



## Research Article

# Application of Patent Right and Trademark Right in Packaging Design Based on Computer Nonlinear Prediction Systems for Virtual Reality Technology

Jia Xin <sup>1</sup>, Guo Yan,<sup>2</sup> and Qiao Song <sup>3</sup>

<sup>1</sup>School of Design, Ningbo Tech University, Ningbo 315000, China

<sup>2</sup>Digital Protection and Application of Paleontology Lab Media & Animation Collage, Lu Xun Academy of Fine Arts, Dalian 116601, China

<sup>3</sup>School of Design, Dalian Minzu University, Dalian 116600, China

Correspondence should be addressed to Qiao Song; [qiaosong@dlnu.edu.cn](mailto:qiaosong@dlnu.edu.cn)

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Comprehensively strengthening the protection of intellectual property rights (IPRs) and stimulating the vitality of innovation to foster a new development paradigm, innovation is the primary driving force behind development, and protecting IPR is equal to protecting innovation. China is changing from Chinese products to Chinese brands, the need to comprehensively strengthen IPR protection from the perspective of national strategy, so as to promote the building of a modernized economy, stimulate the innovation vitality of the whole society, and foster a new development paradigm. This paper is based on application of patent right and trademark right in packaging design based on computer nonlinear prediction systems for virtual reality technology; from the perspective of intellectual property protection and innovation promotion, combining with several cases of packaging design in computer nonlinear prediction system, this paper expounds different forms of intellectual property creation in packaging design practice, and the irreplaceable important role that intellectual property protection plays in the follow-up market operation of products. At the same time, the combination of computer nonlinear virtual reality technology and packaging design can provide more powerful support for the creation and experience of commodity packaging virtual world, emphasizing the importance and urgency of the creative industry to improve the knowledge level of intellectual property, and the ability to create, apply, and protect intellectual property.

## 1. Introduction

As an important part of the product packaging process, packaging design plays a pivotal role in the presentation of products. At present, the packaging design of many products in the market is mostly focused on the use of flat visual elements, and the homogeneity of such innovation is high, and the possibility of innovation is limited. Virtual reality technology is a highly integrated technology, with strong industry extension and high innovation-driven value. It is very important to master the development and evolution trend of virtual reality technology [1]. Virtual reality (VR) integrates immersion, interactivity, and imagination, using software and hardware devices to provide users with

simulated reality experience. Virtual reality technology is widely used in education, architecture, entertainment, and tourism [2]. In order to improve the competitiveness of virtual reality industry, it is necessary to correctly forecast and guide the development trend of virtual reality industry with the support of industrial policy [3].

As the core of intellectual property, patent is the carrier of virtual reality technology innovation. In the global competition of science and technology, it is of great significance to obtain important strategic information of science and technology through patent analysis and formulate the development policy of virtual reality industry scientifically [4]. Chinese scholars select virtual reality technology patents to conduct empirical analysis, understand the trend

of technology research and development, find gaps in technological innovation, and effectively predict the trend of industrial development [5].

With the gradual popularization of the concepts of “big data” and “data nonlinearity,” traditional industries in China begin to pay more and more attention to the cross-border integration with the Internet [6]. This trend is very significant in recent years. However, in the era of big data, the globalization, openness, and data sharing characteristics of Internet bring certain risks to individuals and enterprises in the process of trademark registration [7]. The traditional trademark registration strategy has been unable to provide effective protection for the business security of enterprises, and the incidence of trademark infringement cases is gradually rising [8]. Therefore, corresponding solutions should be formulated.

The nonlinearity of trademark information data is the basic premise for the effective application of trademark big data technology [9]. Although there are certain differences between digital and digitalization, it will certainly promote the process of trademark information digitalization [10]. At present, China has made some achievements in many aspects, such as nonlinear electronic trademark data and network interaction mode, but the trademark information system in China is still lagging behind compared with developed countries, and the data interaction mode and network inquiry system need to be optimized.

Computer virtual reality technology is a comprehensive information technology developed in the twentieth century. This technology not only inherits the connotation of traditional artistic beauty but also integrates multiple factors such as three-dimensional and thinking space. Some industries even integrate touch and smell [11]. And the enterprise is the main body of innovation, to stand firm in the increasingly fierce market competition must have the core technology and intellectual property rights based on continuous innovation. Enterprises need to find another way to constantly dig new innovative points to impress consumers [12]. With the help of IP-assisted design innovation, it will play an irreplaceable and critical role in the future design innovation process.

