

## Research on the Expression Features of Naked-eye 3D Effect of LED Screen Based on Optical Illusion Art

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### Abstract

At present, naked-eye 3D appears more and more commonly on the facades of urban buildings. It brings an incredible visual experience to the audience by simulating the natural 3D 3D space effect. At the same time, it also creates enormous commercial value for city publicity and commercial advertisements. There is much research on naked-eye 3D visual effects, but for right-angle LED screens. Right-angle LED screen's brand-new expression method that has only become popular in recent years, how to convey a realistic naked-eye 3D effect through two LED screens combined at right angles has become a problem worth exploring. To explore the whole design ideas and production process of the naked-eye 3D impact of the right-angle LED screen, this paper is a preliminary study aimed at understanding the performance principle and expression features. Before the case analysis, first, understand the standard virtual 3D space construction techniques. Combining it with the optical illusion phenomenon, according to the expression principle of the naked-eye 3D effect of the right-angle LED screen, it can be summarized into seven expressions: Shadow, Color contrast, Background structure line, Magnify object, Object out of bounds, Object floating, Fusion of picture and background. By analyzing the optical illusion phenomenon used in the case, we summarized the main performance characteristics of the naked eye 3D effect. The emergence of right-angle LED screens breaks the limitation of a single plane of optical illusion art, perfectly combines building facades with naked-eye 3D visual effects, and provides designers with a brand-new creative platform. Understanding its production principles and main expressive features can help designers enter this innovative platform better.

**Keywords:** Optical Illusion Art, Naked-eye 3D, Right-angle LED Screen, Perspective

## 1. Introduction

### 1.1 Research Background and Purpose

With the popularization of three-dimensional(3D) digital technology, more and more 3D digital products flood people's lives. The update of hardware equipment and the release of various 3D production software

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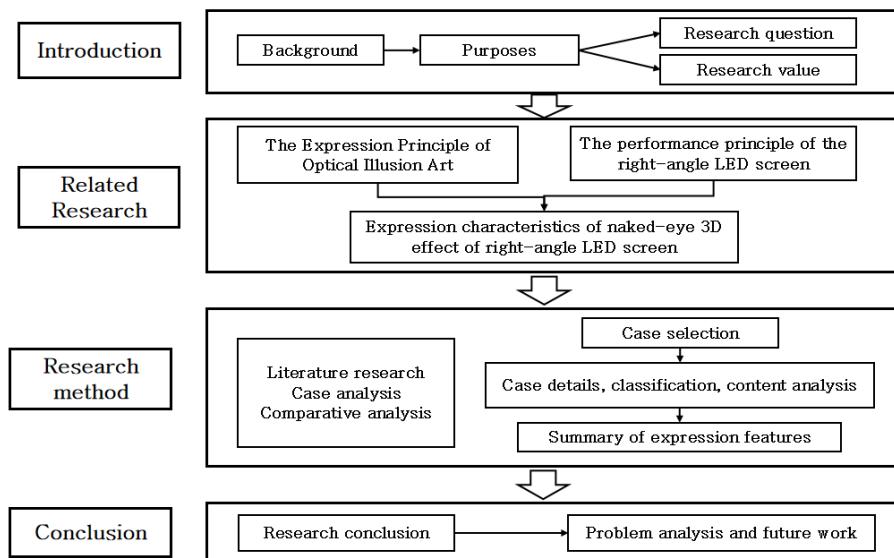
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provide digital media artists with more convenient creation methods and more free space for creativity. Coupled with the use of LED screens, the application scenarios of 3D digital products have been greatly expanded. In 2019, on the L-shaped LED display screen of the COEX K-Pop Plaza at Samseong Station in Seoul, South Korea, "Public Media Art "WAVE" created by the Korean d'strict company brought an incredible 3D visual experience to the citizens by simulating the turbulent and tumbling state of the waves in the building, it presents an amazingly realistic effect. The use of L-shaped LED screens has injected new vitality into the facade of the building with naked-eye 3D digital technology, making naked-eye 3D advertising screens a popular industry hot word on the Internet.

