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Interactive Experience Construction of Brand Packaging Based on Computer Vision

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Abstract. An excellent packaging design can better market goods, and the effective integration of interactive packaging design and emotional experience can effectively convey the information of goods and realize the deep integration with consumers' emotions. Image feature extraction is an important basis for high-level image information analysis and decision-making, and its representation performance directly determines the efficiency and accuracy of actual image processing problems. In this article, the feature extraction algorithm of packaging image based on computer vision and computer aided design (CAD) is proposed, and the packaging CAD design process is improved by combining the emotion recognition model of packaging image. In the aspect of packaging image fusion, this article first uses image feature extraction to extract the effective feature information from the source image, and then fuses according to some fusion rules. The simulation results show that this model has good practicability and high accuracy for image emotion recognition, and can provide technical support for brand packaging image processing. The application of computer vision and CAD improves the interactive experience of brand packaging design process.

Keywords: Computer Vision; CAD; Interactive Experience; Package
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1 INTRODUCTION

The concept of interactive experience is a new concept rising with the growth of economy and society and industrialization, which requires enterprises to interact and communicate effectively with consumers in the process of operation and development, and to stimulate consumers' enthusiasm for consumption in various ways and improve the attractiveness of products. In the tourism industry, brand image is a key factor that determines consumers' impression and attitude towards tourism brands. Social media activities can influence brand image in various ways, such as through content marketing, interactive marketing, and social media marketing. For example, a

tourism company can use social media platforms to publish exquisite images and videos, showcasing the beautiful scenery and various tourism activities of a tourist destination, in order to attract consumers. In addition, social media activities can also enhance the visibility and credibility of tourism brands, as well as strengthen interaction and connections with consumers. In the tourism industry, social media activities have a significant impact on brand image and emotional attachment. Tourism companies can use social media platforms to post exquisite images and videos, provide personalized services and experiences, enhance interaction and connection between brands and consumers, and create shared memories to enhance brand image and strengthen consumers' emotional connection to the brand [1]. Interactive design is mainly based on ergonomics, with the help of the interaction between things, people and things, and people to achieve the purpose of information exchange. The application of interactive packaging design can bring consumers the satisfaction of cultural spiritual needs. Chauhdary et al. [2] analyzed the improved encryption artificial intelligence robot technology for package recognition in the IoT logistics environment. This type of robot uses artificial intelligence algorithms to identify and classify packages to improve logistics efficiency and quality. This type of robot typically uses deep learning technology for training to recognize various features such as shape, size, color, labels, and markings. By using high-resolution cameras and sensors to collect data, robots can quickly and accurately identify different packages, and even identify the items in the packages. During the recognition process, robots use encryption technology to protect the security of data. This can ensure that sensitive information is not stolen or abused, improving the security and confidentiality of logistics business. Packaging is essentially a unique way to convey to consumers the difference between this product and other items, as well as the product's own personality and functions, so as to make it more suitable for sale and achieve effective consumer perception in the market. Blue is the main color of the ocean, and different shades of blue, as well as auxiliary colors such as white and green, can be used in packaging design to showcase the vastness, freshness, and romance of the ocean. Chen and Zhou [3] choose high-quality materials related to the ocean, such as hemp rope, wooden products, metals, etc., to enhance the texture and integrity of the packaging. Adopting a detachable and recyclable packaging structure, it is not only convenient for tourists to use and carry, but also meets environmental requirements. Integrate local specialty ingredients, handicrafts, etc. into packaging design based on local culture to reflect regional characteristics and cultural value. In short, the packaging design of tourism products based on the marine culture of coastal cities needs to fully explore the unique charm of marine culture, combine local characteristics and culture, use appropriate colors and materials, innovate packaging structures, and enhance the brand image and attractiveness of tourism products. In its unique way, packaging design conveys the unique characteristics and functions of the product to customers, thus making the product more suitable for market sales. An excellent packaging design can better market goods, and the effective integration of interactive packaging design and emotional experience can effectively convey the information of goods and realize the deep integration with consumers' emotions, so as to better meet the needs of current consumers. The quality of packaging design will directly affect consumers' sense of products, so in the process of modern product packaging, we must fully integrate into interaction and build an interactive experience. The application of augmented reality technology in takeaway food packaging can have a positive impact on young consumers' negative evaluations of food. By enhancing the authenticity of food, providing additional information, providing interactive experience and increasing Brand loyalty, the brand can better attract and meet the needs of young consumers. Gu et al. [4] analyzed the application of AR technology virtual image overlay to enhance the realism of food in the real world. For example, adding AR labels on food packaging can increase consumers' trust and satisfaction with food by allowing them to see 3D images or simulations of real scenes when scanning the labels. AR technology can provide additional information, such as food ingredients, production dates, shelf life, etc. This can help consumers better understand the quality and safety of food, thereby reducing negative evaluations of food.

