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Application of Vector Illustration based on Multimedia Data in Gift Packaging

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Abstract

Through a reasonable estimation of the market prospects and an in-depth analysis of consumers' "heterogeneity" needs, this paper relies on the technical route of multimedia platform construction to propose a feasible and personalized construction plan of gift packaging design platform. Moreover, this article applies vector illustration to the gift packaging design to provide specific products and design services for each consumer. The system designs various functional modules based on the server one-stop development model. In addition, according to the principle of one-stop server development, system design user permissions and designer permissions are used to distinguish the user side of the system from the system design side, and users and designers interact with related interfaces. From the experimental results, it can be seen that vector illustrations based on multimedia data can play an important role in gift packaging and effectively enhance the effect of gift packaging.

Keywords: multimedia; vector illustration; spatial structure; gift packaging

1 INTRODUCTION

In modern society, people and countries will give gifts to each other. Therefore, the design of gift packaging is also extremely important. Since different countries, ethnic groups, and regions have different cultural customs, it is necessary to pay attention to cultural aspects when designing gift packaging. Moreover, gift packaging design has its unique cultural symbolism, and the spirituality it conveys will be more important than materiality [1]. Present gifts are generally divided into life gifts and business gifts, and their packaging design will be different from the packaging design of ordinary commodities, which is mainly to convey the cultural connotation of gifts. At the same time, there are more and more gift packaging on the market. Research on the design culture of gift packaging is conducive to enhancing the overall value and taste of gift packaging. Gift-giving is a universal social phenomenon, which exists in all periods and regions of human society. Therefore, an ideal gift can express a special desire and convey a special message to both the giver and the receiver. It has novelty, strange characteristics, craftsmanship and practicality. In the gift packaging design, the study of the inner connection with culture has more embodied the spiritual value and aesthetic taste of gift packaging [2].

Iconology is a method of studying art history, with the subject of visual art as the research object. Its purpose is to discover and explain the symbolic meaning of visual art images, and to reveal the formation and changes of images in various cultural systems and civilizations, as well as the ideological concepts and complex social and historical relationships that they express or imply. Therefore, the meaning of visual art images embodied in gift packaging design and the cultural connotations and characteristics expressed by the outer packaging of gifts are analyzed through image science [3].

This article combines multimedia technology to apply vector illustration to gift packaging design to improve the effect of gift packaging design, and at the same time combines the application of vector illustration in gift packaging to provide a reference for subsequent digital design reforms.

2 RELATED WORK

At present, the design of gift packaging is getting more and more exquisite, and the shape of the packaging is becoming more and more artistic. In addition to the novel and beautiful shape of the container itself, many gift packages are also decorated with exquisite tags, ribbons, and knots. According to the requirements of the internal and external protection structure, some also add handles or rope knots[4]. Many gift box-shaped designs are very popular because of their solemnity, stability, elegance and luxury. The composition is mostly symmetrical. At the same time, the patterns and colors are becoming more and more abundant and rigorous, which give people a festive and auspicious meaning to show the value of the gift and the respect for the recipient. Although gift packaging is different from general commodity packaging, it should also follow the principle of " cut clothes by measuring the body ", and design a package with appropriate materials, scientific structure, beautiful and novel, economical and practical according to the product grade [5]. The so-called "body measurement" is to clarify the attributes, grades, consumers, and sales areas of the goods. The so-called "cutting clothes" is to determine the design pattern and design plan. Packaging should not only be based on the principles of "scientific, beautiful, practical, economical, and promotional", but also consider the effect

of environmental protection, which is also an evaluation standard for a designer and packaging design. Only by mastering the "degree" of design, can we be well-informed and confident in packaging design. At present, in the gift packaging market, packaging design basically reflects novel, unique and beautiful features. However, there are some problems in the rationality of the packaging structure [6].

In some traditional holiday consumer markets, a dazzling array of gift packaging floods the shelves. Moreover, some businesses, in order to achieve the purpose of competition, do not hesitate to make a fuss about the packaging structure, in disguised form to improve the product grade and packaging specifications. This approach not only increases energy consumption, but also is not conducive to the spirit of environmental protection [7].

