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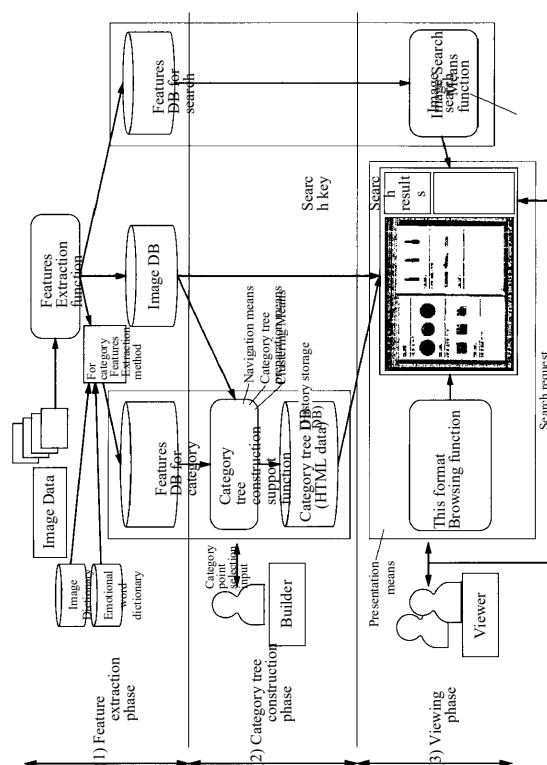
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(54) [Title of the Invention] **Method for hierarchically categorizing images and image category and search device, and a recording medium in which a program that executes this method is recorded**

(57) [Summary]

[Problem] To provide the image category tree construction method for understanding the overall image in the image DB, the presentation method of the image category, and the integration method with the image search, and realize efficient image DB management and utilization.

[Means for Solving] The system presents the user with main category viewpoints such as area color, straight line, object, and image dictionary, for the set of images during navigation. When a user selects an image dictionary, the system presents a category viewpoint, such as "face of person", "sky", or "roof." When the user selects the "face of person", the system presents a collection of portraits, and similarly, for the set of images, [the system] presents the user with sub-category viewpoints of area color, a straight line, object, image dictionary, and category is performed hierarchically by selecting the category viewpoints. Since this navigation history is effective for category in the image DB, it is stored in the system as category tree information. The image DB can be viewed by viewing the entire image of the accumulated category trees using keywords, composite images, and sample images.



[Scope of Patent Claims]

[Claim 1] A method for hierarchically categorizing images characterized in that the method comprises presenting an arbitrary set of images as the subjects for categorizing, presenting the category results categorized according to a specified category viewpoint, and next, repeating once or multiple times the process of presenting the category results further categorized based on the specified category viewpoint, for the respective category results.

[Claim 2] The method for hierarchically categorizing images according to claim 1, characterized in that the method has a table that associates words expressing concepts of images with sets of conditions for image objects, area within images, and feature amounts of straight lines in images that define concepts corresponding to the words; an image dictionary is used for associating these words with a thesaurus of word to extract information for categorizing images; and the respective extracted information is used as one of the category viewpoints to categorize the image.

[Claim 3] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises obtaining a color histogram of Y representative colors normalized by the area of the image and the areas into which the image is divided, where lighter colors have smaller thresholds than darker colors; extracting the color with the maximum value among the colors as the representative area color of the target area, if there is a color exceeding the threshold in the respective color histogram; or considering an area that does not have a representative area color, if there is no color exceeding the threshold; wherein the representative area colors determined above are used as a category viewpoint to categorize the image.

[Claim 4] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises obtaining a color histogram of Y representative colors normalized by the area of the image and the areas into which the image is divided, where the colors are sorted in descending order of the histogram value, for example, a first main color, a second main color, ..., a Y-th main color; wherein these main colors are used as a category viewpoint to categorize the image.

[Claim 5] The method for hierarchically categorizing images according to claim 1, 3 or 4, characterized in that the method comprises integrating that set of images into another set with a similar hue, if the number of images belonging to a certain representative area color is less than a certain number A; or conversely, dividing the images into representative area colors with finer hues, if the number of images belonging to a certain representative area color is greater than a certain number B ($B > A$), when categorizing images using the representative area color as a category viewpoint.

[Claim 6] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises calculating the distance between the emotional word feature in the emotional word dictionary and the color feature extracted from the target image; and categorizing the target image into the most similar emotional word; using an emotional word dictionary that associates emotional words with color features imagined by the emotional words as a category viewpoint.

[Claim 7] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises extracting features such as length, angle, number of straight lines, and relationships between

a plurality of straight lines from the image; and using the extracted features as a category viewpoint.

[Claim 8] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises basing the category viewpoints on features such as the objects in the image extracted from the image, their number, the positional relationship of multiple objects in the image, and the distribution of objects in the image.

[Claim 9] The method for hierarchically categorizing images according to claim 1, characterized in that the method comprises using the representative shape registered in advance as the basis as the category viewpoint, extracting the shape features of objects in the image extracted from the image to be categorized, and calculating the most similar representative shape by calculating the distance between those histograms to categorize the image.

[Claim 10] The method for hierarchically categorizing images according to any one of claims 1 to 9, characterized in that the method comprises providing instructions on category viewpoints through navigation that allows users to select from a combination of a plurality of category viewpoints presented.

[Claim 11] The method for hierarchically categorizing images according to claim 10, characterized in that the method comprises navigating the category tree builder by presenting recommendations to the user in order of category viewpoints that have the largest number of images that correspond to each category viewpoint, for the category viewpoints subject to presentation, excluding the category viewpoints that do not have corresponding images from the subject to presentation, when presenting a category viewpoint.

[Claim 12] The method for hierarchically categorizing images according to claim 10 or 11, characterized in that the method comprises retaining the selection of the category viewpoint by the user in the process of hierarchical category of images by navigation as a category history; and generating a category tree from the respective category history

[Claim 13] A method for hierarchically categorizing images, characterized in that, when categorizing images hierarchically by navigation, several examples of typical category items are determined in advance, where there are the method for hierarchically categorizing images according to any one of claims 3 to 9, wherein each image is categorized into the closest category item; and a clustering category method that uses a clustering method to categorize image features such as color features and shape features of each area into similar sets; and the images are categorized by freely combining [those two methods].

[Claim 14] An image category and search device, characterized in that the device includes a history storage means for storing category viewpoint instructions from a user during the navigation process as a navigation history; an image category tree generation means for constructing a category tree from the navigation history; a presentation means for presenting the respective generated category tree; and a search means for performing a search for image content from the respective category tree, when a search request is made by a user.

[Claim 15] The image category and search device according to claim 14, characterized in that the respective category tree presentation means utilizes an electronic book and expands the nodes of the category tree in the form of chapters and sections of the book in order to express the category results on the electronic book; the nodes are expressed by combining category viewpoints, composite images, and representative samples in order to concisely express chapters and sections; the most distal leaf displays an overview of all images contained in that leaf and when a summary of an arbitrary image is selected from the respective

electronic book, the respective search means searches for an image using the summary of the image as a search key.

[Claim 16] A recording medium that records a program for executing a method for hierarchically categorizing images, characterized in that the program, for executing the processing steps in the method for hierarchically categorizing images according to any one of claims 1 to 13 on a computer, is recorded on a recording medium readable by the computer.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Belongs] The present invention relates to a method for hierarchically categorizing images and device therefor, when efficiently operating and effectively utilizing a multimedia system such as image DB (database) systems and video DB systems that have a large amount of images.

[0002]

[Prior Art] To date, numerous image management systems have been implemented. There are two main methods of management: search and categorize.

[0003] # Image search

There are two ways to search for images: one is to search by text information (keywords, explanatory text, etc.) added to the image, and the other is to search by the similarity of image content information (features such as color and texture).

