. The automatically set shooting conditions are determined based on the assumption that the subject is in very average conditions, so it may not be possible to obtain a desired image under conditions that differ from average conditions, such as lighting conditions at the time of shooting, how light hits the subject, and backlight conditions, etc. For example, under backlight conditions, the scene as a whole is bright, so the main subject (for example, a person's face) may appear dark. In addition, differences in the light sources illuminating the subject (sunlight, fluorescent lights, etc.) and the conditions of the sun outdoors (sunset, cloudy, etc.) may cause a significant shift in the color balance to occur, and the image appears to be distorted. Of course, the same is true for film cameras, etc., and if they are automatically photographed in accordance with the shooting conditions set, the same problem occurs in the image on the film, and the same is true for the digital image read by the film scanner, etc.

[0003] To deal with such defects, it is possible to obtain a desired image by correcting the digital image. However, it is very difficult for a general inexperienced user to adjust the parameters and perform the correction processing while selecting various correction processing. Therefore, it has been considered to automatically correct the image to an optimal image.

[0004] In order to automatically perform image correction processing, it is necessary to recognize what kind of scene the relevant image was photographed, and to perform correction processing according to the shooting scene. Several methods have been proposed to achieve correction processing for images corresponding to such shooting scenes. One of them is, for example, the device described in JP H5-41830, where depending on whether the subject is a person or not, and correction is performed at the time of image acquisition. Also, for example, in the device described in JP H5-336535, the parameters of contour correction are switched between the person in the image and other units. Furthermore, for example, in the device described in JP2000-123164, images are divided into blocks, attributes are determined for each block, and saturation conversion is performed according to the attributes.

[0005] FIG. 14 is a block diagram illustrating an example of a conventional image processing device. In the figure, 11 is the input image, 12 is the main object/area recognition unit, 13 is the correction amount calculation unit, 14 is the correction execution unit, and 15 is the output image. The conventional techniques described above collectively have a configuration as shown in FIG. 14. That is, the main object/area recognition unit 12 detects the presence or absence of a main object, such as a person in the input image 11; the correction amount calculation unit 13 determines the correction method and correction parameters that distinguish between main objects and other objects; and the correction method and correction parameters are used to execute a correction process in the correction execution unit 14, obtaining an output image 15.

[0006] Such conventional technology makes it possible to perform correction processing focusing on the main object, and it is certainly possible to obtain a good image of the main object. However, there is a problem in that corrections are uniquely determined for each object and by the presence or absence of a main object. It is effective to focus the correction on the main objects that humans pay attention to the most, but if correction was made focusing only on the main objects, in some cases, only the main objects are emphasized, and the overall balance is lost, resulting in an unnatural looking image.

[0007] For example, when a “person” is photographed under backlit conditions, the “person” appears dark. To correct this, if the entire image is corrected so that the “person" becomes brighter, the colors of the background such as the sky will be washed out. For example, even when determining a correction method for an object unit, for example, a uniform correction method that emphasizes the brightness of "person" and the saturation of "sky"; in some cases, the correction was not suitable for a scene of "person + sky".

[0008] In the above example, the conventional technology was

explained for the case of correcting an image. For example, when saving an image, category information indicating the content of images is automatically added and stored. In such cases, the main object is extracted from the image and the category information indicating the object is added. However, it is difficult to accurately grasp the content of an image, for example, even if the category information "person" is added to an image in which the person is visible in the center. You could not tell if the photo was taken, for example, at sea or in the mountain. Furthermore, if attribute information indicating objects is simply listed, there is a problem in that the category information is not useful, for example, in a landscape photograph, "sky" is always present.

[0009]

[Problem to Be Solved by the Invention] The present invention is made in view of the circumstances described above, and is intended to provide an image processing device and image processing method that allows for more favorable correction to be made to the image depending on the scene, and an image processing device and image processing method that allows for the addition of more favorable category information to the image. Furthermore, the present invention is intended to provide an image processing program that allows a computer to execute such an image processing method, and a storage medium that stores such an image processing program.

[0010]

[Means for Solving the Problem] The present invention is characterized in that, in an image processing device and an image processing method for correcting an image, a plurality of objects are recognized from an image, and a correction method is determined for those objects based on the recognition results of the scene of the image. In particular, after recognizing the plurality of objects from the image, the main object and the sub-object are determined from the plurality of recognized objects, and the method of correcting the image is configured so as to be determined based on the relationship between the main object and the sub-object. In this way, the method of correction is determined from the recognition result of the scene of the image, in particular, by using the sub-object together with the main object in the image, so it is possible to perform the correction processing according to the surrounding situation, etc., in comparison to the case when correction based on the recognition result of only the main object. Thus, a balanced correction processing can be performed for the image, and a more preferable correction processing can be realized.

[0011] A combination of the types of the main object and the type of the sub-object, or the relationship among at least one of the positions, sizes, and weights of the two objects can be used as the relationship between the main object and the sub-object. In addition, when determining the correction method, it can be performed for the entire image or for each object. Alternatively, the correction method may be determined based on at least one feature among the main object, sub-object, non-recognition target area, and the feature of the entire image, or from the relationship between the attribute information of the main object and the attribute information of the sub-object. The correction method can also include color tone and definition correction.

