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Innovative Path of Dynamic Effects in Dynamic Graphic Design of 24 Solar Terms Based on Computer Aided Design Technology

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SUMMARY: *This article aims to explore the innovative path of dynamic effects in the dynamic graphic design of the 24 solar terms based on computer-aided design technology. Firstly, the historical and cultural background and characteristics of the 24 solar terms were analyzed. Through literature analysis and Analytic Hierarchy Process, a cultural gene map of the 24 solar terms was constructed, and key design factors were extracted. Next, in response to the shortcomings of existing convolutional encoders in feature extraction, a CMSA encoder was designed, which combines residual blocks and Shun Attn mechanism to effectively capture global and local information. In addition, a detail enhanced feedforward layer (DEFL) was designed to improve the encoder's ability to extract local detail features. Finally, by integrating the GENE ANALYSIS MODULE module of CPE, effective fusion of content features and style features was achieved. Through empirical analysis, inspired by the 24 solar terms, using flowers and corresponding seasonal elements in each solar term for creation, and presenting the unique romance of traditional Chinese culture with strong color contrast, the effectiveness of the proposed method in improving the dynamic graphic design effect of the 24 solar terms has been verified. Applying traditional Chinese cultural elements to the dynamic graphic design of the 24 solar terms not only enriches the design field, but also meets consumers' personalized needs.*

KEYWORDS: *computer; Auxiliary design; twenty-four solar terms; Dynamic graphics; Feature extraction; Feature fusion; dynamic graph*

1 Introduction

The 24 solar terms are a dynamically evolving traditional culture that originated from the astronomical observation activities and production and living practices of ancient Chinese people in the Yellow River Basin. Its development and evolution have two major characteristics: first, the division of time gradually moves towards refinement and institutionalization; The second is to gradually achieve the integration of production, life, and time systems, and present rich and colorful cultural expressions. The birth, development, and evolution of the 24 solar terms have gone through a long historical process [1, 2]. The Yellow River Basin was the political, economic, cultural, and agricultural production center of ancient China. From a spatial perspective, the 24 solar terms originated in the middle and lower reaches of the Yellow River, which had distinct four seasons, a long history of agriculture, and developed agricultural civilization. Later, they spread to other regions and overseas countries; From a temporal perspective, the 24 solar terms are time festivals created by ancient Chinese laboring people in

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their long-term agricultural production and rural life. Their basic function as a time scale has gradually improved with the advancement of observation technology and the deepening of scientific understanding. The 24 solar terms are a production and living system formed through generations of inheritance, which includes various natural knowledge such as seasons, climate, phenology, etc. It showcases a rich and colorful agricultural culture and is a combination of "astronomy" and "humanities" [3].

The origin of the 24 solar terms is closely related to the ancient Chinese observation of celestial phenomena. After long-term observation, the Chinese ancestors discovered that the length of the shadow of the sun showed a specific pattern of change throughout the year. Therefore, they began to try to use the principle of "immediate effect" to judge the alternation of the four seasons, as stated in the "L ü shi Chunqiu · Cha Jin": "Judging the yin under the hall, we know the movements of the sun and moon, and the changes of yin and yang." Archaeologists discovered an ancient observatory and a compass with scales at the Taosi site 4000 years ago, proving that Confucius' statement of "using the time of summer" is based on evidence. Studies by linguists have shown that the original meanings of characters such as "fu", "jia", and "zhong" in oracle bone inscriptions are derived from "standing on the table to measure shadows", and most oracle bone inscriptions related to time contain the character "day". The "Xia Xiaozheng" also contains the saying "there is a time to nourish the sun" and "there is a time to nourish the moon". It is generally believed that by the Yin and Shang dynasties at the latest, ancient Chinese people were able to determine the summer solstice and winter solstice through the method of measuring the day with a gnomon [4].

The formation of the 24 solar terms has gone through a process of gradually improving from two periods, two periods to four hours and eight periods, and then to the 24 solar terms. According to the records in the "Book of Documents - Yao Dian" and "Zhou Li - Spring Official Zongbo", as early as the Western Zhou Dynasty, our ancestors had already determined the four solar terms - summer solstice, winter solstice, spring equinox, and autumn equinox [5]. In the middle of the Spring and Autumn period, with the improvement of the technique of measuring the date on the gnomon, the four solar terms of Beginning of Spring, Beginning of Summer, Beginning of Autumn, and Beginning of Winter were determined. The determination of the four seasons and eight solar terms means that the main solar terms among the twenty-four solar terms have been divided. During the Warring States period, the 24 solar terms were basically formed. During the Qin and Han dynasties, the 24 solar terms were fully established, and the names and sequence of the 24 solar terms recorded in Liu An's "Huainanzi" continue to this day. In the seventh year of Emperor Wu of Han's Yuanfeng reign (104 BC), the "Taichu Calendar" formulated by Deng Xiaoping was promulgated nationwide, and the 24 solar terms began to be incorporated into the national calendar, which had a profound impact on later calendars and astronomical calculations [6].