Gift consumption is not only the physical attributes of the product itself, but also the psychological attributes of consumption. The highlight is an emotion and a care [8]. The deep-seated reason is that gifts symbolize a kind of interest and relationship in culture. On the one hand, gifts are to give benefits, and on the other hand, to establish and maintain relationships [9]. Gifts have become a symbol to express a specific relationship. Gifts to parents indicate filial piety; gifts to friends indicate close relationships; gifts to leaders indicate respect: gifts to customers indicate friendly cooperation [10]. The true value of gifts is reflected in the pleasure and joy of the moment of giving and receiving gifts. The degree of this pleasure partly depends on the value of the gift itself, and high price means close relationship [11]. However, even if the gift itself has no expensive value, it can also be a good gift because of its exquisite packaging. Consumers generally have a herd mentality and like to follow trends. Gift consumption is a kind of social behavior, and its consumption characteristics are restricted by consumers themselves, recipients and the entire social consumption environment. Gift consumption behavior is often the result of the interaction of the three aspects [12]. The affordability of gift-giver (gift consumer) and the psychological motivation of gift-giving constitute the basis of gift consumption; the needs, hobbies, and status of the gift-giver are an important aspect that affects the purchase decision of the gift-giver; the overall consumption environment of the society is at the same time Guide the gift-giver and gift-receiver's gift-giving consumption concept [13].

Interactive concept packaging design, as the name suggests, must be interactive. When consumers use packaging, the material, structure, visual image of the packaging, and the way the packaging is opened, will all stimulate and affect the consumer's perception layer, thereby causing interaction between consumers and packaging design [14]. The design adheres to the interactive design concept, and conducts subdivision research on the entire process from the sale of the gift terminal to the completion of the consumer's use, and considers each stage separately, seeking possible interaction points between the consumer and the packaging, and strives to be in the senses and emotions. , Function, intelligence and other aspects to find a fit[15].

Intelligentization is another new direction of packaging design, which coincides with some aspects of interactive design concepts. Therefore, some smart methods will also be introduced in this topic, such as adding a sound device to the gift packaging to increase the user's emotional experience, so that the user is not just staying at the simple process of unpacking the gift, taking out the gift, and discarding the package. This design method not only meets the requirements of modern technology development, but also solves many problems such as boring gift packaging. The specific design plan will verify its feasibility, equipment cost and practicality of application in the subsequent work [16].

3 FRAMEWORK OF IMAGE COPY DETECTION ALGORITHM

As shown in Figure 1, the common gift packaging image copy detection algorithm is mainly composed of three parts: feature extraction, quantification and index construction, and similarity measurement. In the global feature-based copy detection algorithm, there is no quantization and index construction stage, and the global feature vector is directly matched to judge the copy gift packaging image. In the copy detection algorithm based on local features, because of the large number of local features, the vector dimension is high. If direct matching is computationally expensive, the methods of quantifying features and building indexes are used to reduce computational costs and speed up the matching process of local features. The specific process of the copy detection algorithm is as follows:

First, the algorithm extracts the local features of all gift packaging images in the gift packaging image database, and reduces the dimensions of these high-dimensional features through quantification. Then, the algorithm builds an index for these reduced-dimensional local features to improve the efficiency of feature matching. During the online copy detection process, for a given query gift packaging image, all local features in the query gift packaging image are quantified according to the same feature extraction and quantification method as above. Then, by querying the established index structure, these quantified features are matched with those of gift packaging images in the gift packaging image data set, and finally the optimal similarity measurement method is selected to distinguish the copied gift packaging images[17].