After that, this type of advertising screen became famous worldwide. Naked-eye 3D screens around the world have been added to must-see destinations by tourists, becoming a classic case of outdoor advertising. When more and more application cases are generated, this type of digital product is accepted and recognized by the market. The naked-eye 3D screens popular in recent years are, without exception, composed of two pictures from different angles. The display screen folds the picture by 90° and uses video materials conforming to the perspective principle to present a realistic 3D effect. How to simulate a real 3D space through the LED screen and create a natural 3D effect for the audience has become a problem worth exploring. This thesis defines it as a right-angle LED screen according to the same combination of screens. It discusses this issue from the perspective of its production principle and performance features in combination with the performance principle of optical illusion art [1, 2].

**1.2 Research Methods**

The naked-eye 3D effect on the right-angle LED screen studied in this paper is a "pseudo" naked-eye 3D in a strict sense. It uses human visual erroneous perception, and its essence is consistent with the art of optical illusions. Therefore, this paper combines it with optical illusion art and analyzes and summarizes the performance features of right-angle LED screens through optical illusion art's fundamental principles and performance features [3].



**Figure 1. Research process**

Figure 1 shows the research process. Through theoretical analysis, the composition of 3D space in optical illusion art is divided into a plane, solids shape, and 3D. Different combinations of elements will cause different

spatial feelings in the audience. Combining this principle with the performance principle of the naked-eye 3D effect in the right-angle LED display screen proves that the two are essentially the same. It is an optical illusion effect in which the two elements of the 3D plane figure and the 3D space are combined to cause the 3D plane space to expand and extend in the real 3D space. The research process is shown in Figure 1. On this basis, seven optical illusions related to 3D space expression are summarized from three aspects: geometric optical illusion, cognitive optical illusion, and physiological optical illusion. Combining the expression features of the naked-eye 3D effect of the right-angle LED screen and the performance features of the 3D virtual space, the corresponding summary is seven different types: Shadow, Color contrast, Background structure line, Magnified object, Object out of bounds, Object floating, Fusion of picture and background. It also analyzes the use of each performance feature in the selected case. It summarizes the main performance features of the naked-eye 3D effect of the right-angle LED screen through the case analysis. By using the seven expressive features proposed in this paper, the naked-eye 3D effect in optical illusion art can be fully presented on the right-angle LED display screen, creating a more 3D and more intense visual immersion spatial effect.

## 2. Related Research

### 2.1 The Expression Principle of 3D Space in Optical Illusion Art

Optical illusion art is an art that uses people's distorted perception of objective things under certain conditions to create graphics with "visual deception" components. The spatial graphics carrier in the plane trompe l'oeil is in the plane dimension, and its design elements can be arranged in a single arrangement or multiple superpositions [4, 5]. It can be a geometric or 3D plane figure, and its combination is changeable. Optical illusions in spatial dimensions refer to optical illusions that occur in a 3D environment [6]. The designer integrates factors such as spatial relationship, perspective change, and immersive experience with creative graphic design, combines 3D space with plane graphics, and fully uses the structural connection of 3D space for innovative design [7].

**Table 1. Combination method and spatial effect of different visual elements of optical illusion art**

	Plane	Solids shape	3D
Plane		Optical illusion of 3D space in a plane	Optical illusion with weakened sense of 3D space
Solids shape	Optical illusion of 3D space in a plane	Optical illusion of chaos in 3D space	Optical illusion with enhanced sense of 3D space
3D	Optical illusion with weakened sense of 3D space	Optical illusion with enhanced sense of 3D space	

According to the above, optical illusion art usually uses three visual elements: plane, solids shape, and 3D when forming a 3D space. Plane refers to a two-dimensional plane in a geometric sense, solids shape refers to a 3D object drawn on a two-dimensional plane, and 3D refers to an object in a 3D space that exists. The



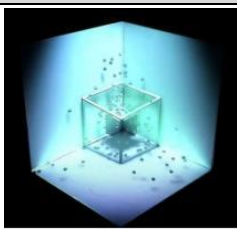
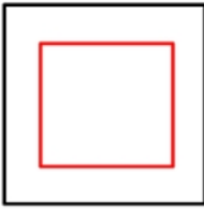
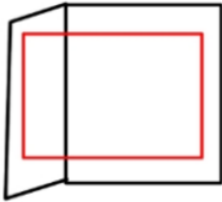
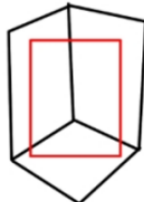
superposition of these three visual elements can create a multi-dimensional mixed contradictory space, confusing the viewer's visual cognition to achieve a 3D visual effect [6, 8].

