J. COMBIN. MATH. COMBIN. COMPUT. 127a (2025) 6829--6844

Journal of Combinatorial Mathematics
and Combinatorial Computing
www.combinatorialpress.com/jcmcc

Combinatorial Press

Characterization and Emotional Expression of Digital Modeling in Film and Television Art

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ABSTRACT

Following the footsteps of the times, an excellent and complete movie cannot be separated from the application of digital modeling. In this paper, we mainly use 3D modeling, motion capture, rendering and other related technologies to edit and produce the character's physique, proportion, contour, etc., design the character's expression, color and action, and build the film and television scenes in 3D space. Thus, it realizes the characterization and emotional expression in film and television. Will be through the traditional 2D film and television and three-dimensional film and television control experiments, from the experimental data can be seen, in the frame rate, three-dimensional modeling technology film and television than the traditional 2D film and television on average 14% to 20% higher. There is also a leading edge in the number of textures. The data color emotion analysis indicated that the color shift and strong contrast connects the plot and the audience's feelings. The quantitative survey of emotional experience through questionnaires shows that the audience in the 3D film and television group is higher than the traditional 2D film and television in terms of immersion experience, interaction experience and learning and enjoyment experience. Therefore, 3D modeling technology plays an important role in the creation of film and television art.

Keywords: three-dimensional modeling, emotional experience, characterization, digital modeling, color analysis

1. Introduction

With the emergence of digital technology, the art of film and television in the form as well as the concept of different degrees of change, and its communication influence is further enhanced, and the content is richer. Advanced digital technology has helped the creation of film and television as well as animation to achieve a technological breakthrough, fully integrating a number of artistic disciplines, and creating favorable conditions for the development of digital technology in the direction of technologization [1-3]. With the continuous integration of digital technology and film and television

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Received 15 January 2024; Revised 25 March 2024; Accepted 30 November 2024; Published Online 15 April 2025.
DOI: 10.61091/jcmcc127a-379

art, the production methods and creation modes of film and television and animation have been revolutionized, and the related art works are more interactive, which can better provide services for the public [4-6]. In the process of filming, production and distribution of the movie, there is always the figure of digital technology, that is to say, digital technology has been inseparable from the art of film and television [7-8]. Through the application of digital technology in film and television works, it can significantly enhance the infectious force of the picture, and also enrich the film type, making the film's expression more flexible and variable [9-11]. As we all know, characterization and emotional expression are the most important elements of film narrative, digital technology can provide support for film elements such as photography, sound, art, props, etc., which can help to improve the level of characterization and emotional expression of film and television works [12-15]. In the future, with the emergence of more requirements, the relevant digital technology will also continue to develop, and the integration of digital technology and film and television art will have more possibilities.

In the creation of film and television art, the use of digital modeling technology to capture the character's physical appearance, proportions, contours and so on. The use of 3D modeling technology to design the character's expression, muscle movement, build the scene, etc., rendering the character and the color characteristics of the film and television screen, to complete the character's emotional expression. In order to verify whether digital modeling is more advantageous in the art of film and television, this article firstly compares it with the traditional 2D film and television methods in terms of the frame rate and the number of textures. Then, we take "Ne Zha" 3D film and television as the research object, and analyze the color expression and emotion through data color analysis. Finally, students aged 19-28 were randomly selected as survey subjects for the control experiment, and after the experience was over, quantitative questionnaire surveys were conducted on immersion experience, interaction experience, and learning and enjoyment experience respectively, to explore the advantages of 3D film and television in terms of their audience's emotional experience.

2. Application of digital modeling in the field of film and television art

2.1. Innovations in digital modeling techniques

With the continuous development of science and technology, the function of digital modeling software becomes more and more powerful, and it becomes very easy in the process of operation, which is loved by people. With the formation of computer as the main technology for visual design, some film and television works have also begun to widely use digital modeling - three-dimensional technology. Film and television special effects this word, I believe that everyone will feel strange, but if we talk about "Avatar", "Lord of the Rings" believe that everyone will not be unfamiliar with these film and television works have become one of the most representative symbols of the development of the times, so it is not difficult for us to see that the development of film and television special effects technology has an unlimited potential.

2.2. Digital Modeling Related Technologies

2.2.1. Introduction to the Composition of 3D Movie and TV System:

1) Data import system: that is, in accordance with the design and planning program will be proposed to build the site of the actual scene drawing, shooting information collected into the computer.

2) Modeling system: computer three-dimensional film and television has always been a research hot spot in graphic imaging, due to the creation of computer three-dimensional film and television application to a variety of technologies, each of which requires related hardware and software support. Therefore, we talk about the computer three-dimensional film and television is not only for the character model for action design, it also includes model construction, material mapping, lighting texture, motion capture and other aspects. Therefore, the computer three-dimensional film and television technology no longer only involves a single hardware or software independent technology,

but a very complex system engineering. Modeling is the basis of computer three-dimensional film and television production, the geometric dimensions of the object and part of the relationship by moving, rotating and stretching and other methods to generate a geometric model.