The social Semiotics approach focuses on how culture affects visual expression and meaning. In tea packaging design, social Semiotics can be used to analyze how specific cultural symbols and

elements convey the brand image, quality and historical significance of tea. For example, the symbols such as dragon, phoenix, and cloud used on the packaging, as well as colors such as red and gold, all represent noble, elegant, and ancient traditions. Hu et al. [5] used visual analysis methods to focus on how the form, color, texture, and other visual elements generate psychological and emotional reactions with the viewer. In tea packaging design, visual analysis methods can be used to analyze the impact of different design styles on consumers' visual perception and purchasing behavior. For example, simple and lively packaging designs may be more suitable for young consumers, while complex and exquisite designs may be more suitable for older consumers. In short, through the use of social Semiotics and visual analysis methods, we can better understand how tea packaging design conveys cultural and emotional significance, and how it affects consumers' perception of the brand image and quality of products. This helps designers better understand consumer needs and preferences, and create more attractive and impactful packaging designs. For the product packaging design in the modern consumer terminal market, the emotional experience gained by users in product packaging mainly depends on the interactive behavior between people and packaging products to gradually improve and improve. A good packaging image processing method can not only save computer storage space, but also reduce the computational complexity for subsequent image processing tasks and improve the packaging interactive experience. Image feature extraction is an important basis for high-level image information analysis and decision-making, and its representation performance directly determines the efficiency and accuracy of actual image processing problems. However, due to the complexity and diversity of image information in the real world, and corresponding to different processing requirements, the characteristics of image feature extraction are not the same, so there is still a great room for development and improvement in the application of image feature extraction. The main idea of interactive packaging design is to establish a new way of communication between people and packaging. Through the interaction between packaging design and consumers, consumers can receive the information transmitted by packaging design, and redesign and reuse the packaging design after processing the information to meet the emotional needs of consumers. In this article, the feature extraction algorithm of packaging image based on computer vision and CAD is proposed, and the packaging CAD design process is improved and the interactive experience of brand packaging is optimized by combining the emotional recognition model of packaging image.

In modern complex control systems, image information is often used as the input of the system together with other signal sources, which plays an important reference role in system state adjustment and parameter tuning. The performance of image representation method has a decisive influence on the performance of image classification and recognition. Image representation can effectively analyze the image and obtain the key information in the image, which is of great significance to the real work life and social development. The problem of image feature information extraction, that is, how to get reliable and effective information from the image source through analysis, can meet the basic requirements of the system for the effectiveness of image information and lay a solid foundation for the practical application of image processing. With the deepening of image emotional computing, the research method has changed from traditional manual feature extraction to representation learning, and the application of deep learning model can effectively bridge the "semantic gap" between the underlying visual features and deep semantic features of images. This article studies the application of emotion recognition algorithm of packaging image in the construction of interactive experience of brand packaging. The main innovations of the research are as follows:

(1) In the aspect of packaging image fusion, in order to avoid the artificial error caused by multi-scale image fusion at pixel level, this article focuses on the feature-level image fusion method, that is, the effective feature information in the source image is extracted by image feature extraction first, and then the fusion is carried out according to some fusion rules.

(2) According to the essential requirements of image fusion application, the fusion rules based on region and error normal form are proposed to further strengthen the influence of image salient

information in characteristic regions on fusion results, while weakening the input of image information in uninterested regions.

In this article, a method of constructing interactive experience of brand packaging with emotion recognition is proposed, and the algorithm of feature extraction and emotion recognition of packaging image is proposed. The effectiveness of the identification method is verified by experiments, and its role in the construction of interactive experience of brand packaging is proved. Finally, the contribution and limitations of this article are summarized, and the next research ideas are put forward.

2 RELATED WORK

The semi-structured interview of brand packaging is a goal-oriented interview method aimed at gaining a deeper understanding of consumers' views and motivations towards brand packaging. Through this interview method, we can better understand consumers' expectations, needs, and preferences for brand packaging, thereby revealing the importance and role of packaging in brand marketing. In semi-structured interviews, Ilich and Hardey [6] guide interviewees based on pre-set questions, while also flexibly adjusting questions based on interviewees' answers to better understand their thoughts and feelings. This interview method can ensure the orderliness and systematicity of the interview content, while also avoiding the interviewee being overly guided or restricted. Through semi-structured interviews, it is possible to better understand consumers' views and needs on brand packaging, thereby providing more targeted packaging design suggestions for brands. These suggestions can help brands better meet consumer needs, enhance brand image and trust, and also bring better market benefits to the brand. Ji and Lin [7] integrate ecological aesthetics into their design to demonstrate respect and protection for nature and the environment. For example, using natural form elements, using green tones, etc. Emphasize sustainability in design to convey the brand's commitment and actions towards sustainable development. For example, using sustainable related logos, slogans, and slogans. Design products that are easy to recycle and recycle to reduce their impact on the environment. For example, designing products that can be disassembled and assembled, and using recyclable materials. In short, in the Visual communication of lasting emotion, sustainable aesthetics can be studied and practiced by using renewable and environment-friendly materials, reducing waste and pollution, reflecting ecological aesthetics, emphasizing sustainability and promoting recycling. These strategies can help brands achieve sustainable development and environmental protection goals while conveying emotions and lasting value. Liliana et al. [8] annotated the plane after 3D mapping using professional annotation tools. When transferring data between different software, a common data format should be used for conversion and transmission, while ensuring the integrity and accuracy of the data. Professional data conversion and transmission tools can be used for operation to avoid inaccuracies and errors in manual operations. When designing packaging, multiple factors such as product characteristics, market demand, and environmental requirements should be comprehensively considered, and a reasonable packaging design should be carried out. At the same time, professional packaging design software should be used for design and ensure the accuracy and completeness of data. In short, by taking the above measures, the problem of planar annotation after 3D mapping and the problem of data transmission between different software in the packaging design process can be effectively solved, improving the efficiency and accuracy of product design. Lydekaityte and Tambo [9] use digital marketing to enable consumers to understand the product's appearance, functionality, and characteristics before shopping. This allows consumers to make wiser decisions before making a purchase and improves the shopping experience. When purchasing in physical stores, consumers can experience the product firsthand, including the texture of the packaging and the user experience. This can enhance consumers' confidence and willingness to purchase the product. Digital marketing can provide timely after-sales service through platforms such as social media to address consumers' issues and concerns. This can enhance consumers' trust and loyalty to the brand. Through digital marketing, brands can better understand consumers' needs and preferences, and provide personalized products and

services, including packaging design. This can increase consumers' interest and attention towards the brand.