The integration of production and life with natural timing creates a rich and colorful knowledge system of the 24 solar terms [7]. As a time identification system, the 24 solar terms have gone through a process of development from simplicity to richness, gradually becoming related to celestial phenomena, calendar, climate, phenology, agriculture, music and other aspects, and thus constructing a 24 solar term system that combines production and life, agriculture and folk customs, time and culture. For example, during the Eastern Han Dynasty, there were many records of folk customs related to solar terms, and the Northern Wei Dynasty's "Qi Min Yao Shu" recorded 24 solar terms and agricultural proverbs, and so on. It is in the process of inheritance and evolution that the 24 solar terms have gradually developed from a simple time scale into a comprehensive knowledge system and its practice, with increasingly rich connotations and values [8].

This article is mainly based on the innovative path of dynamic effects in the dynamic

graphic design of the 24 solar terms using computer-aided design technology. It explores the use of mixed coding feature fusion algorithm to extract gene element features from the dynamic graphics of the 24 solar terms and analyzes them. Taking the 24 solar terms as inspiration, the article uses flowers and corresponding seasonal elements in each solar term to create a strong color contrast that showcases the unique romance of traditional Chinese culture, achieving an improvement in the effect of dynamic graphic design for the 24 solar terms.

2 Related research

Regarding dynamic graphic design, researchers have conducted relevant studies from different perspectives.

(1) In his book "Motion graphic design applied history and aesthetics", John Krasner systematically introduces the origin, development, application, and design and production methods of dynamic graphic design [9]. However, in this work, John Krasner did not provide a clear definition of dynamic graphic design, nor did he explain the relationship between the concepts of "dynamic graphic design" and "animation". Some researchers have attempted to answer the question of 'what is dynamic graphic design', but there has not yet been an authoritative definition recognized by researchers. However, from the relevant descriptions of dynamic graphics by many researchers (such as Niksa Babic, Mohsen Fathi, Ian Crook, etc.), it can be seen that most researchers consider dynamic graphics as a "medium for conveying information" [10].

Ian Crook and Peter Beare discussed the relationship between "dynamic graphic design" and "animation" in their book "Motion Graphics: Principles and Practices from the Ground Up". They believe that the key to distinguishing between the two lies in their purposefulness. They believe that both animation and dynamic graphic design can convey emotions or information, but their focus is different: the main purpose of animation is to convey emotions, while the main purpose of dynamic graphics is to convey information [11]. In addition, they also analyzed the differences between animation and dynamic graphic design from their origins, pointing out that animation originated from the field of illustration, while dynamic graphic design developed from graphic design.

In recent years, the application of dynamic graphic design in foreign countries has expanded to the field of education, and multiple researchers have conducted relevant research to explore the impact of dynamic graphics as a teaching medium on students' learning outcomes. The research of Wiana, Lanto Ningrayati Amali, Muhammad Hanif, and others suggests that dynamic graphics can effectively promote students' learning in fashion design, history, and science courses.

(2) Domestically, research on dynamic graphic design is slightly later than abroad. Tang Chunyan, a researcher from Shantou University, was one of the first to pay attention to this field. In her master's thesis, she comprehensively introduced the origin, characteristics, and information communication advantages of dynamic graphic design [12]. The earliest attempt to propose a definition of dynamic graphic design was by researcher Tong Jiangtao from Ningbo University, who believed that dynamic graphic design is "a visual communication design based on a timeline".

Many domestic researchers have published works that systematically introduce dynamic graphic design. Li Yu introduced the basic concepts, temporal and spatial characteristics, design techniques, and several design examples of dynamic graphic design in his works; Xu Yibing and Xu Xiaoxiao introduced the origin, definition, design methods, and process of dynamic graphic design in their works; Zhang Wei, Li Guanying, and Li Xingli introduced the concept, application, design principles, design methods, and design process of dynamic graphic design;

Wang Fahua and Huang Yucheng introduced the overview, design methods, and classic cases of dynamic graphic design in their works [13]. Researchers such as Long Juanjuan and Ding Nan have also provided detailed introductions to dynamic graphic design in their respective works, covering various aspects such as the definition, development process, design principles, production methods, and specific applications of dynamic graphic design.

In terms of the production methods of dynamic graphics, the researchers who explicitly mentioned the relevant tools mainly introduced Adobe Flash Professional, Adobe Animate, Adobe After Effects Traditional animation or film and television special effects software, while Long Juanjuan and Ding Nan mentioned in their respective works that Processing programming language is also one of the commonly used production methods in dynamic graphic design. Long Juanjuan even provided a detailed introduction to Processing in her book "Dynamic Graphic Design and Implementation" [14].

From domestic theses and journal articles on dynamic graphic design, most researchers focus on the theory and practice of dynamic graphic design itself, but there are also researchers who have expanded their horizons to the field of education [15]. For example, Tong Jiangtao has identified the core competencies of dynamic graphic design talents and proposed corresponding training methods and approaches based on these core competencies; Long Juanjuan developed a course case of dynamic graphic design based on project-based teaching mode in her research; Wu Zhendong and others' research constructed a design and implementation framework for a dynamic graphic design course based on a problem oriented teaching model.