## 2. Materials and Methods

In the era of rapid development of science and technology, intellectual property rights are increasingly valued by everyone. Intellectual property is a lever for the state to weigh the relationship between the inventor and the public interest by legal means. On the one hand, perfect legal system and innovative environment stimulate the enthusiasm of innovators to invent and create, so that the wisdom achievements can be properly protected. On the other hand, through the way of disclosing technical solutions for protection, the public can understand new technologies and inventions in the industry, and finally activate the market economy and promote the development of social economy.

Depending on the type of innovation results, intellectual property rights are broadly divided into industrial property rights, which protect the form, structure, and technical

TABLE 1: Intellectual property type.

Type	Intellectual property type	
	Type	Protection object
Industrial property	Appearance patent rights	Appearance
	Utility model rights	Product structure
	Patents for inventions	Technical solutions
Copyright	—	Fine art works Art works

solutions of industrial products, and copyrights, which protect works of art and fine arts (Table 1).

The purpose of intellectual property protection is not only to protect but also to improve the core competitiveness of products in the market economy through the protection of wisdom results so that the market can be dominated and profits can be made [13].

At the same time, the use of intellectual property tools and knowledge is also the key for businesses to avoid price wars to do differentiated good products. Intellectual property is a weapon to defend rights and a tool for product marketing. Therefore, intellectual property is a systematic thinking from application and protection to use.

Then, understanding the differences in the objects of various types of intellectual property protection at the beginning of the design can provide a clearer creative direction for the design. This forward thinking will greatly enhance the innovative value of the design.

*2.1. Graphic and Packaging Design.* Most of the packaging used by the vast majority of businesses in the market today are mostly IP images, illustrations, patterns, and patterns arranged on the box. The focus is on the graphic content of the flat class presented in the various parts of the box. Such designs can be protected by design patents in the form of six views of the box’s appearance, or by copyright in the form of artwork of the box’s unfolding diagram (Figure 1). The different combinations of such graphic elements make the packaging design content homogeneous, and it is difficult to judge the originality of the content elements. Therefore, these types of designs are easy to be copied [14].

- (1) Design patent right: design patent belongs to the same type of industrial property as utility model patent and patent for invention in intellectual property. Appearance design refers to the new design, which is full of beauty and suitable for industrial application made on the shape, pattern, or its combination of products and the combination of color, shape, and pattern. The appearance design focuses on protecting the creativity and uniqueness of the shape embodied in the appearance of the product, and attaches greater importance to the presentation of the aesthetics of the product. The functional structure of some products determines the appearance of the product form [15].



FIGURE 1: Content packaging design.

- (2) Copyright: the object of copyright protection is the work, not the product. It is an intellectual achievement in the field of literature, art, and science that is unique and can be reproduced in some tangible form. Copyright protection focuses on the originality and aesthetic value of the work.

In China, the principle of “automatic generation and voluntary registration” is applied to copyright. Most businesses use illustrations, patterns, IP images, and other forms of packaging generated by the focus on the aesthetic value of the packaging. At present, most product packaging, hand-drawn drafts, and drawings are recognized as art works, and many enterprises have given priority to adopt copyright to protect product packaging because of the quick timeframe and short cycle of copyright processing. And the packaging for copyright protection can be in the form of package development drawings (Figure 2).



FIGURE 2: Copyright protection form of packaging box development drawings.

2.2. Three-Dimensional Symbols and Packaging Design.

Today, with the rapid economic development, packaging design has become a product that cannot be ignored. Computer virtual reality technology is a computer system that combines computer technology, multimedia technology, and interactive design technology. It can provide a better operating platform for packaging designers and consumers. Technically speaking, virtual reality technology is used, but visually, it is more artistic [16]. Successful packaging design can promote the development of enterprises and open up a new sales market. The use of computer virtual reality technology can be combined with packaging design, which can realize union, intersection, difference, and other operations to a certain extent, and provide designers with more calculation results so that designers can produce more creativity. The specific design model is shown in Figure 3. First of all, finish modeling the appearance package in 3Dmax, then express the package material (material, color), add graphics according to the modeling, and render the output.