As shown in Table 1, The 3D effect formed by the arrangement and combination of different visual elements is different. With the continuous development of optical illusion art, designers are still looking for more to create two-dimensional planes. Still, they integrate the real 3D space as a visual element to create the optical illusion. Integrate factors such as real spatial relationship, perspective change, and immersive experience with creative graphic design, combine 3D space with plane graphics, fully use 3D space's structural relationship, and use visual language for innovative design. This graphical design method in the natural area will enable designers to break away from the traditional two-dimensional plane as the carrier and thus derive the regional 3D space environment as the carrier. At the same time, it also expands the designer's design thinking and methods and enriches the factors that designers can design and consider in the 3D space [9].

### 2.2 The Expression Principle of 3D Sense of Space in the Right-angle LED Screen

The glasses-free 3D effect created for the audience through the combination of screens is divided into three forms. The single-screen composition method is in a two-dimensional plane, and the combination of two-dimensional and 3D graphics brings the audience a 3D optical illusion. The variety of the two screens in an L-shape combines the real 3D space with the two-dimensional plane 3D graphics to create a 3D illusion. The third method is a combination of three screens, with a certain point in space as the base point, and the screens are set in the three directions of the XYZ axis. The principle of this method is consistent with the second method. It also combines 3D space and two-dimensional, 3D graphics to create a 3D optical illusion. Regardless of the visual illusion space created by any expression method, the final picture presented to the audience is a two-dimensional optical illusion. As shown in Table 2, the two-dimensional plane represented by the red wireframe is the last picture shown to the audience [10, 11].

**Table 2. Three different presentation methods of the naked-eye 3D screen**

	One screen	Two screen	Three screen
Case			
Expression			

In many planning exhibition halls, cultural and museum exhibition halls, etc., in order to realize any combination of special-shaped screens, pursue a unified composition, and pursue naked-eye 3D viewing effects at specific visual angles, right-angle LED screens or multi-screen panoramic splicing methods are adopted.

The right-angle LED screen distinguishes and matches the left and right images of the human eye through two left and right 90-degree vertical screens. By utilizing the parallax principle of the human eye, a 3D spatial effect can be displayed on the two screens [12].

Combined with the expressive principle of combining the two elements of the 3D plane picture and the 3D space in the art of visual illusion, the principle of the two to form the visual 3D space is consistent. The structure of the right-angle LED screen itself uses real 3D space, and the audience will actively substitute this real 3D space into the picture when watching. Combining the 3D plane picture with the real 3D space through the right-angle LED screen, the 3D plane space displayed on the screen can be extended in the actual 3D space to achieve the purpose of space expansion [13].

### **3. Expressive Features of Naked-eye 3D Effects in Optical Illusion Art**


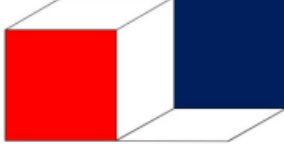
The right-angle LED screen has such a natural 3D effect because it uses the principle of binocular parallax of the human body. Through several methods commonly used in 3D modeling, such as perspective structure, lines, light and shadow, color contrast, etc., to create space and depth, the eyes can deceive the "brain" and present a realistic 3D effect. In addition to modeling methods, there are two general tips: one is to add a "frame" to the video, that is, add a frame around the video, and the frame remains unchanged. The audience thinks it does not belong to this screen, more like a part of the building. The second is to paint the video "black", leaving a part of the black in the video, making people think that the black is outside the video and the screen. Once the subject in the picture crosses the frame or enters the black part, It's like rushing out of the screen. Based on these expressive features, to further explore the performance principle of the naked-eye 3D effect of the right-angle LED screen, this paper combines it with the 3D space performance principle of optical illusion art.

#### **3.1 The Expression Principle of 3D Space in Optical Illusion Art**

Optical illusion art has a wide range of forms and features, which can be divided into physiological optical illusions, geometric optical illusions, and psychological and cognitive optical illusions. This thesis summarizes the fundamental theories of the 3D space expression of the seven optical illusion arts. It combines the expression features of the right-angle LED screen to convert them into seven corresponding performance features [14].