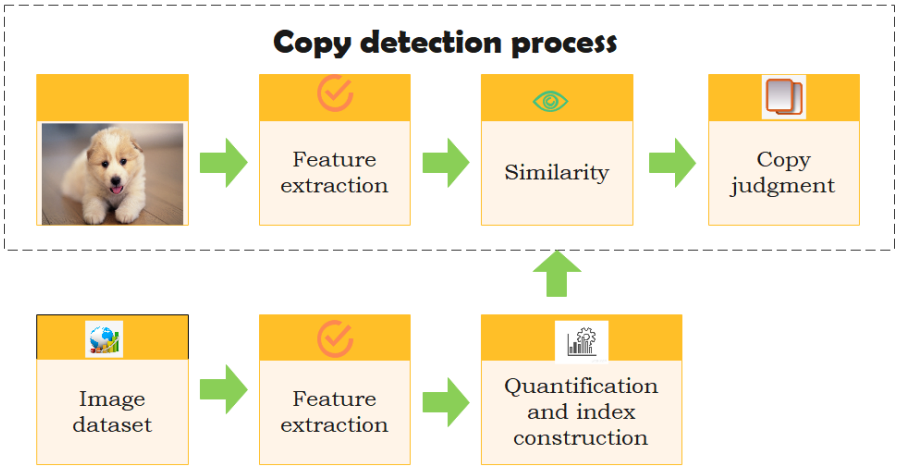

Figure 1 The algorithm framework of gift packaging image copy detection

The distinction and extraction of gift packaging image features and matching efficiency have an extremely important impact on the effect of copy detection. Therefore, feature extraction and quantification are the basis of copy detection algorithms. In the process of feature extraction, the extracted features must meet the following conditions. First, the feature must be able to effectively resist most signal attacks and geometric attacks. Copying gift packaging images can be obtained through a variety of gift packaging image attacks. Therefore, the copy detection algorithm must be robust to various gift packaging image attacks, which requires that the extracted features must have strong robustness. Secondly, the extracted features must have strong discriminativeness. Distinction refers to the ability of a feature to uniquely describe the content of a partial gift packaging image block or the entire gift packaging image content. Only when the features have strong distinguishability, the copy detection algorithm can accurately distinguish the copied gift packaging image from the non-copy gift packaging image. Finally, feature extraction and matching must be highly efficient. The time-consuming process of copy detection is also one of the criteria to measure the pros and cons of copy detection algorithms. In practical applications, only with high efficiency can the copy detection process meet the actual needs of users. According to the extracted features to describe the size of the gift packaging image area, the features can be divided into global features and local features, which will be introduced in detail below.

The global feature is obtained from the entire gift packaging image area and describes the content information of the entire gift packaging image. Global features can be extracted in the spatial domain, or the spatial domain can be transformed to the frequency domain, and then the frequency domain coefficients can be extracted. By changing the spatial domain and frequency domain, the global information of gift packaging images can be effectively extracted, and memory consumption can be reduced. Usually, a gift wrap image is represented by only one global feature vector, such as the order measurement based on the discrete cosine transform (DCT) coefficients, the feature based on the ellipse trajectory, the order measurement based on the circle partition, etc. Then, the copy judgment is made by calculating the distance between the global feature of the gift package image to be detected and the original gift package image. For simplicity of calculation, L1 and L2 norms are usually used to calculate the distance between the global feature vectors[18].

The global feature extraction is simple, can effectively resist the signal attack, and the feature distance calculation is simple, and the efficiency of copy detection is high. Although these global feature-based methods are relatively robust to various well-preserved attacks, including scale scaling, noise, etc., they are difficult to effectively detect copies generated by content discarding attacks, such as cropping and combined rotation and cropping attacks. The content discarding attack will result in part of the content of the gift packaging image being missing. Therefore, the global features extracted from the gift packaging image before and after the attack will be very different. Taking the DCT order measurement method as an example, the method first divides the gift wrap image into sub-blocks, and then calculates the average brightness of each block. Then, DCT transformation is performed on the obtained brightness mean matrix, and finally the order measure of the transformation matrix coefficients is obtained, which is used as the global descriptor of the gift packaging image. The order measure is more sensitive to tailoring attacks. Because these attacks may change the value relationship of matrix coefficients, the DCT order measurement method is not robust enough to geometric attacks.