[0004] Similar search systems using image content information include Informix's VIR and NTT's ExSight. ExSight makes it possible to search for features such as the color and pattern of the entire image, the color, shape, and position of objects within the image, and the length, slope, and position of straight lines within the image.

[0005] # Image category

There are two methods for categorizing images: one method uses text information added to images, and the other uses image content information.

[0006] As a category system using image content information, there are similar scene category systems of California University, Netra, and Kobe University, and they are clustered according to the color and texture of the whole image and the block-divided area of the image.

[0007] # Text Navigation

In the field of text search, a navigation method has been proposed that helps users narrow down information by automatically presenting viewpoints (keywords) for further category of a given set, when narrowing down the information.

[0008]

[The Problem that the Invention seeks to Develop] To provide text information to images, there were the following issues that needed to be resolved:

- it is costly and time-consuming because the granting must be done manually;
- it is difficult to add consistent text information to the entire DB [database] due to large variations depending on the sender;
- there are some items, such as texture images, to which it is difficult to add text information (pattern names, etc.)

[0009] In this context, although technology for content search of images has been developed, there were still the following issues that needed to be resolved:

- Just as a book has an index and a table of contents, it is not possible to get an overview of the image DB just by searching, and as a result, it is

not possible to judge whether the search results are good or bad;

- there are methods to obtain search key images, such as sketch input and digital camera input, but even if you use these methods, it is difficult to provide a search key,
- etc.

[0010] In addition, although image content category technology have been developed in recent years, there were still the following issues that needed to be resolved:

- The system that has been developed so far is dedicated to images in special areas, such as aerial photographs and cloud images, and cannot be applied to general images because special features are used.
- Even if it is applicable to general images, simply performing clustering does not create a hierarchical category tree structure, and in the end, if the number of images increases, it will not function as a category,
- etc.

[0011] The challenges presented in the present invention is to provide an image category tree construction method, an image category presentation method, and how to integrate with image search system to understand the entire image within the image DB, and to realize an efficient image DB management and utilization method.

[0012]

[Means for Solving the Problem] The present invention solves the above challenges by the inventions listed below.

[0013] The first invention is a method for hierarchically categorizing images characterized in that the method comprises presenting an arbitrary set of images as the subjects for categorizing, presenting the category results categorized according to a specified category viewpoint, and next, repeating once or multiple times the process of presenting the category results further categorized based on the specified category viewpoint, for the respective category results.

[0014] This invention is based on the following invention, and realized instructions from a category viewpoint, hierarchical category of images by repeating the category based on this, and construction of category trees.

[0015] The second aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method has a table that associates words expressing concepts of images with sets of conditions for image objects, area within images, and feature amounts of straight lines in images that define concepts corresponding to the words; an image dictionary is used for associating these words with a thesaurus of word to extract information for categorizing images; and the respective extracted information is used as one of the category viewpoints to categorize the image.

[0016] Thesaurus in text represents the conceptual relationship of "words."

A subject that can be expressed in words appears in an image can be defined by combining the features of the image, such as partial images, objects, and straight lines, to express a "word" that expresses the subject using the image feature. The conceptual relationship of the keyword thesaurus can now be used to make a relationship between defined images, and a collection of this information forms an image dictionary that can be used to extract category viewpoints.

[0017] The third aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises obtaining a color histogram of Y representative colors normalized by the area of the image and the areas into which the image is divided, where lighter colors have smaller thresholds than darker colors; extracting the color with the maximum value among the colors as the representative area color of the target area, if there is a color exceeding the threshold in the respective color histogram; or considering an area that does not have a representative area color, if there is no color exceeding the threshold; wherein the representative area colors determined above are used as a category viewpoint to categorize the image.

[0018] For example, the image is colored down to Y representative colors, and a color histogram is created for each area divided into X areas with the same area. At this time, if the maximum value of the histogram exceeds a specific threshold value, the color corresponding to the maximum value is to be the representative area color in that area. If there is no color that satisfies that threshold, it is considered that there is no representative area color in that area. It should be noted that bright and flashy colors are more noticeable to the human eye than dark and plain colors, so the threshold value is set lower for bright colors than for dark colors. Representative area colors extracted by the above method are used as detailed category viewpoints when the user performs the category, and hierarchical category is performed based on this viewpoint.

[0019] The fourth aspect of the present invention is the method for hierarchically categorizing images according to claim 1, characterized in that the method comprises obtaining a color histogram of Y representative colors normalized by the area of the image and the areas into which the image is divided, where the colors are sorted in descending order of the histogram value, for example, a first main color, a second main color, ..., a Y-th main color; wherein these main colors are used as a category viewpoint to categorize the image.

[0020] The representative color for the entire image is not necessarily one color, but in most cases there are a plurality of dominant colors. Therefore, the first main color, the second main color, etc. are selected in descending order of the color histogram value of the entire image area. This is not limited to the entire image area, but can be extended to any image area. This result is used as a category viewpoint when the user performs the category, and hierarchical categorizing is performed based on the viewpoint.

[0021] The fifth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises integrating that set of images into another set with a similar hue, if the number of images belonging to a certain representative area color is less than a certain number A; or conversely, dividing the images into representative area colors with finer hues, if the number of images belonging to a certain representative area color is greater than a certain number B ($B > A$), when categorizing images using the representative area color as a category viewpoint.

[0022] In the case of image categorization using representative area colors, if the number of images subject to category is small, or if the number of images included in one set of categories gradually decreases by repeating hierarchical category, a set of categories that includes only a few images may be formed, when categorizing using the predetermined number of representative colors. Such a category makes the category tree structure meaninglessly complex. Therefore, if the number of images belonging to one representative color is less than a certain number A, the set is integrated into other sets having similar hue to simplify the category tree structure. Conversely, when there are many category images, one set of categories may become very large even if the category is performed using a pre-fixed representative color. Therefore, if there are more images with a certain hue than a certain number B even after being categorized by representative color, a detailed category viewpoint is additionally provided in which one set of categories can be subdivided using representative colors finely divided into hues in the next category.

[0023] The sixth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises calculating the distance between the emotional word feature in the emotional word dictionary and the color feature extracted from the target image; and categorizing the target image into the most similar emotional word; using an emotional word dictionary that associates emotional words with color features imagined by the emotional words as a category viewpoint.

[0024] In order to categorize using the emotional words of “cute” and

“refreshing” from the image, category is performed using an emotional word dictionary that corresponds to the features of the emotional word and color imaged by the emotional word. The distance between the color information extracted from the image and the features of each emotional word is calculated, and the images are uniquely assigned and categorized for the emotional word with the shortest distance.

[0025] The seventh aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises extracting features such as length, angle, number of straight lines, and relationships between a plurality of straight lines from the image; and using the extracted features as a category viewpoint.

[0026] The straight lines that are extracted from within the image based on the edge information often reflect the composition of the image. However, if the individual straight line information consisting of the information of the start point and ending point cannot be used as it is for category as the composition information in that image. Therefore, using the relationship among the number of straight lines, their length, the number of straight lines, etc., we will investigate what kind of composition information does a straight line extracted from a single image reflect, and what kind of relationship between the straight lines have. This result is used as a category viewpoint when the user performs the category, and hierarchical categorizing is performed based on the viewpoint.

[0027] The eighth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises basing the category viewpoint on features such as the objects in the image extracted from the image, their number, the positional relationship of multiple objects in the image, and the distribution of objects in the image.

[0028] The number of objects extracted from the image and the distribution of the centroid position thereof differ depending on the image, and this information also reflects the composition information of the image. Therefore, based on the number of objects and the position of their center of gravity, the distribution situation is extracted, such as where in a single image many objects are photographed. This result is used as a category viewpoint when the user performs the category, and hierarchical categorizing is performed based on the viewpoint.

[0029] The ninth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises using the representative shape registered in advance as the basis as the category viewpoint, extracting the shape features of objects in the image extracted from the image to be categorized, and calculating the most similar representative shape by calculating the distance between those histograms to categorize the respective image.