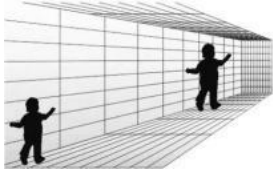
Physiological optical illusions mainly come from the visual adaptation phenomenon of the human body. Human sensory organs will be blunted after being stimulated for too long, which also causes physiological optical illusions of complementary colors and afterimages. Physiological vision is affected by the picture's color and light, and shadow. The audience will have a wrong or distorted visual phenomenon through the different forms of color, the change of color and light intensity, and other factors. It mainly includes distance illusion, contrast illusion, area illusion, and warm and cold temperature illusion. As shown in Table 3, the naked-eye 3D effect specifically utilizes two features of shadow and color contrast in physiological optical illusions [15].

**Table 3. Physiological optical illusion phenomena**

Shadow		Color contrast	
	<ol style="list-style-type: none"> <li>1. Hollow-face illusion</li> <li>2. The opposite 3D space visual effect can be achieved by changing the light and shadow in the picture.</li> </ol>		<ol style="list-style-type: none"> <li>1. Color has the property of visually causing changes in distance, which are called "advancing color" and "receding color".</li> <li>2. Compared with blue, red gives the audience a more forward optical illusion.</li> </ol>




Geometric optical illusion refers to the illusion that the observer's experience of the geometric figure's length, direction, size, and shape does not match reality due to the influence of the geometric elements that make up the figure. The geometric properties of visual objects are different from those of corresponding things in the field of view. Although graphical objects are 3D, the imaging on the retina is a two-dimensional image with X and Y attributes. Therefore, the geometric properties of visual things, such as the position of the point, length, direction, and curvature of the line, will create an optical illusion for the audience after an inevitable transformation. Therefore, making good use of the geometric properties of the visual object can realize the optical illusion of the 3D space in the plane, as shown in Table 4 [15, 16].

**Table 4. Geometric optical illusion phenomena**

Background structure line		Magnify object	
	<ol style="list-style-type: none"> <li>1. Ames room illusion optical</li> <li>2. The structural lines of the room and the structural lines of the floor create an optical illusion of spatial unity.</li> </ol>		<ol style="list-style-type: none"> <li>1. "Size illusion", the actual size of actors on the left and right is the same.</li> <li>2. The audience will supplement the information according to the Grasp the "near the far smaller" law</li> </ol>

Cognitive optical illusion means that when the objective conditions change within a specific range, the mental impression will remain stable to a certain extent. Table 5 analyzes three different cognitive optical illusion phenomena. As the central organ of consciousness, the human brain will have a constant memory and cognition of some objects during growth. After changing the stability of the things in it, there will be visual sensory discomfort or a visual auto-filling effect [17].

**Table 5. Cognitive optical illusion phenomena**

<b>Object out of bounds</b>	
	<ol style="list-style-type: none"> <li>1. The picture in the picture is actually composed of a bunch of irregular patterns, but in the eyes of the audience, it will actively associate with the pattern of a puppy. This phenomenon with a subjective tendency is called "visual extension illusion".</li> <li>2. Once the object exceeds the frame set by the audience's active association, it will achieve the effect of spatial extension.</li> </ol>
<b>Object floating</b>	
	<ol style="list-style-type: none"> <li>1. Moon illusion, that is, when the moon is close to the horizon, it is affected by the reference marks on the ground and looks larger. It looks smaller against the sky as a background.</li> <li>2. When an object is suspended in space, the change from small to large will cause a change in the visual 3D sense of space.</li> </ol>
<b>Fusion of picture and background</b>	
	<ol style="list-style-type: none"> <li>1. The inversion of the relationship between "figure" and "bottom" is a well-known theory in cognitive optical illusions. The vase and human face in the picture are two pictures in which the subject and the background are interchangeable.</li> <li>2. Applying this principle to naked-eye 3D expression, merging a part of the picture with the real scene will cause the audience to take the 3D space of the real scene as a part of the picture illusion.</li> </ol>

### 3.2 The Performance Features of Optical Illusions in Right-angle LED Screen

When the right-angle LED screen expresses the naked-eye 3D effect, it uses corresponding expression methods in content production and image processing. In the production of content, we mainly use the perspective relationship, lines, light and shadow, and color contrast, commonly used in 3D modeling. It combines the basic principles of optical illusion art in 3D space: concave face illusion, color illusion, Ames illusion, size illusion, and moon illusion. Corresponding to the performance features of the right-angle LED screen, it can be converted into five performance features shadow, color contrast, background structure line, Magnified object, and object floating. In order to enhance the visual impact, these case makers will add frames to the pictures during post-processing. Part of the black screen is left outside, allowing the audience to imagine objects rushing out of the screen. The essence of this is to use the illusion of visual extension and the illusion of inversion of image base in the art of optical illusions. The conversion to a right-angle LED screen can be summarized as the objects beyond the picture frame and the Fusion of the picture and background.