3) Surface texture editing system: When the model is finished, according to the surface material texture effect that the model wants to express, select the appropriate material type, according to the texture mapping of different attributes, and utilize the node tools in the 3D software to show the unique effect, so as to enhance the expressive power of the object. The surface texture editing system of the 3D software can interactively edit and modify the surface characteristics of the object, including shape features, surface color, texture effects, surface lighting effects, etc.

4) Imaging rendering system: surface texture and rendering are two different concepts, are essential to the formation of the final picture of the two parts. Rendering imaging three-dimensional software film and television production of the last process, imaging that is, the use of some kind of lighting model on the design of the film and television to calculate a series of real sense of the image of the technology. The rendered image is then modified by other post-production software, and finally presented in front of the audience.

5) Multimedia information post-synthesis system: a series of various image data calculated by three-dimensional software into the computer, the graphic image editing, and then and audio, video signal alignment processing, integrated to generate a variety of images, text, sound, images and other integrated video information, and then through the output device into a video signal.

2.2.2. Three-dimensional film and television key technology analysis and realization. The use of computerized three-dimensional film and television system can simulate a variety of realistic film and television and visual effects, including particle smoke, dynamics and a variety of field effects. From the key technology to analyze, computer three-dimensional film and television mainly use the following techniques to generate film and television: two-dimensional interpolation key frames, wrapping skin deformation, motion capture editing, skeleton control geometric modeling, three-dimensional human body modeling related algorithms.

1) 2D Interpolation Keyframes. The principle of 3D video is to define the start frame and the end frame of the video, and utilize the software to generate the intermediate frame so as to get the video sequence frame. And change the image of the screen parameters can become the key frame of the movie and television, such as positional movement, object rotation, texture changes in the parameters and so on.

2) Wrapped skin deformation. In the process of producing character film and television, in addition to the two-dimensional interpolation keyframe method, the use of three-dimensional geometric modeling to produce wrapped skin deformation is an important method. Many researchers have done long-term research on how to realize the reproduction and deformation of 3D character shapes. The subject models of 3D geometric deformation are divided into two categories: hierarchical models and surface models. Hierarchical models consist of a skeleton layer, an intermediate layer (which simulates the physical behavior of muscles, bones, adipose tissue, etc.), and a skin layer. Since the external behavior of the human body is greatly influenced by the internal musculature.

3) Surface Modeling. Three-dimensional geometric deformation of the subject model type also includes surface modeling, for complex surface modeling, currently in three-dimensional space, the object or scene of the three-dimensional model of the three-dimensional representation of the explicit representation and implicit representation of the two, the explicit representation of the main ways include: voxel, point cloud, mesh, etc., implicitly, including symbols of the distance field, each expression of the data type differences, each has its own advantages and disadvantages, and need to be based on the application of the scene of the specific Each data type has its own advantages and disadvantages, so it needs to be selected according to the application scenario.

Explicit planar representation of 3D models mainly includes voxels, point clouds, and meshes. Voxels, or volume elements, use regular cubes to represent 3D objects and are 3D extensions of pixels in a 2D image.

Implicit surfaces do not visualize the shape of the surface, but rather represent the surface by means of expressions that do not directly represent all the points. Although not visually straightforward, they can be used to quickly pass over the coordinates of a point to determine the relationship between the point and the plane, and can be used to quickly find out if a point is on the surface. Implicit surfaces express three-dimensional space that is continuous. Assuming that Ω is a subset of the metric space, where the model surface is located, X is the metric space, and d is the symbolic distance function, the mathematical definition of SDF can be expressed as follows:

$$f_n(x)=\begin{cases}-d(x,\partial\Omega) & x\in\Omega\\ d(x,\partial\Omega) & x\in\Omega_c\end{cases} \tag{1}$$

where $\partial\Omega$ represents the boundary of Ω, i.e., the bias derivative over the model surface. For any $x\in X$:

$$d(x,\partial\Omega)=\inf_{y\in\partial\Omega} d(x,y) \tag{2}$$

where inf denotes the lower bound, and for d denotes the distance sign function is a continuous function:

$$SDF(x)=s:x\in R^3, S\in R \tag{3}$$

where x denotes the coordinates of the sampling point and $|s|$ denotes the closest distance to the surface, and the surface of the object is implicitly expressed as the equivalent surface of $SDF(x)=0$. A multilayer perceptron is commonly used in deep learning to fit this continuous function as in Eq. (4):

$$f_\theta \approx SDF(x) \tag{4}$$

4) Algorithms related to 3D human modeling. The HMR algorithm solves the SMPL model parameters from RGB images and is implemented based on generative adversarial networks to predict the model parameters end-to-end. The implementation replaces the previous two-stage prediction method, i.e., it no longer relies on the detection of intermediate 2D keypoints, and directly infers the body and pose parameters of the SMPL model from image pixel feature extraction.