[0012] The object to be recognized can be an area, an object, or an aggregate thereof. Of those, the main object can be determined by features such as the size, position, orientation, and number of objects; using a weighting factor determined for each object; or the user's instructions. The image to be processed may be, for example, an image described by PDL other than the bitmap image.

[0013] The present invention also provides an image processing device and an image processing method for categorizing images, including: recognizing a plurality of objects from the image, determining a main object and a sub-object from the recognized plurality of objects, and determining category information of the respective image from the relationship between attribute information of the main object and attribute information of the sub-object. In this way, the category information is determined based on the relationship between not only the attribute information of the main object but also the attribute information of the sub-object, so it is possible to extract the category information, such as whether the photo was taken in the “mountain” or the “sea”, even if the image contains a "person", and it becomes possible to add and store category information that accurately indicates the content of an image to an image. It should be noted that the method of recognizing objects and determining the main object as described above can also be utilized for the present invention. The image to be processed may also be a bitmap, as well as an image described in the PDL.

[0014] Furthermore, the present invention provides an image processing program that allows a computer to execute these image processing method, and a storage medium storing such an image processing program. For example, it can be realized in a personal computer, a workstation, or even a server that provides such image processing.

[0015]

[Embodiments of the invention] FIG. 1 is a block diagram showing one embodiment of the present invention. In the figure, 1 is the object/area recognition unit, 2 is the main and sub-object determination unit, 3 is the correction method determination unit, 4 is the correction amount calculation unit, 5 is the correction execution unit, and 6 is the relational information database. The object/area recognition unit 1 recognizes a plurality of objects from the entered images. The object to be recognized may be an area, an object, or an aggregate thereof. The object, for example, "sky area" can be recognized by having the frequency structure characterized by low frequencies, the position at the top of the image; and color information captured the closed area included in the blue phase. In addition, objects, such as people and faces, can be recognized by using known techniques, such as detecting skin color areas and facial structures. The object recognition technique is optional and various known techniques can be used.

[0016] The main and sub-object determination unit 2 determines the main object and the sub-object from a plurality of objects recognized by the object/area recognition unit 1. The main object can be determined based on, for example, the size and position of the recognized object in the image, the predetermined weight of the object, and the like. Alternatively, the configuration may be such that an image is displayed after the user gives instructions. A recognized

object other than the main object is considered a sub-object. However, if there are a large number of sub-objects, it is not necessary to make all sub-objects.

[0017] The correction method determination unit 3 basically recognizes the scene of the image and determines a correction method for each object based on the recognition result. As an example, here, the main object and sub-object determined in the main and sub-object determination unit 2 are used. First, the relationship between the main object and other sub-objects is analyzed. At the time of analysis, for example, the relational information database 6 can be referred to, and information such as a correction position, a feature amount calculation method, a correction processing method, etc. can be obtained from the relationship between the main object and the sub-object. A combination of the types of the main object and the type of the sub-object, or the relationship between the positions, sizes, weights, etc. of two objects, or the relationship between each attribute information can be used as the relationship between the main object and the sub-object. In addition, the correction point to be determined can be the entire image, or a main object, sub-object, etc., and the correction processing method can be determined for each correction point. The correction processing method may be determined from the features of the main object, the sub-object non-recognition target area, the entire image, and the like, according to the feature amount calculation method obtained from the relationship between the main object and the sub-object described above.

[0018] The correction amount calculation unit 4 calculates the degree of correction according to the correction method determined by the correction method determination unit 3. For example, the feature amount can be calculated based on the feature amount calculation method obtained by the correction method determination unit 3 (or the feature amount calculated by the correction method determination unit 3), and the correction amount corresponding to each correction method can be calculated. Unlike the conventional uniform calculation method, the feature amount calculation method defines which object's feature should be used to calculate the correction amount based on the pattern of combinations of main object and sub-object. Based on this definition, a correction amount is calculated by obtaining feature amounts suitable for each combination of patterns.

[0019] The correction execution unit 5 performs the actual correction processing, for the input image, only for the correction amount that was calculated by the correction amount calculation unit 4, regarding the correction processing determined by the correction method determination unit 3. As the correction process, for example, color tone correction, definition correction, etc. can be performed.

[0020] With such a configuration, it is possible to perform corrections that take into account the object that the user, who is viewing the image, is most interested in, by determining the main object, in comparison to the conventional technology of performing uniform correction processing for each object. Furthermore, by determining not only the main object but also the sub-object, it is possible to apply the optimum correction processing to each object, the non-recognition target area, or the entire image based on the relationship between the main object and the sub-object. Therefore, it is possible to avoid inconsistencies with the surrounding by correcting on only the main object as in the past, and to perform the best correction processing that takes into account the features of the scene as a whole. As an example, consider correcting the skin color of a person. Previously, it was only possible to correct a person's skin tone to a certain target color, but by determining a correction method based on the relationship between the main object and the sub-object, the correction can be changed by the recognized sub-object, such as changing the target color to a healthy wheat color in the case of a figure with a sub-object of "sea".