**Table 6. Expression features of naked-eye 3D effects in right-angle LED screens**

Optical illusion type	Optical illusion phenomenon	Express features in the right-angle LED screen
Physiological optical illusion	Hollow-face illusion	Shadow
	Color illusion	Color contrast
Geometric optical illusion	Ames room illusion	Background structure line
	Size illusion	Magnify object
Cognitive optical illusion	Visual extension illusion	Object out of bounds
	Moon illusion	Object floating
	Double Image illusion	Fusion of picture and background

The essence of right-angle LED screens to create naked-eye 3D effects is to use these optical illusions. You can understand the performance principles by combining these optical illusion principles with the performance features of right-angle LED screens. The following seven methods can be summarized into corresponding performance features, as shown in Table 6.

#### 4. Case Analysis

Since the creation of this type of creativity developed by d'strict in Seoul, South Korea, in 2019, this brand new form of artistic expression has quickly become famous worldwide. According to the OAAA (Out-of-Home Advertising Association) 2021 Statistical Outdoor Advertising Revenue Report, DOOH (Digital Out-of-Home Advertising) operations led the rise in all top ten advertising product categories, achieving double-digit growth. Digitalization has driven the overall development of the outdoor advertising industry.

In October 2020, a hot search about naked-eye 3D spaceships in Chengdu, China, topped weibo's attention. The effect of a big spaceship rushing out of screen from the wall has attracted widespread attention and discussion on the Internet. In July 2021, the sight of a giant tricolor cat on a building opposite the East Exit Plaza of JR Shinjuku Station in Shinjuku, Tokyo, attracted widespread attention and became a hot topic on Japanese social media. This thesis selects the three most famous cases of these three naked-eye 3D advertising screens on the Internet. It analyzes their performance features and performance features in combination with the expression techniques of optical illusion art [18].

According to incomplete statistics from Luxe.CO, 15 luxury brands have tried naked-eye 3D advertisements since 2020, and 12 will be in 2022. Including Dior, Louis Vuitton, Burberry, and other top brands that have launched naked-eye 3D promotions many times. To prove the applicability of the proposed method, this paper was based on the cases of naked-eye 3D advertising of luxury brands since 2022, compiled by the China Zheshang Securities Research Institute. Select ten cases between January and May as further analysis objects, and summarize the usage rules of the seven performance features in these cases. Table 7 is the selected case information [18].





Table 7. Naked-eye 3D advertising cases for luxury brands in 2022

NO.	Name	Content	Time
1	Jaeger-LeCoultre	Ultra-thin Master Series Tourbillon Moon Phase Watch	2022.1
2	Loewe	LOEWE x Spirited handbag	2022.1
3	Dior	Dior Vibe handbag	2022.2
4	Cartier	Valentine's Day campaign	2022.2
5	Bottega Veneta	Cassette handbag	2022.3
6	Pomellato	Nudo series jewelry	2022.3
7	Burberry	Burberry Fawn	2022.3
8	Gucci	Bamboo handbag	2022.4
9	Valentino	Brand handbags	2022.4
10	Louis Vuitton	Nike co-branded Air Force One	2022.5

#### 4.1 Case Analyze Description

##### 4.1.1 Seoul d'strict Multimedia Public Installation "Wave"

<b>Designer</b>	D'strict
<b>Era</b>	2019
<b>Case picture</b>	
	
<b>Case analysis</b>	

This case cleverly combines the two sides of the right-angle LED screen with the two sides of the background cube box. Through the use of auxiliary structural lines and shadows in the background, a semi-open 3D space effect similar to a glass water tank is formed for the audience. At the same time, the existence of auxiliary structural lines in the background enables the audience to create an utterly closed expansion space cognitively. The principle here is consistent with the principle of using the combination of plane and 3D in optical illusion art to achieve the visual effect of space expansion. The right-angle LED screen exists in the 3D space, and the content played on the screen is combined with it in the form of a 3D plane. The performance of this sense of space utilizes the features of physiological optical illusions and cognitive optical illusions.