[0030] When categorizing a set of images having an object within one image in one image, like a clip art, the shape becomes a very important feature. Therefore, several types of representative shapes are set in advance, such as circles, squares, and rectangles, which are basic, and the most similar representative shapes are uniquely categorized. Specifically, the distance between the object image and the shape feature of the representative shape is calculated, and categorized as a representative shape with the shortest distance.

[0031] The tenth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises providing instructions on category viewpoints through navigation that allows users to select from a combination of a plurality of category viewpoints presented.

[0032] In order to achieve hierarchical category, a user selects the viewpoints of the area color, straight line, object, and image dictionary to categorize. First, general category viewpoints (main category viewpoints) such as area colors, straight lines, objects, and image dictionaries are presented. When the user selects the category viewpoint from among these, the system further narrows down the applicable image based on the

previously selected viewpoint, and aggregates the data based on the more detailed selection conditions (sub-category viewpoint). The results are presented to the user as selection conditions together with the image samples corresponding to each sub-category viewpoint. When the user selects this sub-category viewpoint, a category is actually executed and a set of categories is created. By presenting such category viewpoints, the user is guided through repeated hierarchical category to narrow down the images.

[0033] The eleventh aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises navigating the category tree builder by presenting recommendations to the user in order of category viewpoints that have the largest number of images that correspond to each category viewpoint, for the category viewpoints subject to presentation, excluding the category viewpoints that do not have corresponding images from the subject to presentation, when presenting a category viewpoint.

[0034] Too many category viewpoints in the navigation makes the user unsure which one to select as the next category viewpoint, so unnecessary category viewpoints are deleted, and a candidate for the recommended viewpoint is presented. That is, if all images stored in the image database are categorized by area color, straight line, and object, there may be cases in which the applicable item does not exist for the category viewpoint depending on the image data applied. There is no point in presenting such results as a category selection item. Therefore, such a category viewpoint is deleted from the category selection candidate in advance, and the recommended category candidates are presented to the user by rearranging the presentation order in descending order of the number of applicable category viewpoints.

[0035] The twelfth aspect of the present invention is the method for hierarchically categorizing images, characterized in that the method comprises retaining the selection of the category viewpoint by the user in the process of hierarchical category of images by navigation as a category history; and generating a category tree from the respective category history

[0036] The history of the category viewpoint selected by the user is saved during the navigation described above. From this category history, a static category tree that provides an overview of the target image DB is created.

[0037] The thirteenth aspect of the present invention is a method for hierarchically categorizing images, characterized in that, when categorizing images hierarchically by navigation, several examples of typical category items are determined in advance, where there are the method for hierarchically categorizing images described above, wherein each image is categorized into the closest category item; and a clustering category method that uses a clustering method to categorize image features such as color features and shape features of each area into similar sets; and the images are categorized by freely combining [those two methods].

[0038] When categorizing various miscellaneous images, it is desirable to be able to categorize them using as many viewpoints as possible. Therefore, several examples of representative category are determined in advance, such as the method for hierarchically categorizing images of the present invention 3 to 9, and the user selects and categorizes the following two types: a "representative category method" in which individual images are assigned to the closest item, and a "clustering category method" in which features such as color and form are categorized by clustering in each area. Using such a "complex category method" makes it easy to hierarchize category, and also makes it easy to form a meaningful set.

[0039] The fourteenth aspect of the present invention is an image category and search device, characterized in that the device includes a history storage means for storing category viewpoint instructions from a user

during the navigation process as a navigation history; an image category tree generation means for constructing a category tree from the navigation history; a presentation means for presenting the respective generated category tree; and a search means for performing a search for image content from the respective category tree, when a search request is made by a user.

[0040] The history of the category viewpoint selected by the user is saved during the navigation described above. From this category history, a static category tree that provides an overview of the target image DB is created. It is possible to set up a functional means to view this static category tree, and by linking hierarchical category and similarity search, it becomes possible to narrow down the images by switching category and search according to the user's request.

[0041] The fifteenth aspect of the present invention is the image category and search device, characterized in that the respective category tree presentation means utilizes an electronic book and expands the nodes of the category tree in the form of chapters and sections of the book in order to express the category results on the electronic book; the nodes are expressed by combining category viewpoints, composite images, and representative samples in order to concisely express chapters and sections; the most distal leaf displays an overview of all images contained in that leaf and when a summary of an arbitrary image is selected from the respective electronic book, the respective search means searches for an image using the summary of the image as a search key.

[0042] The category tree node constructed as a result of the category is expressed in the form of a chapter or section of a book, using a format of a book that is familiar to the user in daily life as a means of providing the category results to the user. In order to express individual sections and sections in an easy-to-understand manner to the viewers of the electronic book, representative images are displayed as node representations, category viewpoints are described in words, and composite images are displayed. When representing a terminal leaf of a category tree, all images contained in that leaf are displayed. Each chapter or section is linked to a section of those lower levels, and clicking on that link allows you to easily jump to a page displaying the lower level sections. If you select an arbitrary image from the completed electronic book, you can perform an image search using that image as a search key. Additionally, when you select an image of your choice from the search results, a page containing that image will be opened in the e-book. The above node representations can also successfully express the nodes of the category tree in the middle of performing hierarchical categorizing by navigation and visualizing the category tree structure of the image catalog to the user.

[0043] The sixteenth aspect of the present invention is a recording medium that records a program for executing a method for hierarchically categorizing images, characterized in that the program, for executing the processing steps in the method for hierarchically categorizing images described above, is recorded on a recording medium readable by the computer.

[0044] Using this recording medium, it is possible to distribute and store the method for hierarchically categorizing images of the present invention as a recording medium, and it is possible to realize the method of the present invention using a computer.

[0045]

[Embodiments of the invention] The embodiments of the present invention are described in detail below using figures.

[0046] FIG. 1 illustrates a functional block configuration of a system or device for realizing an image category method according to the present invention. In each of the following example embodiments, these functional means are used as appropriate to realize the methods of the present invention. The image category methods according to the present invention are divided into (1) feature extraction phase, (2) category tree

construction phase, and (3) viewing phase.

[0047] In the feature extraction phase, the feature amount for search is extracted from each image in the input set of images and stored in the feature amount DB for search, and in addition, each image data is stored in the image DB. On the other hand, the category feature amount extraction means extracts the category feature amount described in the following example from the image and stores it in the category feature amount DB. An image dictionary or emotional word dictionary may be used when extracting this category feature amount.

[0048] In the category tree construction phase, the category tree construction support function is used to repeatedly categorize the category viewpoint instructions from the builder and the image category based on the instructions, hierarchical categorizing is performed, the category tree is constructed from the category history, and is stored in the category tree DB. The category tree construction support function is realized by a navigation means, category tree preparation means, and clustering means, etc.

[0049] In the viewing phase, the category result (category tree) is presented in this format by the browsing function by the presenting means. When the user issues a search request by this presentation, the image search means performs a search based on the category tree and presents the search results by the presentation means.

[0050] [Example 1] #Configuration of image dictionary

FIG. 2(a), (b), (c) are diagrams illustrating an image dictionary.

[0051] FIG. 2(a) illustrates an example dictionary relating to a sky. For example, "blue sky" may be defined as the representative color of the large area at the top of the image being blue, or the representative color of the large area image object present at the top of the image being blue. Similarly, "cloudy sky" and "night sky" can be defined. Additionally, in combination with thesaurus relating to the sky, an image dictionary corresponding to the concept of "sky" can be configured.

[0052] FIG. 2(b) illustrates an example dictionary relating to a "face of a person". A "face of a person" is a round image object that can be defined as a skin color.

[0053] FIG. 2(c) shows an example dictionary relating to a "roof". A "roof" can be defined as two straight lines, and their positional relationship forms a mountain shape. An image dictionary as shown in FIG. 3 can be constructed by combining words expressing these concepts and their feature quantities, and a thesaurus.