The generative adversarial network can be divided into two parts, encoder and discriminator, and utilizing this generative adversarial network structure for 3D human pose estimation is a commonly used means to alleviate the problem of lack of 3D pose datasets, i.e., a large number of unpaired 2D joints and 3D joints datasets are used for the network training. The overall objective function of this network is shown in equation (5):

$$L=\lambda(L_{reproj}+IL_{3d})+L_{adv} \tag{5}$$

where L_{3d} and L_{reprnj} are the objective functions used in the encoder stage to regress the parameters of the SMPL model, and L_{adv} is the loss function used by the discriminator training to learn the angle of rotation of each joint, which is used to limit the appearance of irrational postures. λ represents the encoder weights, and I represents the exponential function. During the training process, the network inputs a single image, which is first passed through the Resnet-50 coding layer to output the image convolutional features, and then fed into the 3-layer fully-connected regression layer, which outputs the camera parameters, the SMPL model body parameters β, and the motion parameters θ, which together form the output vector $\Theta=\{\theta,\beta,R,t,s\}$. The network predicts the acquired model $M(\beta,\theta)$ and the 3D joint positions of the model $X(\theta,\beta)$:

$$\hat{x} = s\prod(RX(\theta,\beta)) + t \tag{6}$$

$$L_{reproj} = \| (x - \hat{x}) \|_2^2 \tag{7}$$

where s is the camera scaling parameter, R is the rotation parameter, t is the translation parameter, using the model's built-in function J, θ and β are transformed into the coordinates of the human body's three-dimensional joint points, $X(\theta,\beta)$ represents the model's three-dimensional joint position, the coordinates are denoted as $\hat{X}_i$, orthogonal projection Π onto the image, the predicted two-dimensional joint position is $\hat{x}$, and then by calculating the error and back propagating it in order to regulate the network's weights so that it fits the real two-dimensional joint position x and L_{rapsy} represents the error between the predicted joint and the original joint:

$$L_{3d} = L_{3djoints} + L_{3dompl} \tag{8}$$

$$L_{3djoints} = \| X_i - \hat{X}_i \|_2^2 \tag{9}$$

$$L_{3dsmpl} = \| [\theta_i, \beta_i] - [\hat{\theta}_i, \hat{\beta}_i] \| \tag{10}$$

OPENPOSE algorithm is the current 2D human joint detection algorithm with high accuracy and real-time, which adopts a bottom-up approach, i.e., firstly detecting the position of human keypoints, and then connecting the results of the keypoint detection by predicting the peak value of the hotspot map joints Gaussian of the human keypoints. It is realized by multi-stage convolutional neural network, the core of which is to connect the joints between different individuals by using the human key point affinity field vector field features, and the bottom-up detection to get the position of the human joint point.

5) Motion Capture: There are many filmmakers who use AliasMotionBuilder system software with motion capture systems to capture data to drive characters, instead of setting keyframes to simulate real-life motion. Typical data consists of a set of points moving in three-dimensional space, with the positions of sensors on the performer's body representing the positions in each frame of the image.

6) Skeleton Control Geometry "Skin". There are many different categories of Character Video, and it is one of the most challenging and rewarding forms of computerized video. In Character Video, 3D artists combine changes in the digitized skeleton with deformations in the skin to achieve character expression, movement, and action in 3D space.

3. Digital Character Image Construction and Emotional Expression in Film and Television Art

Designers in the process of designing 3D animation characters as shown in Fig. 1 often start from a regular model, try different topologies to change its visual image, and get a non-regular model image as a result. Usually we call the constituent elements that can express the character's identity characteristics, physical characteristics and personality traits as modeling primitives. The matching between different costumes and animals can reflect the specific identity of the character roles. The identity of the character can be directly determined through the depiction of certain details of the costume. Similarly, different preferences, different personalities, and colors can be shown in the details of the design. Together, these form the character's personality traits.