Compared with methods based on global features, methods based on local features can obtain better results when detecting copies generated by various common attacks. However, matching these high-dimensional local features between gift packaging images

requires a lot of time and space resources. In addition, these local features are obtained from a very small local area, and only a small amount of gift packaging image block information can be encoded. Therefore, when two gift packaging images have many visually similar partial gift packaging image blocks, there may be many mismatches. The existence of these mismatches will cause visually similar gift packaging images to be mistakenly detected as copied gift packaging images, which will greatly affect the accuracy of copy detection.

In order to solve the computationally intensive problem of local feature matching, scholars have proposed many quantification and index construction methods. The main methods are divided into two: Local Sensitive Hash (LSH) method and Bag-of-Words (BOW) model. The local sensitive hash method builds an index for each local feature, and multiple hash tables need to be built. Although this method can improve the matching efficiency, it will take up a lot of memory resources and cannot be used in the large-scale gift packaging image copy detection process. In recent years, the content-based gift packaging image copy detection mainly uses the BOW model. As shown in Figure 2, the BOW model quantifies the local features extracted from the gift packaging image into visual words through unsupervised clustering, and puts the visually similar local features into the same bag of words. When matching local features, only need to compare their word bag numbers to determine whether they are a pair of matching features, which effectively reduces the dimensionality of local features and accelerates the matching process of local features.

Although the BOW model can achieve relatively high feature matching efficiency, its shortcomings are also obvious. The quantization process will also cause the loss of accuracy of local features, and different local features will fall into the same bag of words. Inverted index is often used to index quantized local features to provide more detailed information while ensuring matching efficiency[19]

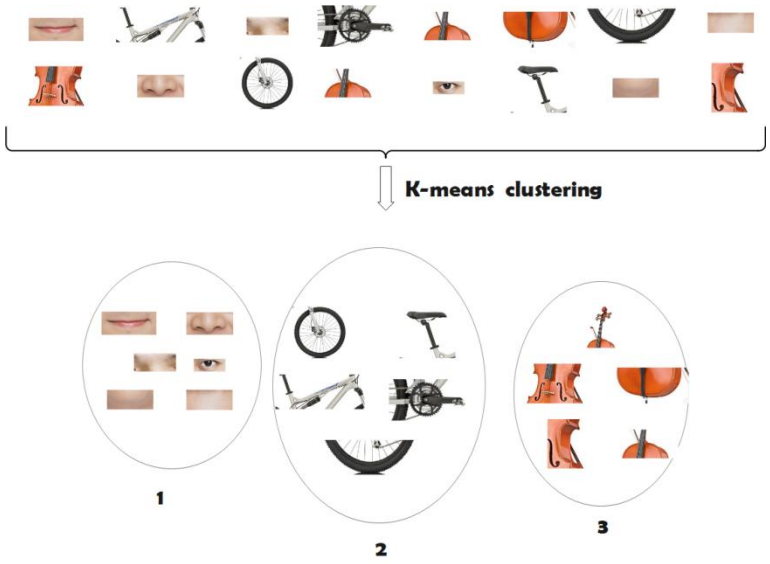

Figure 2 BOW model

As shown in Figure 3, after the local features are quantized as visual words through the BOW model, all the local features quantified as the visual words will be indexed in the same list. At the same time, the list will also save some detailed information of these features, such as the number of the gift packaging image where the feature is located, and the coordinates of the feature in the gift packaging image. Through these detailed information, the discrimination of local features can be effectively enhanced to avoid the occurrence of mismatches[20].