Packaging color is one of the first attributes that consumers notice. Different colors can evoke different emotions and associations, for example, red packaging may imply spicy or sweet taste, while blue packaging may imply freshness and coolness. Marques et al. [10] analyzed that packaging shape can also affect consumer preferences. For example, circular packaging may make people feel friendly and warm, while square packaging may make people feel professional and reliable. The quality and tactile feel of packaging materials can also affect consumer preferences. For example, glass packaging may make people feel high-end and environmentally friendly, while plastic packaging may make people feel lightweight and convenient. The information on packaging labels can also affect consumer preferences. For example, the nutritional information on the label can affect consumers' choices about the health level of the product, while the product certification mark on the label can enhance consumers' trust in the product. In summary, the visual attributes of food packaging have a significant impact on consumer preferences and are closely related to taste and health. Brands need to carefully design packaging to attract and maintain consumer attention and trust in the product. The display and browsing experience of online clothing also have a significant impact on consumer purchasing decisions. For example, consumers may pay attention to clothing details, sizes, comments, and other information to help them make better purchasing decisions. Mo et al. [11] analyzed personalized needs. Consumers have varying needs and preferences for online clothing. Some consumers place more emphasis on brand and visibility, while others place more emphasis on personalized and unique designs. Brands need to meet the different needs and preferences of consumers in order to achieve better market competitiveness. In short, there is a close connection between consumers' visual attention and behavior towards online clothing. Brands need to understand consumer needs and preferences, and carefully design products to increase consumer attention and willingness to purchase. Pelliccia et al. [12] conducted CAD 3D factory simulation software for planning and designing industrial workplaces and process analysis. 3D factory simulation software can be used to train employees and demonstrate production processes. By simulating the actual production environment and workflow, employees can better understand and master the operation and maintenance skills of the factory, improve production efficiency and safety. 3D factory simulation software can simulate and analyze the operational status of factories, discover and solve faults and problems. By simulating and optimizing production processes, production efficiency and quality can be improved, and downtime and costs can be reduced. Saleh et al. [13] conducted an accurate and efficient recognition of deep learning networks. By constructing a digital form of machine learning products, an element application analysis for automated product development has been developed. Through Computer-aided design technology, the product model can be quickly constructed, modified and optimized to reduce the development cycle and cost. At the same time, the product performance can be quickly simulated and tested to reduce the occurrence of tests and errors. Computer-aided design technology can simulate the manufacturing process of products, find and solve manufacturing problems and difficulties in design, provide more accurate design data and documents, and improve the maintainability and repairability of products.

High quality product design can provide better user experience and performance, improve product competitiveness and market share, and better meet user needs and expectations. The special edition packaging has unique visual appeal and can stand out among many similar products. However, Shepherd and Fitzsimons [14] found that it may have some negative impacts on search and shopping experiences. The unique appearance of the special edition packaging may attract consumers' attention, but in some cases, it can also distract consumers from the product itself. Overly flashy or complex designs may make consumers feel confused and annoyed when searching for the information they need. Special edition packaging may increase consumers' fun and excitement during the shopping process, but overly fancy or complex designs may also make consumers feel confused and uneasy. This may affect consumers' trust in the quality of the product and their confidence in purchasing decisions. The design of the special edition packaging may affect the readability and recognition of product labels and information. If the design is too

complex or uses uncommon fonts or colors, it may make it difficult for consumers to read or recognize product information, thereby affecting their understanding of the product and purchasing decisions. Symbolic product packaging can influence consumers' understanding and perception of the brand through visual, tactile, and olfactory aspects, thereby affecting the brand experience. Shukla et al. [15] can make it easier for consumers to remember the brand and enhance its image by using unique and personalized packaging designs. Symbolic product packaging can influence brand trust by increasing brand visibility and credibility. For example, by using clear product information and certification marks, consumers can trust the brand's product quality more. Symbolic product packaging can affect purchase intention by providing product information, stimulating purchase motivation, and enhancing Product differentiation. For example, by using promotional logos and coupons, consumers can be stimulated to purchase and increase their willingness to make purchases. The research on product primitive recognition in computer aided brand product development system mainly involves Computer-aided design and application, artificial intelligence, machine learning and other fields. Product primitives refer to the Urelement and concepts in the product development process, including product functions, performance, appearance, materials, processes, etc. Yang et al. [16] developed an automated product primitive recognition system that can recognize basic product primitives from a large number of product designs. And transform it into a digital form for subsequent product design and analysis. To achieve this goal, the study adopted a machine learning based algorithm that automatically recognizes product primitives by training the model. Specifically, the algorithm first preprocesses the product design drawing using image processing technology, then extracts features from the image using deep learning technology, and finally converts the features into product primitives using a classifier. Green concept CAD considers the recycling of packaging, such as designing reusable packaging structures or designing recyclable packaging materials, in order to reduce waste generation and environmental pollution. Yu and Sinigh [17] analyzed the green concept CAD under the digital simulation and evaluation. Computer-aided design technology was used to carry out digital simulation and evaluation, predict the performance and environmental impact of packaging in actual use, and optimize packaging design. By selecting environmentally friendly materials, optimizing packaging structure, selecting environmentally friendly printing methods, and considering packaging recycling. Simultaneously using digital simulation and evaluation technologies to reduce the environmental impact of packaging and improve the environmental protection and sustainability of products.