By reviewing the current research status of dynamic graphic design both domestically and internationally, it can be found that dynamic graphics, as an important medium for conveying information, have received widespread attention from researchers, and the related research results are relatively abundant. From existing research results, it can be seen that dynamic graphic design is characterized by dynamism and serves the main function of information communication. It integrates visual communication design and dynamic modeling, and programming technology can be used as a production method in the design process. It can be attempted to incorporate it as a novel design learning content into middle school art courses as a supplement to existing textbook content. However, while acknowledging the rich research results, the author also notes that most studies still focus on dynamic graphic design itself, with a relatively small number of studies related to education. Only a few researchers explicitly consider dynamic graphic design as a learning content and explore several teaching modes suitable for dynamic graphic design courses. Moreover, these studies are concentrated in the fields of higher education and vocational education, and there is still a lack of relevant research in the field of basic education.

3 Construction of the Cultural Gene Map of the 24 Solar Terms

The 24 solar terms are an excellent traditional culture of the Chinese nation, reflecting the harmonious relationship between humans and nature. After long-term inheritance and evolution, the cultural connotations and values contained in them have become an important part of people's way of life [16]. There are two different levels of cultural characteristics, one is superficial and the other is deep. Design features are extracted from these two levels of cultural characteristics, and they are an effective way of information transmission that demonstrates the functional value of the system they belong to. The inheritance and design transformation of the cultural genes of the 24 solar terms will be carried out through the following three aspects:

firstly, literature analysis. Through reading and analyzing a large amount of literature, the influencing factors for extracting the cultural genes of the 24 solar terms will be constructed; Secondly, construct a cultural gene map of the 24 solar terms, use the Analytic Hierarchy Process to determine matrix construction and weight calculation, and obtain design factors; Thirdly, using the artificial intelligence software Midjoumey for secondary creation of patterns, selecting colors and patterns that match the 24 solar terms, and then relying on the Touch designer software to particle produce the representative patterns of the 24 solar terms and adapt them to music.

3.1 Induction of Characteristics of the 24 Solar Terms

Through literature research, the characteristics of the 24 solar terms can be summarized into phenological features, agricultural activities, folk activities, and representative floral features analysis. The phenological features exhibited by the 24 solar terms cover multiple dimensions such as plant growth and development, animal activity habits, hydro meteorological changes, and agricultural production activities, as shown in Figure 1.

Figure 1: Poster of 24 Solar Terms Characteristics

The phenological phenomena in the 24 solar terms mainly include plant phenology, animal phenology, hydro meteorological phenomena, and agricultural phenology. Plant phenology refers to the mutual relationship between plants and the periodic changes in environmental conditions. In the beginning of spring, after the east wind thaws, insects will begin to move and fish will reappear on the water surface [17]. Animal phenology involves the migration and reproduction activities of animals due to seasonal changes, as well as changes in their behavioral patterns. During the Awakening of Insects season, dormant animals will begin to awaken, such as peach blossoms blooming, flies chirping, eagles turning into pigeons, and so on. Hydrological and meteorological phenomena include natural phenomena related to hydrology and meteorology, such as initial frost, final frost, icing, melting, initial snow, and final snow. White dew and cold dew reflect the gradual decline process and degree of temperature, while small and large dew are descriptions of high temperatures in summer.

Agricultural phenological phenomena are directly related to the growth cycle of crops, such as the maturity of wheat and harvesting during the Xiaoman period. The phenological phenomena in the 24 solar terms cover a wide range of natural phenomena, involving the growth, development, migration, reproduction, and other aspects of animals and plants, while also reflecting the hydrological and meteorological changes in nature. Agricultural and folk activities also constitute important features of each solar term. By sorting out this information, specific narrative content can be provided for dynamic pattern design, such as graphic and textual analysis of representative flowers, which can provide more intuitive graphic features and images for the 24 solar terms.

3.2 Color Extraction of the 24 Solar Terms

In terms of color, the color gene includes the combination of the main color and environmental color of photographic images taken during various solar terms. Specifically, a large number of photographic images were collected to correspond to the solar terms of spring, summer, autumn, and winter. Adobe Photoshop was used to extract the colors of each image, and four representative main colors were extracted and analyzed. The vibrant green of the grassland, the thick and broad reddish brown of the earth, the light pink of plum blossoms braving snow and frost, and the deep green of lush trees and branches constitute the prominent color visual symbols of the 24 solar terms. Based on the photography of the 24 solar terms and the collection of surrounding environmental colors, the most representative color factors were selected for classification and extraction, and summarized into RGB colors # 3A5441, # B01C25, # F0DFD8, # 223F47, as shown in Figure 2.