In addition to 3D space as the background, ocean waves as the primary body roll in the picture in a form that almost fills the entire room. A 3D wave effect is formed by displaying the cross-section of the wave on the left screen, which is the embodiment of the principle of the combination of 3D graphics and 3D space. The tumbling blue sea water also forms a color contrast with the pure white background, making the waves independent of the whole picture's main body and becoming the audience's visual focus. The realistic 3D

ocean wave effect also enhances the optical illusion of the glass water tank in the background space. The two interact to form a complete naked-eye 3D effect.

Naked-eye 3D effect expression feature analysis		
Physiological optical illusion	Shadow	●
	Color contrast	●
Geometric optical illusion	Background structure line	○
	Magnify object	●
Cognitive optical illusion	Object out of bounds	○
	Object floating	●
	Fusion of picture and background	○

#### 4.1.2 Naked-eye 3D Spaceship in Taikoo Li, Chengdu

Designer	Sichuan Huijuxin Technology Co.,Ltd.
Era	2020

#### Case picture





#### Case analysis

This case mainly uses the optical illusion of space expansion brought by the right-angle LED screen to the audience, and further enhancements are made on the basis of Case 1. Integrate part of the screen with the actual building, and give the audience the illusion that the entire screen content is limited to this through the pictures displayed. When the suspended spaceship gradually flies out of the photograph's frame and exceeds the frame of the audience's perception, it causes the illusion of the spacecraft flying out of the building picture.

The Fusion of the picture and the background make the buildings in the whole experience part of the naked-eye 3D effect. Suspended objects and changes in light and shadows create a surreal illusion for the audience. When the spaceship flies out of the frame of the audience's understanding, the naked-eye 3D visual effect reaches the best optical illusion state. Compared with the previous case, there is no background auxiliary structure line to guide the audience to form a cognition of the closed space. Instead, an open 3D space is created by floating objects and merging the picture with the background, extending the optical illusion effect of the area to the actual 3D space.

Naked-eye 3D effect expression feature analysis		
Physiological optical illusion	Shadow	●
	Color contrast	○
Geometric optical illusion	Background structure line	●
	Magnify object	●
Cognitive optical illusion	Object out of bounds	○
	Object floating	●
	Fusion of picture and background	●

#### 4.1.3 Naked-eye 3D Sanhua cat in Dongkou Square , Shinjuku , Tokyo

<b>Designer</b>	Cross space
<b>Era</b>	2021
<b>Case picture</b>	
	
<b>Case analysis</b>	

This case uses an expression technique that combines the main features of the previous two issues but uses an L-shaped curved screen. This type of screen is consistent with the material production principle of the L-shaped turning screen, but the transition between the two screens on the screen is softer and more natural.

This case also uses background auxiliary structural lines and shadows to create a semi-open box space for the audience. The box's border also creates an optical illusion of a completely closed space. This method is consistent with the glass water tank formed in Case 1. As the main subject, the cat moves in the distance, occupying most of the screen area. At the same time, the colorful fur color contrasts with the pure white wall in the background, which widens the sense of distance between the front and back. Make the audience's visual focus on the cat, resulting in a realistic naked-eye 3D effect.










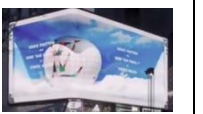
At the same time, this case also uses the two optical illusion features of the Fusion of the picture and the background in the second case, and the object exceeds the picture frame and takes the buildings in the entire actual space as part of the picture. When the cat probes, it will exceed the set initial box frame, breaking the audience's perception of the initially set space and expanding the 3D part of the picture to the entire building, resulting in the visual effect of the cat rushing out of the building surface. The audience will be immersed in the interaction between the flat and 3D space and the real 3D space and regard the two-dimensional and 3D images as part of the real 3D space.

<b>Naked-eye 3D effect expression feature analysis</b>		
<b>Physiological optical illusion</b>	Shadow	●
	Color contrast	●
<b>Geometric optical illusion</b>	Background structure line	●
	Magnify object	●
<b>Cognitive optical illusion</b>	Object out of bounds	●
	Object floating	●
	Fusion of picture and background	●

#### 4.2 Validation Analysis

In order to further illustrate the application performance of the seven performance features proposed in this paper in right-angle LED screens, this paper is based on the analysis of the above three cases, according to the naked-eye 3D advertisements of luxury brands since 2022 compiled by China Zheshang Securities Research Institute, as shown in Table 8, ten cases between January and May were selected as further analysis objects.