3 CONSTRUCTION OF INTERACTIVE EXPERIENCE OF BRAND PACKAGING WITH EMOTION RECOGNITION

3.1 Interactive Packaging Design Based on Emotional Experience

The interactive experience of packaging design establishes a good communication model between consumers and products, and packaging realizes the interactive transmission process with consumers through the characteristics of participation, interest, personalization and humanization. In the process of designing the packaging image, designers need to choose the advantages of products and the corresponding colors and patterns as prominent ways, not only based on the characteristics of products, but also based on the psychological needs and aesthetic needs of target consumers as reference materials, so as to properly select products and the appeal points of packaging design. Interactive packaging design must be an optimized design based on meeting the practical needs of consumers, so as not to bring inconvenience in product use and unhappiness in consumption experience to consumers because of flashy interactive design. Consumers' perception of products depends not only on vision but also on other non-visual sensory experiences, such as hearing, touch and taste. In the non-visual sensory experience, packaging can first use auditory design. For example, objects that can emit strange sounds or music are installed inside the packaging of goods to attract consumers' attention. When consumers know product information, they can imagine and associate with some of their own experiences, use synaesthesia ability to

stimulate their emotional resonance with the product, and then have a good impression on the product.

Behavioral experience is a dynamic behavior of human beings, and this dynamic behavior brings people rich sensory experience. The sensory experience of products can make consumers have a new life experience, and also make consumers know products with their own inherent perception. Driven by consumers' own behavior, there is a good interaction between products and consumers. This interactive process makes consumers feel the pleasure of being controlled by themselves, and also realizes their self-worth to a certain extent. Designers should avoid the implantation of too many interactive factors and ignore the practical function of packaging. For example, too complicated interactive packaging will not only consume consumers' cognition and attention to products, but also affect the consumption experience and waste packaging resources.

In packaging, the tactile sensory experience is used to simulate the texture material, so that consumers can get the cognition and recognition of the product's own attributes at the first time. Consumers can also actively and quickly establish the recognition of products by sensing the surface characteristics of texture. Gestalt psychology holds that when a subject watches an object in front of him, he always associates the image he sees with the image stored in the subject's memory. While watching, he constantly compares the object in front of him with the storage style he has perceived in the past. Once some similar features are found, it will attract attention and realize the experience of emotional resonance.

3.2 Feature Extraction of Packaging Image

In packaging design, we should design and express various visual elements reasonably and creatively, and establish dynamic communication between consumers and words, colors and graphics through emotional experience, so as to attract consumers' attention with colors, associate consumers with graphics, quickly locate consumers, and generate feelings of wanting to know about goods. Finally, consumers can learn more about goods through words. From the growth of image classification, the improvement of network structure is in the central position, but because neural network is sensitive to initialization and optimization, the research on network initialization and optimization algorithm also affects the training of neural network to a great extent. Emotion classification is a multi-class classification problem, which can be directly classified by multi-class classifiers or converted into multiple binary classifications. It is usually reflected by the accurate or nearly accurate composition design on both sides of the horizontal axis, vertical axis or any axis of the image channel. If both sides of an image are recognizable or similar, it is said to be symmetrically balanced.

Human beings have a strong ability to perceive and express emotions, but because of the complexity and abstraction of emotions, it is difficult for people to concretize and clarify emotions conceptually. Feature extraction and selection is an important part of image emotion calculation, which directly determines the final performance of the algorithm. The main task of this step is to extract or select some features, and make them have great similarities within the class and great differences between the classes. The corresponding output can be obtained by learning. Compared with the traditional computer vision method, the advantage of deep learning is that it can increase the generalization ability of the model by increasing the depth of the network. Further, the enhancement of generalization ability can make the neural network learn enough useful information on a larger image data set, thus improving the effect of feature learning. The packaging image processing process is shown in Figure 1.

Assuming that the packaging image size is $M \times N$, the gray level is $\{0,1,\cdots,L-1\}$, and the number of pixels in gray level i is n_i, the frequency of gray level i is:

$$p_i = \frac{n_i}{MN} \tag{1}$$

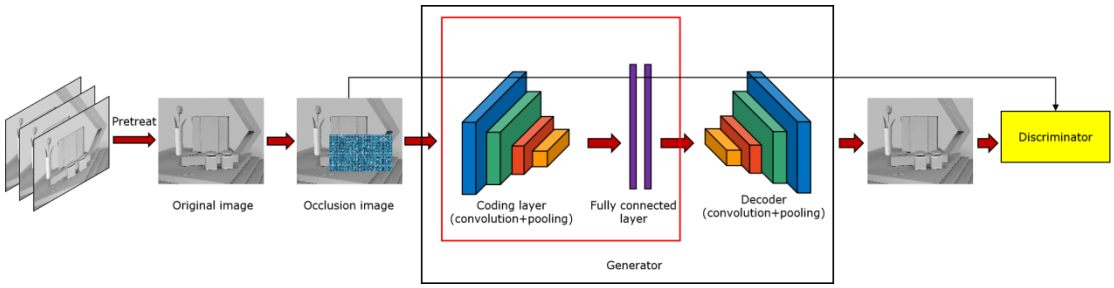

Figure 1: Packaging image processing.