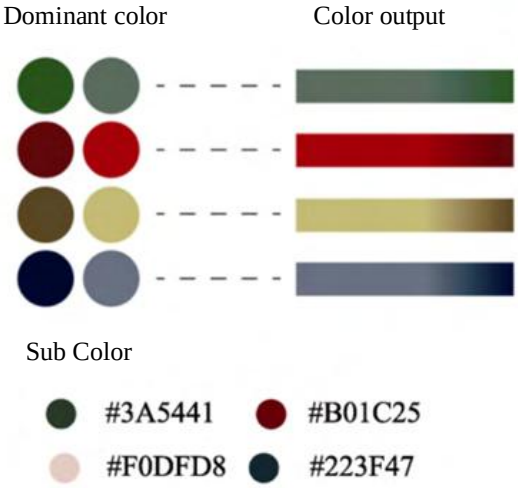

Figure 2: Extraction of Color Genes for the 24 Solar Terms

3.3 Cultural Gene Assessment System

The Analytic Hierarchy Process (AHP) was proposed by American operations researcher Sati in the 1970s. It decomposes elements related to decision-making into several levels and factors, and based on this, judges the importance of each factor between them, establishes a judgment matrix, and selects the best decision method by calculating the weights of each factor in the judgment matrix [19]. In the process of extracting design factors from the dynamic pattern cultural genes of the 24 solar terms, the Analytic Hierarchy Process (AHP) is used to determine the relative importance of the 24 solar terms cultural factors at each level through mutual comparison. The weights of each factor are determined using accurate mathematical methods

as the basis for decision-making in dynamic pattern design.

Firstly, based on the dynamic pattern design evaluation system of the 24 solar terms cultural genes, the system is divided into three levels: target layer A, criterion layer B, and evaluation factor index layer C. Among them, the indicator layer can be further divided into first level indicators, second level indicators, and even third level indicators according to the actual situation and needs, and then a structural model can be established based on the above three levels. Next, five pattern design experts will be assembled to evaluate the influencing factors (phenological characteristics, agricultural activities, folk activities, floral characteristics, and color characteristics) extracted from the cultural genes of the 24 solar terms.

4 Hybrid encoding feature fusion

The dynamic graphics of the 24 solar terms are rich in content, with bright colors, complex structures, and diverse painting techniques. In terms of color, high saturation and strong contrast make the dynamic graphics of the 24 solar terms more vivid. The dynamic graphics of the 24 solar terms also have the characteristic of high resolution, with pixel sizes usually around 1024 × 1024, which increases the difficulty of model training and inference. The existing convolution encoders have the problem of insufficient feature extraction, because the receptive field of convolution operations is limited, which cannot integrate global information, and some important features will be lost with the deepening of the network, resulting in the generation of 24 solar terms dynamic graphics with artifacts and content leakage. Although Transformer encoder is superior to convolutional encoder in global modeling, it has high computational cost and slow inference speed on features with large spatial dimensions, and even cannot reason. In response to the above problems, this paper designs CMSA encoder, which uses downsampling layers in the primary stage of the network to reduce the spatial dimensions (H and W) of the input image and increase the number of channels; Residual blocks have strong local modeling capabilities, can effectively capture local information, and have low computational costs and fast inference speed. They can effectively capture low-level features of the dynamic graphics of the twenty-four solar terms [20].

After 2 downsampling, the feature dimension becomes $(2C, H/4, W/4)$. In the linear embedding layer, the dynamic graphic feature dimension of the 24 solar terms is also downsampled to $(4C, H/8, W/8)$. In this experiment, C was set to 192. Although residual blocks have strong local modeling capabilities, they are far inferior to attention mechanisms in terms of global modeling and capturing long-range dependencies of features. Therefore, based on Transformer, the Shun Attn mechanism is introduced to further integrate global and local information. Shun Attn divides self attention heads into several groups, each with a corresponding attention granularity. Among them, the fine-grained group focuses on detailed local features, while the coarse-grained group captures broader contextual information. This module can ensure comprehensive extraction of dynamic graphic features of the 24 solar terms, improving the overall quality of generated images.

(1) The input features are downsampled at different scales on different attention heads, and then multiplied by the corresponding projection matrix to obtain the query matrix $\boldsymbol{Q}_i$, key matrix $\boldsymbol{K}_i$, and value matrix $\boldsymbol{V}_i$. The formula is [21]:

$$\boldsymbol{Q}_i = X\boldsymbol{W}_i^Q \tag{1}$$

$$\boldsymbol{K}_i = \mathrm{MTA}(X, r_i)\boldsymbol{W}_i^K \tag{2}$$

$$\boldsymbol{V}_i = \mathrm{MTA}\left(X, r_i\right)\boldsymbol{W}_i^V \tag{3}$$

where, X represents input features; MTA stands for Multiscale Token Aggregation (MTA) layer, with a downsampling rate of r_i, implemented using convolution with kernel and stride sizes of r_i for downsampling; The projection matrices $\boldsymbol{W}_i^Q$, $\boldsymbol{W}_i^K$, and $\boldsymbol{W}_i^V$ are used for querying, key and value calculations, respectively, where *i* represents the linear projection parameter of the *i*-th self attention head. By using different downsampling layers, the encoder can not only preserve fine-grained local details during feature extraction, but also capture global information of the 24 solar terms dynamic graphics through a larger downsampling rate, effectively reducing computational costs and memory requirements.