[0054] [Example 2] #Extracting area colors

FIG. 4 is a diagram showing an example of representative area color extraction of an image. The example is divided into 7 patterns and 24 areas as shown. This is the category viewpoint for the area. Furthermore, the color distribution of each area is made into a histogram, and the most frequently appearing color exceeding a specific threshold is determined as the representative area color of that area. If there is no color that exceeds the threshold, the representative area color is not set for that area. The process of calculating this representative area color is shown in a flowchart in FIG. 5. Note that the threshold value may be different for each individual color, and if a bright color has a smaller threshold value than a dark color, the bright color will be emphasized and will be closer to human subjectivity.

[0055] The information on the area and its representative colors is accumulated in the feature DB for category. Images in the DB will be categorized by area and its representative area color. It should be noted that the divided areas may be smaller areas or regions divided using diagonal lines.

[0056] [Example 3] #Extraction from the straight line category viewpoint
FIGS. 6(a)-(f) are examples of category viewpoints using straight lines. The feature related to the length, angle, number of straight lines, and

relationship between a plurality of straight lines of each category viewpoint is extracted for each image or image area, and stored in the feature DB for category. The flowchart for calculating this straight line category viewpoint is shown in FIG. 7.

[0057] [Example 4] #Presentation of recommended category candidates
FIG. 8 shows the processing flow for presenting a recommended category candidate in the area color. After the representative area color is determined for each area for any set of images registered in the database, the number of images X that do not have a representative area color is counted for each area.

[0058] The results of sorting the areas in order of the number of images X are presented to the user as recommended category candidates. Straight lines and objects can also be processed in a similar manner using straight line patterns and object distribution patterns.

[0059] By navigating the user's category using such recommendation candidates, the task of constructing a category tree is facilitated.

[0060] [Example 5] # Use of navigation and history by presenting a category viewpoint

FIG. 9 shows an example navigation by presenting a category viewpoint, and FIG. 10 shows a flowchart thereof.

[0061] In the navigation, you can narrow down your search by adding search conditions. (Generally, the search is narrowed down, but in some cases, the search target may be modified.)

[0062] Furthermore, the category viewpoint is presented in order to assist with subsequent narrowing down as is the case with conventional text navigation. However, the category viewpoint is not text (words), but rather image dictionary, area color, straight lines in images, objects in images, etc.

[0063] In FIG. 9, the system presents the user with a search viewpoint such as area color, straight line, object, and image dictionary for the set of images in the middle of navigation, and the user selects the image dictionary, and the system (or device) presents the "face of a person," "sky" and "roof", and the user selects the "face of a person," to obtain a collection of portraits.

[0064] Further, as a next step, the system presents to the user a search viewpoint such as area color, straight line, object, and image dictionary for the set of images in the same manner as the previous step. In this way, narrowing down images once is performed by selecting two types of viewpoints: general category viewpoints (main category viewpoints), such as an image dictionary, area color, straight lines in images, and objects in images, and a category viewpoints that details them (sub-category viewpoints). The presentation of the recommendation category viewpoint in the area color, which is one of the main category viewpoints, is shown in FIG. 9. Further, FIG. 11 shows a flowchart of the sub-category viewpoints and the category summary that are presented when an area color is selected as the main category viewpoints.

[0065] In FIG. 11, the number of sheets X_i ($0 \leq i \leq N$) belonging to each representative color (N color) is calculated for the area A input by the user, the order of the number of sheets is rearranged in descending order of number, a sample is obtained from among the registered image data in descending order of number of images, and presented together with the number of sheets.

[0066] In the example of FIG. 9, as a second narrowing down, the user selects the area color no. 22, and the system also presents a category overview of the area color no. 22 (statistics, etc. on the category), and the user selects white to obtain a collection of portraits of people wearing white clothes.

[0067] As a history of this navigation, it can be understood that the "face of a person" or "the area no. 22 is white" are effective for categorizing the image DB that is currently being used, so that history is accumulated as static category tree information in the system (or device). The image DB can be viewed by viewing the entire image of the accumulated static

category trees using keywords, composite images, and sample images.

[0068] Image category and similar search are linked as shown in FIG. 12. In the process of narrowing down the image by category, if [a user] wants to obtain an image showing a more specific subject from among the set of categories at that time, enter the key image and perform a similar search. For example, by inputting "Apple" as a key image in the portrait of people wearing white clothes in the set of categories D of FIG. 9, it is possible to obtain "a photograph of a person wearing white clothes and an apple". In addition, it is also possible to switch from search to category.

[0069] [Example 6] #Composite category method (fusion of clustering category and representative category)

When categorizing images hierarchically by navigation, several examples of typical category items are determined in advance, where there are the method for hierarchically categorizing images according to the above embodiment, wherein each image is categorized into the closest category item; and a clustering category method that uses a clustering method to categorize image features such as color features and shape features of each area into similar sets; and the images are categorized by freely combining [those two methods].

[0070] When categorizing various miscellaneous images, it is desirable to be able to categorize them using as many viewpoints as possible. Therefore, several examples of representative category are determined in advance, such as the method for hierarchically categorizing images described above, and the user selects and categorizes the following two types: a "representative category method" in which individual images are assigned to the closest item, and a "clustering category method" in which features such as color and form are categorized by clustering in each area. Using such a "complex category method" makes it easy to hierarchize category, and also makes it easy to form a meaningful set. Specifically, clustering is one of the category viewpoints, and for example, it is presented as color clustering, etc. in the category viewpoint presented for the set of images in FIG. 9. When this color clustering is selected and indicated, clustering by color feature is performed and is generally categorized as a plurality of set of images, so one of them is selected to transition to the next category step.

[0071] [Example 7] #Regression and subdivision of representative colors FIG. 13 is a diagram illustrating representative color regression.

[0072] The method of example 2 is used to determine the area color of a certain area to be either a preset representative color or no representative color. For example, if 1000 images are categorized as 13 representative colors as shown in the figure, there are only 2 images that are light green. Generally, when the number of leaves in category trees is increased, it is difficult to see where the desired image is in the configured category trees, so it is better to construct a simple category tree as much as possible. Therefore, a certain threshold value is set, and if there are only images of less than the threshold value in one leaf, the images are integrated with colors similar to the image value. For example, if there are only two sheets [of photos that are] light green as shown in FIG. 13, they are combined with green having a similar hue. If the number of images in the integrated green set is still less than the threshold, it is further combined with the blue category. By using such a method, a simple category tree is formed.

[0073] On the other hand, if the number of images categorized into a certain color is greater than a certain number of images, an additional category viewpoint is provided that allows for more detailed classification of colors as the next category viewpoint. FIG. 14 shows an example of a detailed color category in the case of a representative color "blue". The standard color "blue" can be categorized as a number of levels of color from "light blue" to "dark blue".

[0074] [Example 8] #FIG. 15, the Nth primary color extraction, is a diagram illustrating the Nth primary color extraction.

[0075] Although it is possible to categorize the representative colors of the entire area using the method of Example 2 described above, depending on the image, there is not necessarily one representative color in the entire area, but a plurality of dominant colors may exist. Therefore, as shown in FIG. 15, the color histogram value of the entire image area is set as the first primary color, second primary color, etc. in descending order of the color histogram value, categorizing using these primary colors. This is not limited to the entire image area, but can be extended to any image area.

[0076] [Example 9] #Representative shape category

FIG. 16 is an example representative shape, FIG. 17 is a flowchart of representative shape category.

[0077] In order to categorize based on shape, a basic image such as a circle, square, or rectangle as shown in FIG. 16 is prepared in advance. The user can replace these representative shapes with any image depending on the type of image to be categorized. As shown in FIG. 17, from these representative shapes and the input category target image, feature extraction and distance calculation of shape feature amounts are performed, and then the representative shape with the shortest distance is categorized.

[0078] [Example 10] #Emotional word category

FIG. 18 shows a flowchart of emotional word categories.