[0021] Hereinafter, detailed operation of each unit will be explained using specific examples. In addition, in the specific example of the image shown below, hatching is used to express color, etc., and when the actual color correction (e.g., brightness correction) has been performed, for example, hatching intervals are shown differently.

[0022] FIG. 2 is an illustration of an example of an object recognized by the object/area recognition unit 1. As stated above, the object/area recognition unit 1 may recognize and define, for example, a face of a person, a certain target article, or a certain closed area as an object. As an example, in a scene image including a person as shown in FIG. 2, objects such as "person", "sky area", "mountain area" can be recognized. For example, the "sky area" object can be captured as a low frequency structure, with position information at the top, and the color information, captured a closed area, in the blue phase. Further, recognition as an object such as a person or a person's face may be performed using a known method. In this example, objects other than the recognized objects are considered to be non-recognition target area.

[0023] Next, the main and sub-object determination unit 2 determines the main object and the sub-object from among the objects recognized by the object/area recognition unit 1. FIG. 3 shows illustrations of examples of a method for determining a main object. FIG. 3 shows an example of a landscape picture of a mountain and sky, showing the process in which a main object is determined by the size of the area. For example, the larger object can be the main object, and the other can be the sub-object as a method of determining the main object. In this case, in the example shown in FIG. 3(A), the portrait of the mountain object is large, so the object of the "mountain area" becomes the main object, and the other object such as the "sky area" becomes the sub-object. In the example shown in FIG. 3(B), on the contrary, the sky is wide, so the "sky area" object is the main object, and other object such as the "mountain area" are the sub-object.

[0024] FIG. 4 is an illustration of another example of a method of determining a main object. Here is an example of determining the main object based on the size, position, orientation, weight factor, etc. of each object. FIG. 4(A) shows the input image, and each recognized object is labeled a to e. That is, the a object is a "sky area," the b object is a "mountain area," and the c to e objects are "persons." The person on the right side is larger. The size, position, and orientation of each of these objects are examined and weighted. The results are shown in FIG. 4(B). As for the position score, the closer to the center and the foreground, the greater the weight. Therefore, the weight of the d object, which is the middle person, is the greatest. The larger the size score, the greater the weight. In this example, the b object indicating the "mountain area" occupies the largest area, so it is given the largest

weight. The orientation score is weighted depending on whether the person is facing the front or in another direction. In this example, a large weight is given to the c object representing the "person" on the right side, assuming that it is facing forward. Note that the "sky area" and the "mountain area" have no orientation, so they are set to 0.

[0025] Further, in this example, a predetermined weighting factor is set for each object. For example, if a person exists, it is generally more likely to be the main character than a mountain or sky object. Therefore, here as well, a larger weighting factor is assigned to objects c to e of "person" than to object a of "sky area" or object b of "mountain area".

[0026] Then, the position score, size score, orientation score, and weighting factor set in this way are combined to calculate a total score. In this example, the overall score is calculated by (position score + size score + orientation score) x weighting factor. The object with the largest total score may be set as the main object. In this example, the c object that is the “person” on the right is determined to be the main object. The other objects are also sub-objects. Note that the number of sub-objects can be limited to several. For example, the objects can be arbitrarily selected, such as by selecting them in descending order of total score, or by selecting objects of different types.

[0027] In the example shown in FIG. 4(B), the size, position, and orientation of the object were numerically used, but it is possible to use various other features. Of course, the method for calculating the overall score is also optional.

[0028] While two methods are shown here for determining the main object, various other methods can be applied. For example, it is also possible to manually select the main object while displaying the image on the monitor screen of a personal computer or the like used by a user.

[0029] Next, the correction method determination unit 3 determines the correction method to be performed for the entered image from the relationship between the main object and the sub-object determined by the main and sub-object determination unit 2 as described above. The combination of the type of the main object and the type of the sub-object can be used as the relationship between the main object and the sub-object used at this time. FIG. 5 shows illustrations of examples of determining a correction method by relationship between the main object and the sub-object type. As also explained in FIG. 3, FIG. 5A is a scene of a "mountain" in which the "mountain area" is the main object and the "sky area" is the sub-object. Such a combination of the main object and the sub-object type can be used, and in the case of this combination, it is possible to associate a correction method such as making the "sky area" a little brighter and the "mountain area" more vivid. As a result, the contrast between the "sky" and "mountain" can be increased, and the image can be corrected to emphasize the "mountain" more. In contrast, FIG. 5(B) is a "sky" scene, in which the "sky area" is the main object and the "mountain area" is the sub-object. In such a case, it is possible to associate a correction method such as making the "sky area" more vivid. As a result, the color of the "sky area" which is the main object can be corrected to be more vivid, taking into account the presence of the "mountain".

[0030] In this way, the combination of the main object and the sub-object type represents a scene in the image, and it is possible to apply a more preferable correction method by determining a correction method by a combination of the main object and the sub-object type. For example, even if there are objects with the same "sky area" and "mountain area" as in the example above, a more preferable correction method can be applied to each image based on the combination of the main and sub images.