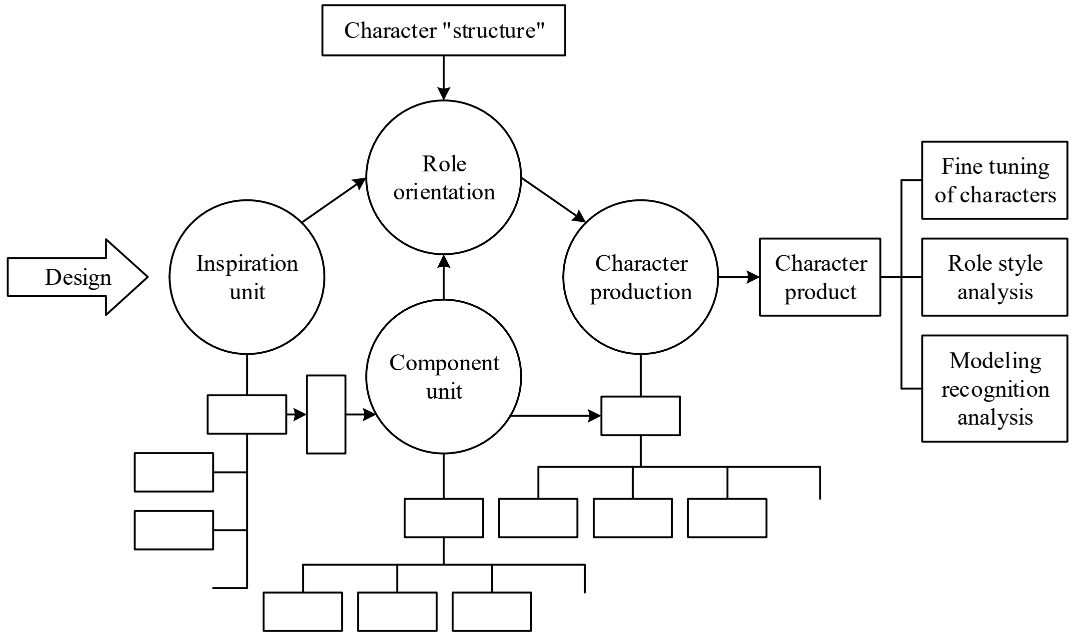

Fig. 1. Role shaping process

In character building under digital modeling technology production, firstly, modelers use professional 3D modeling software, such as Maya, 3DsMax, etc., to build the most basic models according to the character's design draft. These models accurately capture the appearance characteristics of each animal character, such as body shape, proportion, outline, etc., which lays a solid foundation for the subsequent detail portrayal. Next, on top of this basic model, modelers adjust the vertices, edges and faces of the model to further portray the details of the character's muscle structure, skin texture and hair texture. For example, in the movie “Crazy Animal City”, the model of the main character, Judy the rabbit, is very finely constructed, from her long ears to her soft fur to her soulful eyes, all of which demonstrate the high level of digital modeling technology. Her image design retains the cute qualities of a rabbit, but also shows her bravery and resilience through detailing. Each of Judy's fur appears soft and textured, which is in line with the biological characteristics of rabbits and also enhances the realism of the character through fine textures.

Digital modeling technology plays a crucial role in emotion communication, and it successfully creates characters with rich emotions through fine facial micro-expression design, delicate and rich eye contact, and rich body language design. Among them, expression design is one of the most intuitive applications of digital modeling technology in emotion communication. The eyes are the most important part of the emotional communication of animal characters. In Crazy Animal City, digital modeling technology realizes profound eye contact between characters through fine eye modeling and film and television technology. For example, the emotional evolution between Judy, the rabbit, and Nick, the fox, is fully demonstrated through eye contact. From the initial mutual distrust to the gradual establishment of deep friendship, their eyes change from indifference and vigilance to warmth and trust, and this emotional change can be intuitively and deeply perceived by the audience through eye contact. Not only that, body language is also an important means of conveying characters' emotions in movies and television. In Zootopia, the body movements of each animal character are carefully designed to accurately convey their emotional state. This technology is utilized to create realistic terrain, buildings, vegetation and other scene elements to provide a rich background environment for the animation story. These scene elements not only have a high degree of realism, but can also convey visual effects and emotions based on their pairing with the plot.

4. Three-dimensional film and television stage characteristics data analysis

In order to more accurately understand the reality of the state of existence of three-dimensional film and television, and summarize its development law. This paper collects and organizes data on the creation and production of 3D films and TVs worldwide from 1995 to 2018. (1) A total of 607 representative 3D films and TVs released worldwide from 2001 to 2024 are counted, and the number of 3D films and TVs created in different periods is summarized and analyzed. The data show that the development of 3D film and television has shown a geometric growth rate after entering the 21st century, and the number of works created can show the market's acceptance and welcome for this art form. It is expected that by 2025, the number of three-dimensional film and television works will undoubtedly realize the multiplication. 2001-2024 three-dimensional film and television film number as shown in Table 1.

For three-dimensional film and television creation of the promotion and popularization of the situation of summary analysis, the data show that: with three-dimensional film and television production capacity of the country has reached 44, Europe and the United States, such as the United States, Belgium, the United Kingdom, France, Canada, Germany and so on the creation of the total number of leading other countries and regions, which the United States of America's creation of the number of works according to the first. Asian region to the traditional film and television development base of Japan as the first, China, followed by South Korea, India, followed by other countries in Asia also has a relatively wide range of popularity.

Table 1. Participation and production of 3d animation films

National	N	National	N	National	N	National	N
The United States	205	India	14	Mexico	8	Hungary	2
Japan	32	South Korea	14	Turkey	8	Latvia	2
China	22	Italy	14	South Africa	6	Sweden	2
France	20	Australia	13	Brazil	6	Malaysia	1
Canada	20	Luxembourg	13	Netherlands	6	Switzerland	1
Denmark	18	Norway	13	Peru	6	Uae	1
The UK	17	Ireland	12	Czech republic	6	Maldives	1
China	16	Pakistan	12	New Zealand	5	The Philippines	1
Germany	16	Thailand	10	Indonesia	4	Iceland	1
Spain	15	Finland	10	Singapore	4	Nigeria	1
Russia	15	Argentina	10	Lebanon	3	Saudi Arabia	1

The aesthetics of three-dimensional film and television has been established, and is distinguished from traditional film and television by visual realism. The visual style of mainstream three-dimensional film and television has been relatively fixed, with exaggerated and deformed shapes and highly realistic materials, light and shadow as the basic style characteristics. The research and development of 3D technology takes the realistic expression as the stage task, and the technical level of simulating reality has been more mature. The creation process of 3D film and television is basically solidified, presenting clear stages, detailed division of labor, and the process characteristics of multiple parallel lines.