(2) Using depth wise convolution (DC) with residual connections to locally enhance $\boldsymbol{V}_i$ and preserve more low-level features, resulting in clearer local details of the generated 24 solar terms dynamic graphics. The formula is [22]:

$$\boldsymbol{V}_i^{'} = \boldsymbol{V}_i + \mathrm{DC}\left(\boldsymbol{V}_i\right) \tag{4}$$

where, although DC is a convolutional layer, its design allows each input channel to be convolved with only one specific convolution kernel, rather than convolving across multiple channels, preserving more fine-grained features and low-level details. The formula for multi-scale attention is:

$$h_i = \mathrm{softmax}\left(\frac{\boldsymbol{Q}_i\boldsymbol{K}_i^{\mathrm{T}}}{\sqrt{d_h}}\right)\boldsymbol{V}_i^{'} \tag{4}$$

where, h_i represents the output of the *i*-th head; d_h represents the scaling factor.

(3) All the outputs of the attention heads are concatenated and projected back into the original feature space in the multi-scale connectivity layer (MCL), using the following formula:

$$H = \mathrm{MCL}(h) = \mathrm{Concat}\left(h_1, h_2, \cdots, h_H\right)\boldsymbol{W}_{\mathrm{O}} \tag{5}$$

where, $\boldsymbol{W}_{\mathrm{O}}$ represents the projection matrix, and Concat represents the vector concatenation operation. After MCL, feature *H* needs to undergo layer normalization (LN) before finally reaching the feedforward layer.

In order to demonstrate the improvement in computational efficiency of ShuntAtn compared to traditional attention mechanisms, an analysis and comparison of the two are conducted in terms of computational complexity. Assuming that the dimension of input feature *X* is $(h\times w, C)$, the dimension of projection matrix *W* is (*C*, *C*), and the dimension of MLP projection layer is (*C*, *C*), the computational complexity of traditional multi head attention (MSA) is:

$$\Omega(\mathrm{MSA}) = 4hwC^2 + 2(hw)^2C \tag{6}$$

In ShuntAtn, the downsampling rate of MTA is r, the number of downsampling layers is *n*, and the computational complexity of the projection matrix in equations (1) to (3) is $hwC^2 + \sum_{i=1}^{n} 2\left(hw/r_i^2\right)C^2$; The computational complexity of equation (4) is $\sum_{i=1}^{n} 2\left(hw/r_i\right)^2C$; The computational complexity of equation (5) is hwC^2. So, the computational complexity of ShuntAtn is:

$$\Omega(ShuntAttn) = 2hwC^2 + \sum_{i=1}^{n} 2\left(\frac{hw}{r_i^2}\right)C^2 + 2\left(\frac{hw}{r_i}\right)^2 C \tag{7}$$

Obviously, the larger the r_i, the lower the computational complexity of ShuntAtn. By computing self attention from multiple scales, the balance between global and local features is ensured.

In traditional feedforward layers, the fully connected layer (FCL) operates in a point-to-point manner, meaning that in FCL, the connections between each neuron and all neurons in the previous layer are independent, indicating that each neuron processes input features independently without considering the relationships and dependencies between features at different scales, resulting in local blurring of the style transfer result image and low overall quality [23]. Therefore, this article designs detail enhancement feedforward layers (DEFL), which can more effectively learn the relationship between local details and attention heads of different scales, enhance the encoder's ability to extract local detail features, and make the generated image more comprehensive in details, resulting in a more natural and rich visual effect. DEFL connects the DC residual between two DCLs using the formula:

$$x' = \mathrm{FC}(x) \tag{8}$$

$$x'' = \mathrm{FC}\left(\sigma\left(x' + \mathrm{DC}\left(x'\right)\right)\right) \tag{9}$$

where, x represents input features; σ represents the activation function ReLu; x'' represents output features.

The CMSA encoder not only effectively captures global and local information, but also has the advantages of low computational complexity and fast speed, which effectively solves the feature extraction problem of high-resolution 24 solar term dynamic graphics and style images [24, 25]. In order to integrate content features and style features, this article uses attention mechanism as the basis and integrates CPE to design GENE ANALYSIS MODULE module. Its structure is shown in Figure 3. (1) Using residual blocks to isolate input and output better preserves content information and facilitates GENE ANALYSIS MODULE module stacking, achieving different stylized strengths. (2) Utilizing self attention mechanisms to capture the interrelationships between features on a global scale, enhancing the expressive power of content features, and mitigating content leakage issues. The formulas for these two parts are:

$$f_c^{'} = \mathrm{R}\left(f_c\right) \tag{10}$$

$$\boldsymbol{Q},\boldsymbol{K},\boldsymbol{V} = f_{\mathrm{Q}}\left(f_{\mathrm{c}}^{'}\right), f_{\mathrm{K}}\left(f_{\mathrm{c}}^{'}\right), f_{\mathrm{V}}\left(f_{\mathrm{c}}^{'}\right) \tag{11}$$

$$\mathrm{Attn}(\boldsymbol{Q},\boldsymbol{K},\boldsymbol{V}) = \mathrm{softmax}\left(\frac{\boldsymbol{Q}\boldsymbol{K}^{\mathrm{T}}}{\sqrt{d}}\right)\boldsymbol{V} \tag{12}$$