If the image pixels are divided into two types of C_0, C_1 by the threshold T, the probabilities are:

$$w_0 = \sum_{i=0}^{T} p_i, w_1 = 1 - w_0 \tag{2}$$

The average gray values of the two classes are:

$$\mu_0 = \frac{1}{w_0} \sum_{i=0}^{T} ip_i \tag{3}$$

$$\mu_1 = \frac{1}{w_1} \sum_{i=T+1}^{L-1} ip_i \tag{4}$$

Open operation is performed on image A through structural element B, which can be recorded as $A \cdot B$, and can be expressed as:

$$A \cdot B = (A \oplus B) \Theta B \tag{5}$$

The closing operation of brand packaging image is that brand packaging image A is firstly expanded by B, and then corroded by structural element B. Closing the packaging image can not only smooth the packaging image to a certain extent, but also connect the tiny broken parts in the packaging image and fill the tiny holes.

3.3 Emotional Recognition of Packaging Images

Static and flat packaging design can no longer meet the needs of the times and consumers. What consumers need is more self-realization and more participatory interaction. Interactive packaging design can bring more information exchange and more interactive experience to consumers. Based on CNN, the hierarchical feature information and relationships of images were extracted by using the relational learning network model, so as to bridge the gap between image features and emotional semantics, and then accurately realize the task of image emotional classification.

Feature extraction is the process of mapping the target from the image pattern space to the feature space, which greatly reduces the amount of target information. In order to solve the problem that the dimension of the original feature space is too high, irrelevant features and feature data redundancy can be reduced by feature dimension reduction. The frame design of image emotion recognition algorithm is shown in Figure 2, and the algorithm mainly includes three modules: image preprocessing, feature extraction and pattern recognition.

One hypothesis can get a better fit on the training data than other hypotheses, but it can't fit the data well on the data set outside the training data. The main reason for this phenomenon is that there is noise in the training data or too little training data. At the same time, in the process of network training, the gradient will gradually disappear with the time series, that is, the gradient will disappear or explode.

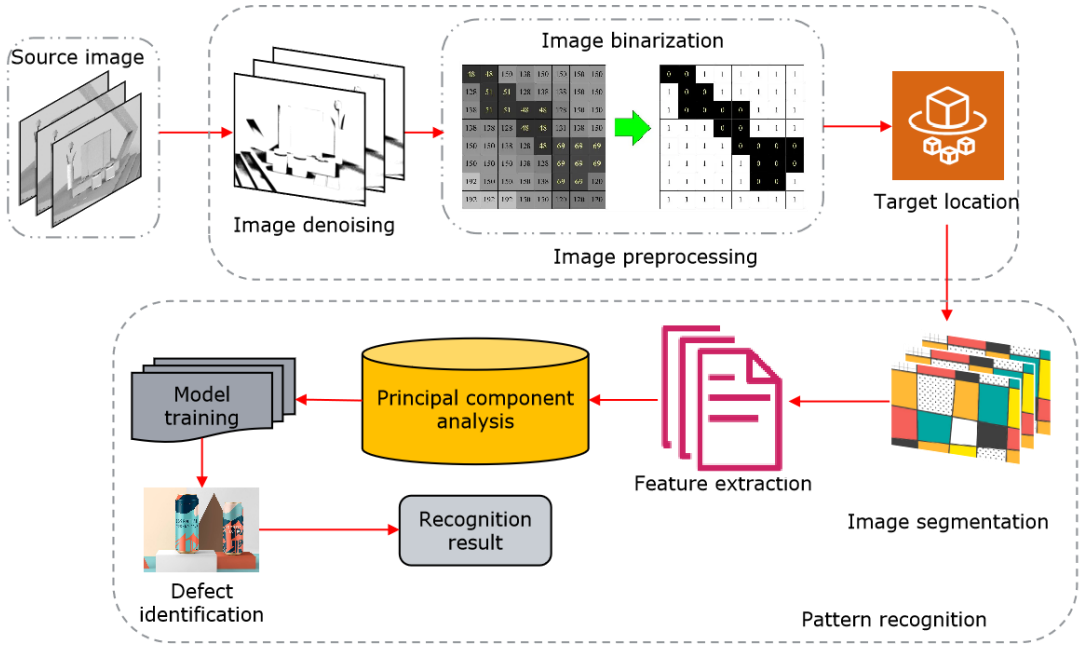

Figure 2: Framework of feature recognition algorithm for packaging image.

In order to make better use of the target word information, the model improves the input context word vector and integrates the target word information. At the same time, in order to obtain the dependency relationship between the target word and the context word, the attention mechanism is used to pay attention to the information of key context words, so as to make the model achieve better performance.

In order to determine the expanded entries of the dictionary, we must first identify and extract the product attributes and evaluation phrases in the field evaluation, and learn the relevant model by combining the opinion elements marked in the training data with the feature template, so as to mark the opinion elements in the test corpus. In order to find this modification relationship, we measure the attribute and assess the possibility of matching by their co-occurrence frequency and distance in the comment sentence:

$$P(attr,eval)=\frac{Count(attr,eval)}{Distance(attr,eval)} \tag{6}$$

$Count(attr,eval)$ represents the co-occurrence frequency of attribute and evaluation phrases in large-scale product reviews, and $Distance(attr,eval)$ represents the number of words between attribute and evaluation phrases in this sentence.

Generally, the method of combining word frequency with inverse text frequency is used in vector space model. If a word appears frequently in a document, but it does not appear frequently in other documents, it can prove that this word has a strong correlation with the document with high frequency of this word. The calculation formula of this method is as follows:

$$W_{ij}=tf\times idf=\frac{n}{N_i}\log_2\frac{N}{m} \tag{7}$$

As can be seen from the above formula, d_j represents the j th document in the review text set. In this document, the weight value of the j th word is represented by W_{ij}. The total number of all words t_{ij} in this text set is represented by the letter m.