In the complex 3D virtual scene, this paper proposes a two-level clipping algorithm, which uses the fade-in and fade-out level of detail algorithm for the first level clipping, and then uses the slow culling algorithm for the second level

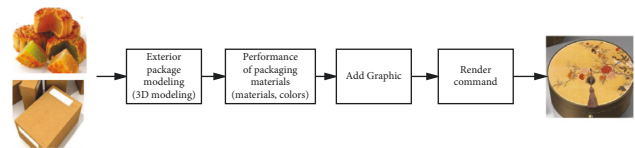


FIGURE 3: The process of packaging design model.

clipping, so as to speed up the rendering speed. Now, assume that when switching from one level to another, a vertex is switched from  $p$  to  $p'$ , the height difference is  $\Delta h$ , and the total transition time is  $t$ . In the switching process, this paper first compensates for the height and then switches between levels. As shown in equation (1), where  $\Delta t$  is the current transition time,

$$h_{p'} = h_p + \frac{\Delta t}{t} \cdot \Delta h. \tag{1}$$

In a large-scale virtual scene, the hierarchical detail algorithm can effectively crop out the model outside the set field of view, and the model can be selected for fine or coarse crop according to the proportion of the model in the field of view, so the fade-in and fade-out hierarchical detail algorithm is used for the first layer of crop.

The traditional culling algorithm mainly calculates the 3D vectors, and the phenomenon of “abrupt crossing” occurs when culling the invisible. The “abrupt crossing” phenomenon is solved by using opacity.

The calculation of two-dimensional vector is mainly to normalize the coordinates of the field of view vector to  $\vec{T} =$

(0, 0, 1) through projection transformation. Assuming that a certain triangular patch is  $\Delta ABC$ , where the coordinates of points A, B, and C are  $(x_1, y_1, z_1)$ ,  $(x_2, y_2, z_2)$ ,  $(x_3, y_3, z_3)$  respectively, the calculation of the normal vector  $\vec{n}$  of  $\Delta ABC$  is shown in formula (2):

$$\vec{n} = \overrightarrow{AB} \times \overrightarrow{BC} = \begin{vmatrix} \vec{x} & \vec{y} & \vec{z} \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ x_3 - x_1 & y_3 - y_1 & z_3 - z_1 \end{vmatrix}. \quad (2)$$

Multiply point  $\vec{n}$  by field of view vector  $\vec{T} = (0, 0, 1)$  as shown in equation (3):

$$\vec{n}, \vec{T} = (x_2 - x_1)(y_3 - y_1) - (y_2 - y_1)(x_3 - x_1). \quad (3)$$

It can be seen from equation (3) that the point multiplication result at this time is independent of the  $z$ -axis coordinates, which is converted into the calculation of two-dimensional vector coordinates. At this time, the angle is calculated by equation (4):

$$\vec{n}, \vec{T} = |\vec{n}| \times |\vec{T}| \times \cos\theta. \quad (4)$$

Judge which faces are visible and which faces need to be removed according to  $\theta$ .

The three-dimensional symbol type of packaging design will continue to simplify and condense the appearance of the product packaging form into a visual symbol with significant brand differences, and by obtaining the exclusive rights of the three-dimensional trademark to empower the product packaging, to ensure the smooth operation of its products in the subsequent market operation process.

The practical application of registering packaging as a body mark has been very successful in the market. Italy Ferrero Co., Ltd. filed a trademark application for chocolate three-dimensional shape in December 2012 in China (Application No. 11839757) and the three-dimensional trademark was approved for registration in February 2014, allowing its use in the 30th category of pastries, sweets, chocolate, and other categories. In 2015, Shanghai Golden Monkey Food Co., Ltd. counterfeited its three-dimensional registered trademark without the permission of Italy Ferrero Co., Ltd., and was ordered to immediately stop production, confiscate infringing goods, and fined 1.93 million yuan (Figure 4). This case is the first three-dimensional trademark infringement case broken by Shanghai, and it is also the trademark infringement case with the highest administrative penalty in Shanghai in recent years.

There are many other cases like this, such as the familiar Estee Lauder small brown bottle, Coca-Cola bottle, Martell XO wine bottle, that are not just packaging, but three-dimensional trademark. Moreover, more and more mature enterprises are beginning to focus on the application of three-dimensional trademarks in product packaging. This kind of packaging not only fully considers the beauty of product packaging from the visual form but also protects the packaging with three-dimensional trademark as early as possible, which has the forward-looking thinking of preventing intellectual property infringement in the market



FIGURE 4: Ferrero licensed three-dimensional trademark.

operation, and this form of application combining packaging and intellectual property is worth learning and using for reference.