[0031] When determining the correction method in this manner, it is necessary to determine for each combination which parts to correct and how to use which features to correct them, based on the combination of the types of the main object and the sub-object. What to correct means whether to correct either the main object or the sub-object, or whether to correct the entire image. Also, what kind of features means, for example, what kind of feature quantity, such as hue, shading, or specific color, should be used, for which part of the main object, sub-object, non-recognition target area, or the entire image. Furthermore, it is necessary to use such features to determine what kind of correction processing should be performed, such as color correction, definition correction, emphasis correction, etc.

[0032] In this example, the relational information database 6 is used to determine where, what features to use, and how to perform the correction. FIG. 6 shows illustrations of examples of the content of a relational information database. The relational information database, as an example, shown in FIG. 6 is configured with an object combination table shown in FIG. 6(A), a main object table shown in FIG. 6(B), a sub-object ranking table shown in FIG. 6(C), feature amount calculation data shown in FIG. 6(D), and a correction data shown in FIG. 6(E)

[0033] The object combination table shown in FIG. 6(A) is a table for referring to a main object table from a combination of objects present in an image. In this example, objects such as "person", "sky", "sea", and "mountain" are defined. Here, as shown in FIG. 2, it is assumed that an image including "person", "sky", and "mountain" is input, and an arrow indicating a pointer to the main object table is illustrated.

[0034] The main object table shown in FIG. 6(B) is a table for referring to a sub-object ranking table depending on which object is the main object among the objects in the entered image. This example illustrates an example where the "person" object was the main object, and illustrates an arrow line indicating a pointer to the sub-object ranking table.

[0035] The sub-object ranking table shown in FIG. 6(C) is a table for selecting feature amount calculation data and correction data according to the priority order among sub-objects. Feature amount calculation data and correction data will be selected by the following references so far: What objects are present in the image? What is the main object among those objects? Depending on how the sub-objects are prioritized, The example shown in FIG. 6(C) shows a case where "sky" is given priority over "mountain".

[0036] The feature calculation data shown in FIG. 6(D) defines what features are extracted from which objects in the priority order of the objects, main object, and sub-object present in the images determined by each of the tables described above. This example shows that the shading information is obtained from the "person" object, the mean

hue information, average hue information and shading information are obtained from the "sky" object, and the mean hue information is obtained from the "mountain" object.

[0037] The correction data shown in FIG. 6(E) also defines what kind of correction processing is to be performed, with what kind of feature used for which object in the priority order of the objects, the main object, and the sub-object, present in the image determined by each table described above. Although the feature amounts to be used are defined in the feature amount calculation data shown in FIG. 6(D), the object from which the feature amounts are extracted and the object from which the correction process is performed using the feature amounts do not necessarily match. Conversely, it is possible to perform correction processing based on the features of other objects. For example, in the example shown in FIG. 6 (E), when the main object is a "person," and the sub-objects are "sky" and "mountain" in order of priority, it is defined that "person" is to be corrected in which a human skin is brighten based on the shading information of "sky". Further, for "sky", it is defined that the average hue of "sky" is corrected based on the average hue information of "mountain". Furthermore, it is defined that no correction processing is performed for "mountain" and the entire image. By defining the correction processing by utilizing the features of other objects in this manner, it is possible to perform the correction processing according to the surrounding situation, and it is possible to perform a more favorable correction.

[0038] FIG. 7 shows illustrations of examples of applying a determined correction method to an image. For example, if an example of an image shown in FIG. 2 is input and features calculated as shown in FIG. 6(D) and correction data shown in FIG. 6(E) are obtained, by searching for the relational information database 6 as shown in FIG. 6, the shading information of the “sky” is reflected in the "human skin" areas, especially the face, as shown by the arrow in FIG. 7(A) according to the definition, and the average hue information of "mountain" is reflected in the hue of "sky". This results in correction as shown in FIG. 7(B), for example. In this way, since correction is performed for each object according to the scene of the image, it is possible to perform correction processing that is more harmonious as a whole than when correction processing is performed on each object alone.

[0039] The method of correcting which object and using which feature amount of which object can be changed depending on the definition of the correction data. FIG. 8 is an illustration of an example correction with different correction targets. The images entered in FIGS. 8(A), (B) are the same, with “sky” as the main object and "mountain" as the sub-object. In such cases, the main object may be corrected, or the sub-object may be corrected. For example, as shown in FIG. 8(A), by adjusting the color of the main object "sky", the sky can be made to look nice. Alternatively, as shown in Figure 8(B), there is also a correction method that does not adjust the "sky" but instead adjusts the color of the sub-object "mountain" to make the main object "sky" look better. Of course, there are cases where the entire image is corrected. Which correction method to apply depends on the definition of the correction data. Alternatively, it is possible to use various other information such as object type, size, and attributes described below, or to use a configuration in which the correction data itself is switched based on the feature amount of each object extracted according to the feature amount calculation data.

[0040] In this way, the relational information database 4 can be used to determine the feature amount to be calculated and the correction method using the feature amount from the object recognized by the object/area recognition unit 1, the main object and the sub-object determined by the main and sub-object determination unit 2 (the order of the sub-objects is also determined at this time).