Assume that the set V contains all the words in a specific corpus, and x_n is the end mark of the sentence; $P(x_1, x_2, \cdots, x_n)$ represents a possible distribution of the set V, where for any $(x_1, x_2, \cdots, x_n)$, the following two conditions must be met at the same time:

$$\begin{cases} P(x_1, x_2, \cdots, x_n) \geq 0 \\ \sum (x_1, x_2, \cdots, x_n) P(x_1, x_2, \cdots, x_n) = 1 \end{cases} \tag{8}$$

When all singular values are arranged into a vector, the sparsity of the vector corresponds to the low rank of the matrix. Therefore, low rank is a strong global constraint and a good measure of two-dimensional sparsity, which can be regarded as the expansion of sparsity on the matrix. Non-negative and sparse constraints are added to the algorithm, and the corresponding convex function is constructed and optimized. The obtained image similarity representation includes not only the local and global features of the image, but also the semantic consistency information of the image. Finally, a similarity graph based on non-negative sparse low-rank constraint with label information is constructed, in which all nodes represent images, and the weight coefficients in the graph are found by imposing non-negative, sparse and low-rank constraints on the reconstruction coefficients of each node.

This model mainly applies the text attention mechanism to feature extraction of target words, which is used to distinguish the different importance of multiple words that make up the target words:

$$A_t = O_B \times W_A \tag{9}$$

$$A_m A_t^T + mask \tag{10}$$

$$A_a = soft\max(A_m) \tag{11}$$

W_A represents the randomly initialized parameter matrix that can be trained and adjusted in the model, and T represents the transposition of the vector.

4 EXPERIMENT AND ANALYSIS

The main purpose of image preprocessing is to use spatial filter to remove image noise, and then divide the single-channel image into threshold values, and realize target location through the connected component labeling algorithm of binary image to obtain the target image, thus reducing unnecessary redundant operations in the process of trademark pattern feature extraction. Generally speaking, the target area is the largest connected area in the binary image, so this article uses the boundary tracking method to mark the connected area, removes noise interference through area screening, realizes the target location and obtains the target image.

In this section, firstly, the influence of adding the samples with the highest uncertainty and the unlabeled samples with the highest confidence on the experimental results is studied. In each iteration, 200 most uncertain sample instances are selected to join the training set. On this basis, a comparative experiment is conducted with different learning steps (that is, 100, 200, 300 and 400 unlabeled sample instances with the highest confidence are added to the training set in each iteration) (see Figure 3).

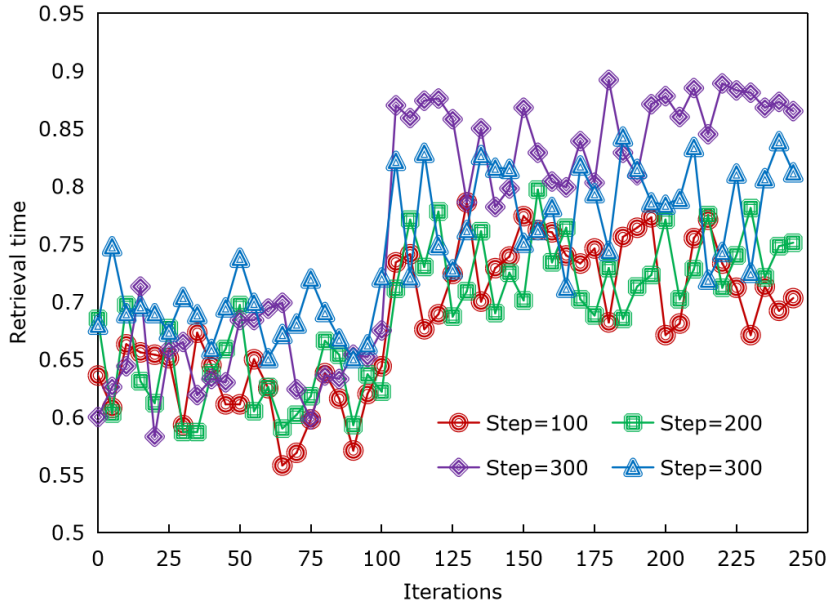

Figure 3: Relationship between active learning training set expansion method and performance.

Under the condition of the same number of iterations, it can be seen that adding the unlabeled set with the highest confidence can improve the performance of the classifier. Tag information is forcibly added to the original low-rank representation problem as an additional constraint, and the original unsupervised method is improved into a semi-supervised learning algorithm. This semi-supervised algorithm can ensure that the same kind of images in a database enjoy similar representation forms, thus achieving the purpose of saving storage space.
The form element itself is an abstract image that does not express a specific image. Only by deeply understanding the characteristics of various morphological elements and mastering the quantitative expression and calculation methods of these elements can designers design packaging shapes with emotional interaction from consumers. In order to test the effectiveness of this algorithm, it is compared with the accuracy of packaging image feature recognition by shape matching method, as shown in Table 1.

Commodity number	***Paper algorithm***	***Shape matching method***	***SVM***
1	96.88	84.425	90.926
2	96.17	83.538	88.619
3	93.06	83.209	90.929

Table 1: Accuracy of packaging image feature recognition by different methods.

It can be seen that the accuracy of feature recognition of packaging image in this article is 95.37%, which is 11.65% higher than that of shape matching method. For the feature recognition of product packaging image, the shape matching method is worse than the emotion recognition accuracy of this algorithm. The main reason is that shape matching is an approximate matching process, and there are shortcomings in matching accuracy. In addition, it can be seen that the support vector machine (SVM) method has higher recognition accuracy than the shape matching

method, which shows that SVM moments have stronger expression ability for the shape characteristics of trademark patterns.