- Three-dimensional trademark: so what is a three-dimensional trademark? What are the evaluation criteria for the approved registration of a three-dimensional trademark?
- Trademark: trademarks are legal marks that are used to distinguish products and services from other similar brands in the same industry. Trademark right is the exclusive right protected by national law, and in the process of market economy operation, trademark is the fundamental for the survival of the enterprise, and also the basis for the enterprise to be able to develop and grow continuously in the market economy. It can be said that the trademark is the enterprise's "business base, the source of living business" [16]. The acquisition of a trademark requires a series of rigorous legal processes of application-examination-approval, and the trademark rights can be obtained only after the examination and approval by the State Intellectual Property Office. Trademark rights entitle the trademark applicant to enjoy semipermanent and exclusive rights. The acquisition of trademark rights is more beneficial for the applicant to obtain the initiative in the market.
- Constituent elements of trademarks: the constituent elements of a trademark usually consist of a combination of words, graphics, English, numbers, colors, and sounds. In Figure 5, common types of trademarks are single trademarks, combination trademarks, sound trademarks, and three-dimensional trademarks. Significance is the core evaluation criterion for whether a trademark can be approved for registration. The trademark needs to have a distinctive difference that distinguishes other corporate logos in the same industry.
- Three-dimensional trademark: the trademark law defines three-dimensional trademark as a three-dimensional sign or a trademark consisting of a three-dimensional sign containing other signs. The three-dimensional trademark reinforces the characteristics of the brand's products and services with the help of the shape of the goods themselves, the packaging or other three-dimensional signs.





FIGURE 5: Trademark type.



FIGURE 6: Binggrae banana milk three-dimensional trademark.

In Figure 6, the picture shows the packaging container design of Korean Binggrae banana milk. This design applied for a design patent in South Korea on May 31, 1975 and has been patented. The validity of the design patent was maintained for the next ten years. However, annual fees are required to maintain the appearance patent rights, and once the patent rights disappear, the technology becomes public knowledge and is used by the general public. As a result, Korean Binggrae applied for a trademark in 2001 and was approved for registration in 2003. Korean Binggrae applied for a three-dimensional trademark in 2004 and a color trademark in 2009, and have continued to use their trademark rights to protect their product packaging [17]. Such efforts not only clarify the brand’s impression characteristics in consumers’ hearts but also better maintain the brand image. At the same time, this differentiated feature is obviously separated from competing products. At the market level, improving consumers’ purchasing decisions has achieved good results. The unified visual identity system on the cylindrical container, such as packaging appearance, color, and font, especially the Binggrae banana bottle logo, is continuously strengthening the image of the product in the minds of consumers, thereby increasing customer loyalty and brand value.

**2.3. Structural Innovation and Packaging Design.** Another direction of application of packaging is the innovation of packaging structure. Niannian Youyu Koi lantern is a couplet stocking gift box designed by Shenzhen MSHC Wenchuang Technology Development Co., Ltd. in 2020, which runs the cultural allusion “Yu Chuan Chi Su” into the product contents and packaging. In ancient times, every holiday, the letter will be stuffed into the belly of the fish to friends and relatives, to express the feelings of longing. The fish is the package and the Chi Su is the content.

Niannian Youyu couplet stocking gift box deeply excavates the innovation of packaging structure on the basis of

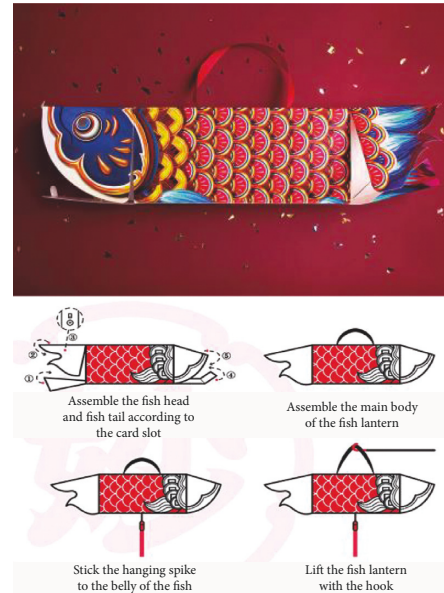


FIGURE 7: Niannian Youyu.