[0041] In the above example, an example is shown in which a correction method is determined from only the combination of the main object and the sub-object, but the correction method can also be determined by taking various information into consideration. FIG. 9 shows illustrations of examples of determining a correction method by relationship between the type and size of a main object and a sub-object. FIG. 9 shows an example in which the size factor is taken into consideration as well as the combination of the main object and the sub-object. In the two examples shown in FIG. 9, the objects present in the images are a "sky", a "mountain", and a plurality of "clouds". Here, because “sky” has a large area, the “sky” object is the main object, and the "mountain" and "cloud" objects are the sub-objects. However, in FIG. 9(A), the presence of "cloud" is large. In such a case, just make the main object "sky" a little more vivid. Furthermore, if there are only small "clouds" as shown in FIG. 9(B), it is possible to judge that these "clouds" can be ignored and adjust the "sky" to be more vivid.

[0042] In this way, by determining a correction method by taking into account the size, etc., of the existing object, it is possible to accurately grasp the scene of the image without being affected by the presence of a small object, and it is possible to perform the desired correction on the entire image.

[0043] FIG. 10 shows illustrations of examples of determining a correction method by relation of the attributes of the main object to the sub-object. This example shows examples in which more detailed adjustments can be made by using object attributes. It is possible to change the reproduction method, for example, even when the objects "sky" and "mountain" are combined, the difference is whether the "sky" is a clear sky or a sunset sky. The example shown in FIG. 10A shows a case where "clear skies" is added as an attribute value to the main object "sky" object. In the case of such a clear sunny scene, for example, in order to vividly reproduce the sky, the feature amount of the "mountain" object can be used to vividly reproduce the "sky".

[0044] The example shown in FIG. 10(B) shows a case where "sunset" is added as an attribute value to the main object "sky" object. In the case of a sunset scene like this, to emphasize the colors of the sunset, it is possible to use the feature values of the "sky" object to make corrections to reproduce the "mountain" darkly so as to give a silhouette effect at the cost of the details of the mountain.

[0045] In this way, by utilizing the object attributes, correction processing according to the respective attributes is possible, and more detailed correction processing is possible. In order to switch the correction method based on such attribute values, for example, an attribute value table or the like may be provided in the relational information database 6, and the feature value calculation data and

correction data may be switched based on the attribute values.

[0046] Once the correction method is determined by the correction method determination unit 3 as described above, information on the correction method is passed to the correction amount calculation unit 4 to determine the correction amount by the correction amount calculation unit 4. For example, in each of the above examples, abstract expressions such as "bright," "dark," and "vivid" are used. The correction amount calculation unit 4 calculates how much "brightness", "darkness", and "vividness" to make. At this time, the correction amount of the object to be corrected is calculated from the feature amount of the specified object, based on the feature quantity calculation data and correction data obtained by searching the relational information database 6 in the correction method determination unit 3, according to the definition in the correction data. The feature amount may be extracted by the correction method determination unit 3 and passed to the correction amount calculation unit 4, or the feature amount calculation data may be passed from the correction method determination unit 3 to the correction amount calculation unit 4 to extract the feature amount at the correction amount calculation unit 4.

[0047] The correction method determination unit 3 and the correction amount calculation unit 4 determine what kind of correction processing is to be performed for which object (or the entire image) and to what extent. The correction execution unit 5 performs correction processing on the input image based on these, and outputs it. As the correction processing performed by the correction execution unit 5, correction processing of image elements such as brightness, saturation, contrast, memory color, and sharpness can be performed. Of course, various other correction processing may be performed.

[0048] Although there is no particular limitation as an image to be input in the above description, it is assumed a so-called bitmap image, for example, taken with a digital camera, entered with a reflective scanner, or obtained by scanning film taken with a film camera using a film scanner, etc. However, the present invention is not limited thereto, and may be image data written in PDL or the like, for example. In this case, the objects recognized by the object/area recognition unit 1 include, for example, text objects, photographic (image) objects, etc. in a broader sense that exist within one page. The scene of the image on one page can then be recognized to determine a correction method for each object. For example, it is possible to determine a main object and a sub-object in the main and sub-object determination unit 2, and to determine a correction method based on the relationship between these main object and sub-object.

[0049] FIG. 11 shows illustrations of examples to the image data described by PDL. In the example shown in FIG. 11(A), a large photo is arranged with the headline text. In this image, the main object is a "Photo" and the sub-object is a "Text". Such an image is an image that appears in, for example, a pamphlet, and in many cases, it is desirable that the photograph be preferably reproduced. Therefore, it is only necessary to correct the "photo" to make it more vivid and preferable using the feature amount of the "text".

[0050] In the example shown in FIG. 11(B), a "photo" and "text" explaining the photograph are arranged side by side. Such documents are often found in, for example, product explanation materials, and it is often desired to make the main objects in the photograph particularly clear. Therefore, it is advisable to perform a correction process that uses the feature amounts of the "text" to blur the background in the "photo" to make the main objects stand out.