In order to further analyze the expressive ability and classification performance of the three descriptors, the accuracy of emotion recognition of the algorithm, shape matching method and SVM in different offline training sample sets is tested, as shown in Figure 4, Figure 5 and Figure 6.

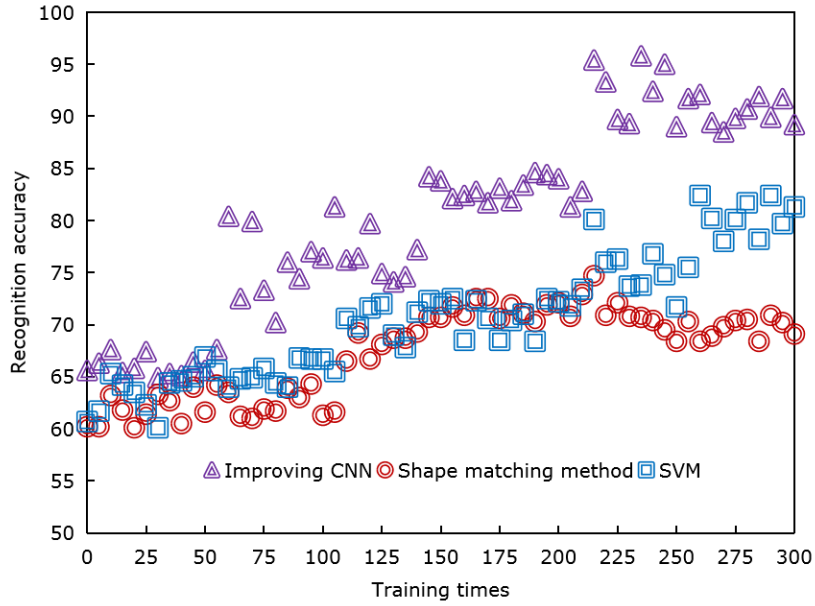

Figure 4: Classification performance of commodity 1.

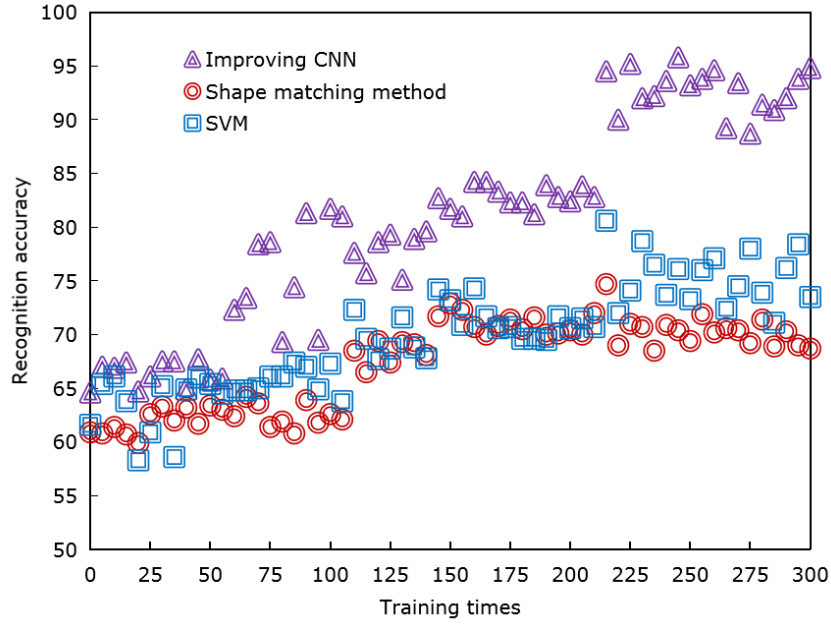

Figure 5: Classification performance of commodity 2.

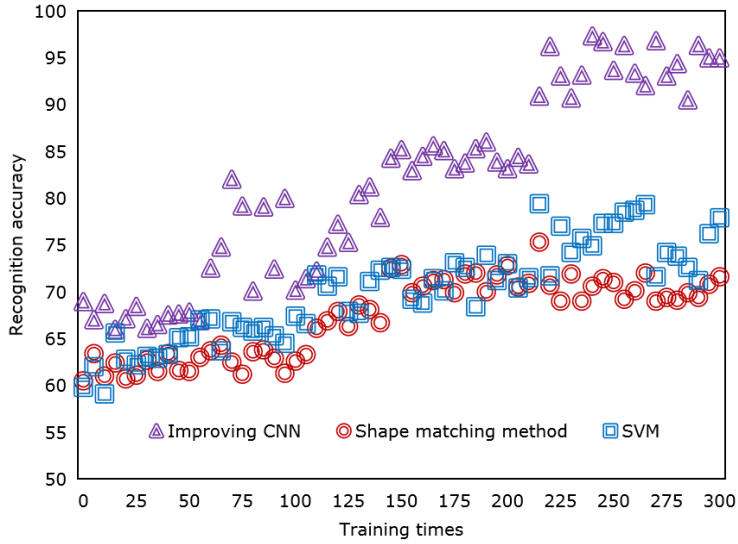

Figure 6: Classification performance of commodity 3.

It can be found that on the basis of retaining the main information, this algorithm improves the classification performance and the accuracy of packaging image feature recognition. SVM has stronger feature description ability than shape matching method, and the accuracy of packaging image feature recognition is higher, mainly because high-order SVM has very strong detail description ability.