content. As shown in Figure 7, it uses the packaging package to simply transform a box into a Koi lantern without changing or adding structure, leaving a carp in the home to signify abundance in the coming year. Using this clever format, the value of the product continues from the festive symbolism of the couplet to the fun experience of the New Year, while achieving 0 waste in packaging. Meanwhile, this Koi lantern applied for a utility model patent in 2019 called “deformable multi-purpose packaging box,” using the cultural core to create a good product both inside and outside. From the content to the structure is the continuous improvement of innovation ability so that the product stands out in many stocking gift boxes, with the help of innovative structural design, improves the differentiation of the product, enhances the core competitiveness on the commercial battle, and ultimately enhances the market value of the product [18].

### 3. Results and Discussion

An understanding of the various types of intellectual property can provide more clear design direction for design practice. So what are the differences between patent right and trademark right mentioned earlier? How should we differentiate and make a choice?

**3.1. Different Protection Objects.** A design patent protects an industrial product that is aesthetically pleasing for industrial mass production, and the scope of protection is limited to the six views of the designed product submitted in pictures or photographs. A utility model patent protects the structure of an industrial product and requires the creativity or novelty of the product’s exterior form or product structure (Table 2).

Unlike patents, trademarks do not take into account originality or novelty. However, because its constituent

TABLE 2: Various types of intellectual property.

Type	Comparison of the objects of protection of various types of intellectual property		
	Appearance design	Utility model	Trademark
Object	Shapes, patterns or their combination and the combination of color, shapes, and patterns	Product structure	Combination of text, graphics, English, numbers, colors, and sound composition

TABLE 3: Approved standards for of intellectual property.

Type	Approved standards for various types of intellectual property infringement		
	Appearance design	Utility model	Trademark
Time limit	Novelty	Innovativeness	Significance

elements form a remarkable overall image in the composition of a series of visual recognition systems such as text, graphics, and form, it is unique and has nothing to do with the functionality of commodities, after a long period of use and a lot of publicity; it has the function of identifying the source of its goods and belongs to the scope of trademark protection. The scope of trademark protection is relatively broad, and its protection covers not only on approved goods or services but also the use of a trademark identical or similar to its registered trademark on the same goods or similar goods. Trademarks mainly distinguish different sources of the same or similar goods or services based on their principles of significance and identification, so as to realize the maximization of commercial interests in commercial competition. By granting exclusive rights, trademarks emphasize more on ensuring the maintenance of proper commercial order than remuneration and compensation [19].

**3.2. Different Standards of Infringement Approval.** The standard for judging patent infringement is whether the overall visual effect between the sued product and the design patent is similar, and whether the product structure is similar to that of the utility model patent to judge infringement (Table 3).

The standard for determining trademark infringement is whether the accused logo is likely to cause confusion among general consumers compared with the overall text, graphic, and combinations thereof of the trademark, and if it causes confusion among consumers, it constitutes infringement [20].

## 4. Conclusions

More and more packaging designs focus on the cultural content itself. Symbols, patterns, and stories are active in the two-dimensional space. The single reinforcement method starting from “shape” is the most common, but few people jump out of the two-dimensional dimension to think and explore new ideas. Through the application of computer virtual reality technology, it can bring more visual effects to packaging design, and through the combination of computer digital technology and virtual reality technology, it provides

a brand-new and distinctive product design method for the development of enterprises. Creativity today is inseparable from the understanding and use of intellectual property. Future designers should have the ability to apply design skills, technology, and legal rules to realize the commercial value and strategic application of products. To embrace computer nonlinear virtual reality technology, we must rely on the virtual reality industry. Take technology as the fundamental driving force for development, break through the key core technologies of virtual reality, identify cutting-edge technologies of virtual reality, and establish a complete virtual reality industry chain. Virtual reality technology enables users to gain immersion, interactivity, and imagination, and is used in the fields of intellectual property and trademarks. The development of virtual reality has broad prospects and has attracted attention and from all walks of life. As the driving force of innovation economy, virtual reality technology must be in line with international standards, occupy an important position in the global industrial value chain, and follow the path of international competition and development. In short, the value of data needs to be released by relying on innovative analysis. After data sharing, society will get more datasets related to economic and social indicators that can be analyzed, which is a challenge and an opportunity for government agencies.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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