[0051] Even in the case of image data described in PDL in this way, by switching the correction method depending on the scene of the image within one page, for example, the layout of the main object "photo" or the layout of the sub-object "text", a more preferable correction method can be applied to the one-page document (document).

[0052] FIG. 12 is a block diagram illustrating another example of the present invention. In the figure, parts similar to those in FIG. 1 are designated by the same reference numerals, and description thereof will be omitted. 7 is the category information determination unit, and 8 is the image database. In the above-described embodiment, recognition of the object, determination of the main object and sub-objects, and their relationship are shown in the example utilized for image correction. However, the relationship of the main object and the sub-object can also be utilized for other applications. The example shown in FIG. 12 shows an example in which the present invention is applied to an image database system in which the entered images were classifies and stores.

[0053] The category information determination unit 7 generates category information for the entered images based on the relationship between the main object and sub-object determined by the main and sub-object determination unit 2. The category information is then registered and stored in the image database 8 along with the entered image. This makes it possible to categorize images in consideration of their subject matter, and to search for images from the image database 8 based on, for example, the relationship between main object and sub-object.

[0054] FIG. 13 shows illustrations of examples of relationship between an image and category information. For example, if the entered image is a photograph of a person in a mountain, as shown in FIG. 13(A), then the main object is the "person" and the sub-object is the "mountain" or “sky”. FIG. 13(B) is a photograph of the same person, but taken at sea. In this case, the main object is the "person" and the sub-object is the "sea" or “sky”. Such a relationship of the main object and the sub-object can be stored in the image database 8 as category information. Therefore, it is possible to perform category that accurately indicates the scene of the image, such as a photo of a person taken in a mountain in FIG. 13(A) and a photo of a person taken at the sea in FIG. 13(B).

[0055] In the past, because the category of images was performed only based on the main object, any of the images shown in FIG. 13 were "persons" as category information, and it was not possible to distinguish between these in a search. However, in the present invention, the relationship between the main object and the sub-object is stored in the image database 8 as category information, so it is possible to perform a search, for photos taken of the sea, although it is a photo of a person.

[0056]

[Effect of the Invention] As is clear from the above explanation, according to the present invention, it is possible to determine a correction method based on the recognition results of the scene of the image, such as the relationship between the main object and the surrounding sub-objects, instead of uniformly determining the correction method depending on the object in the image, so it is possible to achieve a more favorable correction processing depending on the scene of the image.

[0057] Furthermore, by using such relationships of the main object and the sub-object as category information, it is possible to add more favorable category information to the image, and it is possible to achieve category that accurately indicates the entire image and accurate search based on image content.

[Brief Description of the Drawings]

FIG. 1 is a block diagram showing one embodiment of the present invention.

FIG. 2 is an illustration of an example of an object recognized by the object/area recognition unit 1.

FIG. 3 shows illustrations of examples of a method for determining a main object.

FIG. 4 is an illustration of another example of a method for determining a main object.

FIG. 5 is illustration of examples of determining a correction method by way of a relationship between a main object and a sub-object type.

FIG. 6 shows illustrations of examples of the content of a relational information database.

FIG. 7 shows illustrations of examples of applying a determined correction method to an image.

FIG. 8 shows illustrations of examples of correction with different correction targets.

FIG. 9 shows illustrations of examples of determining a correction method based on the relationship between the type and size of the main object and the sub-object.

FIG. 10 shows illustrations of examples of determining a correction method based on an attribute relationship between a main object and an object of a sub-object.

FIG. 11 is illustrations of examples to the image data described by PDL.

FIG. 12 is a block diagram illustrating another embodiment of the present invention.

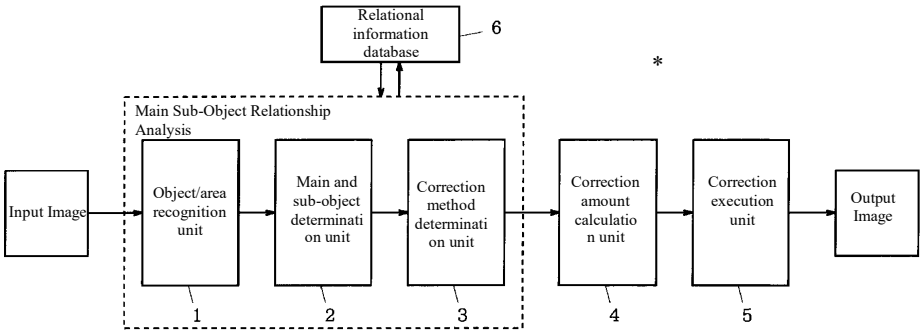
FIG. 13 is illustrations of example relationships between an image and category information.

FIG. 14 is a block diagram illustrating an example of a conventional image processing device.

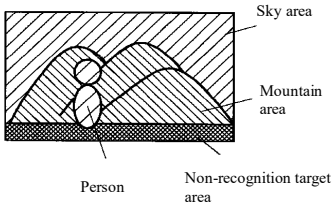
[Explanation of References]

1 ... object/area recognition unit, 2 ... main and sub-object determination unit determination unit, 3 ... correction method determination unit, 4 ... correction amount calculation unit, 5 ... correction execution unit, 6 ... relational information database, 7 ... category information determination unit, 8 ... image database, 11 ... input image, 12 ... main object/area recognition unit, 13 ... correction amount calculation unit, 14 ... correction execution unit, 15 ... output image.

