Claims

1. A method for recommending online products, comprising:

specifying, by a processor, a main product zone of a query product image;

removing, by the processor, an image background from the main product zone to obtain a modified main product zone;

calculating, by the processor, a center of gravity of the modified main product zone;

dividing, by the processor, the modified main product zone into a plurality of local zones based on the calculated center of gravity;

extracting, by the processor, color features from a local zone, wherein the extracting is performed by dividing the local zone into a plurality of portions using a hue, saturation, and brightness space;

looking up, by the processor, candidate recommended product images sharing common characteristics with the query product image based on the color features of the local zone;

matching, among the found candidate recommended product images, product images that are similar in terms of color matching to the query product image;

providing the matched product images as recommended product images to a client for display; and

establishing, by the processor, an inverted index for the product images based on numbers of words in the product images, wherein:

the main product zone is comprised of high-dimensional vectors, a high-dimensional vector representing a vector corresponding to a distribution of a plurality of dimensions, a dimension corresponding to a color.

2. The method for recommending online products as described in claim 1, wherein the looking up of the candidate recommended product images sharing the common characteristics with the query product image comprises:

accessing entries of the inverted index corresponding to word frequencies that occur within a query product image P to calculate a similarity between the query product image P and a recommendable product image Q based on a cosine of an angle in a high-dimensional space

formed by two high-dimensional vectors composed of the word frequencies of the query product image P and the recommendable product image Q; and

selecting a top-ranked preset quantity M recommendable product images from the calculated similarity as candidate recommended product images, wherein M is an integer greater than one.

3. The method for recommending online products as described in claim 2, wherein the calculating of the similarities between the query product image P and the recommendable product image Q comprises:

$sim(P,Q) = \sum_{i=1}^{w} \frac{p_i q_i}{|P||Q|}$, wherein w represents a quantity of high-dimensional vectors contained in each product image, w= r × m, r represents a quantity of local zones into which each image has been divided, m represents a quantity of colors contained in the local zone, | | represents a modulus operator, $|P| = \sqrt{\sum_{i=1}^{w} p_i^2}$, $|Q| = \sqrt{\sum_{i=1}^{w} q_i^2}$, p_i represents a word frequency corresponding to an i^{th} high-dimensional vector element within the query product image P, q_i represents a word frequency corresponding to the i^{th} high-dimensional vector element within the recommendable product image Q, and a background zone word frequency is zero.

4. The method for recommending online products as described in claim 3, wherein the matching of the product images that are similar in terms of color matching to the query product image comprises:

performing matching calculations on one of the candidate recommended product images at a time;

reducing differences between the one candidate recommended product image and the query product image with respect to these color intervals based on dominant hues shared by two images that are matched;

strengthening differences between the one candidate recommended product image and the query product image with respect to these color intervals based on details or different color parts of the two images that are matched to obtain a color matching similarity colorsim (P,Q) for each candidate recommended product image Q and the query product image P; and

performing one of the following:

1) acquiring a preset quantity N product images top-ranked by similarity from among the candidate recommended product images and regarding the preset quantity N product images as recommended product images similar in terms of color matching to the query product image, wherein N is an integer greater than one; or
2) selecting, from among the candidate recommended product images, product images whose similarity to the query product image is greater than a preset similarity threshold value and regarding the product images as recommended product images.

5. The method for recommending online products as described in claim 4, wherein the obtaining of the color matching similarity colorsim (P,Q) of each candidate recommended product image Q and the query product image P is:

$colorsim(P,Q)=\sum_{j=1}^{r} colorsim(P_j,Q_j)$, wherein r represents the quantity of local zones into which each image has been divided, $colorsim(P_j,Q_j)=\chi^2(P_j,Q_j)=\frac{1}{2}\sum_{k=1}^{m}\frac{(p_k-q_k)^2}{p_k+q_k}$, m representing the quantity of colors contained in the local zone.

6. A system for recommending online products, comprising:

at least one processor configured to:

specify a main product zone of a query product image;

remove an image background from the main product zone to obtain a modified main product zone;

calculate a center of gravity of the modified main product zone;

divide the modified main product zone into a plurality of local zones based on the calculated center of gravity;

extract color features from a local zone, wherein the extracting is performed by dividing the local zone into a plurality of portions using a hue, saturation, and brightness space;

look up candidate recommended product images sharing common characteristics with the query product image based on the color features of the local zone;

match, among the found candidate recommended product images, product images that are similar in terms of color matching to the query product image;

provide the matched product images as recommended product images to a client for display; and

establish an inverted index for the product images based on numbers of words in the product images, wherein:

the main product zone is comprised of high-dimensional vectors, a high-dimensional vector representing a vector corresponding to a distribution of a plurality of dimensions, a dimension corresponding to a color; and

a memory coupled to the at least one processor and configured to provide the at least one processor with instructions.

7. The system for recommending online products as described in claim 6, wherein to look up the candidate recommended product images sharing the common characteristics with the query product image comprises to:

access entries of an inverted index corresponding to word frequencies that occur within a query product image P to calculate a similarity between the query product image P and a recommendable product image Q based on a cosine of an angle in a high-dimensional space formed by two high-dimensional vectors composed of the word frequencies of the query product image P and the recommendable product image Q; and

select a top-ranked preset quantity M recommendable product images from the calculated similarity as candidate recommended product images, wherein M is an integer greater than one.