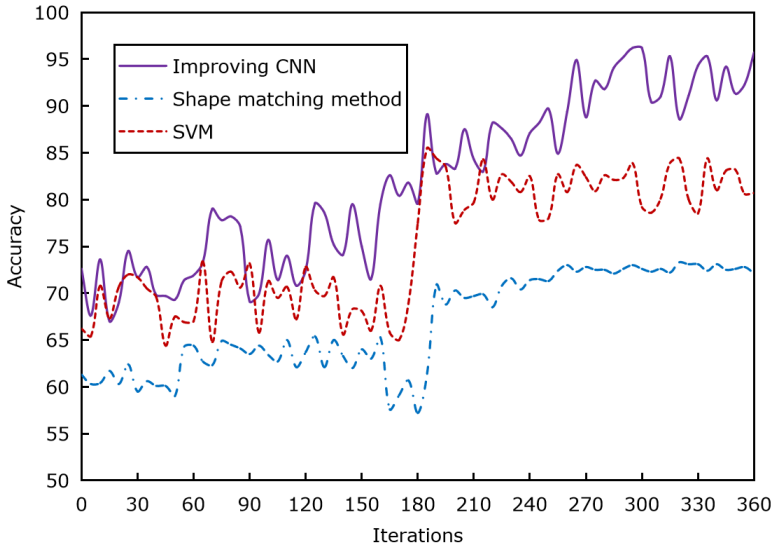

Figure 7: Five classification results.

In the experiment, the model in this article is classified into two categories and five categories. The test results of the three models on the verification set are shown in Figure 7 and Figure 8. From the results, we can see that the emotion recognition model proposed in this section can

achieve good results in the two-category and five-category experiments when using word embedding, which shows that the model is very dependent on word vector expression.

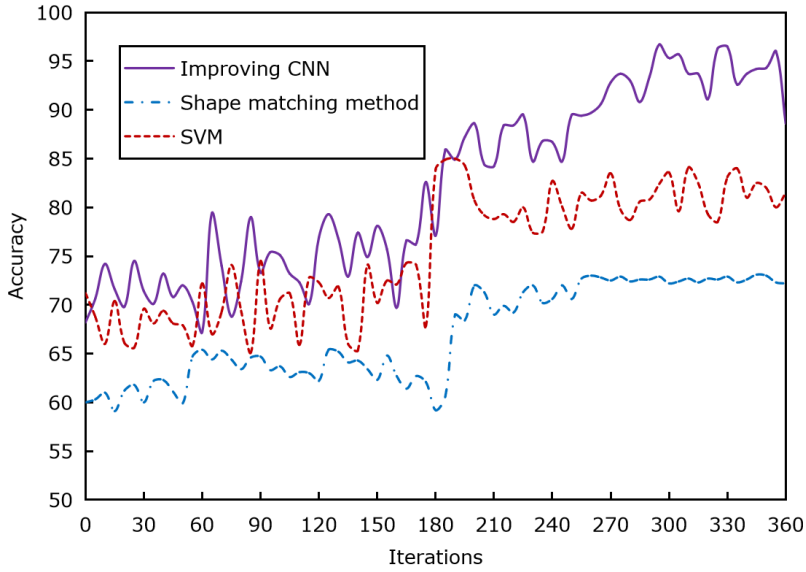

Figure 8: Two classification results.

In this article, the attention mechanism is added to the model, so that the sentence expression depends not only on the representation of the last node, but also on the representation of all nodes in the tree structure. The importance of node information is related, and the corresponding weights are obtained by node expression. Thus, this model has good practicability and high accuracy for image emotion recognition, and can provide technical support for brand packaging image processing. The application of computer vision and CAD improves the interactive experience of brand packaging design process.

The product packaging design is based on the drawing paper of conceptual design. Pictures are loaded by three-dimensional design software, key points are established by tracing points, boundary curves are constructed by connecting key points, and the curves are adjusted by using curve handles to get the boundary curves as close as possible to the design sketches. Then use the surface generation tool of CAD software to generate independent surfaces, and then complete the construction of the whole appearance surface through surface merging; Finally, the surface is materialized by using the materialization tool to complete the product entity packaging design. Designers should understand society, products and consumers, and make accurate design positioning. Thus, emotions can be transformed into cognizable representations, so that the audience can find a home to meet their emotional needs, get physical comfort and psychological pleasure, and resonate with sensibility and rationality in the emotional interaction between people and things.

5 CONCLUSIONS

For the product packaging design in the modern consumer terminal market, the emotional experience gained by users in product packaging mainly depends on the interactive behavior between people and packaging products to gradually improve and improve. Image feature extraction is a basic but challenging problem in image processing, which involves a wide range of knowledge, covers rich content and has a broad application field. According to different application

fields, the contents and methods of feature extraction are different. In this article, the feature extraction algorithm of packaging image based on computer vision and CAD is proposed, and the packaging CAD design process is improved and the interactive experience of brand packaging is optimized by combining the emotional recognition model of packaging image. The attention mechanism is added to the model, so that the sentence expression depends not only on the representation of the last node, but also on the representation of all nodes in the tree structure. The importance of the information of strong and weak nodes is related, and the corresponding weights are obtained by using the node expression. Although the self-encoder network proposed in this article has achieved high accuracy in the recognition task of packaging images, it is still a general image feature learning method, and there is no special optimization for product packaging design images. If we want to achieve higher accuracy in this kind of task, we need to make some network innovations according to the data characteristics, or add the prior knowledge of human experts about pictures, and make some necessary innovations in data preprocessing and initial feature extraction.

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