[0079] The system (or device) has an emotional word dictionary that corresponds to the emotional words and the colors received from the emotional words. The user can select the emotional word to be registered at his/her discretion. When an image to be categorized is input, the emotional word feature value based on the color is extracted, and the distance from all emotional words registered in the emotional word dictionary are calculated. Among them, the input image is uniquely categorized for the emotional word that is the closest.

[0080] [Example 11] #Electronic System (or Device)

FIG. 19 is an example of an electronic system (or device).

[0081] The node of the category tree constructed by repeating the category is expressed in the form of a chapter or section of the book, and a table of contents page is provided at the beginning of the electronic book to make it easier to understand the overall category results. In order to express the contents of individual chapters and sections in a concise and easy-to-understand manner to readers of an electronic book, it is necessary to display representative pictures that have been explained or to express the category viewpoints in words. For only the terminal leaf of the category tree, a page is created that displays all images included in that leaf.

[0082] The electronic book created by the above method can be flipped through and viewed just like a real book. Furthermore, each chapter or section is provided with a link function for moving to the lower-layered sections, so that it is possible to easily jump to a page displaying the lower-layered sections as shown in (1) of FIG. 19.

[0083] When an arbitrary image is selected from the completed electronic book, a search is performed using the image as a search key, as shown in (2) of FIG. 19. Additionally, when you select an image of your choice from the search results as shown in (3) of FIG. 19, a page containing that image will be opened in the e-book. You can try seamlessly going back and forth between the category->search and search->category methods described above until you find the desired image.

[0084] [Example 12] #Recording medium for computer programs that perform hierarchical category

Some or all of the functions of the functional block configuration shown in FIG. 1 can be achieved using a computer. Alternatively, it goes without saying that the processing procedures shown in FIGS. 5, 7, 8, 10, 11, 12, 17, 18, 19, etc. can be executed by a computer. A program for realizing the functions of each part on a computer, or a program for

carrying out the procedure on a computer can be recorded on a computer-readable storage medium such as a floppy disk (FD), MO, ROM, memory card, CD, DVD, removable disk, etc., provided, and distributed.

[0085]

[Effect of the invention] According to the present invention 1, images are categorized hierarchically and category trees can be easily constructed.

[0086] According to the second aspect of the present invention, hierarchical categorizing based on the subject or concept of the image can be realized. In addition, a category tree can be created with a classification order that is close to the human category sense.

[0087] According to the third aspect of the present invention, it becomes possible to perform hierarchical categorizing using representative colors that are close to the color impressions people receive from images.

[0088] According to the fourth aspect of the present invention, it is possible to categorize images having a plurality of dominant colors.

[0089] According to the fifth aspect of the present invention, hierarchical representative area color category results are obtained according to the scale of the aggregate.

[0090] According to the sixth aspect of the present invention, hierarchical image category based on human emotion is possible.

[0091] According to the seventh aspect of the present invention, it becomes possible to perform hierarchical categorizing that reflects the linear composition of images.

[0092] According to the eighth aspect of the present invention, it is possible to perform hierarchical categorizing that reflects the composition of the image based on the object distribution.

[0093] According to the ninth aspect of the present invention, hierarchical categorizing by similar shape is possible.

[0094] According to the tenth aspect of the present invention, it is easier to narrow down the images in the process of categorizing the images hierarchically.

[0095] According to the eleventh aspect of the present invention, it is possible to present a promising category viewpoint from among a large number of category viewpoints at the top, and it is possible to reduce the burden on the user.

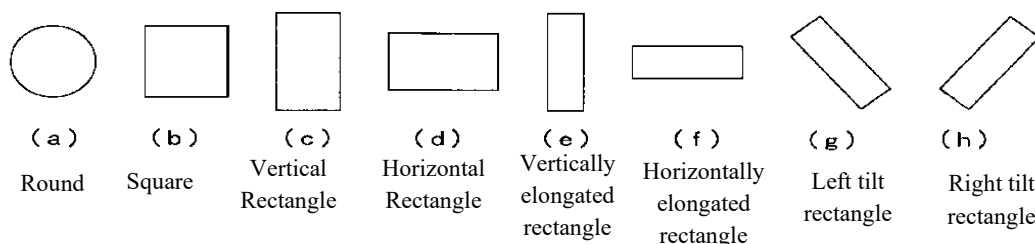
[0096] According to the twelfth aspect of the present invention, an image category tree can be easily created.

[0097] According to the thirteenth aspect of the present invention, it is possible to create a category tree with which the desired image is easy to find.

[0098] According to the fourteenth aspect of the present invention, a user can easily create an image category tree and get an overview of the images registered in the database, and perform searches, while understanding the overview of the image DB. This makes it possible to find images that were missing from the search results.

*

[FIG. 16]



[0099] According to the fifteenth aspect of the present invention, a user can easily view the image category tree and search for images, while flipping through the pages of an electronic book. In addition, it is possible to narrow down the images seamlessly using both category and search functions.

[0100] According to the sixteenth aspect of the present invention, the method for hierarchically categorizing images can be stored, provided, and distributed as a computer program, and the hierarchical category of images can be performed by a computer.

[Brief Description of the Drawings]

FIG. 1 is a functional block configuration diagram of a system (or device) for realizing a method for hierarchically categorizing images according to the present invention.

FIG. 2 (a) is a diagram showing an example of image dictionary construction, (b) is a diagram showing an example of image dictionary construction, and (c) is a diagram showing an example of image dictionary construction.

FIG. 3 is a diagram illustrating an example configuration of an image dictionary.

FIG. 4 is a diagram illustrating an example representative area color extraction of an image.

FIG. 5 is a flowchart for calculating representative area colors;

FIG. 6 (a), (b), (c), (d), (e), and (f) are illustrations showing examples of straight-line category candidates.

FIG. 7 is a diagram showing a flowchart showing the calculation of a straight line category viewpoint.

FIG. 8 is a flowchart showing the viewpoint of recommended category in the area color.

FIG. 9 is a diagram showing an example navigation category of an image DB utilizing a category viewpoint.

FIG. 10 is a flowchart of navigation by presenting a category viewpoint.

FIG. 11 is a flowchart of the presentation of a category overview in the area.

FIG. 12 is a flowchart of image category and image search linkage processing.

FIG. 13 is a diagram illustrating representative color regression examples.

FIG. 14 is a diagram showing a detailed color category example of a representative color (in the case of "blue").

FIG. 15 is a diagram illustrating extraction of the Nth main color.

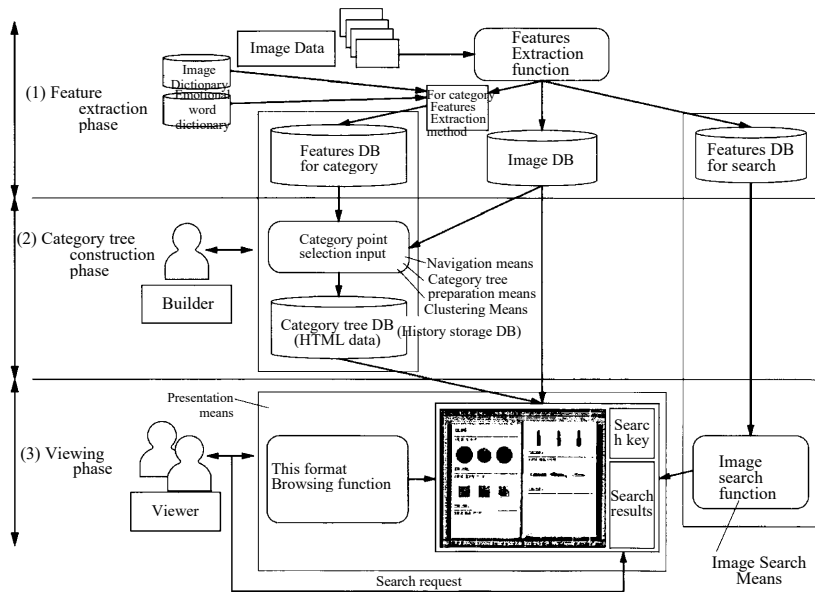
FIG. 16 (a), (b), (c), (d), (e), (f), (g), and (h) are illustrations showing examples of representative shapes.