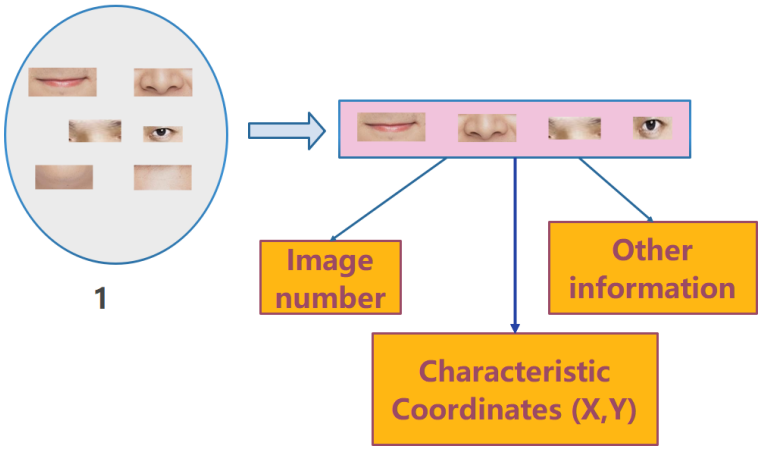

Figure 3 Inverted index structure

In the process of copy detection, whether it is global feature or local feature matching, it involves the calculation of feature vector distance. The calculation method of the distance between the vectors should be selected according to the actual situation. Only by selecting a method that meets the characteristics of the feature can a better copy detection effect be obtained. The common distance calculation methods mainly include the following:

We assume that the vector is X, Y, and the distance between the two vectors is d(X, Y). Then: (1) Euclidean distance is[21]:

$$d(X,Y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \quad (1)$$

Euclidean distance is the most common distance calculation formula, which describes the distance relationship between two points in Euclidean space.

(2) Manhattan distance is:

$$d(X,Y) = \sum_{i=1}^{n}|x_i - y_i| \quad (2)$$

Manhattan distance is also called city checkerboard distance. It describes not the straight-line distance between two points, but the number of unit lengths that need to pass from the starting point to the end point.

(3) The angle cosine distance is:

$$d(X,Y) = \frac{\sum_{i=1}^{n} x_i y_i}{\sqrt{\sum_{i=1}^{n} x_i^2}\sqrt{\sum_{i=1}^{n} y_i^2}} (3)$$

The angle cosine is used to calculate the angle between two vectors in space. When the modulus difference of the two vectors is relatively large, the difference between them can still be calculated effectively.

(4) Mahalanobis distance is:

$$d(X,Y) = \sqrt{(X-Y)^T S^{-1}(X-Y)} \quad (4)$$

In Mahalanobis distance, X and obey the same distribution. Using Mahalanobis distance can well describe the relationship between vectors.

(5) The intersection distance of the histogram is:

$$d(X,Y) = \frac{\sum_{i=1}^{n} min(x_i - y_i)}{min(\sum_{i=1}^{n} x_i - \sum_{i=1}^{n} y_i^2)} \quad (5)$$

If the vectors X and Y are histograms, the intersection distance of the histograms can better highlight their differences.

(6) The Hamming distance is:

$$d(X,Y) = \sum_{i=1}^{n}(x_i \oplus y_i) \ (6)$$

Hamming distance is suitable for characterizing the difference between two binary vectors. Two binary vectors perform XOR operation according to the number of digits, and then count the number of digits whose result is 1 is the Hamming distance.

The precision-recall (P-R) curve is a curve that characterizes the relationship between the recall and the precision of the copy detection algorithm. It is widely used in the evaluation of copy detection algorithms. Among them, P refers to Precision, that is, query precision rate, and R refers to Recall, that is, recall rate. They are defined as:

$$Pr\,e\,cision = \frac{C_r}{C_r + C_s} \quad (7)$$

$$Re\,c\,all = \frac{C_r}{C_r + C_n} \quad (8)$$

Among them, Cr refers to the number of correctly copied gift packaging images in the detection result of the copy detection algorithm, and Cs is the number of non-copy gift packaging images that are incorrectly detected as copied gift packaging images in the detection result. It can be seen from the above definition that the precision rate reflects the ability of the copy detection algorithm to distinguish between copied gift packaging images and non-copy gift packaging images. Cn refers to the number of undetected copy gift packaging images in the gift packaging image data set to be detected. The recall is actually the ratio of the number of correct copies detected by the copy detection algorithm to the total number of gift packaging images copied in the gift packaging image data set, reflecting the robustness of the copy detection algorithm against various gift packaging image attacks.