where, R stands for residual block; f_c represents content features; f_Q, f_K, and f_V represent different embedding layers, which are composed of learnable projection matrices. (3) The output of the self attention layer is fed into a conditional position generator (CPG) composed of multiple DCs. Firstly, the input feature $X \in \mathbb{R}^{B\times N\times C}$ is reshaped back into the two-dimensional 24 solar terms dynamic graphic space $X' \in \mathbb{R}^{B\times H\times W\times C}$, and the function F is used to generate the position encoding $X'' \in \mathbb{R}^{B\times H\times W\times C}$ with conditional information. Finally, the $X''' \in \mathbb{R}^{B\times N\times C}$ is reshaped to obtain $\boldsymbol{Q}'$ by adding it to the input feature X, and the style feature

is used as K' and V'. Based on the attention mechanism, the fusion feature f_{cs} is obtained by fusing the content feature and style feature. In this experiment, *F* is implemented by DC.

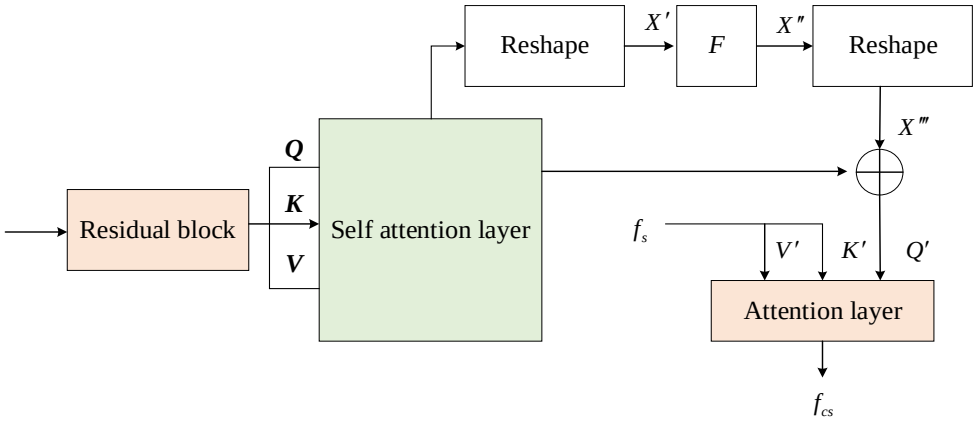

Figure 3: Structure of the Gene Analysis Module for the 24 Solar Terms

CPE dynamically generates position codes based on input features, which can flexibly respond to inputs of different sizes; Due to the translational invariance of CPE, which means that the model can consistently apply style patterns throughout the entire image without knowing the exact location of content features, the problem of information loss caused by feature position changes is avoided, thereby ensuring the visual consistency of the generated image.

The Gene analysis module module can dynamically adjust the position encoding ability with the help of CPE while maintaining content information, enabling the model to better control the matching of style features and content features, achieve alignment between style color and texture information in the generated image and semantic information in the content image, and improve the sense of hierarchy and delicacy of the generated image.

5 Empirical analysis

5.1 Design Concept

Spring rain startles the clear valley sky, summer is full of radiance, summer and summer are connected, autumn is dew, autumn is cold and frost falls, winter snow and snow, winter is small and cold. The 24 solar terms in China are from the daily life and formed in the East. They are the brocade raft woven by time and the time scale of the Chinese people. In the details of all things in heaven and earth, there are twenty-four flower letters that record the rich flavor and atmosphere of China. The series is called the "24 Solar Terms Dynamic Graphic Series" (Figure 4), inspired by the 24 solar terms, using flowers and corresponding seasonal elements in each solar term to create a strong color contrast that showcases the unique romance of traditional Chinese culture.

Figure 4: Dynamic graphic design of 24 solar terms

5.2 Theme Performance

Based on the extracted elements and application methods of the 24 solar terms, follow the principles of applying cultural elements of the 24 solar terms in design; Integrate the unique phenological phenomena and elements of each solar term, and integrate various art forms such as poetry and other literary works related to each solar term: summarize the theme image, extract and summarize the elements, and summarize the theme emotion (Table 1); To concretize the expression of the 24 solar terms and create emotional resonance between people and the culture of solar terms.

From Table 1, it can be seen that the theme emotions conveyed by each solar term are different. To express the theme of each solar term, innovation must be carried out on the basis of following natural laws. Therefore, when designing, the form of solar terms should be based on the theme of emotions. In the artistic expression of spring solar terms, the most important thing is to showcase the vitality and natural beauty through visual elements, integrating "freshness and hope" into the dynamic graphic design of the 24 solar terms, so that people can feel the vitality brought by spring. In the artistic expression of summer seasonal atmosphere, the overall color and pattern dynamics should be used to express the theme emotions of "heat and enthusiasm"; In the design of autumn solar terms, the pattern form of "desolate and cool" should be chosen to highlight the calm and atmospheric feeling of the solar term; In the artistic expression of winter solar terms, emphasis should be placed on expressing the theme emotions of "tranquility and purity", showcasing a hidden vitality amidst tranquility.