FIG. 17 is a flowchart of representative shape category.

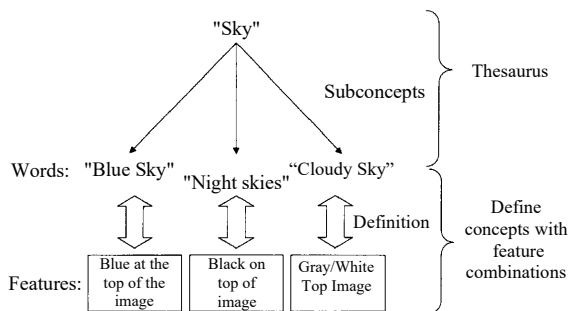
FIG. 18 is a flow chart of emotional word categories.

FIG. 19 is a diagram illustrating an example of an electronic book system (or device).

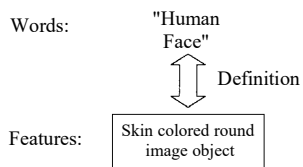
[FIG. 1]



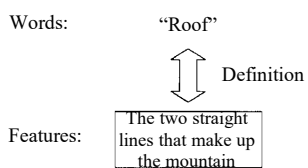
[FIG. 2]



(a) Example of an image dictionary

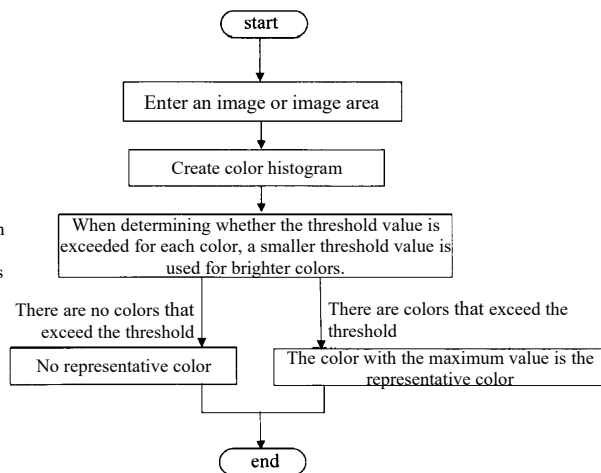


(b) Example image dictionary

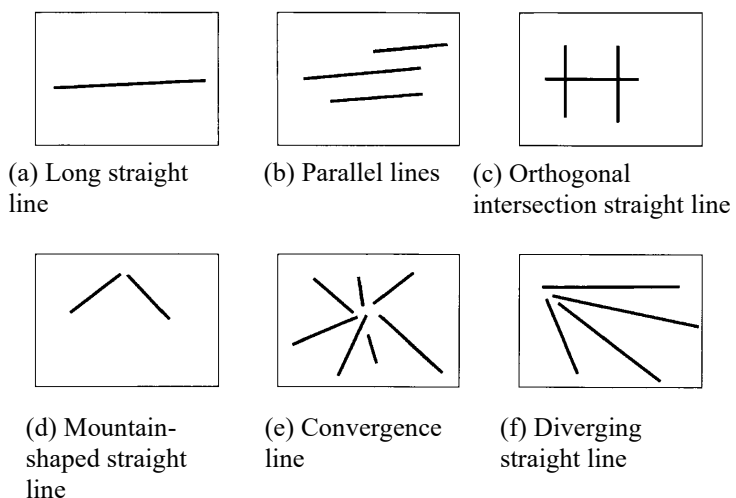


(c) Example of an image dictionary

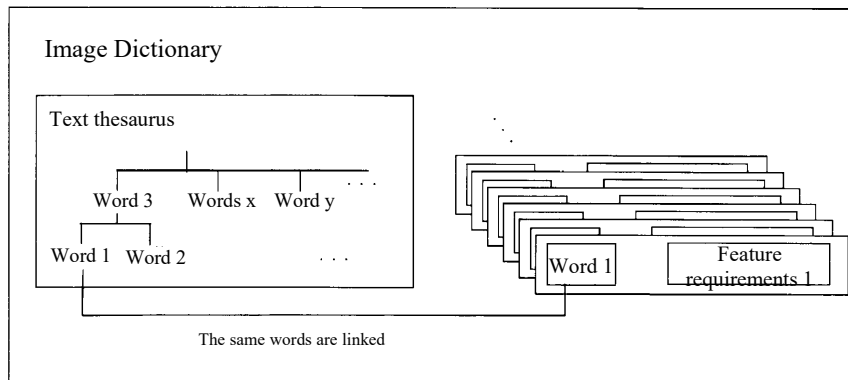
[FIG. 5]



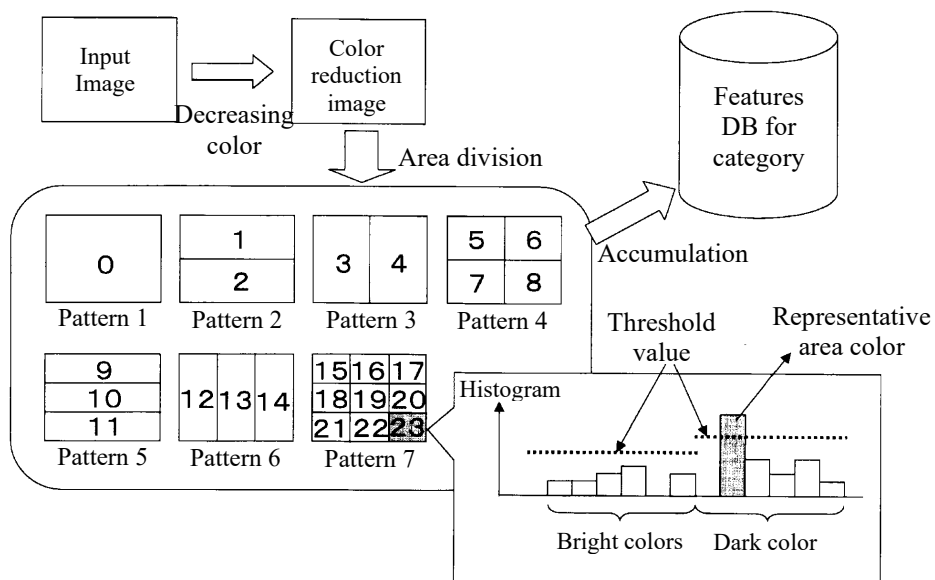
[FIG. 6]



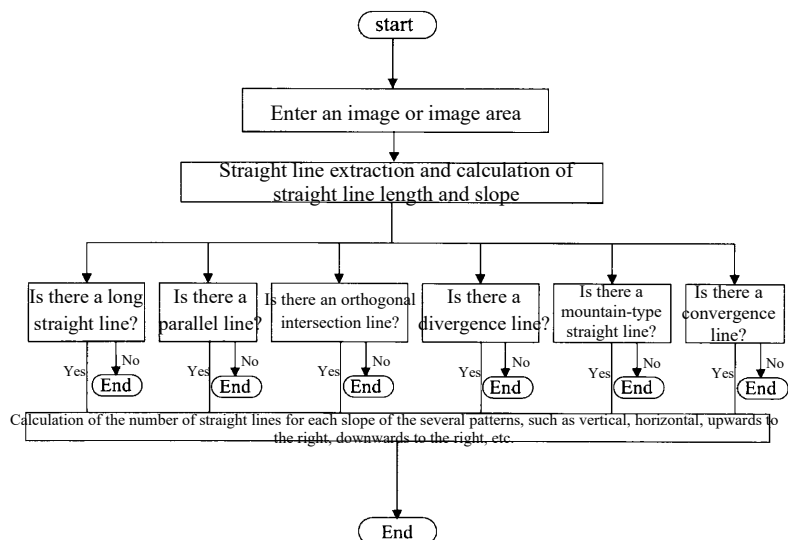
[FIG. 3]