8. The system for recommending online products as described in claim 7, wherein to calculate the similarities between the query product image P and the recommendable product image Q comprises to calculate

$sim(P,Q) = \sum_{i=1}^{w} \frac{p_i q_i}{|P||Q|}$, wherein w represents a quantity of high-dimensional vectors contained in each product image, w= r × m, r represents a quantity of local zones into which each image has been divided, m represents a quantity of colors contained in the local zone, | | represents a modulus operator, $|P| = \sqrt{\sum_{i=1}^{w} p_i^2}$, $|Q| = \sqrt{\sum_{i=1}^{w} q_i^2}$, p_i represents a word frequency

corresponding to an i^{th} high-dimensional vector element within the query product image P, q_i represents a word frequency corresponding to the i^{th} high-dimensional vector element within the recommendable product image Q, and a background zone word frequency is zero.

9. The system for recommending online products as described in claim 8, wherein to match the product images that are similar in terms of color matching to the query product image comprises to:

perform matching calculations on one of the candidate recommended product images at a time;

reduce differences between the one candidate recommended product image and the query product image with respect to these color intervals based on dominant hues shared by two images that are matched;

strengthen differences between the one candidate recommended product image and the query product image with respect to these color intervals based on details or different color parts of the two images that are matched to obtain a color matching similarity colorsim (P,Q) for each candidate recommended product image Q and the query product image P; and

perform one of the following:

1) acquire a preset quantity N product images top-ranked by similarity from among the candidate recommended product images and regard the preset quantity N product images as recommended product images similar in terms of color matching to the query product image, wherein N is an integer greater than one; or
2) select, from among the candidate recommended product images, product images whose similarity to the query product image is greater than a preset similarity threshold value and regard the product images as recommended product images.

10. The system for recommending online products as described in claim 9, wherein the color matching similarity colorsim (P,Q) of each candidate recommended product image Q and the query product image P is:

$colorsim(P,Q) = \sum_{j=1}^{r} colorsim(P_j, Q_j)$, wherein r represents the quantity of local zones into which each image has been divided, $colorsim(P_j, Q_j) = \chi^2(P_j, Q_j) = \frac{1}{2}\sum_{k=1}^{m} \frac{(p_k - q_k)^2}{p_k + q_k}$, m representing the quantity of colors contained in the local zone.

11. A computer program product for recommending online products, the computer program product being embodied in a tangible non-transitory computer readable storage medium and comprising computer instructions for:

specifying a main product zone of a query product image;

removing an image background from the main product zone to obtain a modified main product zone;

calculating a center of gravity of the modified main product zone;

dividing the modified main product zone into a plurality of local zones based on the calculated center of gravity;

extracting color features from a local zone, wherein the extracting is performed by dividing the local zone into a plurality of portions using a hue, saturation, and brightness space;

looking up candidate recommended product images sharing common characteristics with the query product image based on the color features of the local zone;

matching, among the found candidate recommended product images, product images that are similar in terms of color matching to the query product image;

providing the matched product images as recommended product images to a client for display; and

establishing an inverted index for the product images based on numbers of words in the product images, wherein:

the main product zone is comprised of high-dimensional vectors, a high-dimensional vector representing a vector corresponding to a distribution of a plurality of dimensions, a dimension corresponding to a color.

12. The computer program product for recommending online products as described in claim 11, wherein the looking up of the candidate recommended product images sharing the common characteristics with the query product image comprises:

accessing entries of an inverted index corresponding to word frequencies that occur within a query product image P to calculate a similarity between the query product image P and a recommendable product image Q based on a cosine of an angle in a high-dimensional space formed by two high-dimensional vectors composed of the word frequencies of the query product image P and the recommendable product image Q; and

selecting a top-ranked preset quantity M recommendable product images from the calculated similarity as candidate recommended product images, wherein M is an integer greater than one.

13. The computer program product for recommending online products as described in claim 12, wherein the calculating of the similarities between the query product image P and the recommendable product image Q comprises:

$sim(P,Q) = \sum_{i=1}^{w} \frac{p_i q_i}{|P||Q|}$, wherein w represents a quantity of high-dimensional vectors contained in each product image, w= r × m, r represents a quantity of local zones into which each image has been divided, m represents a quantity of colors contained in the local zone, | | represents a modulus operator, $|P| = \sqrt{\sum_{i=1}^{w} p_i^2}$, $|Q| = \sqrt{\sum_{i=1}^{w} q_i^2}$, p_i represents a word frequency corresponding to an i^{th} high-dimensional vector element within the query product image P, q_i represents a word frequency corresponding to the i^{th} high-dimensional vector element within the recommendable product image Q, and a background zone word frequency is zero.

14. The computer program product for recommending online products as described in claim 13, wherein the matching of the product images that are similar in terms of color matching to the query product image comprises:

performing matching calculations on one of the candidate recommended product images at a time;

reducing differences between the one candidate recommended product image and the query product image with respect to these color intervals based on dominant hues shared by two images that are matched;

strengthening differences between the one candidate recommended product image and the query product image with respect to these color intervals based on details or different color

parts of the two images that are matched to obtain a color matching similarity colorsim (P,Q) for each candidate recommended product image Q and the query product image P; and

performing one of the following:

1) acquiring a preset quantity N product images top-ranked by similarity from among the candidate recommended product images and regarding the preset quantity N product images as recommended product images similar in terms of color matching to the query product image, wherein N is an integer greater than one; or
2) selecting, from among the candidate recommended product images, product images whose similarity to the query product image is greater than a preset similarity threshold value and regarding the product images as recommended product images.

15. The computer program product for recommending online products as described in claim 14, wherein the obtaining of the color matching similarity colorsim (P,Q) of each candidate recommended product image Q and the query product image P is:

$colorsim(P,Q) = \sum_{j=1}^{r} colorsim(P_j, Q_j)$, wherein r represents the quantity of local zones into which each image has been divided, $colorsim(P_j, Q_j) = \chi^2(P_j, Q_j) = \frac{1}{2}\sum_{k=1}^{m} \frac{(p_k - q_k)^2}{p_k + q_k}$, m representing the quantity of colors contained in the local zone.