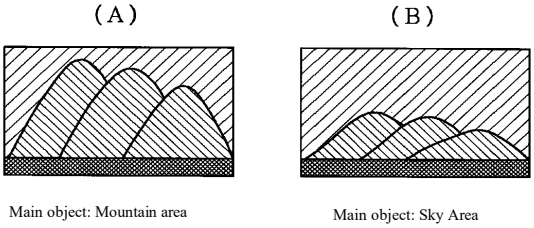
[FIG. 1]



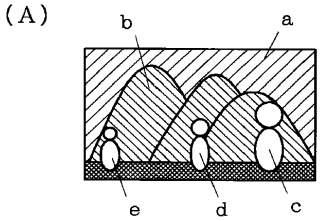
[FIG. 2]



[FIG. 3]



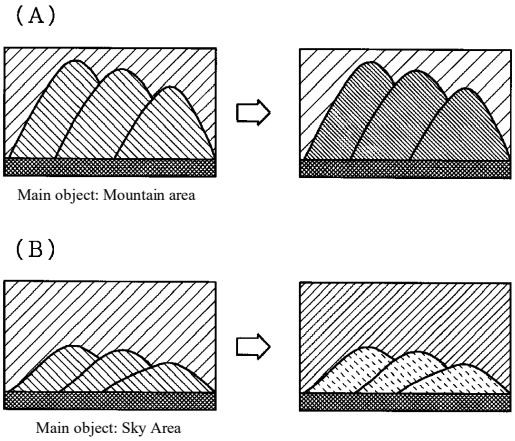
[FIG. 4]



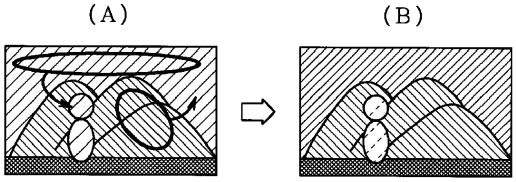
(B)

	Position score	Size score	Orientation score	Weighting factor	Total score
a (Sky)	1	4	0	0. 5	2. 5
b (Mountain)	2	5	0	0. 5	3. 5
c (Person on the right)	4	3	5	1	1 2
d (Person in the middle)	5	2	3	1	1 0
e (Person on the left)	3	1	3	1	7

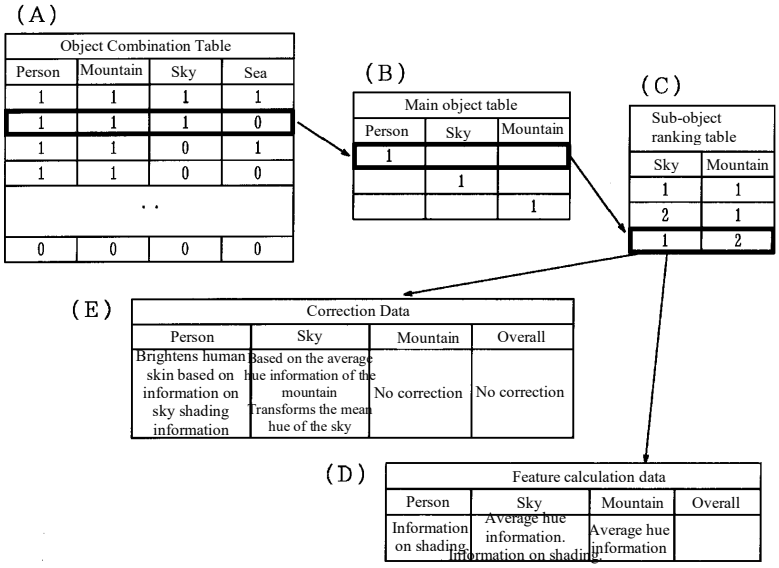
[FIG. 5]



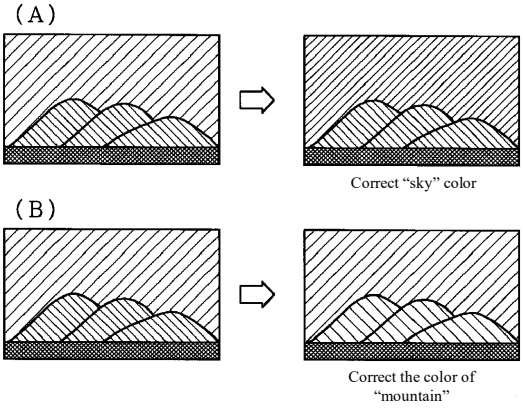
[FIG. 7]