Receiver Operating Characteristic (ROC) curve is a mathematical statistical method based on information theory. Its abscissa is 1-specificity, which is false detection rate, and its ordinate is sensitivity, which is correct detection rate. When drawing the ROC curve, by setting different similarity thresholds, the points corresponding to the correct detection rate and the wrong detection rate are obtained, and then these points are used to draw the curve to intuitively reflect the relationship between the correct detection rate and the wrong detection rate.

The correct detection rate is defined as:

$$P = \frac{\|S_C \cap C\|}{\|C\|} \quad (9)$$

The error detection rate is defined as:

$$F = \frac{\|S_C \cap R\|}{\|R\|} \quad (10)$$

Among them, S_C is the set of copied gift packaging images detected by the copy detection algorithm. C is the set of all true copy gift packaging images in the gift packaging image data set, and R is the set of all non-copy gift packaging images in the gift packaging image data set. $\|*\|$ is the number of elements in the set.

The ROC curve depicts the intuitive comparison of detection capabilities when different thresholds are selected under the same stimulus. The larger the area enclosed by the ROC curve and the two coordinate axes, the higher the detection accuracy.

4 APPLICATION OF VECTOR ILLUSTRATION BASED ON MULTIMEDIA DATA IN GIFT PACKAGING

For a product that wants high sales volume, in addition to the quality of the product, it also needs a good packaging. Whether the packaging of the Dragon Boat Festival product can accurately convey the content to the consumer determines the value of the Dragon Boat Festival product. In this era of network information, there are more and more choices of the same type of goods, but the packaging design has too much information and mechanical feeling, and there is less human touch. Illustrations are derived from art, have a certain aesthetic and affinity, a very creative expression, and make it easier for consumers to accept. Compared with words, pictures can bring a stronger impact to the human senses. When there are patterns that are different from common expressions, it is easier to leave consumers with a basic impression of the product. This artistic expression will improve The value of the commodity. In the era of digital media, visual presentation has changed from flat and three-dimensional display to a diversified situation coexisting with multimedia, and the impact on the senses is becoming more and more direct. From a design perspective, these impacts have text, color, and pattern, but the most direct transmission is color and pattern. Illustration art is a perfect way of combining colors and patterns. It is highly creative and recognizable. Illustrations have certain advantages in graphic changes. They can transform abstract things into tangible patterns. Make it easier for people to understand and accept its content. A good illustration art can establish a good product image and publicity theme, and even replace the text language to a large extent to bring consumers a better visual experience. Through the drawing method of illustration, the art is integrated into life, and the value of the product is enhanced through art, so that people can receive the information transmitted by the product while enjoying the product. This way of using painting to narrate can more easily stimulate the inner emotions of consumers. Achieve accurate transmission of information.

This article uses the control flow shown in Figure 4. The complete image acquisition process is: after the sensor detects the position information of the vector illustration, it sends pulses to the camera control module, the camera control module controls the camera shutter, and after the exposure is completed, the image is output to the image capture card for subsequent processing. After locating the position of the vector illustrator in the entire image, the position deviation value of the vector illustrator and the image center is calculated, and the deviation value is fed back to the camera control module, and the camera control module adjusts the next shutter opening time according to the last deviation value.