**Table 8. Details of luxury naked-eye 3D advertisements in 2022**

No.	1	2	3	4	5
Name	Jaeger-LeCoultre	Loewe	Dior	Cartier	Bottega Veneta
Time	15S	30S	30S	30S	15S
Content					
No.	6	7	8	9	10
Name	Pomellato	Burberry	Gucci	Valentino	Louis Vuitton
Time	15S	30S	15S	30S	30S
Content					

**Table 9. 2022 luxury naked-eye 3D advertising expression features analysis**

	Shadow	Color contrast	Background structure line	Magnify object	Fusion of picture and background	Object out of bounds	Object floating
1		●	●	●	●	●	●
2	●			●		●	●
3	●	●		●	●	●	●
4		●	●	●		●	●
5	●	●	●	●	●	●	●
6	●	●	●	●	●	●	●
7	●	●	●	●		●	
8	●	●	●	●		●	●
9			●	●		●	●
10	●		●	●	●	●	●

The seven performance features proposed in this paper are used in each case by collating and analyzing the above ten issues. As shown in Table 9, the methods of "Magnify object" and "Object out of bounds" are used in all ten cases. By combining the principle of area trompe l'oeil and visual extension trompe l'oeil, these two methods can make the plane's 3D space extend in real space. In contrast, creating a substantial visual impact and dramatically enhances the 3D effect of naked-eye 3D. It also reflects from the side that these two expressive features, as the primary means of expression, play a crucial role in creating naked-eye 3D visual effects.

"Object floating" appeared nine times in the case and is also the primary expression of the naked-eye 3D effect of the right-angle LED screen. According to the principle of moon optical illusion, it is easier for floating

objects to visually distance themselves from the background and enhance the 3D sense of space. Compared with objects that stay on the ground, floating objects allow the audience to see more perspective relationships behind the things, enhancing the spatial immersion experience. The "background structure line" has been used eight times. As the most intuitive way of expressing the perspective relationship in the 3D space, the reasonable use of the structure line can help the audience quickly form the 3D space's cognition. In the expression of naked-eye 3D effects, the auxiliary structure lines of the background can not only quickly create a 3D space but also assist in the formation of spatial distance changes in combination with the size changes of objects in the scene and can expand the sense of 3D space.

## **5. Conclusion**

In order to understand and explore the performance features and performance principles of the naked-eye 3D effect of the right-angle LED screen, we summarized the performance principles of the 3D stereoscopic effect into three types: plane, plane 3D, and 3D based on studying the artistic expression principle of optical illusions. Element. Different combinations of features will achieve other visual effects. In terms of expressing the sense of 3D space, optical illusion artists mainly combine 3D plane graphics with the actual 3D space to create a visual illusion effect for the audience. According to the performance principle of the right-angle LED screen, it is essentially a combination of plane and 3D graphics and 3D space, and it is a form of expression of 3D effects in the art of optical illusions. Using the principle that the combination of plane and 3D in optical illusion art can expand the visual 3D space to enhance the 3D effect.

The different expressions of optical illusion art can be divided into a physiological optical illusion, geometric optical illusion, and cognitive optical illusion. According to these three other expressions, we explained the optical illusion principles used in each feature of the naked-eye 3D effect of the right-angle LED screen. Summarize the seven expression features of shadow, color contrast, object beyond the frame, object enlargement, image and background Fusion, background auxiliary structure line, and object are floating. And through the case analysis explains the use of these seven expressive features in the actual case production in detail.

As for cases, we selected Seoul, Chengdu, and Tokyo, three cases with high popularity on the Internet, as the analysis objects. The use of the seven techniques in the cases was analyzed in detail. Based on the insufficient sampling of the three cases, according to the statistics of the China Zheshang Securities Research Institute's statistics on the naked-eye 3D advertising cases of luxury goods listed in 2022, ten cases from January to May were selected as further analysis objects. The case analysis results show that the right-angle LED screen mainly uses four methods: "background structure line," "Magnify object," "Object floating," and "Object out of bounds" when expressing the naked-eye 3D effect. This research can help producers better understand the right-angle LED screen's performance principle and expression features. According to the seven performance features proposed in this paper, it is more convenient to design the same type of project and provide theoretical references for design workers on production methods and design ideas.

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