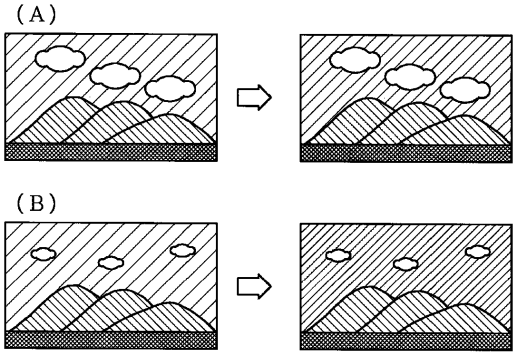
[FIG. 6]



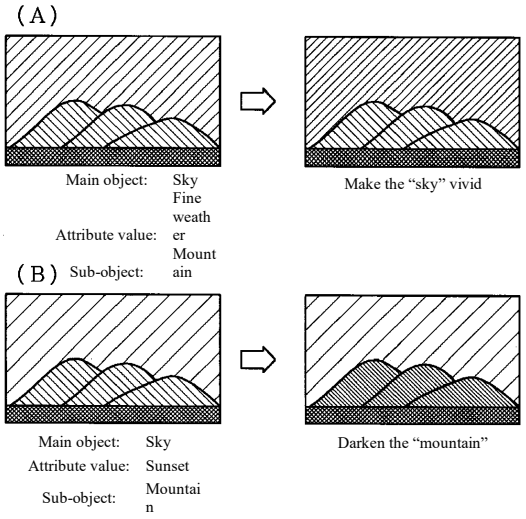
[FIG. 8]



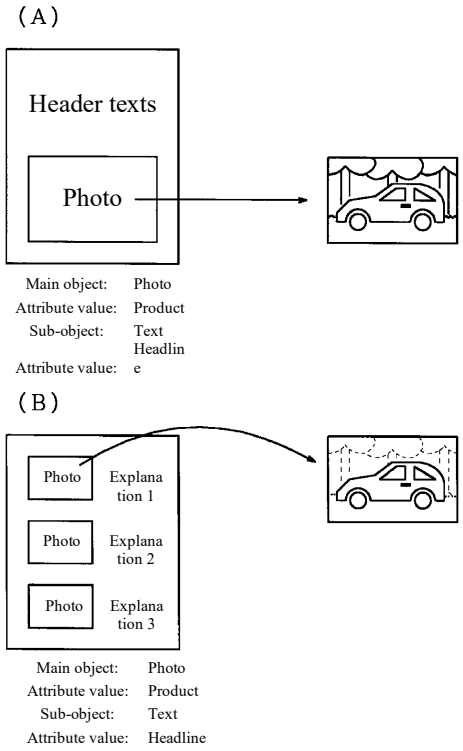
[FIG. 9]



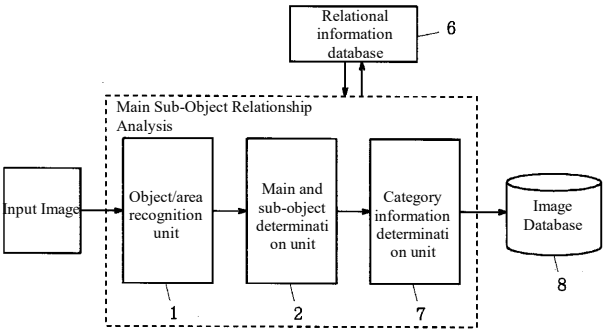
[FIG. 10]



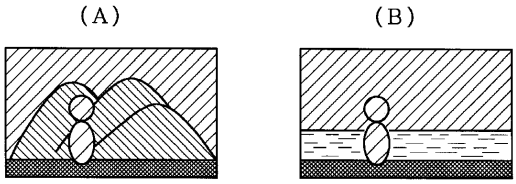
[FIG. 11]



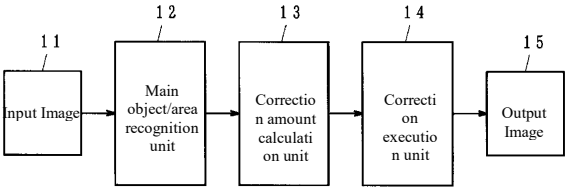
[FIG. 12]



[FIG. 13]



[FIG. 14]



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Source Language: Japanese

Target Language: English

Linguist Name: Natalia Lehmann

TransPerfect Office Partnership: London

Office Location: 1st Floor, 33 Aldgate High St, London EC3N 1AT, United Kingdom

List of Linguist Qualifications:

I, NATALIA LEHMANN, am fluent in the Japanese and English Languages, I have been translating documents for over 17 years and am competent to translate from Japanese to English. I have been speaking Japanese since 2000 and passed the Japanese language proficiency test Level 1, which is the highest level. I earned my Bachelor of Engineering degree from Kindai University in Osaka, Japan and have been working as a professional Japanese-to-English translator since 2000. I have translated patents since 2006.

Linguist Signature:

Name: Natalia Lehmann

Title: Senior Linguist

Date: 12 June 2024

Authorized Signature:

Jacob Harris (Jun 13, 2024 09:01 GMT+1)

Name: Jacob Harris

Title: Project Manager

Date: 12 June 2024

Jacob Harris
E-signed 2024-06-13 09:01AM GMT+1
jacharris@transperfect.com
TransPerfect

Reason for signature: I approve the accuracy of this document content as written

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