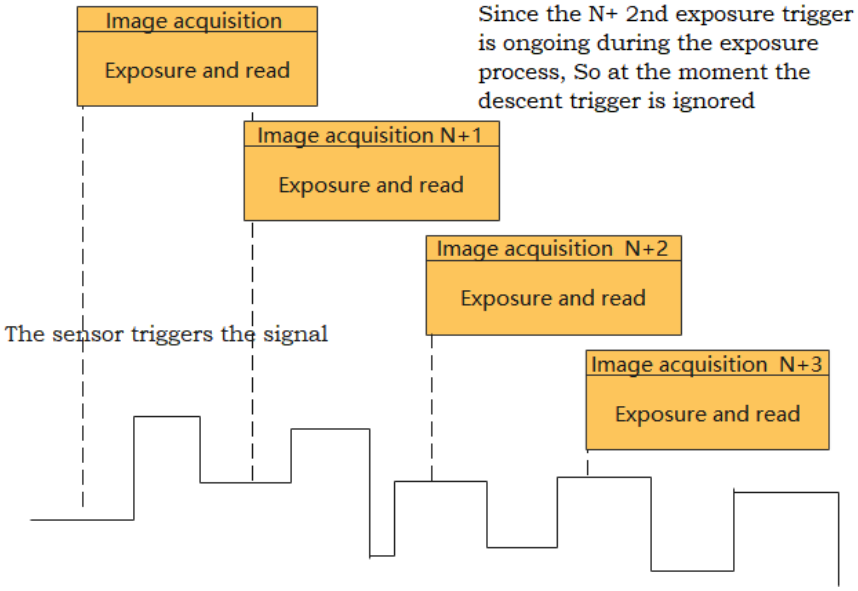

Figure 4 Schematic diagram of trigger mode

In the machine vision acquisition of vector illustration images, the blurred image produced by the vision imaging system is shown in Figure 5. Because the navel orange moves in a uniform straight line along a certain direction during the exposure time, the vector illustration and the CCD photosensitive element move in a plane perpendicular to the optical axis of the camera lens. The fuzzy imaging of the CCD sensor is formed by the integration of light during the exposure time, and the size of the sensor's imaging is larger than the actual size of the object under test in the static state.

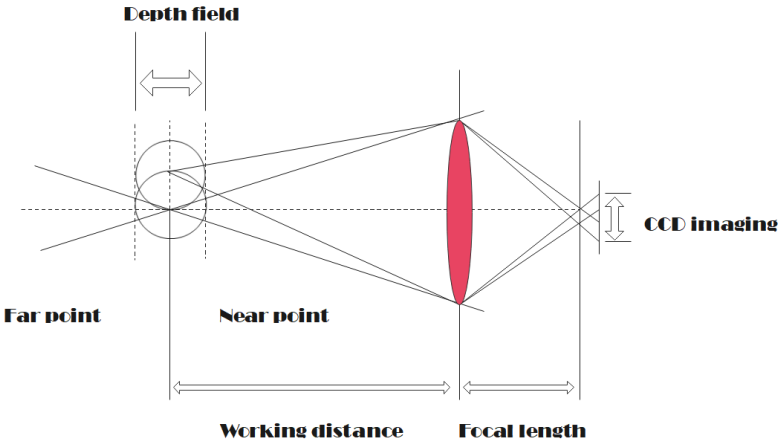

Figure 5 The generation mechanism of blurred images

The system designs various functional modules based on the server one-stop development model. According to the principle of one-stop server development, system design user authority and designer authority distinguish the user end of the system from the system design end, and the user and designer interact with related interfaces to complete the overall process of the system

and complete the customized design. The functional modules of the system are divided into three major modules, including user management module, user end module, and design end module, as shown in Figure 6.

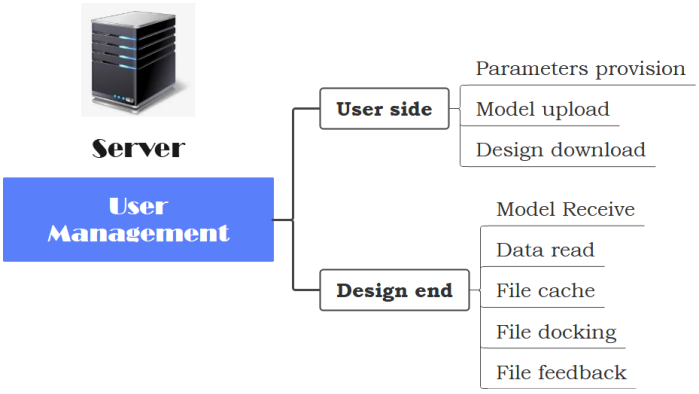

Figure 6 The functional modules of the system

As a channel for designers to connect with users, the user terminal effectively receives user feedback according to user needs, and designs and plans user interfaces from three aspects: function, interaction, and appearance. The three functional modules simplify the information interaction process in acquiring user needs and receiving feedback, and plan the user interface structure with the design principle of simplicity and ease of use. Figure 7 shows the user interface structure design.