In 3D modeling character design, character drawing and modeling are key steps that directly affect the appearance and performance of the final virtual character. In order to verify the advantages of digital modeling, traditional 2D film and video methods are chosen as a comparison.OpenGL, as a mature graphics standard, has been widely used in many 3D modeling and rendering projects. Five different 3D character models were selected to ensure that their complexity and level of detail are reflected in both platforms.

In this simulation experiment, two key indexes are mainly concerned: the frame rate and texture number of movie and TV character modeling. Firstly, the character model is loaded and rendered on this model simulation platform, and the frame rate and texture number are recorded, and then the same operation is carried out using the 2D movie and television method and the corresponding data are recorded.

The comparison test results of the two movie and television production methods are shown in Table 2. From the experimental data, it can be seen that the film and television based on 3D modeling technology is slightly better in terms of frame rate, an average increase of 14% to 20%. This is mainly due to the visual simulation optimization in the work module of 3D modeling technology. In terms of the number of textures, there is little difference between the two, but 3D modeling shows a slight advantage in some of the characters.

As technology continues to advance, the field of 3D modeling character design continues to evolve and improve. It is compared with the traditional 2D film and television methods through simulation experiments, and the results clearly show that this model demonstrates superiority in both character design rendering performance and texture processing, and has a certain promotion value.

Table 2. The 3d modeling method compares the test results

Three-dimensional role model	2D frame speed	Opengl frame speed	2D texture number	Opengl texture number
Role A	123	103	36	37
Role B	118	98	42	48
Role C	115	93	38	40
Role D	120	104	40	43
Role E	117	100	38	40

5. Research on Color Emotion Analysis in Three-dimensional Film and Television

Excellent color design brings strong visual conflicts to the audience, and at the same time, it also displays an important influence in the portrayal of characters, rendering of environmental atmosphere, and promotion of the storyline. Take “The Descent of Nezha the Magic Boy” as an example to analyze the color expression and emotion.

1) As the main character, Nezha's colorful image and theme colors are naturally interdependent. Nezha's costume is still predominantly red, with a consort-red blouse combined with a white lotus flower decoration, which is simple yet playful. (2) Ao C (The overall character image is colored in blue, white and purple. The white color is to highlight its identity as a white dragon, at the same time, the white color is not pure enough to represent the ambiguity of its identity. Blue symbolizes the sea, and the powder blue on Ao B has some melancholy, just like its psychology and character. (3) Taiyi Man expresses his character with pink and light blue. The colors are used to interpret a joyful image of gluttony and love of beauty. The use of gaudy color symbols endows Taiyi Zhenzhen with worldly happiness and emotions, which contrasts with Shen Gongbao's black, single symbol color. (4) Li Jing's overall costume color is dark green. Li Jing's image is calm and rational, with the dignity and indifference of being a father as a patriarch on the outside, and the infinite paternal love of a loving father for his son on the inside. Mrs. Li's costume in the movie is mainly a set of lavender Hanfu, which reflects Mrs. Li's infinite beauty and gentleness.

The three-dimensional image generated by the color analysis of the data is shown in Figure 2, which shows the comparison of the red and blue color ratios in the time axis of the development of the same 1/24 frame samples (the Z-axis is the time axis, and the XY-axis is the ratio of R-value and B-value). The movie “Ne Zha” has strong contrasting colors, and the aesthetic sense of color is conveyed to the general public at a high frequency, and the color tones are rich and harmonious, which is in essence catering to the needs of the contemporary pursuit of strong visual stimulation preferences. In essence, it also caters to contemporary people's preference for strong visual stimulation, with rich color contrasts to satisfy people's experience of watching scenes, combined with the national tradition of using colors. For example, when Ne Zha was three years old and a thunderbolt was about to strike, Shen Gongbao intentionally sabotaged and distorted the facts, implying that Ao Bian annihilated the Chentang Pass in order to save the dragon race. This decrease in the purity of the blue color also hints at the transformation of Ao Bi's character, from goodness to a murderous aura. When Nezha returns to the scene after realizing the truth, the contrast between the white background and the light grey-blue color of Nezha's color changes from dark red to bright red, showing the transformation of Nezha's character from goodness to kindness in the same way that the brightness is increased. The contrast between light and dark colors also puts the audience into the narrative space of the animated film, where emotions are rapidly transformed, pushing the audience to “sympathize” with the plot, with the power to touch people's hearts and suggest their feelings.