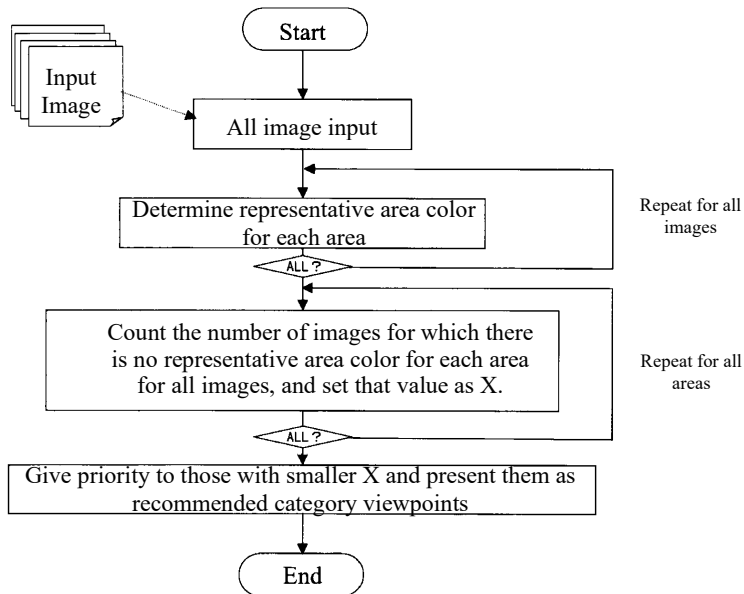
[FIG. 4]



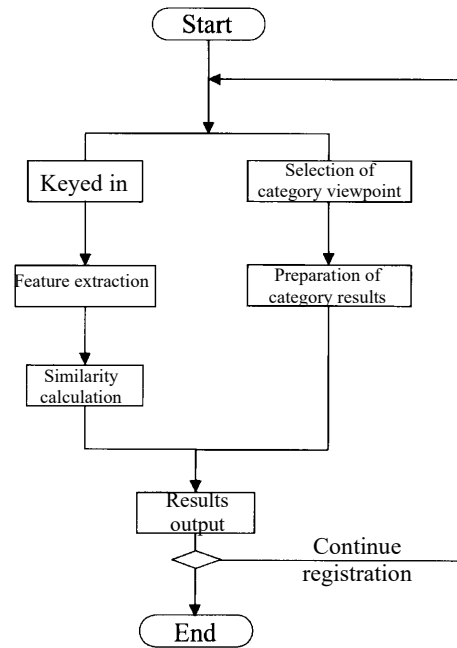
[FIG. 7]



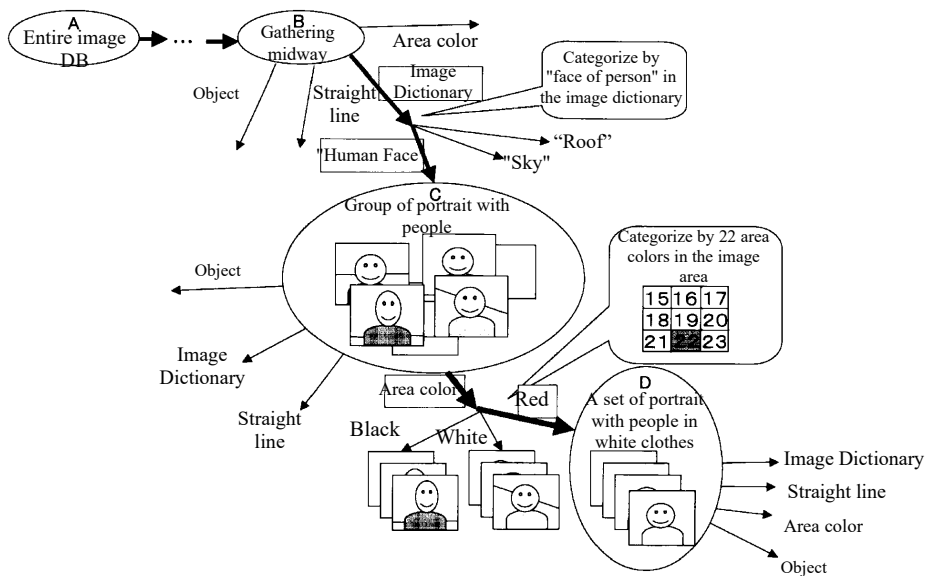
[FIG. 8]



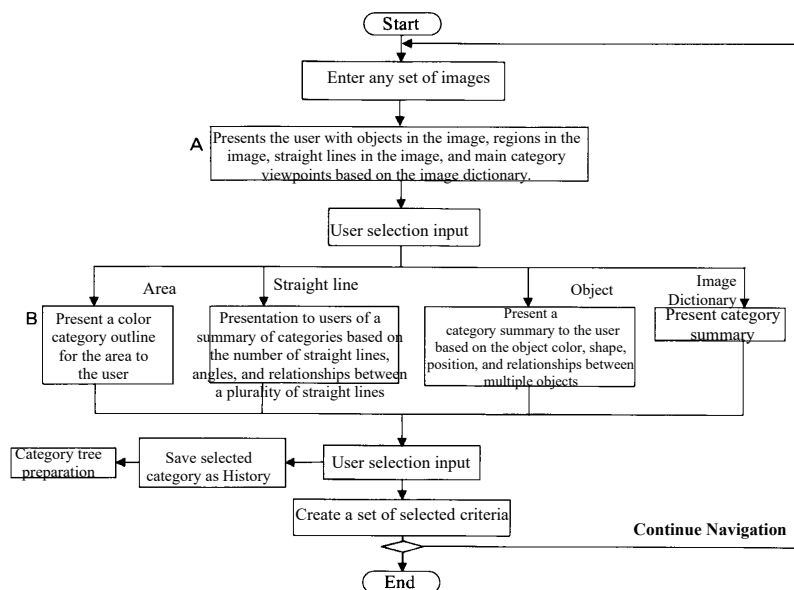
[FIG. 12]



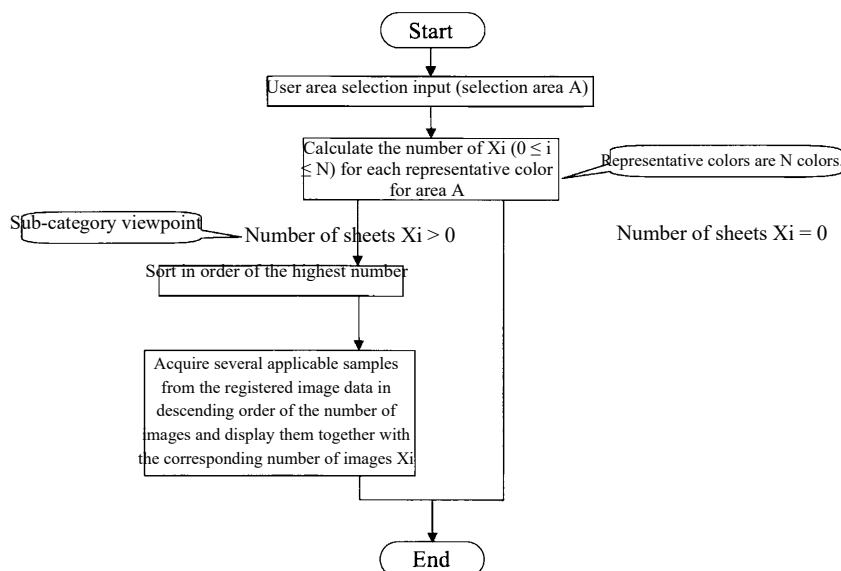
[FIG. 9]