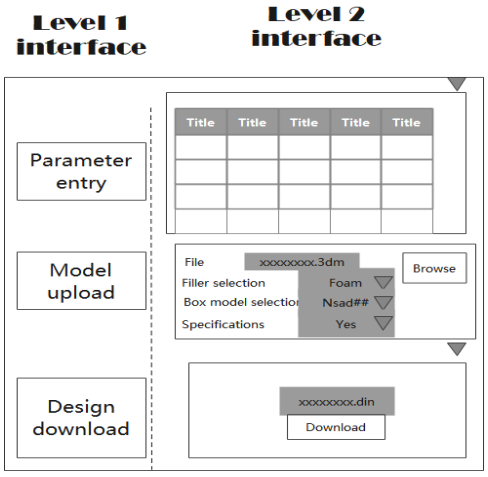

Figure 7 User interface structure design

On the basis of the above research, the performance of the system constructed in this paper is verified, and the vector illustrator feature recognition, vector illustrator feature processing, and system design effects are shown in Table 1 to Table 3.

Table 1 Feature recognition of vector illustration

Number	Feature recognition	Number	Feature recognition	Number	Feature recognition
1	95.5	11	91.1	21	85.7
2	94.8	12	94.6	22	95.5
3	94.7	13	93.5	23	92.1
4	91.0	14	92.4	24	90.5
5	96.5	15	85.7	25	92.1
6	84.3	16	84.3	26	92.5

7	88.7	17	91.3	27	88.2
8	85.7	18	90.1	28	85.6
9	85.1	19	86.7	29	94.4
10	93.3	20	84.6	30	90.1

Table 2 Feature processing of vector illustration

Number	Image Processing	Number	Image Processing	Number	Image Processing
1	79.4	11	82.1	21	90.2
2	88.1	12	89.6	22	80.9
3	85.6	13	83.9	23	86.2
4	84.6	14	93.2	24	87.3
5	80.5	15	94.0	25	88.6
6	79.3	16	90.5	26	83.2
7	80.8	17	88.5	27	93.6
8	79.6	18	93.0	28	90.4
9	84.7	19	81.2	29	79.9
10	91.8	20	90.8	30	89.8

Table 3 Design effects of gift packaging

Number	Design effect	Number	Design effect	Number	Design effect
1	84.3	11	75.8	21	86.0
2	91.3	12	83.9	22	75.1
3	75.7	13	74.3	23	75.2
4	83.1	14	77.0	24	76.1
5	75.8	15	79.0	25	84.1
6	87.3	16	83.6	26	80.2
7	83.0	17	82.9	27	78.4
8	83.0	18	91.3	28	88.9
9	89.2	19	77.0	29	87.1
10	77.4	20	75.7	30	90.4

Judging from the above test results, vector illustrations based on multimedia data can play an important role in gift packaging and effectively enhance the effect of gift packaging.

5 CONCLUSION

With the development of modern economy, gifts have become an indispensable means for people to enhance their feelings in communication. Moreover, a large number of companies specializing in gift packaging have also appeared, and the types of gift packaging have become more abundant. Therefore, studying its cultural nature helps to improve the overall image of gift packaging. Gift packaging is different from ordinary commodity packaging. The design should reflect the culture of "li". Research on the culture of ritual in packaging can not only enrich the theory of packaging, but also provide better convenience

for academic research and practical design. The content of gift packaging can be enriched by studying the cultural characteristics of gift packaging. In addition, the study of cultural characteristics can enable people to have a deeper understanding and appreciation of them, and expand a broader space for future research and artistic design. This article combines multimedia technology to apply vector illustration to gift packaging design to improve the effect of gift packaging design, and at the same time combines the application of vector illustration in gift packaging to provide a reference for subsequent digital design reforms.

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