Table 1: Theme Performance

Solar terms	San Hou	Solar term elements	Theme imagery	Theme Emotions
Spring Equinox	The mysterious bird arrives, thunder makes sound, and electricity begins	Magnolia flowers, paper kites, swallows	Spring is full of vitality, spring geese return to their nests	Fresh and hopeful
Grain Rain	Pingshi grows, Mingwu brushes its feathers, Dai Ren descends on soft decaying grass as fireflies, soil moistens the bedding, and travels during heavy rain	Wisteria, Willow Fields, Spring Rain	Continuous spring rain, full of vitality	Vitality and tranquility
Autumn Equinox	Rotten grass breeds fireflies, moistens the soil, and thrives during hot and heavy rain	Lotus, lotus pod, watermelon: Osmanthus, scarecrow, wheat	The scorching sun and lotus leaf fields	Moxibustion heat, passion
Major Snow	Thunder begins to subside, salt insects damage households, water begins to wither	Bauhinia, Snowman, Snowflake, Cedar, Snow Mountain	Fallen leaves drifting, abundant year after year	Xiao Evil, Qingleng
Winter Solstice	Penggu doesn't chirp, tiger begins to mate, Li stands out	Plum, rice dumpling, warm in winter	Pure and flawless, the pine trees stand tall and firm	Peaceful and pure
solar terms	Lizard worm knot, Mi Jiao Jie, Water Spring Movement	Solar term elements	Tranquil and peaceful, blooming wintersweet	Peaceful and reserved

5.3 Design Proposal

Summarize cultural elements from three aspects: natural phenomena, historical culture, and customs, draw inspiration from the quatrains of tongue lovers, and analyze the unique color characteristics and climate changes of each solar term. At the same time, using corresponding seasonal elements and colors of warmth and coldness to express the changes of the four seasons and the harmonious beauty of all things. In addition, referring to the 2023 color trend in color matching, the design works can better meet the current aesthetic needs and create a work that combines cultural connotation and fashion sense.

The design scheme with the theme of the Spring Equinox solar term is inspired by the poem "Village Residence" by the Qing Dynasty poet Gao Ding, which goes: "Grass grows long, birds fly to the sky in February, willows brush against the embankment, and spring smoke is mellow. Children return early from school, busy taking advantage of the east wind to fly paper kites. The combination of paper kites and magnolias symbolizing the vernal equinox creates an atmosphere of revival and prosperity for all things in spring. The main colors used are fresh green and white, giving people a feeling of being close to nature.

The design scheme with the theme of Guyu solar term is inspired by Chen Zhongping's

"Xianju Qiqi Jingxingyan" from the Qing Dynasty, which states "The spring breeze brushes the green terraced fields, and the bamboo in the temple still lingers in the cold rain". The poem depicts the scene of the Grain Rain season, where soil and paste pulsate and everything thrives under the rain. The terraced fields of Grain Rain, combined with the wisteria flower element symbolizing Grain Rain, create a vibrant atmosphere during the Grain Rain season. The main colors used are calm light blue and purple, expressing the artistic conception of the revival of the object.

The design scheme with the theme of the Great Heat solar term is inspired by the Tang Dynasty poet Wei Yingwu's poem "Summer Solstice at the North Pool", which states, "Green clouds still contain powder, round lotus flowers begin to bloom. When you are tired of holding wine, you can stretch your tendons towards China." The round lotus element in the poem, combined with the watermelon element representing heat, forms the characteristic of the Heavenly solar term with a strong sense of dryness and heat. The main colors used are hot rose red and deep purple, expressing the passion and exuberance of summer.

The design scheme with the theme of the Autumn Equinox solar term is inspired by the Song Dynasty poet Xie Yi's poem "Dian Jiang Lips", which states "The golden energy of the Autumn Equinox, the wind is clear and the dew is cold, and the autumn season is half over. The cool toad shines brightly. The osmanthus seeds are ripe and fragrant far away. The poem depicts the scene of the autumnal equinox season, with clear autumn air, red maple trees everywhere, and osmanthus flowers on the branches. The combination of osmanthus elements and the scarecrow guarding the harvest of wheat fields creates a peaceful and tranquil atmosphere in autumn. In terms of color, bright orange and yellow are mainly used to express the joy of harvest.

The design scheme with the theme of heavy snow season is inspired by Fan Yun's poem "Ode to Cold Pine" from the Southern and Northern Dynasties, which goes: "Xiu Tiao Fu Lian Han, Mi Ye Zhan Tian Xun. Ling Feng knows the strength of the season, and negative snow reveals the loyalty of the heart. The combination of pine trees and snowmen in the snow, along with the element of the Bauhinia flower symbolizing the snow, creates a beautiful winter scenery with a cold atmosphere and pink makeup. The main colors used are pure white and blue, giving people a feeling of purity and purity.