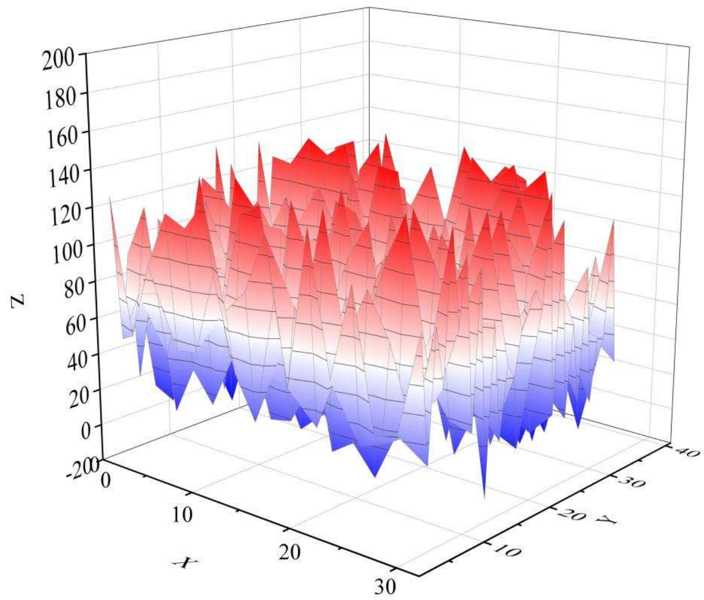

Fig. 2. Data color analysis

6. Results and Analysis of Emotional Experience Survey Data

6.1. Comparison of emotional experiences at the instinctual level

Instinctive Layer-Characters and graphics fulfill the immersive experience of sensory appeal.

In this study, we recruited 45 test subjects through online enrollment in the form of a free experience, and all of them were undergraduate, graduate, and doctoral students between the ages of 19 and 28. The basic requirements of the test subjects were that they were in good health, free of cardiovascular disease and other chronic diseases, and willing to participate in the experience and questionnaire survey. Through the data collection of this test, a total of 45 emotional experience questionnaires and 40 memory questionnaires were finally filled out (19 in the traditional 2D film group and 21 in the 3D film group). A total of 19 items in the emotional experience questionnaire are shown in Table 3, including 6 items for immersion evaluation, 6 items for interactive experience evaluation, and 7 items for learning and enjoyment evaluation, and the scales are all based on the Likert 7-point scale, in which F7 in the interactive experience dimension is a reverse proposition to detect the validity of the audience's filling in the questionnaire.

Table 3. Questionnaire survey

	Qeustion
Immersion dimension Instinct layer	Very satisfied with emotional expression Q1
	Emotional experience is consistent with reality Q2
	It's natural Q3
	Sensory immersion Q4
	Immersion Q5
	No other influence Q6
Interaction experience dimension Behavior layer	Can emotional interaction information be easy to receive Q7
	Whether the function of emotional interaction is achieved Q8
	The way emotional interaction information is transmitted is effective Q9
	Emotional interaction systems respond to users in a timely manner Q10
	The emotional interaction process is reasonable Q11
	The level of emotional interaction of the audience Q12
Learn and enjoy Reflective layer	Curiosity Q13
	Attention concentration Q14
	Feel very happy Q15
	Enjoy Q16
	You can understand the information by viewing Q17
	You can understand history by viewing Q18
	You can grow knowledge by viewing Q19

Emotional experience questionnaire data are independent small sample mean difference analysis and ANOVA, and before the test of the overall questionnaire samples of the three emotional levels of independent small sample variance chi-square test, to determine whether the overall variance estimates of the traditional group and the three-dimensional film and television group at the three levels of the variance chi-square, selected F as the test amount, after the calculation, which instinctive level samples, the sample of the behavioral level, the sample of the reflection level to meet normality

The assumption that the variance is chi-square allows for a significance test of the difference in means. *P<0.05**P<0.01.

According to the Q1-Q6 items in the Emotional Experience Questionnaire filled out by the subjects, the differences in the instinctive level in the emotional experience of traditional 2D movies and 3D movies were compared. The results of 40 valid questionnaires were collated and averaged, and the results are shown in Figure 3.