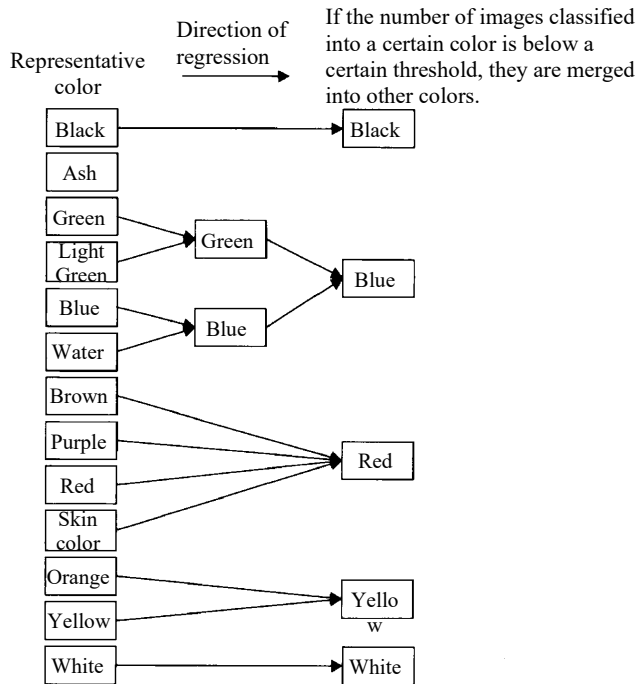
[FIG. 10]



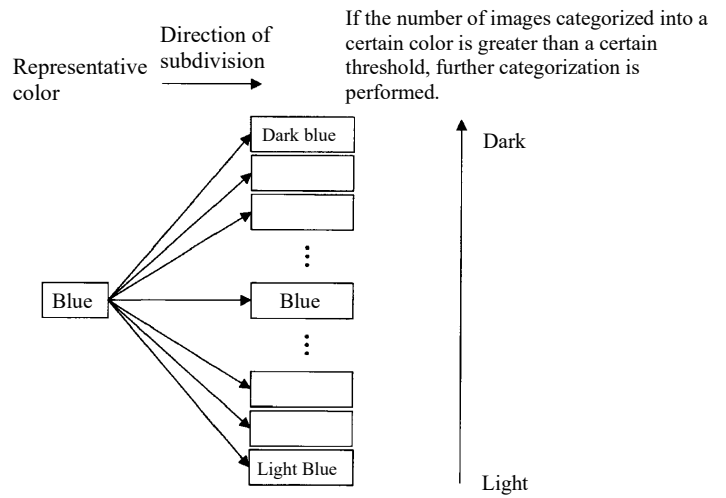
[FIG. 11]



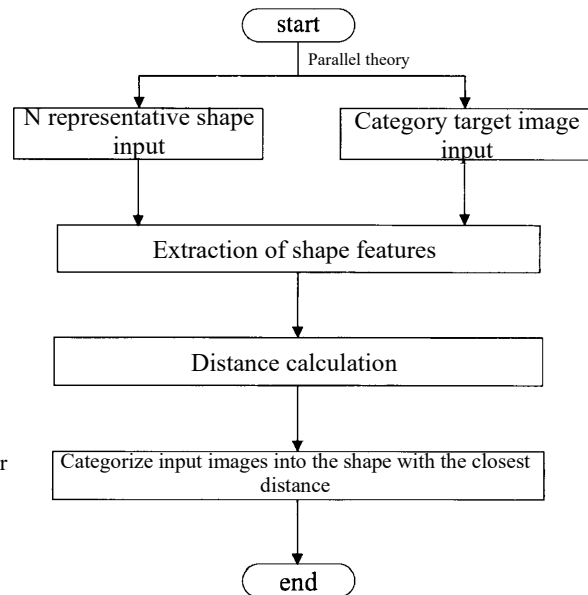
[FIG. 13]



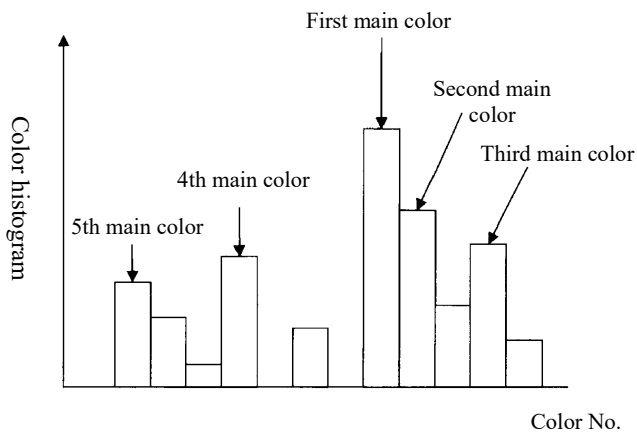
[FIG. 14]



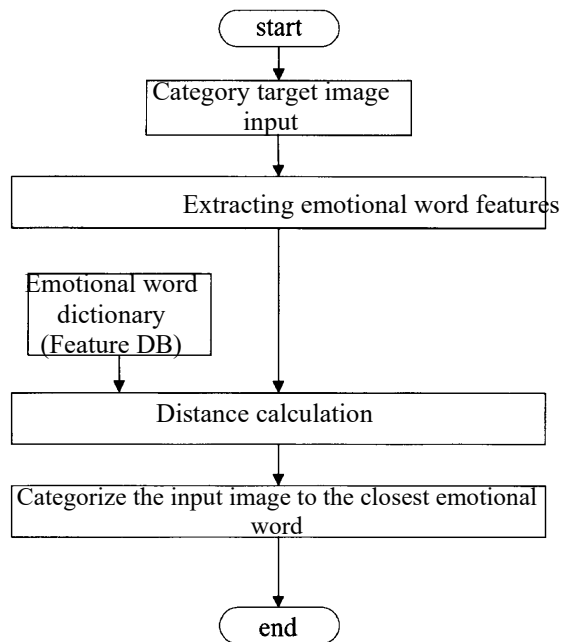
[FIG. 17]



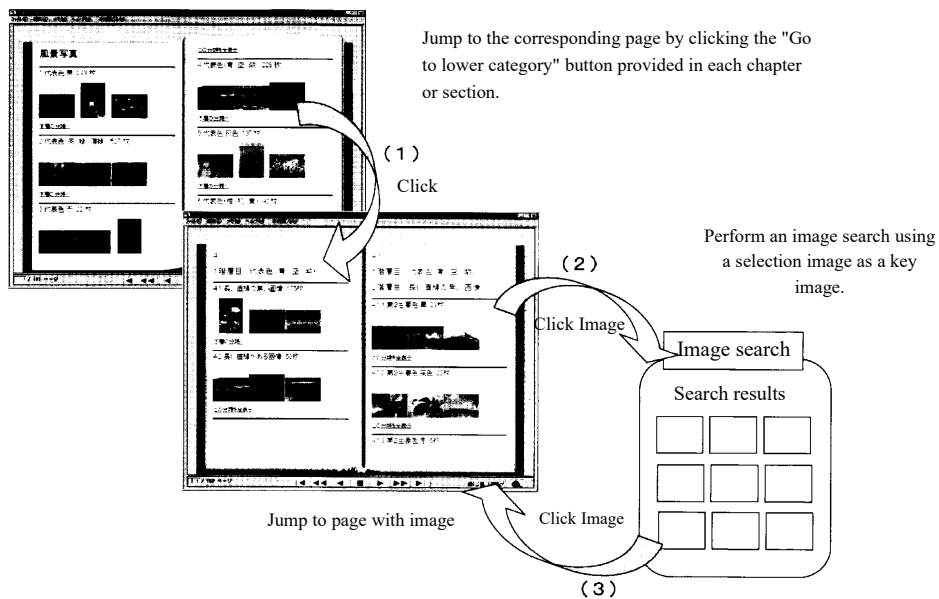
[FIG. 15]



[FIG. 18]



[FIG. 19]



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