The design scheme with the winter solstice solar term as the theme is inspired by the Tang Dynasty poet Du Fu Xiaozhi's famous lines, "At the time of passing, people and days are urging each other, and the sun on the winter solstice gives birth to spring literature" and "On the shore, waiting for the waxing of willows, the mountain is rushing cold and ready to bloom plum blossoms". The elements of wintersweet, which stand for the winter solstice, plus the elements of rice dumpling, which symbolize the winter solstice, set off the atmosphere of depression in the winter solstice. The main colors used are gloomy gray and eggplant purple, expressing a peaceful and serene atmosphere.

The "24 Solar Terms Dynamic Graphics Series" combines the elements of the 24 solar terms with seasonal characteristics, and innovates the pattern elements in various parts of the 24 solar terms dynamic graphics, making the entire design richer and more layered. With the increasing global awareness of environmental protection, the dynamic graphic design of the 24 solar terms should also develop towards a more environmentally friendly and sustainable direction. Therefore, biodegradable materials should be selected in terms of material, and a circular economy model based on the dynamic graphics of the 24 solar terms for recycling and reusing waste should be adopted. In addition, different materials can be selected for the dynamic graphic design of the 24 solar terms based on their climatic characteristics. For example, when designing dynamic graphics for the 24 solar terms of the Beginning of Summer, ventilated and breathable materials are used to cope with hot weather; when designing dynamic graphics for the 24 solar terms of the Heavy Snow solar term, warm materials are used to cope with

extremely cold weather. Reasonable selection of materials can improve the comfort and functionality of the dynamic graphics of the 24 solar terms, making them both aesthetically pleasing and of high practical value. In addition, the design of this series also combines the names of each solar term in the form of Chinese calligraphy with patterns related to solar terms, embroidered at the sock opening and incorporating details related to solar terms. These details not only enhance the visual appeal of the dynamic graphics of the 24 solar terms, but also better showcase the unique charm of traditional cultural elements.

6 Conclusion

As the crystallization of the ancient wisdom of the Chinese nation, the 24 solar terms contain rich cultural elements and carry the Chinese people's profound understanding of nature, time and life. By deeply extracting and analyzing the cultural elements of the 24 solar terms, we can discover that they contain various information such as changes in yin and yang, phenological characteristics, agricultural activities, and folk customs. For example, the Beginning of Spring marks the beginning of spring and carries the meaning of the revival and vitality of all things; Qingming combines natural solar terms with cultural commemoration, offering both the joy of spring outings and the solemnity of commemorating ancestors. These cultural elements are the spiritual wealth of the Chinese nation and an inexhaustible source of inspiration in modern design.

Applying traditional Chinese cultural elements to the dynamic graphic design of the 24 solar terms has multiple positive implications. From the design itself, it has brought new creativity and inspiration to the dynamic graphic design of the 24 solar terms. Traditional elements such as ancient farming tools, traditional clothing patterns, and symbolic flora and fauna can add unique charm to graphic design, enriching the field of dynamic graphic design for the 24 solar terms and making it no longer limited to a single form of expression. From the perspective of consumer demand, in the context of globalization, consumers' demand for products with ethnic characteristics and cultural connotations is increasing day by day. Integrating traditional cultural elements into design can meet consumers' pursuit of personalization and highlight the ethnic characteristics and cultural heritage of the design. When consumers wear design works with traditional cultural elements, they can experience beautiful emotions, enhance their sense of identity and pride in national culture, and further promote the inheritance and development of traditional culture. However, when applying traditional cultural elements, it is necessary to respect and protect the original flavor of traditional culture, and avoid improper use and distortion of traditional culture. We need to innovate on the basis of inheritance, rather than arbitrarily altering or distorting the connotation of traditional culture.

In recent years, with the enhancement of people's cultural confidence and a renewed understanding of traditional culture, the application of traditional cultural elements in fashion design has received increasing attention. At the same time, technological advancements have also presented new trends in the application of the 24 solar terms elements. With the continuous development of computer artificial intelligence assisted technology, intelligent recommendation systems based on big data and machine learning algorithms can provide more accurate personalized dynamic graphic matching suggestions for people's 24 solar terms. The application of blockchain technology provides a new way to protect and inherit the culture of the 24 solar terms, ensuring the authenticity and integrity of the culture through the immutable nature of blockchain. At the technical level, the development of digitalization and 3D printing technology has brought more possibilities for design. By utilizing artificial intelligence technology to analyze consumers' wearing habits, suitable dynamic graphic clothing styles for the 24 solar terms can be recommended to consumers, achieving precise marketing. Through

3D printing technology, exclusive 24 solar term dynamic graphic clothing can be customized for consumers, perfectly combining personalization and customization to meet their unique product needs. In addition, the cross integration with other fields will also bring new opportunities and challenges to the application of the 24 solar terms elements. For example, cooperation with fields such as film and television, gaming, and animation can present the culture of the 24 solar terms to the public in a more vivid and interesting way, expanding its influence.

In short, the cultural elements of the 24 solar terms have great potential and practical value in modern design. We should fully explore and utilize these elements, combine modern technological means, and innovate designs on the basis of respecting and protecting traditional culture, so that the 24 solar terms, an ancient cultural treasure, can shine with new vitality and vigor in the new era.

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