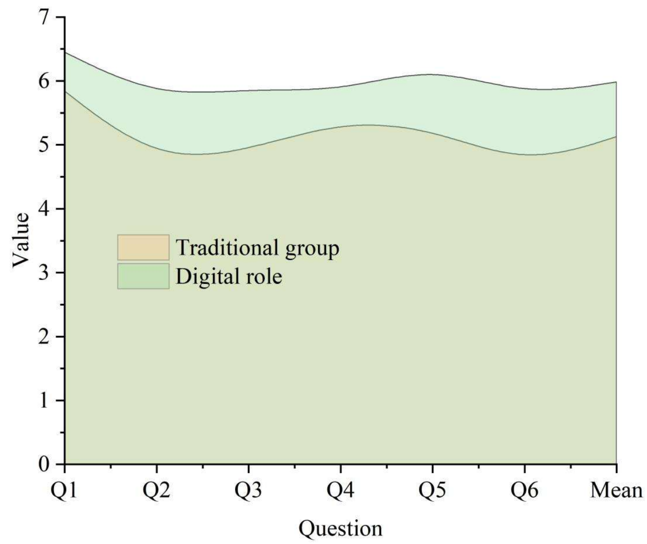

Fig. 3. Emotional experience questionnaire results

The individual question item ANOVA chi-square test revealed that Q2 (F=11.845, P=0.003), Q3 (F=9.024, P=0.007), and Q5 (F=14.167, P=0.002) revealed significance and ANOVA chi-square, and Q1 (F=5.482, P=0.026), Q4 (F=2.231, P=0.149), and Q6 (F=7.325, P=0.009) were variance aligned, so Welch ANOVA was used for Q2, Q3, and Q5, and one-way ANOVA was used for Q1, Q4, and Q6. The results of the data analysis showed that the traditional 2D film and television group and the 3D film and television group did not exhibit significant differences in the Q4 item, but presented significant differences in the Q1, Q2, Q3, Q5, and Q6 items, as shown in Table 4. From the overall data mean, the effect on the audience instinctive level experience, i.e., the audience's immersion experience, was higher in the 3D film and television group than in the traditional 2D film and television, especially in the Q2, Q3, and Q5 question items.

Table 4. Analysis of variance analysis

	The experimental group		F	P
	Traditional group	Digital role		
Q1	5.84±1.12	6.58±0.63	5.482	0.026*
Q2	4.72±1.03	5.74±0.76	11.845	0.003**
Q3	4.92±1.30	5.94±0.63	9.024	0.007**
Q4	5.42±0.95	5.84±1.22	2.231	0.149
Q5	5.22±1.14	6.35±0.65	14.167	0.002**
Q6	4.61±4.57	5.78±1.20	7.325	0.009*

6.2. *Comparison of Behavioral Level Emotional Experiences*

Behavioral level- Interaction guidance with characters for the purpose of establishing film and television content.

According to the Q7-Q12 items in the Emotional Experience Questionnaire filled out by the subjects, the differences in the behavioral layer in the emotional experience of traditional 2D film and television and virtual 3D film and television were compared. The results of 40 valid questionnaires were collated and averaged, and the results are shown in Figure 4.

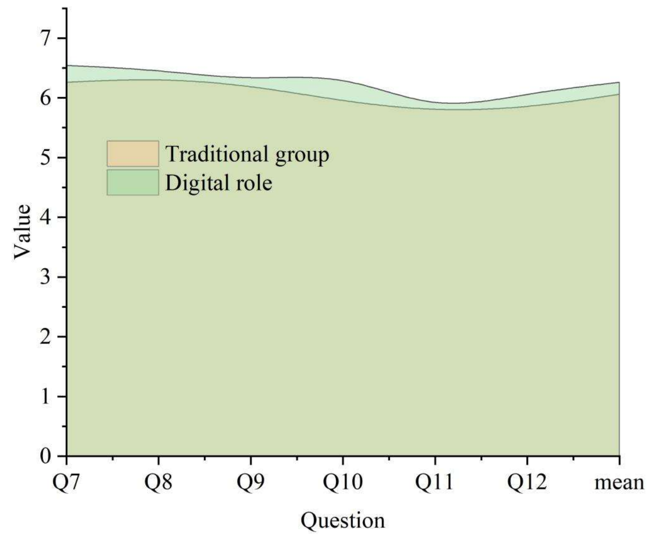

Fig. 4. Emotional experience questionnaire results

A single question item ANOVA chi-square test revealed that Q11 (F=0.053, P=0.836) showed no significance and was not ANOVA chi-square, Q7 (F=0.669, P=0.425), Q8 (F=0.025, P=0.914), Q9 (F=0.113, P=0.745), and Q10 (F=7.582, P=0.010), Q12 (F=1.245, P=0.283) were variance aligned, so Welch ANOVA was used for Q11 and one-way ANOVA was used for Q7, Q8, Q9, Q10 and Q12. The results of the data analysis are shown in Table 5. As shown in the table, none of the items in the traditional 2D and 3D film and television groups showed significant differences, except for Q10. From the overall mean data, the two groups did not show a large difference in the effect on the audience's behavioral level of emotional experience, i.e., the audience's interactive experience, and from the results of the existing data samples, the overall mean value of the 3D film and television group in the interactive experience was slightly higher than that of the traditional 2D film and television group.

Table 5. Analysis of variance analysis

	The experimental group		F	P
	Traditional group	Digital role		
Q7	5.84±1.12	6.38±0.79	0.669	0.425
Q8	6.45±0.96	6.35±0.72	0.025	0.914
Q9	6.34±0.85	6.22±0.67	0.113	0.745
Q10	6.42±0.73	5.94±0.65	7.582	0.010**
Q11	5.76±1.48	5.82±0.96	0.053	0.836
Q12	6.14±0.98	5.83±0.97	1.245	0.283

6.3. *Comparison of Emotional Experiences at the Reflective Level*

Reflective level-constructing character interpersonal relationships and emotional memory of movie and television content.

According to the Q13-Q19 questions in the emotional experience questionnaire and the results of the memory questionnaire filled out by the subjects, the difference between the reflective level in the emotional experience of traditional 2D movies and 3D movies was compared. The results of 40 valid emotion questionnaire results were collated to take the mean value and the correct rate of 40 memory questionnaires, and the results are shown in Figure 5.

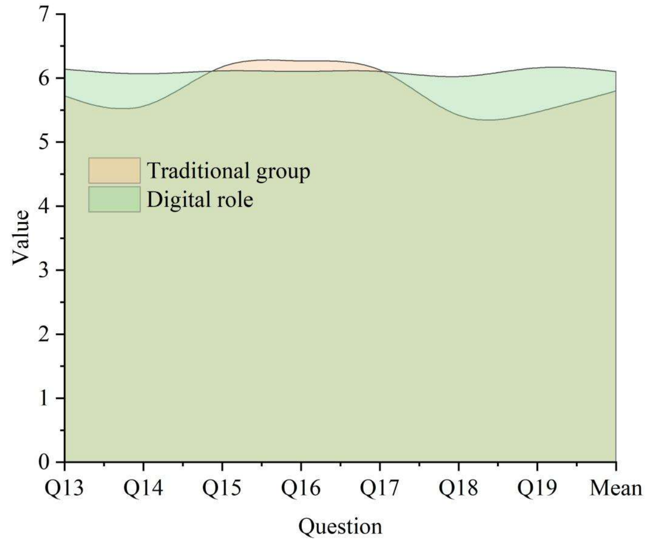

Fig. 5. Reflection layer emotional experience questionnaire results

It was found that Q14 (F=6.478, P=0.022) showed significance and variance lopsided by individual question item variance alignment test, Q13 (F=1.974, P=0.174), Q15 (F=0.422, P=0.526), Q16 (F=0.687, P=0.417), Q17 (F=0.623, P=0.443), Q18 (F=8.956, P=0.006), and Q19 (F=6.942, P=0.015) were ANOVA aligned, so Q14 was analyzed by Welch's ANOVA, and Q13, Q15, Q16, Q17, Q18, and Q19 were analyzed by one-way ANOVA. The results of the data analysis are shown in Table 6, which shows that the traditional 2D film and television group and the 3D film and television group did not show significant differences on items Q13, Q15, Q16, and Q17, but presented significant differences on items Q14, Q18, and Q19. From the overall data means of the available samples, the overall mean of the audience's emotional experience at the reflective level, i.e., in learning and enjoyment, is slightly larger in the 3D film and television group than in the traditional 2D film and television group, which is mainly reflected in the Q14, Q18 and Q19 upper question items.

Table 6. Analysis of variance analysis

	The experimental group		F	P
	Traditional group	Digital role		
Q13	5.78±1.25	6.14±0.85	1.974	0.174
Q14	5.26±1.24	6.08±0.79	6.478	0.022*
Q15	6.25±0.94	6.05±0.85	0.422	0.526
Q16	6.22±0.92	5.98±0.82	0.687	0.417
Q17	6.28±0.84	6.17±0.75	0.623	0.443
Q18	5.33±0.89	5.94±0.76	8.956	0.006**
Q19	5.41±1.02	6.23±0.82	6.942	0.015*

According to the results of the 40 memory questionnaires filled out by the audience after one week of experience correct rate results are organized, the results are shown in Table 7. From the overall sample data, the test experience three-dimensional film and television group of the audience in the memory experience, the correct rate of the relevant questions is higher than the traditional 2D film and television group of the audience in general, the main difference is from the plot memory difference, three-dimensional film and television group to the audience to bring about the degree of memory about the plot of the correct rate of the answer to the degree of the answer to be significantly higher than the traditional 2D film and television group.

Table 7. The results of the two sets of tests were recorded

Group	Episodic memory	Music memory	Character memory	Image memory
Traditional group	56%	52.3%	54.8%	54.6%
Digital role	78.6%	53.8%	67.5%	66.5%

7. Conclusion

This paper focuses on the design and production of character modeling, expression and body movement in film and television through digital modeling - 3D modeling technology, to complete the scene modeling and color rendering in film and television, and to realize the character shaping and emotional expression. Using the questionnaire and experimental comparison method, it can be concluded that in terms of film and television frame rate, the film and television based on 3D modeling technology is higher than the traditional 2D film and television. 3D modeling also reflects some advantages in the number of textures. The data support is provided by the change of the time axis in the 3D film, which analyzes the process of the rapid transformation of color and emotion, mainly from sky blue-light grey-blue-white-red. Through the comparison test between traditional 2D movie and 3D movie, the audience's immersion experience, interactive experience and emotional experience of learning and enjoyment, the 3D movie group is overall better than the traditional 2D movie group. The correct rate regarding the degree of memorization of the plot was significantly higher than that of the traditional 2D film and television group by 22.6%.

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